

## Book Review

**Cyril Perret and Thierry Olive (eds.):** *Spelling and writing words: Theoretical and methodological advances*. Leiden and Boston: Brill, 2019, pp. 226, ISBN: 9789004391871, <https://doi.org/10.1163/9789004394988>

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Writing plays a necessary part in the human language system. Although in the majority of cases writers combine words into sentences and paragraphs in daily communication, in some cases isolated words can also be applied, such as when preparing lists of purchases or taking notes. Therefore, as basic components of language, it is necessary to investigate written word processing in order to better understand the processing of larger linguistic units. This edited volume deeply explores the cognitive mechanism of written word production from the perspective of theory and method.

At the theoretical level, this volume starts with several key research problems, introduces the existing theoretical achievements, and also puts forward several controversial research problems in this research field that require further study in the future. At the methodological level, this volume introduces various research methods applied in the studies of written word production, from the traditional linguistic research methods to the behavioral experimental research methods and brain-imaging technology. It also concludes the significance and limitations of these research methods and shows the trend toward combining multiple methods in future studies of written word production. In a word, this volume embodies the perfect combination of theory and practice in exploring the psychological, cognitive, and neural mechanisms of writing a word. It contains 12 chapters which are made up of an introductory chapter and 11 chapters divided into three parts, a theoretical and empirical part (chapters 2–6), a methodological part (chapters 7–10), and a concluding part (chapters 11–12). The contents of these chapters are introduced in the following section.

In the introductory chapter, Perret and Olive introduce the main theoretical

issues on word production, establish the theoretical framework of studies on written word production, and pave the way for the methodological and statistical aspects of research on word production. They give an overall presentation on the psychological processes, methods for studying, and central issues in the research of written word production and summarize the contents of follow-up chapters. In the first section, two major stages of processing in writing down an isolated word are introduced, namely, central and peripheral processes. The methods used to retrieve orthographic information from written words are referred to as central processes; peripheral processes, on the other hand, refer to the conversion of the abstract language code into a set of motor commands that can then be carried out by the neuromuscular systems. Two ways of accessing orthographic representation are also mentioned, that is, via the lexical pathway and via the sublexical pathway. At the end of this section, Perret and Olive use a series of linguistic phenomena to further illustrate the cognitive architecture, which allows the abstract linguistic theories to be better understood. In the second section, two major approaches are illustrated in terms of their mechanisms, tasks, and variables. Evaluating the feasibility and limitations of these two methods provides enlightenment for further experimental research on written word production. The third section involves two central issues on the written production of isolated words that are widely discussed, namely, the role of phonology and the role of articulation between the central and peripheral levels of processing. On the role of phonology, it is believed that phonology plays a part in retrieving orthographic information by employing a sublexical pathway. However, this conception may have difficulties in explaining non-alphabetic language phenomena such as Chinese. On the articulation between the central and peripheral levels of processing, it is generally accepted that information continuously cascades from higher-level processing to lower-level processing. Nevertheless, questions about how information cascades from the higher level to the lower level remain to be answered.

In Chapter 2, Markus Damian talks about the role of phonology in orthographic production. To briefly review the role of phonology in orthographic production, Damian first talks about two opposite views on whether phonology plays a part in orthographic production, and in the following two parts, he overviews existing literature on this issue, specifically, from early studies from a neuropsychological angle to modern experimental studies. It can be concluded from the historical review that written language is largely “parasitic upon” spoken codes. Nevertheless, recent neuropsychological studies discuss whether the contribution from phonology is obligatory. A

dominant perspective is that orthographic output codes can be directly accessed from conceptual representations. To speak to this issue, the experimental evidence is sorted and summarized according to the tasks used. So far, researchers have applied a variety of tasks to investigate the contribution of phonology, for example, picture–word interference tasks, implicit priming tasks, masked priming tasks, bare picture naming tasks, picture-picture priming tasks, cross-modal long-lasting repetition priming tasks, and Stroop tasks. Damian first introduces the specific content and mechanism of the tasks and then lists the concrete experimental research and results. However, the result of different studies that applied the same task can be conflicting. In the next part, by reviewing the previous study, Damian puts forward the development prospects of future research in this field and the problems that need to be solved and further studied. Firstly, the null or inconsistent findings require further discussion. Secondly, writing across different scripts should be considered and compared in further studies. Thirdly, longer expressions with multiple words involved in writing in real life need to be explored. Fourthly, individual differences should be taken into consideration. Last but not least, to make progress in investigating the time course of form encoding, measurements such as EEG should be considered in future studies. From all previous studies mentioned above, two questions that need further research remain unanswered, specifically, under what circumstances and at what times is phonology activated during writing.

Chapter 3 mainly focuses on the statistical learning of graphotactic regularities, and the impact of graphotactic knowledge on spelling and spelling acquisition. Graphotactic regularities are patterns in the arrangement and order of letters in written words, for example, particular letters or letter sequences will likely appear in particular positions in the words of a particular language. (Chetail 2017; Mano 2016; Treiman 2017; Treiman and Boland 2017). Sébastien Pacton et al. first review the experimental studies that investigate graphotactic knowledge through non-word spelling tasks and non-word judgment tasks. From the previous studies, although it may be demonstrated that children have some graphotactic knowledge, sensitivity to more complicated graphotactic regularities takes time to develop. In the next section, Pacton et al. review the study that investigates the influence of graphotactic knowledge on spelling and learning new spellings. From the previous studies, it is obvious that learning new spelling inevitably relies on our knowledge of graphotactic regularities, and the influence has been tested with various graphotactic patterns, different learning conditions, different types of orthographic learning assessments, and spellers of different ages and different levels of graphotactic knowledge.

According to Pacton et al., further studies are required to explore more precisely the deeper reasons for the impact of graphotactic knowledge and how graphotactic knowledge works on our cognitive spelling system.

In Chapter 4, to present a theoretical framework to account for bilingual spelling abilities and to guide future research in this area, Marie-Josèphe Tainturier proposes a theory of bilingual spelling in alphabetic systems (BAST). The theory proposed is derived from theories and literature on monolingual spelling on the one hand and research on bilingual spoken word production on the other. As for monolingual spelling processes, it is widely accepted that there are two main stages included in the processes of spelling a single word to dictation, namely, the lexical process and the sublexical process. On the one hand, the lexical process, which is semantically mediated, entails extracting the orthographic information of familiar words from human long-term memory. On the other hand, the sublexical process is activated by phonological input, either explicitly or implicitly. By the sublexical route, before translating them into letters, spellers first parse the phonological input into sound units. At the graphemic stage, the two different mechanisms interact with one another and cooperate to activate feasible graphemic sequences. Later on, the activated graphemic sequences are stored in a short-term memory system, namely, a graphemic buffer, so that the graphemic sequences can be available during peripheral processes.

When it comes to bilingual spoken word production, it is worthwhile to first mention theories and literature on the processes involved in monolingual spoken word production. In monolingual spoken word production, it is believed that a set of semantic features corresponding to the meaning are firstly activated, then the lexical representation of the corresponding word is activated, and finally, the phonological elements are activated for further articulation. What's more, according to the cascaded writing process, the processes involved in monolingual spoken word production are parallel, not sequential. Depending on the contributions to monolingual spoken word production, several theories and models have been put forward to account for bilingual spoken word production. Tainturier proposes that lexical representations in both languages are activated simultaneously by semantic input, which includes the representation corresponding to the target word, its translation equivalent in the other language, and even to a lesser extent, a series of semantically related words in both languages. The pattern of activation cascades to the phonological level. In the next section, the overall structure and general processing assumptions of BAST are presented. In brief, it is proposed that the distinct but highly interconnected orthographic lexicons are activated simultaneously in

both the lexical and the sublexical pathways and the information cascades into a graphemic level. In the lexical spelling pathway, three stages are involved, namely, lexical activation and selection, graphemic activation and selection, and grapheme to lexeme feedback. On the other hand, the degree of overlap between the phonology to orthography mapping regularities produced from two different languages determine how effective the sublexical pathway is. For bilingual spelling, interference will not only appear within languages through a mismatch between lexical and sublexical activation but also across languages. To support this theory, experimental evidence from the spelling performance of healthy and neurologically impaired bilingual adults is presented. Nevertheless, BAST is now a theoretical model that has been assumed based on current theories of bilingual spoken language production and monolingual written-language production. Several questions on this issue, such as, to what extent the overlapping of the two languages influence spelling performance, whether spelling using different alphabets can be applied to BAST, or whether the competence of two languages influences spelling performance, etc. remain unsolved.

It is obvious that people's writing behaviors are changing gradually along with the development of digital tools. Interestingly, transcription may not only influence our writing processes but also our reading abilities. In Chapter 5, Yannick Wamain looks deeply into the issue that whether the recollection of the movement required to produce the graphic trace plays a role in its visual perception, in other words, whether how people write has an impact on how they read it. In the first section, Wamain reviews previous psychological studies on the interconnection of action and perception. It is suggested that action comprehension may have its roots in the recruitment of motor knowledge during movement perception via a resonance event. Therefore, the motor laws that control the action behavior should affect how we perceive the same action if perceptual and action processing are both active at the same time during action perception (Gentsch et al. 2016; Schutz-Bosbach and Prinz 2007). Moreover, neuropsychological studies using brain-imaging techniques provide further evidence that motor resonance will not only show up in situations where the action was clearly demonstrated, but also show up when the movement was merely hinted at or indicated. Therefore, as a static condition that is frequently encountered in writing behaviors, graphic traces are applied to be appropriate stimuli to reveal the motor-perceptual interactions. In section 2, Wamain reviews behavioral studies and studies applied neuro-imaging techniques on graphic traces and postulates that motor information related to how a character or a letter is produced was reactivated during passive observation, even if the

character or the letter was presented in a static condition, and this reactivation is dependent on the amount of motor information embedded in the passive observation. In the next section, Wamain discusses the functional role of motor trace activation in visual letter recognition. To investigate this issue, he reviews previous studies using visual discrimination tasks, applying eye-tracking techniques, and neuropsychological studies on patients. It can be concluded that the activation of the neural network classically involved during the production of a specific letter plays an important role in the visual perception and recognition of such characters. In the last section, Wamain talks about the debate around the transformation of writing tools at school and holds that writing notes shouldn't be replaced by typing, because sensorimotor memory traces that are constructed and consolidated from the experience of handwriting facilitate written-language acquisition. Considering all the previous studies, further investigation should focus on the specific advantages and disadvantages of typing and writing in school learning, and optimize the formation of specific motor representations of a letter using new technological tools.

In Chapter 6, Olivia Afonso et al. examine the writing difficulties of children with developmental disabilities, especially, Specific Language Impairment (SLI), Developmental Dyslexia (DD), and Developmental Coordination Disorder (DCD). By looking into the studies investigating the writing process and writing production, Afonso et al. make inferences on the internal mechanisms of the occurrence of these developmental disabilities. SLI encompasses language production and comprehension problems that are primarily oral rather than receptive in nature (Dockrell et al. 2014: 552). DD is defined as reduced reading achievement, while DCD is defined as poor motor coordination.

Although all three developmental disabilities lead to the reduction of children's writing efficiency, clear differences have been found in the nature of writing difficulties experienced by these three groups. With SLI, it is found that one of the major impairments in SLI is that it is inclined to affect morpho-syntactic information processing in oral and written-language production, especially in verb morphology while writing, in which inflectional morphology represents a particular challenge. On this issue, further investigations are required to explain the cognitive mechanism of this phenomenon.

On DD, difficulties have been found in both reading and writing, especially poor spelling and more pauses during writing. Previous studies on keyboarding and handwriting indicate that the writing difficulties in DD lie in the cognitive process of spelling, not the execution of handwriting. However, the origin of the spelling difficulties is controversial. On the one hand, through

the error analysis of the written production of children with DD, difficulties may occur from correctly applying the phonology-orthography conversion rules. On the other hand, some researchers believe that the spelling difficulties can be better explained by a selective impairment of the orthographic lexicon. What's more, children with DD experience a word length effect in their writing processes, which indicates that it may also be difficult for children with DD to maintain information in orthographic working memory. Interestingly, according to the previous studies, the age of groups of children with DD may also affect the extent of spelling difficulties. Taking all the previous evidence into consideration, further studies should be devoted to digging deeper into the internal causes for the spelling deficit in children with DD, the development of the spelling deficit in children with DD over time, and the influence of the spelling deficit on reading processes in children with DD.

As for DCD, difficulties with motor processes of handwriting may be the dominant reason (Asher 2006; Prunty et al. 2013). Children with DCD have been found to pause more often and for a longer time. One interpretation was that in the DCD group, the inability to automate handwriting may make it difficult for them to simultaneously engage in higher-order writing processes. However, recent studies found that spelling and handwriting processes are closely related (Afonso et al. 2018; Berninger and Amtmann 2003; Bosga-Stork et al. 2016). To the best of our knowledge, evidence for spelling difficulties in children with DCD is limited, which required further exploration. In conclusion, further studies should continue working on the specific processes affected to unify the research method and explore the relationships between writing and other cognitive domains (such as oral language production, reading, and movement).

The methodological part of the volume introduces the methodological and statistical aspects of research on word production, including task differences, individual differences, measurement, variables, and the EEG method in studies on written word production. In studies of written word production, different tasks have been applied to investigate the spelling processes and psychological mechanisms involved, namely, written naming tasks, spelling to dictation tasks, and immediate copying tasks.

In Chapter 7, Patrick Bonin and Alain Méot begin by introducing the three kinds of tasks and then review studies applying these tasks to reveal the internal principle involved. What's more, issues on individual differences and the general applicability of the tasks are discussed in the following section. With regard to the picture naming task, it was frequently used to investigate spoken language production at first, and then gradually applied to study written-

language production, usually with an interference paradigm. Participants are asked to write down the name of a picture as quickly as possible after its presentation on a computer screen while ignoring the distractors, which can be semantically related, phonologically related, or unrelated words. The investigation of spoken and written word production reveals that written and spoken words seem common in some conceptual and lexical-semantic processes, but differ in word-form encoding.

As for spelling to dictation tasks, the guiding theory is the dual-route model which was proposed by Tainturier and Rapp (2001: 263). According to this model, two ways are applied to access the orthographic information of a word, namely, the lexical route and the sublexical route. One accesses orthographic information from the lexicon by semantic codes, while the other applies the regular correspondence of phoneme to grapheme to access orthographic information. Through spelling to dictation tasks, it is found that acoustic duration, objective word frequency, phonology-orthography consistency, and word length are the factors that affect spelling speed. Interestingly, consistency effects were also found to interact with word frequency. After introducing the line of reasoning in the previous tasks, studies also work on exploring the individual differences involved. It is a popular belief that there is a trade-off between word frequency and phonology-orthography consistency, but the trade-off might be influenced by participants' exposure to print. Thus, it is expected that participants who read a lot are more sensitive to word frequency and should be less sensitive to phonology-orthography consistency. However, more studies are required to continue seeking evidence on this assumption.

In terms of the general applicability of tasks, the key point is to talk about the extent to which these three spelling tasks share similar or different processes. Through reviewing previous studies applying the three types of tasks, it is acknowledged that although some factors do have an influence on all spelling tasks, for example, word frequency, there are also effects that are more specific to certain kinds of tasks, such as phonology-orthography consistency in spelling to dictation tasks. Therefore, the processing pathway appears to be different according to different types of tasks, so it is important to consider task differences in further studies. What's more, not only individual differences but also precise knowledge about the different pathways involved in different tasks need to be further understood.

In Chapter 8, Olivia Afonso and Carlos J. Álvarez discuss the variables that are frequently measured in experimental studies of written word production. They firstly review the studies on the interaction between central and peripheral processes. What's more, four major measures of the peripheral



processes involved are mentioned in this chapter, namely, whole-word duration, inter-letter intervals (ILIs), mean stroke durations, and letter durations. As for the interaction between central and peripheral processes, a great proportion of studies have been conducted to investigate the influence on peripheral processes of both the lexical pathway and the sublexical pathway involved in central processes. For the sublexical pathway, for example, the syllable boundary effect, which refers to the fact that participants produce longer ILI durations between syllables than within syllables, provides evidence for the effect on peripheral processes of central processes. In addition, it is reported that whole-word durations, mean stroke durations, and ILIs can also be affected by phonology-orthography consistency. Compared with sublexical pathways, evidence from the lexical pathway is more limited. Word frequency is found to only influence the writing durations of children. Although measuring peripheral processes provides evidence of revealing the relationship between central processes and peripheral processes, limitations of applying these measurements still need to be concerned.

As for whole-word durations, different letters have different durations, which is hard to manipulate in the studies, and not all strokes have the same duration because of the different lengths and curvatures of strokes. Additionally, whether the linguistic variables affect the actual writing movements or only in-air pen time also requires further exploration. From the previous studies, three main concepts on the relationship between central and peripheral processes have been proposed. Some hold that central processes do not affect peripheral processes, and that findings on longer ILIs can be explained as switching between central processes and peripheral processes. However, the best-acknowledged concept is that information cascades from the central to the peripheral processes, which is supported by the increasing writing durations mentioned above. Another important assumption that should be mentioned is that central and peripheral processes compete for the shared resource. However, this assumption has seldom been experimentally tested. All in all, according to Afonso and Álvarez, the way of analyzing and interpreting the data of writing movements should be unified, and theoretical proposals are required to be established with more detailed and precise predictions so that they can be tested experimentally.

To understand the variability of letter production among people and further provide an empirical methodological basis for writing experiments that require measurement of writing duration based on stroke number, in Chapter 9, Laurence Séraphin-Thibon et al. present their study on upper-case letter production. In this study, two groups of participants were required to

write the letters of the alphabet in upper case on a digitizer, one with a model (WM), while the other without (WOM), that is to say, letters in the upper case were presented to the WM group on a laptop screen before they wrote. Data processing and analysis are controlled by *Ductus*, which recorded the trajectory and velocity during letter production. Strokes were counted under both conditions based on the velocity peak, while at the same time, in-air movements were also taken into consideration. The results show that there are letters that are more variable than others, and writing the letter with the model can produce less variability than without the model. This study reveals the variability of letter production in upper case and provides a methodological contribution to handwriting studies. As this study was limited to upper-case letters, further studies should examine variability in other writing styles and lower-case writing.

In Chapter 10, EEG methods of exploring written word production are introduced. In the beginning, Cyril Perret and Qingqing Qu summarize the existing methods that are applied to explore written word production, for example, error analysis and mental chronometry studies. Although these two methods do provide information about the cognitive representation involved in written word production, they are limited in looking precisely into a different level of processing. Therefore, there's a necessity for applying an electroencephalographic method to studies of written word production. EEG methods are introduced from the following aspects, namely, internal mechanism and reasoning, operation, and analytical approaches of EEG methods. Studies on written word production applying EEG methods are also presented. At the end of this chapter, Perret and Qu hold a positive view on the prospect of EEG, but also mention the limitations of applying EEG in studies of written word production. In terms of the introduction of EEG, electrodes on the subject's scalp are used to record the electrical activity of pyramidal neurons in the cerebral cortex that are synchronized to carry out a cognitive activity. After eliminating the noise in the EEG signal, a raw wave of evoked potentials for each experimental condition and each participant is obtained for further analysis.

Two kinds of analyses are introduced in this chapter, namely, waveform analysis and spatio-temporal segmentation. As for waveform analysis, three methods have been applied to analyze the amplitudes of grand average ERP in language production, to define time windows of interest and regions of interest (ROI), to perform onset latency analysis, and to perform correlation analyses. However, waveform analyses have their limitations. On the one hand, the measures used are dependent on the reference electrode, while on the other

hand, the interpretation of results from waveform analyses in terms of cognitive processes is also problematic. As for spatio-temporal segmentation analysis, it divides the ERP wave into several stable spatial electric field configurations that are separated by abrupt transitions. Compared with waveform analysis, spatio-temporal segmentation is independent of the reference electrode and makes it possible to specify where the ERP difference arises from. It is clear that EEG methods make it possible to analyze the time course of the cognitive processing more precisely. However, EEG methods have their limitations, for example, it is hard to explore the cascaded transmission of activation flow between processing levels and it is better used to explore questions related to larger linguistic units. Therefore, Perret and Qu hold that EEG is better to be seen as an additional research method while exploring written word production.

The last two chapters as a concluding part summarize the significance of the research, current research results, and problems to be solved.

In Chapter 11, Michel Fayol first reviews the well-acknowledged theoretical and experimental results on written word production and then focuses on the hot issues in the studies of written word production, namely, the phonological mediation hypothesis, the relation between central and peripheral processes, and the limited capacity of the graphemic buffer. On phonological mediation, although several experiments suggest that phonological mediation is almost always involved, there are some phenomena that are hard to explain in terms of the hypothesis. What's more, according to Fayol, the role of phonology should be further explored in larger linguistic units rather than words.

On the relations between central and peripheral processes, the lexical route and sublexical route are widely accepted to be involved in written word production. It is reported that the influence of variables in both routes of central processes, especially consistency, cascades to the peripheral processes. What's more, the two routes are activated concurrently and compete at the level of the graphemic buffer (Delattre et al. 2006: 1338). On the graphemic buffer, it is believed that the capacity of the graphemic buffer is limited, and as a result, it may affect the activation of peripheral processes. However, whether the limited capacity of the graphemic buffer has influences on the central processes should be further investigated. Besides focusing on the hot issue, Fayol also raises questions for further studies, that is, not only larger segments (sentences and texts), but also the smaller processing units (strokes, letters, syllables, etc.) should be considered in further investigation.

Chapter 12 reviews writing research in the 21st century and makes expectations for future research. At the beginning of this chapter, Brenda

Rapp expounds on the importance of writing for human daily life and cultural development and then moves on to talk about the necessity of writing research. According to Rapp, increasing the use of written language in the age of e-communication requires researchers to better understand the writing process. Additionally, through studies on written-language production, we can also gain insight into foundational issues in the mind and brain, for example, whether the human brain performs representation and processing in an integrated way or if there is functional specialization (Finger 2001), whether recently evolved abilities have separate neural substrates or rely on the substrates of earlier evolutionarily developed talents, and the degree to which human cognition can be seen as reactivation of sensory and motor brain states encoded during previous experiences.

After summarizing the contributions of studies on written word production, Rapp predicts the future development of research in this field. In Rapp's view, future studies in this field will be inclined to apply multiple methods, in particular, mentioning the role of neuroimaging methods in writing research. In writing research, the application of neuroimaging technology plays an irreplaceable role, for example, in linking cognitive processes with brain responses. Further knowledge about the exact area of our brains where the cognitive operations are carried out can be gained through fMRI data, while EEG analysis enables researchers to closely examine the various spelling processes that may be launched at various time points. Rapp also mentioned the importance of exploring acquired, developmental, and reversible deficits in further understanding the nature of writing. What's more, in the 21st century, computational models and theoretical developments are becoming increasingly important for further studies.

Language is the most important communication tool of human beings, and the invention of words overcomes the limitations of language communication in time and space and expands the scope of language communication. For human society, human culture and history can be better recorded through written language. Words can promote the development of thinking. Words have no class character. Written language is one of the most excellent materials for studying ancient social life and living fossils of culture. For individuals, there is a great difference in intelligence and ability between literate people and illiterate people. Words make thinking a physical representation, which can be retained in time and space and pondered repeatedly.

Therefore, the study of written language is of great significance in linguistic research. In fact, several studies focus on the written process, but there are still deficiencies in the study of writing, for example, compared with

other language abilities, such as speaking. Research on writing processes started late, and the research results are also often disputed. What's more, in the new era, with the rapid development of science and technology, the importance of writing in people's lives and the way people write are also changing, for instance, with digital writing tools such as mobile phones and personal computers, etc. People are inclined to type more than write. And the type of communication also changed to include such formats as blogs, instant messages, and so on. Taking all these changes in human writing types into consideration, the development of writing skills deserves to be further understood.

In the existing research on the psychological mechanism of writing, linguists have proposed a number of models to explain the cognitive mechanism of writing. Linguists have verified these models by applying different methods, and there are still some areas of debate. In order to address various research approaches and diverse research findings, the need for a comprehensive evaluation of the available research through a systematic review becomes imperative. This volume provides a just such a review of the theoretical and methodological achievements of research into written word production, which is the greatest value of the volume in linguistic research. The following section evaluates the contribution of this volume in detail in terms of different aspects, such as academic, scientific, and practical considerations.

From an academic angle, research on written word production has unique significance in the era of e-communication, when the use of writing has become more extensive. As a symbol of human civilization, words have become an indispensable symbol in people's life. Speaking serves as a tool for immediate human communication, while writing makes it possible for communication to be realized despite the limitations of time and space. There is no doubt that writing plays an irreplaceable role in our life, especially in the current age of e-communication. People focus on their phones, sending messages or emails, which suggests that they may possibly write more frequently than before. A study examining the issue of human communication modalities was carried out recently by Rapp, Shea, and Wiley. In this study, participants are required to rank different types of communication in terms of electronic and non-electronic, spoken and written language, for example, spoken-non-electronic communication, which refers to talking to someone face to face, spoken-electronic communication, which refers to talking via electronic devices such as phone, online videos, Skype, etc., written-non-electronic communication, which refers to writing on paper, and written-electronic communication, including typing in electronic media such as texting, e-mail, online chatting,

etc. The results show that people aged over 36 are less inclined to use written-electronic communication than spoken-non-electronic, whereas, among people aged between 18–25, written-electronic communication is the most common communication modality. This study suggests a tendency that younger people are exposed increasingly to written language in the current communication environment. As a result, there's a growing necessity for a better understanding of the writing process to learn more about the human language system and brain in theoretical terms and facilitate the teaching and learning of writing, the treatment of language disorders, the reformation of writing instruments, etc.

Also, it makes up for the deficiency of the research on written processes compared with other language skills (reading, listening, speaking). The written form of human language appears later than the spoken form. Therefore, linguists supposed that phonology plays a mediating role in written production. Whether it is true or not is still under heated discussion in studies of written word production. Studies on writing processes are based on the results of speaking processes, and linguists make interpretations of the psychological mechanism of written-language production based on the spoken language production model. In Chapter 4, Tainturier provides a review of the existing model that explains the psychological mechanism of spoken and written-language production. Based on the theory of bilingual spoken word production, BAST has been put forward, which proposes that producing bilingual spelling is also a cascaded process. However, the effectiveness of the sublexical pathway depends on the extent to which phonology to orthography mapping regularities generated from two separate languages overlap. Although the theory needs to be further examined, it also gives enlightenment to further studies that language abilities are not isolated; development of studies on spoken language production can also promote investigations on written-language production and vice versa. Compared with speaking processes, studies of written word production are relatively insufficient. In modern society, writing plays a more important role in people's lives. However, compared with speaking processes, studies of written word production are relatively insufficient, which requires further exploration.

What's more, handwritten production is a combination of linguistics, psychology, cognitive science, and neuroscience. This volume reviews early and modern studies on written word production, involving not only classical error analysis studies, but also psycholinguistic studies and neuroimaging studies, which suggests a multi-method and interdisciplinary tendency in future studies on written word production. At an earlier stage, studies on written word production mainly applied traditional linguistic methods, such

as error analysis. However, it is not possible to look into dynamic issues from this approach. Thus, psychological methods have been applied to investigate writing processes. On the one hand, various psychological tasks have been used to explore the cognitive processes of writing, for example, picture naming tasks, copying tasks, dictation tasks, and Stroop tasks. On the other hand, based on the tradition of studies of mental chronometry in cognitive psychology, measuring reaction time, writing movement times, and writing speed allows researchers to move forward to the writing process instead of the product. And with EEG recordings, researchers can analyze precise information about the time course of the cognitive processing operations. All these approaches have their own benefits but also their limitations. Just as error analysis has never been replaced by latencies (e.g., Goldrick and Larson 2008), EEG recording should also be seen as a supplemental method for precise information of writing processes. Generally speaking, the research methods of the writing process tend to be integrated and diversified. By studying the process of writing in linguistics, psychology, and cognitive neuroscience, this volume analyzes and evaluates various research results more comprehensively and objectively. It is an excellent work on organically combining various disciplines in writing research.

Last but not least, the structure of the book is logical and easy to understand. This volume consists of a preface and three parts, a theoretical part, a methodology part, and a conclusion. The preface introduces some basic knowledge of written word production, which establishes the theoretical basis for the following chapter. In the theoretical part, the authors introduce the main research problems and theoretical results, and reviews the existing writing processing model and hypothesis in detail. Questions are used as the title of each chapter, and each chapter reviews the existing studies on this question, which makes it reasonable and understandable for readers. It can also enable readers to quickly find the problems in the research field they are interested in and read with emphasis. In the methodology part, the authors introduce the methods that have been applied in the existing studies on written word production and evaluates the advantages and disadvantages of each method, which makes it clear for the selection of method in further studies. And the conclusion summarizes the existing problem and future research trends in written word production. Above all, a clear logical structure gives readers a clearer understanding of written word production, and allows them to quickly read for references.

For the contributions to further scientific research, this volume involves most of the topics under heated discussion in the studies on written word

production. According to this volume, studies on written word production mainly focus on three issues, namely, the role of phonology in written processes, the relation between central processes and peripheral processes, and the limited capacity of the graphemic buffer. On the role of phonology in written processes, although most of the studies suggest that phonology systematically mediates the writing process, evidence from several neuropsychological and experimental studies shows the mandatory character of phonological mediation in word production. Therefore, further studies need to testify to the phonological mediation of word production, especially with non-alphabetic languages. Moreover, whether phonology has a systematic or mandatory effect on sentence and text written production should be further considered. On the relation between central processes and peripheral processes, it is widely acknowledged that the two routes are activated concurrently in written word production. However, when it comes to longer language units, several studies have shown that the two processes are activated simultaneously but compete at the level of the graphemic buffer while applying a spelling to dictation task. Therefore, future studies should focus more on the task differences and longer language units. On the limited capacity of the graphemic buffer, more evidence has shown that the limited capacity of the graphemic buffer has an impact on the peripheral processes (Fayol 1999: 171), although some studies have discovered the impact of limited OWM on central processes among children, and more evidence needs to be found among adults in future studies. By summarizing the research results of these three main research problems at this stage, this volume gives readers a clear understanding of the development of research on written word production and lays a foundation for future research.

Moreover, this volume provides a methodological reference for future research. The second part of this volume reviews the methodology in the existing studies on written word production. At first, researchers applied a classical error analysis method to explore the internal mechanism of written word production, which has obvious limitations in revealing the writing processes. Therefore, modern research on this issue applies a variety of tasks in psychological experiments, for example, picture naming tasks, copying tasks, dictation tasks, Stroop tasks, and so on. What's more, the neuroimaging method has been used to explore the cognitive basis of writing. Each approach has its own significance and limitations. The traditional linguistic approach focuses more on the writing product, while the psychological and cognitive experimental approach looks into the process of writing. And as an additional approach, the neuroimaging method gains detailed information about the



process and time period. By introducing and evaluating the pros and cons of different methods, this volume proposes that these research methods are indispensable, no single one is better or worse; instead, further studies should organically combine various research methods according to the research purpose.

Most importantly, this volume summarizes the limitations of current studies and puts forward the problems to be solved in future research. According to the authors, most studies on writing processes focus on word production, so two main questions remain for further investigation. Firstly, native writers seldom produce single words, instead, they combine them into large units. Thus, future studies on writing processes should explore the psychological mechanism of the writing process in a more natural language environment instead of an ideal one, and focus more on sentence production rather than written word production. Secondly, working memory demands imposed by text-production processes are different from those imposed by single-word production processes, so studies on written processes should move a further step from isolated written word production to text production.

The volume also makes contributions to certain practical areas, such as teaching and clinical and cultural aspects.

For insights into the teaching of writing, in this volume, Chapter 3 talks about the statistical learning of graphotactic regularities, and the impact of graphotactic knowledge on spelling and spelling acquisition. It is suggested that children and adult writers rely on graphotactic regularities while learning new spellings, which requires that graphotactic regularities should be paid more attention in L1 writing teaching. Teachers need to reconsider if a standardized series of graphotactic regularities should be taught to the students, and if so, explicitly or implicitly. Chapter 4 talks about theories of bilingual spelling in alphabetic systems comparing the differences between L1 spelling and L2 spelling and mentions the factors affecting second language spelling. This theory proposes that the effectiveness depends on the extent to which phonology to orthography mapping regularities generated from two separate languages overlap. BAST gives teachers and researchers a new understanding of how to improve the teaching efficiency of second language writing and spelling. In Chapter 5, it is proved that how people write influences how people read. Specifically, the sensorimotor memory traces that are constructed and consolidated during the practice of handwriting exercise facilitate written-language acquisition. Therefore, according to Wamain, typing cannot take the place of writing in language learning. That's the reason why taking notes on paper rather than typing on the laptop or tablet is recommended in the

classroom.

On the contributions to the treatment of language disorders, in Chapter 6, Afonso et al. examine the writing difficulties of children with developmental disabilities. By distinguishing different writing difficulties such as SLI, DD, and DCD in terms of their symptoms, Afonso et al. put forward hypotheses on the internal mechanism of writing difficulties. SLI is a problem of comprehension and production of the specific use of language, DD is a problem of language retardation, while DCD is more like poor motor coordination. The understanding and in-depth study of language disorders can enable us to detect children's language disorders earlier and intervene according to the characteristics of different language disorders.

As for cultural communication, it is proposed that how people write influences how they read. According to the studies on handwriting and typing, although handwritten letters are harder to recognize, they are especially present in the field of art or publicity. For example, in advertising, many companies use handwritten letters in their logos to better establish the brand image and make a deeper impression on consumers. Further investigation is required into whether it is because the handwriting traces evoke consumers' sensorimotor memory or consumers' affective reaction. Digging deep into the secrets of writing processes can promote the development of commerce, advertising, and publishing, for written language is the most important carrier of cultural communication.

In summary, this volume reviews the studies on written word production from the theoretical and methodological angle and expounds on several key research problems in this field, research methods, and problems that need to be further studied in the future. It has made contributions to academic theory, scientific research, and practical application. However, as mentioned in the volume itself, it focuses more on the study of alphabetic languages, and studies on ideographic languages such as Chinese are seldom included. Above all, this book is a systematic and comprehensive review of studies on written word production.

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