Bristol, July 6-7

2017 Writing Word(s) Workshop

University of
BRISTOL

WELCOME

Dear friends and colleagues,

We would like to welcome you to the 2017 WWW(s) Workshop in Bristol! This is the second in a hopefully continuing series of workshops dedicated to orthographic production, and we are quite excited! It's a tall order to follow in the footsteps of the supremely well-organised first instance of this series which took place in July 2015 at the Université de Poitiers, France, but we hope we'll manage (sorry, no free wine tasting event this time around!). This year, attendants hail from Germany, USA, Spain, France, UK, and Italy, so it's a truly international meeting of researchers sharing a common interest in the psychology of writing.

We hope that you will enjoy this workshop, and your visit to the lovely city of Bristol!

Yours

The organisers

Markus Damian

Mark Torrance

PROGRAMME OVERVIEW

Thursday July 6, 2017

9:30-10:00 Coffee and Introduction (2D2)

10:00-12:00 Session A (2D2)

12:00-13:30 Posters Session (2D17, Senior Common Room)

13:30-14:30 Lunch

14:30-16:30 Session B (2D2)

16:30-17:00 Coffee break

17:00-18:40 Session C – "Writing tools" (2D2)

19:00 Conference dinner – "The Townhouse" - 85 Whiteladies Rd, Bristol BS8 2NT;

Walking route

Friday July 7, 2017

9:00-10:00 Keynote lecture (2D3)

10:00-10:30 Coffee break

10:30-12:30 Session D (2D2)

12:30-14:00 Closing discussions and outlook (2D2)

KEYNOTE LECTURE

Friday, July 7, 2017, 9:00AM

Location: 2D3

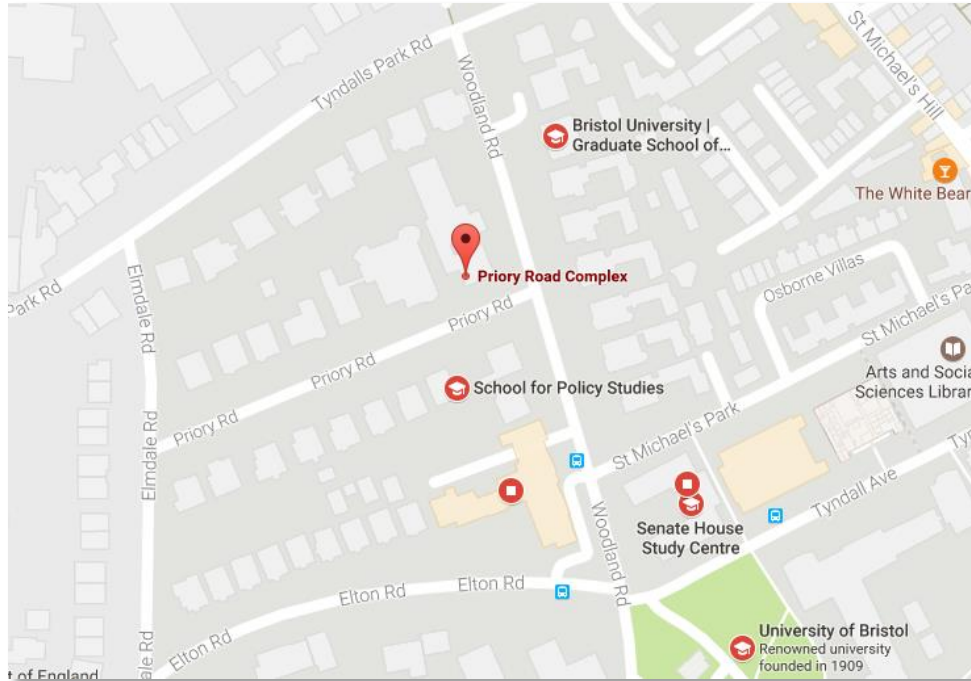## Spelling research and awake surgery: A fruitful relationship?

Gabriele Miceli

Università degli Studi di Trento, Italy

VENUE

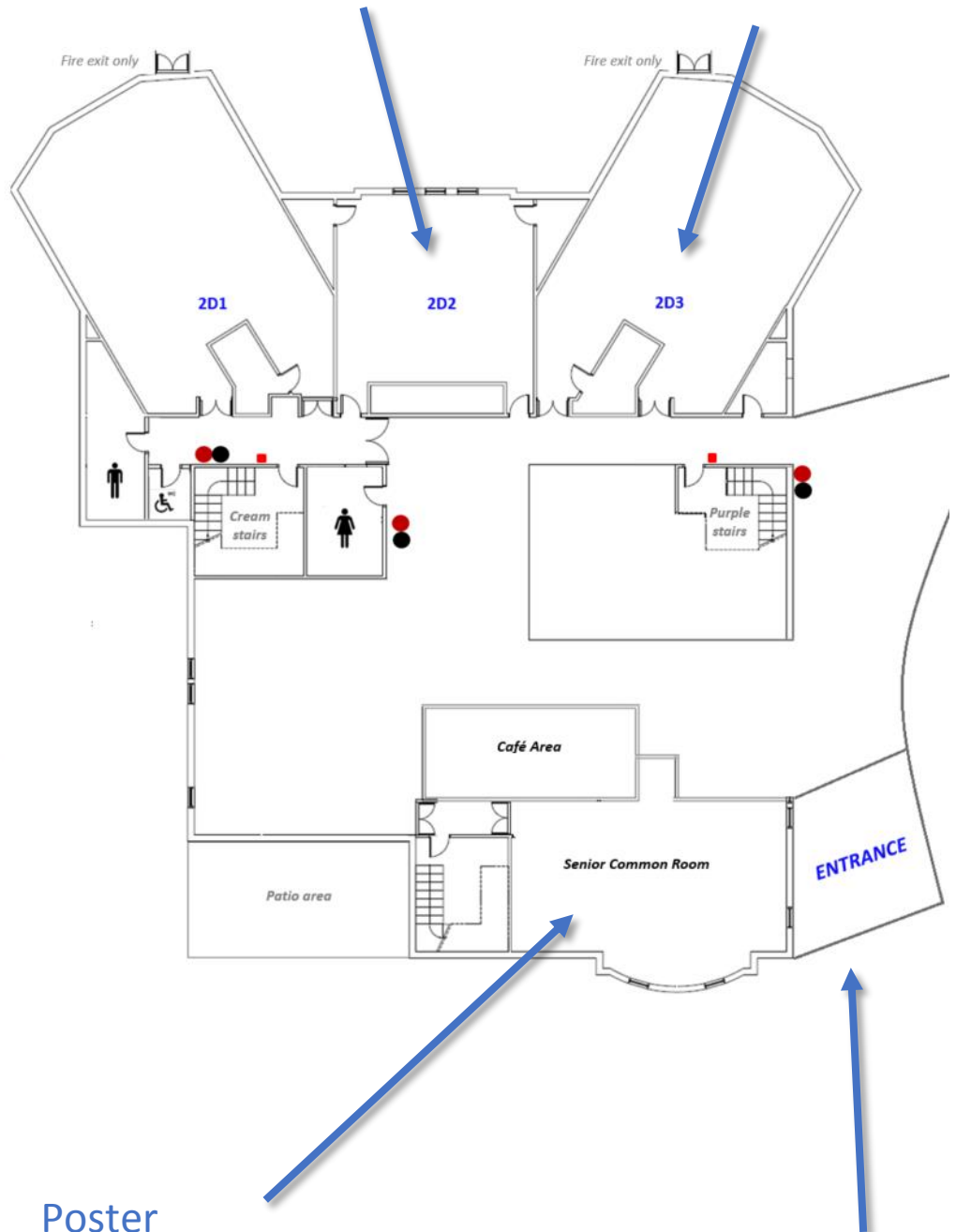Priory Road Complex, University of Bristol
12 Priory Road, Bristol BS8 1TU

FLOOR MAP

Oral Sessions

Keynote lecture

Fire exit only

Fire exit only

2D1

2D2

2D3

Cream stairs

Purple stairs

12a Priory Rd

SECOND FLOOR

Key

🔴 Water extinguisher

⚫ C02 extinguisher

🟥 Fire break glass

Café Area

Senior Common Room

ENTRANCE

Patio area

Poster Session

Entrance to building from Priory Road

PROGRAMME

Session A
Chair: Eric Lambert

TIME	PRESENTATION
10:00-10:30	Sonia Kandel, Delphine Lassus-Sangosse, Géraldine Grosjacques, and Cyril Perret. **Word writing when orthographic processes are impaired: A study with dyslexic/dysgraphic children**
10:30-11:00	Ronja Laarmann-Quante, Stefanie Dipper, Jessica Ernst, Sonia Kandel, and Eva Belke. **Effects of surface properties of written language on spelling performance**
11:00-11:30	Guido Nottbusch and Carola Schnitzler. **Differences between children with and without dyslexia in executing a graphomotor test battery**
11:30-12:00	Paz Suárez-Coalla, Cristina Martínez-García, and Fernando Cuetos. **Spelling in Spanish children with and without dyslexia: the role of morphology**

Session B
Chair: Eva Belke

TIME	PRESENTATION
14:30-15:00	Olivia Afonso, Anna L. Barnett, and Vincent Connelly. **Repetition facilitation and repetition inhibition on word writing**
15:00-15:30	Michael McCloskey and Gali Ellenblum. **Stroke patterns in written letter production: An optimality theory analysis**
15:30-16:00	Michael Vernon, Mark Torrance, and Thom Baguley. **Re-syllabification effects in keystroke production**
16:00-16:30	Clara Solier, Christiane Soum-Favaro, Vanda Marijanovic, Stéphane Vautier, and Michel Billières. **Impact of orthographical form on existent phonological representations in L2 oral acquisition: first results**

Session C - "Writing Tools"
Chair: Mike McCloskey

TIME	PRESENTATION
17:00-17:20	Stefan Hess, Petroula Mousikou, and Sascha Schroeder. **Application of oscillation theory to handwritten language production**
17:20-17:40	Guido Nottbusch. **PGMT – Potsdam Grapho-Motor Test**
17:40-18:00	Cyril Perret. **Exploring the dynamics of process during handwritten production via EEG**
18:00-18:20	Svetlana Pinet, Christelle Zielinski, Sebastiaan Mathôt, Stephane Dufau, F-Xavier Alario, and Marieke Longcamp. **Measuring sequences of keystrokes with jsPsych: Reliability of response times and interkeystroke intervals**
18:20-18:40	Mark Torrance and Sol Simpson. **OpenEyeWrite: Open-source software for tracking eye-movement within emerging text during typing**

Session D
Chair: Sonia Kandel

TIME	PRESENTATION
10:30-11:00	Jens Roeser, Mark Torrance, and Thom Baguley. **Conceptual ambiguity requires non-linear phrase planning**
11:00-11:30	Mark Torrance. **Cross-language differences in written picture-naming timecourse**
11:30-12:00	Markus F. Damian, Qingfang Zhang, and Qingqing Qu. **Tracking the time course of lexical access in orthographic production: An event-related potential study of word frequency effects in written picture naming**
12:00-12:30	Marieke Longcamp, Sarah Palmis, Jean-Luc Velay, Elie Fabiani, Bruno Nazarian, Jean-Luc Anton, Michel Habib, and Sonia Kandel. **The impact of spelling regularity on handwriting: A coupled fMRI and kinematics study**

POSTERS

LOCATION	PRESENTATION
1	Ophélie De Sousa Oliveira, Eric Lambert, and Thierry Olive. **The phonological mediation in writing depends on characteristics of the priming task**
2	Elie Fabiani, Sonia Kandel, Jean-Luc Velay, Cyril Perret, and Marieke Longcamp. **The interaction between spelling and motor processes in a writing-to-dictation task: The impact of orthographic regularity and its position**
3	Eric Lambert, Ophélie De Sousa Oliveira, and Eunhyung Park. **The syllable, or ortho-syllable, as a processing unit in handwriting: Evidence from Korean**
4	Betty Laroche, Thierry Olive, and Cyril Perret. **Visual feedback in written word production**
5	Cyril Perret and Gwendoline Le Du. **The modulation of activation flow between central and peripheral processing levels: A comparison between Handwritten and Oral Spelling**
6	Qingqing Qu and Markus F. Damian. **Eye movements during written word production**
7	Christiane Soum Favaro, Samuel Planton, and Mélanie Jucla. **New French Consistency Measurements: effects on errors rates and latencies in adult writing-to-dictation performance**

ABSTRACTS

Word writing when orthographic processes are impaired: A study with dyslexic/dysgraphic children

Sonia Kandel[1], Delphine Lassus-Sangosse[2], Géraldine Grosjacques[2] & Cyril Perret[3]

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Word writing experiments with adults revealed that spelling processes modulate the kinematic parameters of motor execution. Previous developmental studies observed that spelling processes start to affect movement production with the *automation of motor processes*. Before ages 8-9 spelling and motor processes are independent from one another. The present study examined word writing in a situation where the *automation of spelling processes* is not fully achieved, like in dyslexia/dysgraphia. French dyslexic/dysgraphic children and matched controls wrote words and pseudo-words on a digitizer. The words were orthographically regular and irregular of varying frequency. The results revealed that orthographic processing affected movement production during word writing in both groups, but the impact was stronger for the dyslexic children before and during movement execution. Latencies indicated that spelling retrieval for irregular words was very time consuming for the dyslexic children. Movement time and dysfluency were higher for irregular than regular words. Word frequency did not have a major impact on word writing. Pseudo-word writing was also difficult for the dyslexic children. This data pattern suggests that the interaction between spelling and motor processes was stronger for the dyslexic group than controls. The interference of spelling processes on motor production can be so strong that some dyslexic/dysgraphic children are diagnosed with peripheral dysgraphia when in fact they do not have any motor or praxic disorders.

Effects of surface properties of written language on spelling performance

Ronja Laarmann-Quante, Stefanie Dipper, Jessica Ernst, Sonia Kandel and Eva Belke

Ruhr-Universität Bochum, Germany

Implicit learning enables speakers to acquire knowledge of the statistical properties of written utterances, i.e. patterns of co-occurrence and contingencies of letters in written word forms arising from graphotactic, phonological and morphosyntactic principles in orthography. We hypothesize that implicitly acquired morphosyntactic and orthographic skills are an essential fundament of a strong proficiency in reading and writing and should be reflected in solid knowledge about the statistical properties of orthography. A critical prediction following from this is that the statistical properties of orthography impact on writers' performance and that this impact is stronger for good than for poorer writers. We tested this prediction based on a large longitudinal corpus of German primary school children's written texts, assessing whether the correlation of word frequency and mean bigram frequency with accuracy was stronger for writers who committed few errors than for writers who committed many errors. The results did not confirm our initial hypothesis, possibly because the writers were too young to display the effects we were looking for. We discuss the findings with respect to methods of orthography instruction implemented in German primary schools and outline further avenues for testing our prediction experimentally.

Differences between children with and without dyslexia in executing a graphomotor test battery

Guido Nottbusch and Carola Schnitzler

Universität Potsdam, Germany

For our experiment dyslexic children (grade 5, N=9), chronologically age-matched (grade 5, N=9) and spelling-ability matched children (grade 3, N=9) took part in a graphomotor test battery. The tasks contained alphabet writing (at normal speed and under time pressure), a number of basic strokes (up- and downstrokes, left-right and diagonal strokes), geometrical shapes (circles, triangles, etc.), line tracing and several single letters and words (dictated and copied). As expected, we found strong differences between the 3rd and the 5th-graders concerning speed and accuracy but, for some tasks, also between the two groups of 5th-graders. Large differences were found for reactions times initiating word writing, where dyslexic 5th-graders took as long as the non-dyslexic 3rd-graders. More differences were found concerning the alphabet task (under time pressure) and, to less extents, for automaticity in single letters. The processes assumed to be involved in the different tasks and their influence on the performance of the three different groups will be discussed.

Spelling in Spanish children with and without dyslexia: the role of morphology

Paz Suárez-Coalla, Cristina Martínez-García and Fernando Cuetos

University of Oviedo, Spain

Recent studies reported that the effect of morphology is present in spelling, as morphological information facilitates spelling accuracy and influences handwriting timing. That suggests morphemic units contribute to process morphologically complex words. However, it could depend on the orthographic system and reading ability. The goal of this study was to investigate the role of morphology in spelling in Spanish children with and without dyslexia and to find out if facilitation depends on the root frequency or not. For that purpose, a group of 20 dyslexics and an age-matched group of 20 children without reading disabilities completed a spelling-to-dictation task of isolated words and pseudowords, where morphological complexity (morphemic vs. non-derived) and root frequency (high vs. low) were manipulated. Writing latencies and first-three-letters writing durations (root for derived words) were considered for the analysis. Results showed that Spanish children (with and without dyslexia) benefit from the morphological structure when spelling words and pseudowords, as latencies and first-three-letters writing durations were higher for non-derived words. However we can observe differences between groups. The findings were discussed considering reader's ability and morphological processing models.

Keywords: morphology, spelling, dyslexia, Spanish.

The phonological mediation in writing depends on characteristics of the priming task

Ophélie De Sousa Oliveira, Eric Lambert and Thierry Olive

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The role of phonology in handwriting is still in debate. According to the obligatory phonological mediation hypothesis, activation of phonological codes is systematically required to recover orthography (Damian, et al., 2011). By contrast, the orthography autonomy hypothesis suggests that orthographic codes can be retrieved without mobilizing phonological codes (Roux & Bonin, 2011). In two experiments, we tested if the phonological mediation depends on characteristics of the priming task. We presented the primes visually (Experiment 1, with phonological and orthographic codes) or orally (Experiment 2, with only phonological codes). We used a task inspired by the Stroop task, with words as primes and colors as targets. The participant had to write the colors' name while ignoring the primes. The primes and the targets were 1/ phonologically and orthographically related (they shared their first phonemes and first letters, e.g., ORANGE – ovale (oval)); 2/ only phonologically related (their only shared their first phoneme**,** e.g. ORANGE – auteur (author)); or 3/ unrelated (e.g., ORANGE – cabane (hut)). In Experiment1 (reading), priming occurred only in the phonological-orthographical condition in comparison to the two-other conditions. The analysis of writing durations exhibited the opposite pattern. In Experiment 2 (hearing), priming occurred again in the phonological-orthographical condition, and also in the phonological condition in comparison to the unrelated condition. The analysis of writing duration exhibited no significant difference.
In these studies, retrieval of orthographic codes depended on how they were primed: An orthographical facilitation appeared only when reading the primes. By contrast, a phonological facilitation was observed only when hearing the primes. Globally, the phonological mediation depended on characteristics of the priming task.

Keywords: word production; handwriting; phonology; orthography; orthographic access

The interaction between spelling and motor processes in a writing-to-dictation task: The impact of orthographic regularity and its position

Elie Fabiani[a], Sonia Kandel[b], Jean-Luc Velay[a], Cyril Perret[c] and Marieke Longcamp[a]

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Writing a word implies both retrieving a sequence of letters (orthographic processes) and producing them one after the other (motor processes). Most models of writing assume that orthographic processes precede motor processes. Spelling retrieval should be terminated when movement programming starts. In contrast, several psycholinguistic studies revealed that spelling processes affect motor execution during word writing. Orthographic processes interact with motor programming and are still active during letter production. However, the impact of orthographic processing on writing is modulated by the position of the inconsistent letters in the word, the type of task, and the nature of the variables analyzed. To clarify whether and when orthographic processes spread on motor production, we conducted a spelling-to-dictation experiment where we manipulated phono-orthographic consistency and its position within the word. French participants had to write words on a digitizer. The words had an inconsistency at the beginning (e.g. PHARAON; pharaoh) or at the end (e.g. CAFARD; cockroach). These words were matched to consistent words (e.g. FACILE; easy). We analyzed accuracy, latency, total writing duration, letter duration, and inter-letter intervals. The results indicated that the presence of an inconsistency slows down the initiation and execution of writing, and decreases accuracy. Inconsistency at the beginning increased latency and the duration of the first letter. Inconsistency at the end increased writing duration throughout the word. The effect was stronger for the last letters. The impact of orthographic complexity was therefore maximal when the inconsistent letters were being produced. Inter-letters intervals were not affected by the presence of an inconsistency. These results confirm that orthographic complexity can spread on motor production. In addition, the lack of reliable effects on the intervals suggests that orthographic complexity affects motor execution more strongly than motor programming.

The syllable, or ortho-syllable, as a processing unit in handwriting: Evidence from Korean

Eric Lambert, Ophélie De Sousa Oliveira, and Eunhyung Park

Université de Poitiers and Centre National de la Recherche Scientifique (France)

Research on writing has shown the role of the syllable as a processing unit (Kandel et al., 2011; Lambert et al., 2008) and has suggested that such syllable would be orthographic and not phonological (the ortho-syllable, Lambert et al., 2015). To investigate this issue, Korean spelling (*Hangul*) has interesting features: Each Hangul letter represents a sound, and the grapheme–phoneme connections are generally consistent. Although Korean spelling is alphabetic, Korean is written as a syllabary in which two or more letters are clustered into a uniform square syllable block (e.g., 갈색: /galsék/ (brown)). Relatively simple compared with English, the syllable structure of Korean is mostly CV or CVC, with no initial consonant clusters (Cho & Chiu, 2015). We asked native Korean speakers to copy words twice in a row on a digitizer tablet. We analysed latency before the second copy and pause duration at the syllabic boundary. In Experiment 1, we used 2-and 3-syllable words that were composed of with CV or CVC syllables. The results indicate effects of the number of syllables and of complexity of the syllabic structure, with no interaction between these two factors. Because words with a complex syllabic structure (CVC) also contain more characters than words with a simple structure (CV), the syllabic complexity effect may come from the number of phonemes or from the number of graphemes. However, Hangul has a special character "O" which, when placed at the beginning of a syllable, is a silent character that is not pronounced (e.g., 금액: /geum.ék/ (CVC.OVC). In Experiment 2, the bi-syllabic words to copy had or not an "O" at the beginning of the second syllable. The results showed that the longer latencies resulted from number of characters and not from number of phonemes suggesting that the syllables were processed by grapheme and not according to their phonology. This confirm the role of the syllable in modulating the dynamic of handwriting. Moreover, the present results support the existence of ortho-syllables organized around graphemes and not phonemes also in Korean. (pause durations between syllables are being analysed.)

Visual feedback in written word production

Betty Laroche, Thierry Olive and Cyril Perret

Université de Poitiers and Centre National de la Recherche Scientifique, France

Much work on the role of visual feedback in handwriting has shown how vision helps to control graphomotor processes. A recent study showed however that the visual feedback also affects the orthographic processes in handwriting (Perret & Laganaro, 2013). In two experiments, we attempted to further specify how visual information during word writing affects central processes. In a first experiment, thirty-five participants performed a picture naming task on 193 pictures with normal and inkless pen. Reaction times (RT) analysis replicated Perret and Laganaro's (2013) findings: RTs were shorter when participants were deprived of visual information. Although orthographic errors were more numerous in the inkless condition than in the normal condition, we did not observe any interaction between the RT predictors and the visual conditions, suggesting that suppression of visual feedback did not impact writing latencies. Therefore, to further understand the role of visual feedback on orthographic processing we conducted a second experiment in which we focused on writing durations. Thirty-one participants performed the same picture naming task with a new set of 92 pictures. We replicated findings of Experiment 1 on latencies. Moreover, writing durations were longer when participants could not visually monitor their production. These findings indicate that suppression of visual feedback impacted the time course of the orthographic processes: Some of the orthographic processes that normally take place during latencies are delayed during handwriting when participants are deprived of visual information.

The modulation of activation flow between central and peripheral processing levels: A comparison between Handwritten and Oral Spelling

Cyril Perret and Gwendoline Le Du

Université de Poitiers and Centre National de la Recherche Scientifique (France)

The present study was aimed at testing the neurolinguistic framework which assume that central processes are common regardless the output-modality, i.e., typing, handwriting or oral spelling. We addressed this hypothesis comparing Oral and Handwritten spelling. Seventy-three participants had to handwrite and spell out aloud the label of two hundred and nineteen pictures. The reaction times were longer for Oral Spelling, suggesting that peripheral processes are processed slower in this output-modality in comparison with those involved in Handwriting. Four factors explained a significant part of the RTs variance regardless the output-modality: Name Agreement, Image Agreement, Image variability and Age-of –Acquisition. The size of the orthographic neighborhood and the number of letters were reported as significant predictors only for the oral spelling modality. Finally, the effect of Age-of-Acquisition was modulated by the output-modality. In an equal increase of AoA, increased of reaction times is higher for Oral Spelling compared to Handwriting. These results were discussed in the light of the coordination between central and peripheral processing levels and this modulation across the output-modalities.

Eye movements during written word production

Qingqing Qu[a] and Markus F. Damian[b]

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Eye movements have been shown to have a very tight relationship with many aspects of human cognitive processing, especially language processing such as reading and spoken language comprehension. More recently, eye movement have been shown to reflect speech planning during spoken picture naming. In the present study, we investigated whether eye movements reflect written planning processes during written picture naming. In a picture-word interference task, we asked Chinese participants to write down the names of pictures on a graphic tablet while attempting to ignore written distractor words which were phonologically and orthographically related, only phonologically related, only orthographically related, or unrelated to the picture names. Besides written response latencies, we also measured gaze shift latencies, defined as the time interval between the onset of the first and the offset of the last fixation on pictures. Word-form overlap between picture names and distractor words significantly reduced response latencies as well as gaze shift latencies on the pictures, which indicates that writers tend to shift their gaze after form retrieval of picture name. We conclude that eye movements reflect central planning processes in written picture naming, and the writers' viewing time of the pictures is contingent upon word form encoding of the picture names.

New French Consistency Measurements: effects on errors rates and latencies in adult writing-to-dictation performance.

Christiane Soum Favaro[a], Samuel Planton[ab], and Mélanie Jucla[a]

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More and more studies explore how people deal with orthographic information in writing tasks (e.g. Bonin et al., 2008; Bonin et al. 2015). Generally, researchers use phono-orthographic consistency measurements to evaluate opacity effects on writing (Peereman and Content, 1999). Such analysis consists in measuring the degree of correspondence between phonological and orthographical words codes; this is then manipulated to highlight the effects on written production. Indeed, strong consistency effects are observed in French on both errors rates and latencies in writing-to-dictation, written-picture-naming and copying. However, these important findings are based on monosyllabic material only, that represent a minority of French words (Vallée and Rousset, 2004). The present study aims at specifying these findings. We computed new consistency values across orthographic forms taken from the Lexique 3.80 database (N ≈ 142 000; New et al. 2004). We restricted our calculations on the initial and final phonemes of each word. Then we manipulated this new material in adult writing to dictation performance. Participants were 27 right-handed, native French-speaking university students. We observed a strong consistency effect on both errors rates and latencies.

Bonin, P., Collay, S., & Fayol, M. (2008). La consistance orthographique en production verbale écrite: Une brève synthèse. *L'Année Psychologique*, 108, 517-546.

Bonin, P., Méot, A., Lagarrigue, A. & Roux, S. (2015). Written object naming, spelling to dictation, and immediate copying: Different tasks, different pathways? *The Quarterly Journal of Experimental Psychology*, 68, 1268-1294.

New, B., Pallier, C., Brysbaert, M., & Ferrand, L. (2004). Lexique 2: A new French lexical database. *Behavior Research Methods, Instruments, & Computers*, 36, 516-524.

Peereman, R., & Content, A. (1999). LEXOP: A lexical database providing orthography-phonology statistics for French monosyllabic words. *Behavior Research Methods, Instruments, & Computers*, 31, 376-379.

Vallée, N., & Rousset, I. (2004). Indices en typologie des structures lexicales et syllabiques pour la discrimination et l'identification des langues*. Identification des langues et des variétés dialectales par les humains et par les machines : proceedings of the MIDL workshop*, pp 37-42. Paris.

Repetition facilitation and repetition inhibition in word writing

Olivia Afonso, Anna L. Barnett, and Vincent Connelly

Oxford Brookes University

Orthographic working memory is a system that fulfils two important functions during writing: maintaining the serially-ordered sequence of letters that build a word up and selecting each letter in the correct order for overt production. In this study we focus on the well-documented effects of repetition facilitation and repetition inhibition classically obtained in serial recall tasks. Repetition facilitation refers to better recall and shorter inter-response times for items that are repeated close together in a series than for non-repeated items. Repetition inhibition refers to worse recall and longer inter-response times for items that are repeated but separated by a number of intervening items than for non-repeated items (Kahana & Jacobs). Letter doubling effects (or repetition facilitation) have been observed in writing research (Tainturier & Caramazza, 1996), but the case of repetition inhibition has not been systematically addressed. In the present study two experiments were conducted in order to ascertain whether or not repetition facilitation and inhibition effects can be detected in a word writing task. Experiment 1 replicated the typical design used in serial recall research. Words including massed repetitions of letters (BIZARRE) and repetitions separated by three letters (PROVERB) were compared to words with the same letter in the same position in a non-repetition context (VAMPIRE). This design tests the effect produced by the previous production of a letter on its second repetition. Given the anticipatory nature of the motor processes during handwriting, Experiment 2 was designed to test the effect of a forthcoming repetition on the first production of a letter (INNOVATE and INFERNAL compared to INTERVAL). Analyses conducted on inter-letter intervals and letter durations will be reported and commented in relation to facilitation and inhibition of abstract representations and/or motor patterns.

Stroke patterns in written letter production: An optimality theory analysis

Michael McCloskey and Gali Ellenblum

Johns Hopkins University

Writing by hand requires conversion of abstract character representations into sequences of writing strokes. For any given character (e.g., upper-case print *A*) the strokes could be produced in various directions and orders. Some variation in stroke patterns is observed, but most possible patterns never occur (e.g., for *A*: right-side diagonal, then horizontal stroke, then left-side diagonal). Researchers have proposed principles underlying stroke patterns, but the principles often conflict, and are frequently violated. What, then, determines how characters are written? Applying Optimality Theory (OT), a computational framework developed by Prince and Smolenksy in the context of phonology, we propose that stroke patterns are governed by violable, rank-ordered constraints (e.g., *Start at the Left*, *No Upward Strokes*). Stroke patterns violating only low-ranking constraints are favored over those violating higher-ranking constraints. We report modeling of prescribed stroke patterns in English and Hebrew writing, as well as modeling of actual English and Hebrew stroke patterns (obtained from adults writing on a digitizing tablet). We argue that the OT framework sheds light on stroke patterns that do and do not occur, and on variation across individuals and writing systems. We also suggest that the framework may contribute to understanding of stroke errors in children and dysgraphic individuals, and may have implications for the teaching of writing.

Re-syllabification effects in keystroke production

Michael Vernon, Mark Torrance, and Thom Baguley

Nottingham Trent University

Our research explores the possibility of resyllabification, a phonological/phonetic process, within written (keyboarded) production. Re-syllabification involves changing the syllable structure of word pairs during phonetic processing based on morphological/phonological constraints (e.g., maximisation of onset) to form new phonological words (e.g., They scream it ⧄/They.screa.mit/) to aid pronunciation/articulation. Examining this re-syllabification process in typing tests the hypothesis that orthographic production is influenced by phonological processing to the point of phonetic encoding. In two experiments (Ns = 18 and 18) participants typed phrases containing word triples where re-syllabification occurs in speech (*they scream it*) or does not occur in speech (*they scream that*). Analysis of inter-key intervals compared across experimental and control conditions found significantly slowed keystroke latencies after the point of resyllabification. These findings suggest that keystroke motor planning is not informationally encapsulated and can be influenced by concurrent phonological codes (inner speech) and / or that lexical planning scopes over units that are not strongly jointed at word boundaries.

Impact of orthographical form on existent phonological representations in L2 oral acquisition: first results

Clara Solier, Christiane Soum-Favaro, Vanda Marijanovic, Stéphane Vautier, and Michel Billières

URI Octogone-Lordat (EA 4156)
Université Toulouse 2 Jean-Jaurès

Usually, research in French as a Foreign Language (FFL) gives little importance to the role of written language in oral L2 acquisition (Billières, 2005). With the transition from oral to written language being pushed into the background, the issue of FFL oral acquisition is confined to the notion of phonological deafness (Dupoux & Peperkamp, 2002). However, recent studies showed that written skills are likely to change phonological competence (e.g. Bürki et al., 2012) and orthographical input can facilitate L2 oral production (e.g. Showalter & Hayes-Harb, 2013). Accordingly, we hypothesize contact with written form to help L2 learners modify erroneous or incomplete phonological representations and improve their pronunciation. The study was carried out in 2016 in Rabat (Morocco) on 100 Moroccan native participants, all beginning FFL learners (A1/A2, Conseil de l'Europe, 2001). The participants were split in five groups of 20 L2 learners. Each group performed a different task; T1 - repetition of minimal pairs, T2 - repetition with verbo-tonal pronunciation correction (Renard, 1979), T3 - copy, T4 - vocalized copy and T5 - dictation. Before and after these tasks, all participants completed the same pre- and post-test word repetition task. Each stimulus of the experimental protocol (n=108) contained one of four target vowels in final word position: /ɔ̃/, /ɑ̃/, /i/, /e/. Vowels were selected based on the preliminary corpus analysis of Moroccan students' written productions (Solier, 2014). We will present findings of the pre- and post-tests pronunciation of target vowels. The comparison between pre- and post-tests results will allow us to determine the benefit of each task. We could then verify if the orthographical word form has an impact on existent phonological representations and therefore on pronunciation accuracy.

Billières, M. (2005). Les pratiques du verbo-tonal-Retour aux sources. In M. Berré (éd.), *Linguistique de la parole et apprentissage des langues. Questions autour de la méthode verbo-tonale de P. Guberina* (p. 67-87). Mons: CIPA.

Bürki, A., Spinelli, E., & Gaskell, M. G. (2012). A written word is worth a thousand spoken words: The influence of spelling on spoken-word production. *Journal of Memory and Language*, *67*(4), 449-467. https://doi.org/10.1016/j.jml.2012.08.001

Conseil de l'Europe. (2001). Un cadre européen commun de référence pour les langues: apprendre, enseigner, évaluer. Didier.

Dupoux, E., & Peperkamp, S. (2002). Fossil markers of language development : phonological « deafnesses » in adult speech processing. In J. Durand & B. Laks (éd.), *Phonetics, Phonology, and Cognition* (p. 168-190). Oxford: Oxford University Press.

Renard, R. (1979). *La méthode verbo-tonale de correction phonétique*. Mons: CIPA.

Showalter, C. E., & Hayes-Harb, R. (2013). Unfamiliar orthographic information and second language word learning: A novel lexicon study. *Second Language Research*, *29*(2), 185-200. https://doi.org/10.1177/0267658313480154

Solier, C. (2014). Le rapport phonie-graphie dans l'acquisition du FLES : le cas des apprenants marocains. Mémoire de Master 2.

Application of oscillation theory to handwritten language production

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Research on handwritten language production has flourished over the past 35 years. As a result, mathematical models that parameterize handwriting signals to describe and explain motor mechanisms of handwritten language production have been developed. In the present study, we developed an algorithm, which extracts features from high-resolution handwriting data to formulate a model that implements an oscillation theory of handwriting (Hollerbach, 1981). Based on extracted stroke information, the algorithm also recognizes letters. Sixty-eight children from grade three and thirty adults were asked to write digraphs on tablets, while handwritten productions were recorded with high spatiotemporal resolution. Our analyses sought to determine the fit of the model to the data in order to gain an insight into the different processes that characterize developmental and skilled handwritten language production. Our results offer support for the idea that an oscillation theory of handwriting can successfully explain processes underlying handwriting in both developmental and skilled writers. Further, our algorithm automatizes the pre-processing of handwriting data, thus forming a critical tool for handwritten language production research.

PGMT – Potsdam Grapho-Motor Test

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In this demo I'd like to show the tasks in the Potsdam Grapho-Motor Test Battery – an economic tool for dynamic handwriting diagnosis. For the battery, we chose a small number of tasks to discriminate between automated and non-automated handwriting performance. I'll guide the audience through the analyses: For capturing GetWrite from the OpenHandWrite toolset is used. The preparation of the data will be done using MarkWrite from the same toolset and the final processing and analyses will be performed within the R Project for Statistical Computing.

Exploring the dynamics of process during handwritten production via EEG

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Mental chronometric studies using Reaction Times do not allow to explore issues of time course in handwritten production. Comparing RTs of several experimental conditions is tantamount to indicating an order based on the overall processing speed, without access to the duration of each process. In other words, latencies are a consequence of the output produced by a large number of individual cognitive processes. The increase / decrease of the reaction times is then difficult to attribute to the variations of a specific cognitive process. In this communication, I propose to show how electroencephalographic recordings can partially compensate for the limitations of mental timing measurements. First, I will describe the characteristics of the EEG measurements. I will focus on the spatio-temporal segmentation analysis. In a second step, I will develop an example with the main aim describing how EEG studies allow to specify the time period of Age of Acquisition effects and thus to make an assumption about the level or levels of treatment influenced by these variables (Perret, Bonin, & Laganaro, 2014).

Measuring sequences of keystrokes with jsPsych: Reliability of response times and interkeystroke intervals

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Although the precision and reliability of response time (RT) measurements performed via Web-based interfaces have been evaluated, sequences of keystrokes have never been investigated in detail. Keystrokes often occur in much more rapid succession than RTs, and operating systems may interpret successive or concomitant keyboard events according to both automatic and user-based settings. Sequence keystroke timing could thus be more sensitive than single RTs to noise in online measurements. Here, we quantified the precision and reliability of timing measures performed during sequences of keystrokes. We used the JavaScript jsPsych library to create an experiment involving finger-movement sequences, and ran it online with 633 participants. We manipulated the structure of three keystroke motor sequences, targeting a replication of previous findings regarding both RTs and interkeystroke intervals (IKIs). Our online data accurately reproduced the original results and allowed for a novel assessment of demographic variables such as age and gender. In parallel, we also measured the objective timing accuracy of the jsPsych interface by using specialized hardware and software, showing a constant 60-ms delay for RTs and a 0-ms delay for IKIs across the sequences. The distribution of IKIs revealed quantizing for a majority of participants, most likely due to the sampling frequency of their USB keyboards. Overall, these findings indicate that JsPsych provides good reliability and accuracy in sequence keystroke timings for mental chronometry purposes, through online recordings.

OpenEyeWrite: Open-source software for tracking eye-movement within emerging text during typing

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When producing spontaneous multi-sentence text writers often look back into the text that they have just produced. This activity is sometimes associated with extended reading, but often involves series of fixations that hop back and forth between words in the previous sentence (Torrance, Johansson, Johansson, & Wengelin, 2016). Tracking these eye movements is potentially useful in testing hypotheses about cognitive processes associated with monitoring what has been written and with planning what to say next. A necessary first step, however, is to relate specific fixations with the particular word that is being fixated. Achieving this is problematic (a) because we do not know in advance what the writer will type – and so cannot pre-define areas of interest, and (b) editing, scrolling and wrapping means that words change their screen location as the text develops on the screen. OpenEyeWrite (OEW; an open source version of an older program described in Wengelin et al., 2009) overcomes these problems. OEW provides a simple text editor that can be used within experiments written using PsychoPy (Peirce, 2007). This captures keystroke and fixation data, identifying for each fixation the letter (word, sentence) that is being fixated. OEW is hardware independent. Eye-tracker permitting, it provides fixation-location information at runtime, making possible gaze-contingent experimental paradigms (e.g., masking the word currently fixated only if it is spelt incorrectly).

Peirce, J. W. (2007). PsychoPy—Psychophysics software in Python. *Journal of Neuroscience Methods*, *162*(1–2), 8–13. http://doi.org/10.1016/j.jneumeth.2006.11.017

Torrance, M., Johansson, R., Johansson, V., & Wengelin, Å. (2016). Reading during the composition of multi-sentence texts: an eye-movement study. *Psychological Research*, *80*(5), 729–743. http://doi.org/10.1007/s00426-015-0683-8

Wengelin, Å., Torrance, M., Holmqvist, K., Simpson, S., Galbraith, D., Johansson, V., & Johansson, R. (2009). Combined eyetracking and keystroke-logging methods for studying cognitive processes in text production. *Behavior Research Methods*, *41*(2), 337–351. http://doi.org/10.3758/BRM.41.2.337

Spelling research and awake surgery: a fruitful relationship?

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My talk starts from two considerations:

a. Spelling (and reading) skills are critical in everyday life, due to the massive use of computers, tablets, smartphones, etc. In the recent past, increasing interest in the cognitive neuroscience of spelling has resulted in detailed neuroanatomical and functional hypotheses, that can account for normal and pathological spelling performance, and guide the diagnosis and treatment of dysgraphias.

b. Awake surgery is increasingly popular in the treatment of gliomas. It allows extensive removal of tumour tissue, while at the same time monitoring and preserving language and communicative skills. Preoperative neuropsychological testing identifies items to be administered during surgery. Intraoperative mapping pinpoints the cortical and subcortical regions involved in language, to be spared during surgery. Postoperative and follow-up assessments allow monitoring the outcome of surgery and guiding speech-language therapy, if needed. In short, awake surgery is an individually-tailored set of procedures that aims at removing the largest extent of tumour tissue while preserving the patient's quality of life.

Notwithstanding these facts, language testing during awake surgery procedures is still largely restricted to speech (automatic series, object naming, spontaneous narratives). Reports on writing are exceedingly rare.

A thorough search of the awake surgery literature only yields 23 studies that mention writing, and only 9 that report interpretable spelling performance. However, even such a small database provides relevant information. Dysgraphia was observed post-operatively in 26.9% of the patients with intact pre-operative writing, and persisted at follow-up in 45% of these. Intra-operative stimulation interfered only with writing in 48.1% of the cases. Coherent with data from stroke and fMRI investigations, a network of frontal, parietal and temporal regions was found to be critical for writing. Interestingly, while damage to some regions affected both 'central' and 'peripheral' spelling processes, damage to other areas selectively interfered with 'central' or with 'peripheral' stages.

A retrospective study from our group shows that subjects in whom spelling was mapped intraoperatively had a better prognosis and/or recovered pre-operative spelling skills more quickly and fully than subjects in whom no assessment had been carried out. A prospective study on the impact of intraoperative mapping of reading on postoperative reading and writing skills shows that the procedure does preserve reading, but protects spelling only in some cases. In contrast, dedicated intraoperative mapping of spelling results in intact postoperative performance.

Cognitive neuroscience of spelling and awake surgery practice can fruitfully interact in at least two critical areas. From a clinical perspective, current knowledge of the functional neuroanatomy of spelling can inform awake surgery at all stages (pre-, intra, post-operative and follow-up) – for example, by selecting patients for whom the intraoperative assessment of spelling is mandatory, advisable or redundant. From the perspective of cognitive neuroscience, carefully designed intraoperative mapping might shed light on stages of spelling (e.g., modality-specific spelling skills, like written spelling, oral spelling, typing), that are largely unamenable to testing in stroke cases, due to the nature of vascular lesions.

Conceptual ambiguity requires non-linear phrase planning

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Sentence planning operates incremental by preparing the first determiner-noun pair before production onset (Griffin, 2001). Under conditions that are yet to determine the production system exceeds this scope (see Bock and Ferreira, 2014; Konopka and Brown-Schmidt, 2014). Evidence for non-linear planning strategies comes from studies that found that planning duration is longer for syntactically more complex noun phrases, while linear planning makes it possible to delay some processing until after production onset (Allum and Wheeldon, 2007; Lee et al., 2013; Smith and Wheeldon, 1999). However, whether or not syntactic processing is permitted to unfold incrementally must necessarily be determined by a pre-syntactic operation. We therefore examined whether, independently of syntactic structure, the conceptual plan of the intended message determines whether or not planning proceeds incrementally. In three image description experiments (Ns=32, 64, 64) we elicited phrases with modifier-head (e.g., the B's A) or head-modifier structure (e.g., the A with the B). Subjects were required to name one image (the A) in an array, using the modifier B for disambiguation in one of two contexts: (1) B's A and not C's A; (2) B's A and not B's C (for both phrase types). If non-linear planning was introduced during the conceptualisation process, more advanced planning should be dedicated to the B in the context of ambiguous head referents as in (1). We found evidence in eye movements and onset latencies showing that processing of the modifier referent B was facilitated for ambiguous target referents. This provides evidence that the conceptual plan influences the linearity of the planning process even when the syntactic structure is held constant.

Cross-language differences in written picture-naming timecourse

Mark Torrance

Nottingham Trent University

The Multilanguage Written Picture Naming Dataset (Torrance et al., 2017a, 2017b) comprises data from writers in 14 European languages naming the 260 pictures in a colourised version of the Snodgrass and Vanderwart set of pictures of everyday objects (Ns = 60 to 121). For each language the dataset provides measures of spelling and name diversity, of response-onset latency (RT), and of within-word keypress latencies (IKI). Analyses of just trials where the response was the correctly-spelled dominant name, conducted separately for each language, suggest that across all languages high image familiarity, name frequency, and name agreement give quicker RT in all languages. In some, but not all, languages effects of frequency (controlled for length) persist beyond typing onset to affect mean IKI. Spelling agreement (as a proxy how easy a word was to spell) showed no effect on RT, but there was some evidence of an effect on IKI in some languages. One hypothesis suggested by these preliminary findings is that whether orthography is prepared fully in advance of output onset may be language-specific. Independently of the regularity of the particular word being spelt, we might predict a bias towards incremental letter-by-letter assembly in languages with shallow orthography. In my presentation, in addition to the findings summarized above, I plan to present analyses that more directly test this hypothesis.

Torrance, M., Nottbusch, G., Alves, R. A., Arfé, B., Chanquoy, L., Chukharev-Hudilainen, E., … Wengelin, Å. (2017a). Timed Written Picture Naming in 14 European Languages. *Behavior Research Methods*.

Torrance, M., Nottbusch, G., Alves, R. A., Arfé, B., Chanquoy, L., Chukharev-Hudilainen, E., … Wengelin, Å. (2017b). Multilanguage Written Picture Naming Database. http://doi.org/10.6084/M9.FIGSHARE.4898144.V3

Tracking the time course of lexical access in orthographic production: An event-related potential study of word frequency effects in written picture naming

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Previous studies of spoken picture naming using event-related potentials (ERPs) have shown that speakers initiate lexical access within 200 ms after stimulus onset. In the present study, we investigated the time course of lexical access in written, rather than spoken, word production. Chinese participants wrote target object names which varied in word frequency, and written naming times and ERPs were measured. Writing latencies exhibited a classical frequency effect (faster responses for high- than for low-frequency names). More importantly, ERP results revealed that electrophysiological activity elicited by high- and low frequency target names started to diverge as early as 168 ms post picture onset. We conclude that lexical access during written word production is initiated within 200 ms after picture onset. This estimate is compatible with previous studies on spoken production which likewise showed a rapid onset of lexical access (i.e., within 200 ms after stimuli onset). We suggest that written and spoken word production share the lexicalization stage.

The impact of spelling regularity on handwriting: A coupled fMRI and kinematics study

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Current models of writing assume that the orthographic processes involved in spelling retrieval and the motor processes involved in the control of the hand are independent. This view has been challenged by behavioral studies, which showed that the linguistic features of words have an impact on motor execution during handwriting. We designed an experiment coupling functional magnetic resonance imaging and kinematic recordings of movements during a writing to dictation task. The participants wrote orthographically regular and irregular words. Behavioral results confirmed that the presence of an irregularity impacts not only the initiation of the writing movement, but also its fine motor execution. At the brain level, the left inferior frontal and fusiform gyri, two regions belonging to the core of the language system in the brain, were found to be sensitive to the presence of an irregularity and also to its position in the word. Importantly, this effect occurred during writing execution. In addition, the left superior parietal lobule and the right cerebellum, two motor-related regions, displayed a stronger response to irregular than regular words. The left superior frontal gyrus, corresponding to the so-called Exner's area, presented a different effect of orthographic regularity when the first and last letters of the word were being written. Taken together, these results constitute direct evidence that orthographic and motor processes occur in parallel and interact during writing.

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