

The Impact of Working Memory and Second Language Proficiency Level on Second Language Writing

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Abstract

The present study, which constitutes part of a wider research study, aimed to investigate whether working memory capacity and second language proficiency level affect the quality of second language writing produced by teenagers. To that end, narrative texts were solicited from 30 Greek second-year junior high school students, produced in English, being their second language. The texts were assessed in terms of fluency and accuracy, according to *Curriculum Based Measurement for Writing (CBM-W)* criteria. Students' working memory capacity was assessed with the application of relevant tests, based on Pickering and Gathercole's (2001) Working Memory Test Battery for Children (WMTB-C). A standardized test, which focused on grammar and vocabulary use, was implemented for the assessment of students' second language proficiency level. The statistical analysis of quantitative data collected revealed no statistically significant correlation between working memory capacity and the quality of the second language texts. Students' second language proficiency level, however, was found to be statistically significant for the quality of narrative texts generated by teenagers. The findings are discussed in relation to previously conducted research.

Keywords: working memory, second language proficiency level, second language writing

Writing constitutes a cognitively demanding process, as it entails the coordination of several linguistic and cognitive processes. It is far more challenging when carried out in a second language in which the writer has not yet acquired the relevant second language knowledge and lacks second language linguistic resources (Weigle, 2005). Composing written texts in a non-native language requires an array of writing skills along with cognitive resources of the new language. Several scholars (Bereiter & Scardamalia, 1987; Berninger et al., 1996; Flower & Hayes 1981; Hayes, 1996, 2012) have attempted to shed light on the complex and multidimensional nature of writing.

Hayes and Flower (1981), following the development of cognitive psychology in the decade of the '70s, proposed a pioneering, for that time, model of process writing. They described the various subprocesses a writer goes through when composing a text. Writing was approached as a procedure of non-linear, recursive phases. The original model was revised twice by Hayes (1996, 2012). Writing was studied within a communicative context, which involved various parameters among which were the writer's goals, motives and predisposition, the audience, the pre-existing relevance to the topic knowledge which was stored in the writer's long-term memory, etc. Hayes (1996, 2012) also acknowledged working memory's contribution to writing. In their first revision of the original model, they attributed a central role to working memory, by placing it in the center of the new framework of the writing process. Working memory supports the execution of the various cognitive and linguistic sub-processes that take place, when composing a written text (Hayes, 1996, 2012; Kellogg, 1996).

Working memory, as proposed by Baddeley and Hitch (1974), is a multi-component memory system. It is responsible for the short-term storage and processing of information.

Working memory's function is essential for language acquisition and the development of linguistic skills. The original working memory model consisted of three components, the phonological loop, the visuospatial sketchpad, and the central executive. In 2000, Baddeley revised the model and added a fourth component, the episodic buffer.

Working memory is a memory system that functions as an interface node between short-term and long-term memory (Baddeley, 1996, 2003). The information that enters the system remains in the phonological loop for short-term retention and processing. The phonological encoding of the information remains active in the specific sub-component, so as to be processed. This is accomplished through the articulatory rehearsal that takes place in the phonological loop. The other function that is performed in the same sub-component is the phonological retention. The non-verbal information (e.g., images, shapes) is phonologically encoded before entering the phonological loop. Information may come from some external source or be retrieved from long-term memory.

The visuospatial sketchpad is responsible for the short-term retention and processing of visual information and information that relates to movement and dimensions. Several scholars distinguish two parts of this particular subsystem of working memory, the visual and the spatial (Deyzac et al., 2006; Logie, 1995, as cited in Baddeley, 2003; Smith & Jonides, 1997). The visual element is responsible for the short-term retention of static visual information, such as images, while the spatial component is responsible for the short-term retention of information that relates to space, motion, and dimensions.

The central executive plays a supervisory role in the working memory system. It acts as the central processor, responsible for coordinating the functions of the subsidiary systems. It is also responsible for the performance of several cognitive functions and the management of

attention (Baddeley, 1996, 2006). The central executive allocates cognitive resources for the execution of cognitive processes, contributes to the selection and application of appropriate strategies and the achievement of individual goals, and supports the performance of higher order language tasks.

The episodic buffer, which was added by Baddeley in 2000, facilitates the creation of single mnemonic episodes or representations by integrating information, which may come from the phonological loop, the visuospatial sketchpad, or long-term memory. Its function supports the central executive, which is responsible for the performance of several cognitive tasks (Baddeley & Wilson, 2002). It is also responsible for the processing of abstract concepts. The function of the episodic buffer is particularly important in learning, as it helps to process and integrate new information, so as to create new mnemonic representations and cognitive schemata.

Literature Review

Research has revealed working memory's contribution to second language acquisition. Working memory has been found to support vocabulary learning (Cheung, 1996; Efstathiadi, 2016; Gui & Ismail, 2024; Kormos & Sáfár, 2008; Martin & Ellis, 2012; Masoura & Gathercole, 1999; 2005; Nawaz et al., 2024; Teng, 2022, 2024), oral comprehension (Joh & Plakans, 2017; Masrai, 2019; Satori, 2021), oral production (Ahmadian, 2012; Awwad & Tavakoli, 2022; Gilabert & Munoz, 2010), written comprehension (Escobar & Espinoza, 2024; Liu et al., 2024; Shahnazari, 2023), correct use of grammar, syntax, and pronunciation (Ellis, 1996; Ellis & Sinclair, 1996; O'Brien et al., 2006; Serafini & Sanz, 2016), and the improvement of second language proficiency level (Mackey & Sachs, 2012; Wright, 2009).

Acknowledging the central role that has been attributed to working memory in the first language writing process (Hayes, 1996, 2012; Kellogg, 1996), scholars attempted to investigate working memory's role in second language writing. However, as many scholars (Mallahi, 2019; Michel et al., 2019; Mujtaba et al., 2021; Peng et al., 2022; Wen & Li, 2019) have noted, research on working memory's contribution to second language writing production is still limited. It is also worth mentioning that most of the studies that have been carried out in this field focus on writing by adults (Mujtaba et al., 2021; Teng & Zhang, 2024; Yi & Ni, 2015; Zalbidea, 2017). Research involving adolescent students' writing is even more limited (Abu-Rabia, 2003; Kormos & Sáfár, 2008; Michel et al., 2019).

Research has displayed variation in relation to the parameters studied and the methods implemented. This paper focuses on working memory, second language proficiency level, and second language writing quality, assessed in terms of fluency and accuracy. Working memory has been found to exert a positive effect on second language writing performance (Abu-Rabia, 2003; Peng et al., 2022). Teng and Zhang's study (2024) revealed working memory's predictive impact on second language writing performance. These researchers also found a statistically positive correlation between the participants' second language proficiency level and their second language writing performance ($r = .456, p < .01$). Another research study, conducted by Vasylets and Marin (2021), revealed working memory's statistically positive correlation with second language writing accuracy produced by participants with a low second language proficiency level ($r = -.28, p < .05$). They also found a positive effect of working memory on lexical sophistication ($t = 3.29, p < .01$) but no link between working memory and fluency.

Individual differences in working memory capacity were found to relate to second language writing performance. Bergsleithner (2010) concluded that writers with higher working

memory capacity tend to produce second language texts with fewer errors. The positive effect of working memory's capacity on second language writing accuracy is supported by some other studies (Mallahi, 2019; Mujtaba et al., 2021; Zalbidea, 2017). A statistically significant correlation was detected between learners' working memory capacity and the writing accuracy achieved in their second language texts. Moreover, Mavrou (2020) concluded that individual differences in some executive functions of working memory may predict linguistic accuracy in second language writing. Although Michel et al. (2019) did not find a statistically significant effect of working memory functioning on second language writing, they detected a positive but not statistically significant correlation with the writers' editing performance, which relates to accuracy. They also found that writers with high working memory capacity had a more consistent performance across a variety of tasks of different modality in comparison to those with low working memory capacity. However, some studies revealed no statistically significant correlation between working memory functioning and second language writing accuracy (Yi & Luo, 2013; Yi & Ni, 2015; Zabihi, 2018).

Working memory capacity has played a significant role in some cases for second language writing fluency (Mallahi, 2019). Writers' ability to assess and process information, employ linguistic and cognitive functions, and apply strategies in order to compose written texts is associated with working memory functioning. Mallahi (2019) found that individual differences in working memory associated with writers' ability to achieve a better performance in terms of fluency. This conclusion complies with the findings of other studies (Yi & Luo, 2013; Yi & Ni, 2015), in which it was revealed that working memory exerts a significant effect on writing fluency. Moreover, Zabihi (2018) found that verbal working memory may function as a predictor of second language writing fluency. An indirect impact on fluency was also detected by Grace

Kim (2021). They found that working memory had a positive effect on linguistic resources, which could predict greater fluency.

Finally, Lu (2010) found that working memory had little impact on second language writing and could not predict writing performance. Second language proficiency level, instead, was found to be a significant predictor of second language writing performance. In a similar study (Manchón et al., 2023) results revealed no correlation between working memory and writing, but showed that second language proficiency level correlated significantly with writing fluency and accuracy.

Methodology

Participants

The sample consisted of 30 second-year junior high school students. Eighteen students were girls (60%) and 12 were boys (40%). The participants did not all attend the same school, but two different ones. They were all native speakers of Greek, who had been studying English as a second language since the first grade of primary school. They all had also attended English classes in the private sector. None of students exhibited any special educational needs. Since there were no students with special education needs in this participation pool, the group of participants was an atypical class compared to most public-school classes around the world.

Procedure

The administration of standardized tests delivered the data required for the assessment of working memory capacity and second language proficiency level. The tests were administered in groups, on two different school days. On the first day the participants completed the tests for the assessment of the phonological loop and second language proficiency level. On the second day they completed a test for the assessment of the central executive and also composed a narrative

text in the second language. The whole procedure was scheduled and carried out according to the *Guidelines for the Approval of Educational Programs and Research* (2021) issued by the Ministry of Education and Religious Affairs of Greece. The IBM SPSS Statistics 28 software was used for the statistical analysis of the data.

Tools

Working Memory

The assessment of working memory capacity was administered through the assessment of two sub-components of working memory, the phonological loop and central executive. The tasks for the assessment of both sub-components were based on the Working Memory Test Battery for Children (Pickering & Gathercole, 2001). The tasks used were a translation of the English version with necessary adaptations, where necessary, into Greek (Chrysochoou, 2006).

A serial recall memory task was used for the assessment of the phonological loop capacity. The participants listened to sets of two-syllable words and had to remember and write them down in the same order they had heard them. The task was composed of six blocks of sets of words. The number of words the sets contained increased from block to block, so as to increase the cognitive load applied on the phonological loop for the completion of the task.

A listening recall task was used for the assessment of the central executive capacity. The task required both short-term storage and processing of aural information. In particular, the participants listened to sets of short, simply structured sentences and had to judge their veracity and remember the last word of each sentence. Students were asked to write down the information required. The last words of the sentences should have been written in the same order they were heard. The participants were presented with five different blocks of sets of sentences. The

number of sentences in each block increased from block to block, raising the cognitive load applied on central executive.

Second Language Proficiency Level

A standardized test was used for the assessment of the participants' second language proficiency level. It was a multiple choice, cloze test, which focused on grammar and vocabulary use assessment. It consisted of part of the English Speaking Board (ESB) official assessment exams. The specific standardized exams provided officially acknowledged certificates of the assessment of the English language proficiency level in Greece.

Writing

Participants were asked to compose a written narrative text. The specific genre was selected as more relevant to them, since they are familiar with both of its forms (oral and written) from an early age. As such, they were expected to be well motivated to complete the activity assigned and achieve a good performance. Following the Curriculum Based Measurement for Writing (CBM-W) (Cusumano, 2007; Deno, 2003; McMaster et al., 2011) students were provided with a prompt sentence. They were informed that they could think for one minute and then they would have 6 minutes to write their narrative.

The texts were assessed in terms of fluency and accuracy according to CBM-W (Cusumano, 2007; Deno, 2003; McMaster et al., 2011) guidelines. The total of written words produced constituted the fluency rating. Accuracy was studied in relation to the amount of the Correct Word Sequences (CWS) and the Incorrect Word Sequences (INCWS) identified in the texts. A correct word sequence is defined as two adjacent words that are acceptable within the context of a phrase to a native speaker of a language (Videen et al., 1982). Certain criteria were

followed for the assessment of word sequences as correct or incorrect. The criteria were related to correct punctuation, syntax, grammar, spelling, semantics, and vocabulary use.

Findings and Discussion

The present study aimed to investigate the potential impact of working memory capacity and second language proficiency level on second language writing quality. Writing was assessed in terms of fluency and accuracy. The data collected were statistically analyzed with the use of *IBM SPSS Statistics 28* software.

Pearson correlation analysis was applied to study the relation of the variables phonological loop (PL), central executive (CE), second language (L2) proficiency level, and second language (L2) writing fluency. The analysis revealed statistically significant correlation ($r = .777$, $p = .001$) only between the variables second language proficiency level and second language writing fluency, as shown in Table 1.

Table 1

Pearson Correlations Among Phonological Loop, Central Executive, Second Language Proficiency Level and Second Language Writing Fluency

Variables	PL	CE	L2 proficiency level	L2 Writing fluency
PL	—	.357	.127	.102
CE	.357	—	.202	.268
L2 proficiency level	.127	.202	—	.777*

Note: * $p < .01$

Pearson correlation analysis was also applied for the study of the relation among the variables phonological loop (PL), central executive (CE), second language (L2) proficiency

level, correct word sequences (CWS), and incorrect word sequences (INCWS). The analysis revealed statistically significant correlation ($r = .754$, $p = .001$) only between the variables second language proficiency level and correct word sequences, as shown in Table 2.

Table 2

Pearson Correlations Among Phonological Loop, Central Executive, Second Language Proficiency Level, Correct Word Sequences, and Incorrect Word Sequences

Variables	PL	CE	L2 proficiency level	L2 CWS	L2 INCWS
PL	–	.357	.127	.179	-.071
CE	.357	–	.202	.296	-.069
L2 proficiency level	.127	.202	–	.754*	.104
L2 CWS	.179	.296	.754*	–	-.109
L2 INCWS	-.071	.296	.104	-.109	–

Note: * $p < .01$

After the Pearson correlation analysis, a hierarchical linear multiple regression analysis was used aiming at achieving a thorough study of the relationships among the variables involved and producing appropriate explanatory models to describe these relationships. In the first regression analysis writing fluency was used as the dependent variable. The phonological loop, the central executive, and the second language proficiency level were added in the regression as independent variables. The models produced are presented in Table 3.

Table 3*Hierarchical Linear Multiple Regression Analysis*

Dependent variable: L2 fluency			
	Model 1	Model 2	Model 3
Constant	63.465 (14.323)	45.568 (19.450)	-14.820 (16.155)
PL	.703 (1.293)	.50 (1.365)	-.275 (.894)
CE	—	3.005 (2.246)	1.469 (1.490)
L2 proficiency level	—	—	5.532* (.907)
Observations	30	30	30
R^2	.010	.072	.618
Adjusted R^2	-.025	.003	.574
Residual Std. Error	28.286	27.895	18.232
F Statistic	0.296 ($df=1,28$)	1.047 ($df=2,27$)	14.036* ($df=3,26$)

Note: * $p < .001$

The regression analysis revealed a statistically non-significant contribution of the phonological loop in explaining the variance of the dependent variable. The first model, resulting from the regression analysis, was statistically non-significant ($F_{1,28} = .296$, $p = .591$). The addition of the second predictor, the central executive, contributed an additional 6.2% to the total variance of the dependent variable, but its contribution was statistically non-significant ($\Delta R^2 = .062$, $p = .192$). The model explained 7.2% of the total variance of the second language fluency. The model was statistically non-significant ($R^2 = .072$, $F_{2,27} = 1.047$, $p = .365$). The third model, resulting from the addition of the variable second language proficiency level, was statistically

significant and explained 61.8% of the variance of the dependent variable, second language writing fluency, ($R^2 = .618$, $F_{3,26} = 14.036$, $p < .001$). The third variable contributed by 54.6% to the explanation of the variance of the dependent variable. Its contribution was statistically significant ($\Delta R^2 = .546$, $p < .001$).

In the second regression analysis the variable, correct word sequences, was used as the dependent variable. The phonological loop, the central executive, and the second language proficiency level were added in the regression as independent variables. The models produced are presented in Table 4.

Table 4*Hierarchical Linear Multiple Regression Analysis*

Dependent variable: Correct word sequences			
	Model 1	Model 2	Model 3
Constant	45.878 (15.179)	26.651 (20.598)	-35.115 (17.860)
PL	1.318 (1.370)	.617 (1.446)	.284 (.991)
CE	—	3.229 (2.378)	1.658 (1.651)
L2 proficiency level	—	—	5.658* (1.005)
Observations	30	30	30
R^2	.032	.094	0.592
Adjusted R^2	-.003	.027	.544
Residual Std. Error	29.977	29.536	20.207
F Statistic	0.926 ($df=1,28$)	1.398 ($df=2,27$)	12.554* ($df=3,26$)

Note: * $p < .001$

The regression analysis revealed a statistically non-significant contribution of the phonological loop in explaining the variance of the dependent variable, correct word sequences. The phonological loop explained 3.2% of the variance of the dependent variable. The first model was statistically non-significant ($R^2 = .032$, $F_{1,28} = .926$, $p = .344$). The second predictor, the central executive, contributed 6.2% to the explanation of the variance of the dependent variable. Its contribution was statistically non-significant ($\Delta R^2 = .062$, $F_{1,27} = 1.843$, $p = .186$). The second model, resulting from the addition of the central executive, explained 9.4% of the variance of the dependent variable and was overall statistically non-significant ($R^2 = .094$, $F_{2,27} = 1.398$, $p = .264$). The contribution of the third predictor, the variable second language proficiency level, was statistically significant. The third independent variable contributed 49.8% to the explanation of the total variance of the variable correct word sequences ($\Delta R^2 = .498$, $F_{1,26} = 31.687$, $p = .001$). The third model was statistically significant. It explained 59.2% of the variance of the dependent variable ($R^2 = .592$, $F_{3,26} = 12.554$, $p < .001$).

Finally, in the third regression analysis the variable incorrect word sequences was used as the dependent variable. The phonological loop, the central executive and the second language proficiency level were added in the regression as independent variables. The models produced are presented in table 5.

Table 5*Hierarchical Linear Multiple Regression Analysis*

Dependent variable: Incorrect word sequences			
	Model 1	Model 2	Model 3
Constant	19.548 (5.707)	20.897 (7.996)	16.872 (10.247)
PL	-.195 (.515)	-.146 (.561)	-.167 (.568)
CE	—	-.226 (.923)	-.329 (.947)
L2 proficiency level	—	—	.369 (.577)
Observations	30	30	30
R^2	.05	.007	.023
Adjusted R^2	-.030	-.066	-.090
Residual Std. Error	11.271	11.466	11.593
F Statistic	0.143 (df=1,28)	0.099 (df=2,27)	0.201 (df=3,26)

The third analysis revealed a minimal contribution of the predictive factors to the explanation of the variance of the dependent variable. Specifically, the phonological loop contributed 0.5% ($\Delta R^2 = .005$, $p = .708$), the central executive by 0.2% ($\Delta R^2 = .002$, $p = .808$) and the second language proficiency level by 1.5% ($\Delta R^2 = .015$, $p = .528$). These contributions were statistically non-significant. None of the explanatory models that are produced was statistically significant. The third model resulting from the addition of the third predictive factor

explained a total of only 2.3% of the variance of the variable incorrect word sequences. It is statistically non-significant ($R^2 = .023$, $F_{3,26} = .201$, $p = .895$).

The statistical analysis revealed no correlation between working memory capacity and second language quality. Neither the phonological loop nor the central executive was found to have statistically significant effect on second language writing fluency or accuracy. Both subcomponents support the cognitive and linguistic processes required for the composition of written texts (Baddeley, 1996, 2003; 2006; Kellogg, 1996). The negative correlation may be related to the small sample used in the research or the genre of the writing investigated. The specific findings complied with results from some previous research (Lu, 2010; Manchón et al. 2023) in which no correlation between working memory and second language writing was identified. They also complied partially with results of previous studies. Vasylets and Marin (2021) found a positive link between working memory and accuracy, but no association with second language writing fluency. Other studies revealed working memory's effect on fluency but not on accuracy (Yi & Luo, 2013; Yi & Ni, 2015; Zabihi, 2018). The results of the present study contradicted some previous research in which working memory was found to have positive correlation with or predict second language writing performance (Abu-Rabia, 2003; Bergsleithner, 2010; Mallahi, 2019; Mavrou, 2020; Michel et al., 2019; Mujtaba et al., 2021; Peng et al., 2022; Zalbidea, 2017).

The statistical analysis also revealed that the participants' second language proficiency level was statistically significant for the quality of their narrative texts. Second language proficiency level was found to positively correlate with second language writing fluency and correct word sequences. It was also revealed as a strong predictor of the variance of the specific variables. The data indicated to the team of researchers that the wider linguistic resources one

has acquired, the better writing performance they may achieve. The results supported the findings of previous research, in which second language proficiency level was found to be a strong predictor of second language writing performance (Lu, 2010; Manchón et al., 2023). Also, Teng and Zhang (2024) found a positive correlation between second language proficiency level and second language writing, while Vasylets and Marin (2021) concluded that second language proficiency level mediates the effect of working memory on second language writing performance.

These findings lead to certain educational implications. It is always important that teachers hold a good profile of their classes. Any information related to students' learning characteristics and educational needs are of high importance for developing essential instruction. Identifying any problematic areas in the use of second language would enable teachers to plan more efficient teaching. Improving students' second language proficiency level would have a positive impact on second language writing.

The above presented findings are only indicative of tendencies of the variables studied. The present study exhibited certain limitations. It was a small-scale research study that involved a small sample and made use of one assessment tool for each parameter studied. Some further research which would involve a wider range of participants and would make use of more tools for the working memory assessment could yield more robust results. Working memory capacity and its impact on second language writing could also be studied through the assessment of all its three components (phonological loop, visuo-spatial sketch-pad, central executive). Moreover, the use of more texts and of different genres for the study of second language writing may lead to more reliable results.

Conclusion

Research has yielded interesting findings about the contribution of working memory to second language acquisition. However, the impact of working memory on second language writing produced by teenagers has received little attention. The present study aimed at investigating the effect of working memory and second language proficiency level on second language writing quality. The statistical analysis of the data revealed no correlation between working memory and second language writing fluency and accuracy. Second language proficiency level, however, was found to be a strong predictor of second language writing performance. These findings, which partially comply with results of previous research, are only indicative of tendencies of the variables involved. Some wider research, which may involve a larger sample or more texts of different genres produced by teenagers, may yield more robust results. Identifying working memory's role in the development of second language writing skill may prove beneficial for the structuring of more efficient teaching approaches and methods.

References

- Abu-Rabia, S. (2003). The influence of working memory on reading and creative writing processes in a second language. *Educational Psychology*, 23(2), 209–219. <https://doi.org/10.1080/01443410303227>
- Ahmadian, M. J. (2012). The Relationship between working memory capacity and L2 oral performance under task-based careful online planning condition. *TESOL Quarterly*, 46(1), 165–175. <https://doi.org/10.1002/tesq.8>
- Awwad, A., & Tavakoli, P. (2022). Task complexity, language proficiency and working memory: Interaction effects on second language speech performance. *International Review of Applied Linguistics in Language Teaching*, 60(2), 169–196. <https://doi.org/10.1515/iral-2018-0378>
- Baddeley, A. (1996). Exploring the central executive. *Quarterly Journal of Experimental Psychology*, 49 A(1), 5–28. <https://doi.org/10.1080/027249896392784>
- Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences*, 4, 417–427. [https://doi.org/10.1016/s1364-6613\(00\)01538-2](https://doi.org/10.1016/s1364-6613(00)01538-2)
- Baddeley, A. (2003). Working memory and language: An overview. *Journal of communication disorders*, 36(3), 189–208. [https://doi.org/10.1016/S0021-9924\(03\)00019-4](https://doi.org/10.1016/S0021-9924(03)00019-4)
- Baddeley, A. (2006). Working memory: An overview. In S. J. Pickering (Ed.), *Working memory and education* (pp. 1–31). Academic Press.
- Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. A. Bower (Ed.), *The psychology of learning and motivation*, Volume 8, pp. 47–90. Academic Press.

- Baddeley, A., & Wilson, B. (2002). Prose recall and amnesia: Implications for the structure of working memory. *Neuropsychologia*, 40, 1737–1743. [https://doi.org/10.1016/s0028-3932\(01\)00146-4](https://doi.org/10.1016/s0028-3932(01)00146-4)
- Bereiter, C., & Scardamalia, M. (1987). *The psychology of written composition*. Lawrence Erlbaum Associates.
- Berninger, V. W., Fuller, F., & Whitaker, D. (1996). A process model of writing development across the life span. *Educational Psychology Review*, 8(3), 193–218. <https://doi.org/10.1007/BF01464073>
- Bergsleithner, J. M. (2010). Working memory capacity and L2 writing performance. *Ciências & Cognição*, 15(2), 2–20. <https://bit.ly/30JOsrh>
- Cheung, H. (1996). Nonword span as a unique predictor of second-language vocabulary language. *Developmental Psychology*, 32(5), 867–873. <https://doi.org/10.1037/0012-1649.32.5.867>
- Chrysochoou, E. (2006). Working memory contributions to young children's listening comprehension. [Doctoral Dissertation, Aristotle University of Thessaloniki, Greece]. School of Pedagogy. Department of Early Childhood Education and Education Sciences. Department of Psychology and Special Education. <https://doi.org/10.12681/eadd/14127>
- Cusumano, D. L. (2007). Is it working? An overview of curriculum-based measurement and its uses for assessing instructional, intervention, or program effectiveness. *The Behavior Analyst Today*, 8(1), 24–34. <https://doi.org/10.1037/h0100099>
- Deno, S. L. (2003). Developments in curriculum-based measurement. *The Journal of Special Education*, 37(3), 184–192. <https://doi.org/10.1177/00224669030370030801>

Deyzac, E., Logie, R., & Denis, M. (2006). Visuospatial working memory and the processing of spatial descriptions. *British Journal of Psychology*, 97, 217–243.

<https://doi.org/10.1348/000712605X67484>

Efstathiadi, L. (2016). Vocabulary acquisition by young Greek learners of L2 English. The predictive role of complex working memory in early foreign language learning. [Paper presentation]. In *Selected Papers of the 21st International Symposium on Theoretical and Applied Linguistics (ISTAL 21)*, (527–547). <https://doi.org/10.26262/istal.v21i0.5253>

Ellis, N. C. (1996). Sequencing in SLA: Phonological memory, chunking, and points of order. *Studies in Second Language Acquisition*, 18(1), 91–126.

<https://doi.org/10.1017/S0272263100014698>

Ellis, N. C., & Sinclair, S. G. (1996). Working memory in the acquisition of vocabulary and syntax: putting language in good order. *Quarterly Journal of Experimental Psychology*, 49A(1), 234–250. <https://doi.org/10.1080/713755604>

Escobar, J. P., & Espinoza, V. (2024). Direct and indirect effects of inhibition, working memory and cognitive flexibility on reading comprehension of narrative and expository texts: Same or different effects? *Reading & Writing Quarterly*, 1–17.

<https://doi.org/10.1080/10573569.2024.2400993>

Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College composition and communication*, 32, 365–387. <https://doi.org/10.2307/356600>

Gilabert, R., & Muñoz, C. (2010). Differences in attainment and performance in a foreign Language: The role of working memory capacity. *International Journal of English Studies*, 10(1), 19–42. <https://doi.org/10.6018/ijes/2010/1/113961>

- Grace Kim, Y.-S. (2021). Do written language bursts mediate the relations of language, cognitive, and transcription skills to writing quality? *Written Communication*, 39, 200–227. <https://doi.org/10.1177/07410883211068753>
- Gui, J., & Ismail, S. M. (2024). The effect of planning time on vocabulary acquisition in a task-based environment: the mediating roles of working memory and field (in)dependence. *BMC Psychology*, 12, 145. <https://doi.org/10.1186/s40359-024-01638-4>
- Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C. M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences, and applications* (pp. 1–27). Lawrence Erlbaum Associates, Inc.
- Hayes, J. R. (2012). Modeling and remodeling writing. *Written Communication*, 29(3), 369–388. <https://doi.org/10.1177/0741088312451260>
- Joh, J., & Plakans, L. (2017). Working memory in L2 reading comprehension: The influence of prior knowledge. *System*, 70(1), 107–120. <https://doi.org/10.1016/j.system.2017.07.007>
- Kellogg, R. T. (1996). A model of working memory in writing. In C. M. Levy & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences, and applications* (pp. 57–71). Lawrence Erlbaum Associates, Inc.
- Kormos, J., & Sáfár, A. (2008). Phonological short-term memory, working memory and foreign language performance in intensive language learning. *Bilingualism: Language and Cognition*, 11(2), 261–271. <https://doi.org/10.1017/S1366728908003416>
- Liu, S., Li, N., Zhang, X., & Wang, L.-C., & Liu, D. (2024). Effects of working memory and visual search skill on Chinese reading comprehension: examining the simple view of reading. *Reading and Writing*, 1–23. <https://doi.org/10.1007/s11145-024-10515-w>
- Logie, R. H. (1995). *Visuo-spatial working memory*. Hove: Erlbaum.

- Lu, Y. (2010). *Cognitive factors contributing to Chinese EFL learners' L2 writing performance in timed essay writing*. [Dissertation, Georgia State University]. Scholar Works at Georgia State University. https://scholarworks.gsu.edu/alesl_diss/13
- Mackey, A., & Sachs, R. (2012). Older learners in SLA research: A first look at working memory, feedback, and L2 development. *Language Learning*, 62(3), 704–740. <https://doi.org/10.1111/j.1467-9922.2011.00649.x>
- Mallahi, O. (2019). The role of working memory (WM) in fluency, accuracy and complexity of argumentative texts produced by Iranian EFL learners. *Iranian Journal of Learning and Memory*, 2(5), 55–65. <https://doi.org/10.22034/iepa.2019.91050>
- Manchón, R., McBride, S., & Martínez, M. D., & Vasylets, O. (2023). Working memory, L2 proficiency, and task complexity: Independent and interactive effects on L2 written performance. *Studies in Second Language Acquisition*, 45(3), 737–764. <https://doi.org/10.1017/S0272263123000141>
- Martin, K. I., & Ellis, N. C. (2012). The roles of phonological short-term memory and working memory in L2 grammar and vocabulary learning. *Studies in Second Language Acquisition*, 34(3), 379–413. <https://doi.org/10.1017/S0272263112000125>
- Masoura, E. V., & Gathercole, S. E. (1999). Phonological short-term memory and foreign language learning. *International Journal of Psychology*, 34, 383–388. <https://doi.org/10.1080/002075999399738>
- Masoura, E. V., & Gathercole, S. E. (2005). Contrasting contributions of phonological short-term memory and long-term knowledge to vocabulary learning in a foreign language. *Memory*, 13, 422–429. <https://doi.org/10.1080/09658210344000323>

- Masrai, A. (2019). Exploring the impact of individual differences in aural vocabulary knowledge, written vocabulary knowledge and working memory capacity on explaining L2 learners' listening comprehension. *Applied Linguistics Review*, 11(3), 423–447.
<https://doi.org/10.1515/applirev-2018-0106>
- Mavrou, I. (2020). Working memory, executive functions, and emotional intelligence in second language writing. *Journal of Second Language Writing*, 50.
<https://doi.org/10.1016/j.jslw.2020.100758>
- McMaster, K. L., Ritchey, K. D., & Lembke, E. (2011). Curriculum-based measurement of elementary students' writing: Recent developments and future directions. In T. E. Scruggs & M. A. Mastropieri (Eds.), *Assessment and intervention: Advances in learning and behavioral disabilities* (pp. 111–148). Emerald.
- Michel, M., Kormos, J., Brunfaut, T., & Ratajczak, M. (2019). The role of working memory in young second language learners' written performances. *Journal of Second Language Writing*, 45, 31–45. <https://doi.org/10.1016/j.jslw.2019.03.002>
- Mujtaba, S. M., Kamyabi Gol, A., & Parkash, R. (2021). A study on the relationship between language aptitude, vocabulary size, working memory, and L2 writing accuracy. *Foreign Language Annals*, 54, 1059–1081. <https://doi.org/10.1111/flan.12584>
- Nawaz, S., Qanwal, S., & Parveen, S. (2024). Exploring the relationship among multimedia input, working memory and l2 vocabulary learning. *International Journal of Linguistics and Culture*, 5(1), 65–83. <https://doi.org/10.52700/ijlc.v5i1.260>

- O'Brien, I., Segalowitz, N., Collentine, J., & Freed, B. (2006). Phonological memory and lexical, narrative, and grammatical skills in second language oral production by adult learners. *Applied Psycholinguistics*, 27(3), 377–402.
<https://doi.org/10.1017/S0142716406060322>
- Peng, A., Orosco, M. J., Wang, H., Swanson, H. L., & Reed, D. K. (2022). Cognition and writing development in early adolescent English learners. *Journal of Educational Psychology*, 114(5), 1136–1155. <https://doi.org/10.1037/edu0000695>
- Pickering, S., & Gathercole, S. E. (2001). *Working Memory Test Battery for Children (WMTB-C)*. The Psychological Corporation.
- Satori, M. (2021). Effects of working memory on L2 linguistic knowledge and L2 listening comprehension. *Applied Psycholinguistics*, 42(5), 1313–1340.
<https://doi.org/10.1017/S0142716421000345>
- Serafini, E. J., & Sanz, C. (2016). Evidence for the decreasing impact of cognitive ability on second language development as proficiency increases. *Studies in Second Language Acquisition*, 38(4), 607–646. <https://doi.org/10.1017/S0272263115000327>
- Shahnazari, M. (2023). The role of WM in second language reading comprehension: Does L2 proficiency level matter? *Learning and Motivation*, 82.
<https://doi.org/10.1016/j.lmot.2023.101875>
- Smith, E. E., & Jonides, J. (1997). Working memory: A view from neuroimaging. *Cognitive Psychology*, 33, 5–42. <https://doi.org/10.1080/0144341042000211715>
- Teng, M. F. (2022). Incidental vocabulary learning from captioned videos: Learners' prior vocabulary knowledge and working memory. *Journal of Computer Assisted Learning*, 39(2), 517–531. <https://doi.org/10.1111/jcal.12756>

- Teng, M. F. (2024). Young beginning learners' vocabulary learning via input and output tasks: The role of working memory. *Studies in Second Language Learning and Teaching*, 14(4), 731-767. <https://doi.org/10.14746/sslt.36123>
- Teng, M. F., & Zhang, L. J. (2024). Assessing self-regulated writing strategies, working memory, L2 proficiency level, and multimedia writing performance. *Language Awareness*, 33(3), 570–596. <https://doi.org/10.1080/09658416.2023.2300269>
- Vasylets, O., & Marín, J. (2021). The effects of working memory and L2 proficiency on L2 writing. *Journal of Second Language Writing*, 52. <https://doi.org/10.1016/j.jslw.2020.100786>
- Videen, J., Deno, S., & Marston, D. (1982). *Correct word sequences: A valid indicator of proficiency in written expression* (Research Report No. 84). University of Minnesota, Institute for Research on Learning. <https://files.eric.ed.gov/fulltext/ED225112.pdf>
- Weigle, S. C. (2005). Second language writing expertise. In K. Johnson (Ed.), *Expertise in second language learning and teaching* (pp. 128–149). Palgrave Macmillan. https://doi.org/10.1057/9780230523470_7
- Wen, Z., & Li, S. (2019). Working memory in L2 learning and processing. In J. W. Schwieter & A. Benati (Eds.), *The Cambridge Handbook of Language Learning* (pp. 365–389). Cambridge University Press. <https://doi.org/10.1017/9781108333603.016>
- Wright, C. (2009). The role of working memory in the development of L2 grammatical proficiency. In A. G. Benati (Ed.), *Issues in Second Language Proficiency* (45–60). Continuum International. Newcastle University. <https://eprints.ncl.ac.uk/154701>

- Yi, B., & Luo, S. (2013). Working memory and lexical knowledge in L2 argumentative writing. *Asian Journal of English Language Teaching*, 23, 83–102.
<https://muse.jhu.edu/article/537822>
- Yi, B., & Ni, C. (2015). Planning and working memory effects on L2 performance in Chinese EFL learners' argumentative writing. *Indonesian Journal of Applied Linguistics*, 5(1), 44–53. <https://doi.org/10.17509/ijal.v5i1.830>
- Zabihi, R. (2018). The Role of Cognitive and Affective Factors in Measures of L2 Writing. *Written Communication*, 35(1), 32–57. <https://doi.org/10.1177/0741088317735836>
- Zalbidea, J. (2017). ‘One task fits all’? The roles of task complexity, modality, and working memory capacity in L2 performance. *Modern Language Journal*, 101(2), 335–352.
<https://doi.org/10.1111/modl.12389>