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WRITING TWO WORDS FROM PICTURES: AN INTERFERENCE PARADIGM STUDY

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Abstract: Participants were presented with pairs of pictures the names of which they had to write down using two bare nouns, e.g. *dog-ball*. The pairs were presented with auditory distractors that were phonologically/orthographically related either to the first noun, to the second noun, or unrelated to them. Latencies were shorter when the distractors were related to the first noun than when they were unrelated. No form facilitation effect was obtained with distractors related to the second noun. These findings are in line with Meyer's (1996) spoken picture naming study and suggest that in both production modes only the first target form is selected before naming onset.

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Most studies of writing have been devoted to the investigation of high processing levels (Hayes & Flower, 1980). These studies have suggested that different kinds of units are prepared at different moments during text production but, so far, they have not provided clear answers to the questions of what *precisely* is the nature of the representations that are planned, when they are planned and, for any given type of representation, what is the span of the units that are planned.

Studies of writing that have focused on specific components, such as lexical access, are very scarce. This is unfortunate because the use of naming tasks performed in *well-defined situations*, which permit a fine-tuned control of the variables, can help us to gain an insight into the nature of the representations mobilised in writing together with their time course of activation (Bonin & Fayol, 2000; Bonin, Fayol, & Gombert, 1997).

The picture is clearly different in speech production research. A number of studies have provided evidence for the different kinds of representations that are activated. It is generally assumed that speech production entails three major levels of processing: conceptualizing, formulating, and articulating (Levelt, Roelofs, & Meyer, 1999). Formulating involves lemma retrieval and access to the corresponding phonological form, i.e. phonological lexeme. Lemmas encode the meanings and the syntactic properties of words, but they do not contain phonological information (Levelt, 1989). The evidence for such a distinction comes from speech errors, analyses of brain-damaged patients and experimental studies (for a review see Ferrand, 1994).

A number of studies have sought to identify the units that are planned in spoken sentence production (Dell & O'Seaghdha, 1992; Ferreira, 1991; Kempen & Huijbers, 1983; Lindsley, 1975; Levelt & Maassen, 1981; Schriefers, 1992), but these have not yet provided us with an entirely clear picture. For instance, while some studies have suggested that the phonological planning units comprise no more than two words (Kempen & Huijbers, 1983; Levelt & Maassen, 1981), others have suggested that the phonological units are longer (Dell & O'Seaghdha, 1992; Ferreira, 1991). Interestingly, Meyer's (1996) study has provided clear evidence from interference paradigm experiments for the span of the phonological units that are planned before speech onset *in a well-defined situation* (see below).

Although the interference paradigm has been used in a few studies to investigate the written production of isolated words (Bonin & Fayol, 2000; Bonin et al., 1997), we are not aware of any written picture naming study that has made use of it to investigate the advance planning issue. In contrast, this paradigm has frequently been used to study the spoken production of isolated words (Schriefers, Meyer, & Levelt, 1990; Meyer & Schriefers, 1991), noun phrases or sentences (Meyer, 1996; Schriefers & Teruel, 1999). Its key interest lies in the possibility of identifying the nature of the representations that are activated at any given moment of processing.

In this technique, a target, e.g. the picture of a *CAT*, is accompanied by the auditory or visual presentation of a distractor item, e.g. the word *horse*. The participant's task is to name the target as quickly as possible while attempting to ignore the distractor. Depending on the relation between the target and the distractor, the processing of the target may be slowed down or, in contrast, accelerated. Another important aspect is that the delay between the presentation of the distractor and that of the target, i.e. the Stimulus Onset Asynchrony (SOA) can be manipulated. The manipulation of SOAs makes it possible to determine the nature of the representations that are relevant at a given moment in processing and not relevant, or less so, at another moment. Thus, the presentation of the distractor can precede that of the target, i.e. negative SOA, be simultaneous with it, or can follow it, i.e. positive SOA.

We used the interference paradigm in our study to explore the advance planning issue in written picture naming. Precisely, we sought to determine whether in the written production of two words from pictures both word forms would be selected before writing onset or whether only one of the two forms, namely that corresponding to the first noun to be written down, would be selected. Since we took Meyer's (1996) spoken picture naming study as our starting point, we made use of her design, but, as we are focusing on written picture naming, only a written picture naming task was used.

In Meyer's (1996) study, Dutch participants were presented with pairs of pictures which they had to name using either noun phrase, e.g. *the ball and the dog*, or sentences, e.g. *the ball is next to the dog*. Each pair was presented with an auditory distractor which was semantically related to the first or to the second noun or unrelated to both of them in Experiments 1 and 2, and with a distractor which was phonologically related to the first or to the second noun or unrelated to both of them in Experiments 3 and 4. The distractors were presented at various SOAs: 0 and –150 ms in Experiments 1 and 2, and 0, +150 and +300 ms in Experiments 3 and 4, (and also at SOA = +450 ms in Experiment 3). The main findings were as follows. In Experiments 1 and 2, in which semantically related distractors were used, a semantic interference effect was observed at both SOAs and for both targets nouns, that is to say that the mean latency was longer when distractors were semantically related to the first or to the second noun than when they were unrelated. As suggested by Meyer (1996), because the lemma level is thought to underlie the emergence of semantic interference in picture naming (see also Schriefers et al., 1990), these findings indicate that both lemmas were selected before speech onset. In contrast, in her

Experiments 3 and 4, a phonological facilitation effect was found only for the first noun, that is to say that the mean spoken latency was shorter when distractors were related to the first noun than when they were unrelated (this effect was obtained at SOAs = 0 and +150 ms in both Experiments 3 and 4). Also, a weak inhibition effect, albeit nonsignificant, was obtained with distractors that were related to the second noun. As far as this latter effect is concerned, it is worth stressing, however, that this tendency towards an inhibitory effect was found by Meyer (1996) in her both two experiments that manipulated the phonological relatedness, and that this effect came close to reaching significance in each experiment. The author has therefore suggested that in the production of two-word utterances, even though the lemmas of both nouns are selected before speech onset, the phonological encoding of the two nouns is sequential despite the fact that both word forms are activated to some extent given the slight inhibitory effect found for the second noun. Because our study focused on word form encoding in written picture naming, the experiment reported below did not include a semantic manipulation and therefore provides a partial replication of Meyer's (1996) study in the written domain.

At first sight, a study of the word form advance planning issue in written picture naming might appear to be superfluous given it might be thought that the effects that were observed in speaking by Meyer (1996) are mostly unlikely to differ in writing. But, if we are to elaborate views on written picture naming, it would seem somewhat bizzarre to construct potential models of the writing process on rather a priori grounds. In effect, it was long assumed that writing was parasitic on speech (Luria, 1970). According to this view, writing and speaking involve similar processes. However, this view has not as yet received strong empirical support. Very few experimental studies involving normal adults have investigated the extent to which the processes and the representations involved in written production resemble those involved in spoken production (Bonin & Fayol, 2000; Bonin, Fayol, & Gombert, 1998). Therefore, from a general standpoint, the purpose of the present study was to shed light on this "similarity" problem. Our basic assumption was that, if we were to find similar effects, this would indicate that similar processes are involved in both language production modes. Indeed, if it is hypothesized that written picture naming does not differ from spoken picture naming in that the processes devoted to word form encoding behave in a similar manner, we should find evidence that in a situation in which two nouns have to be written down from the presentation of pairs of pictures, only the form of the first noun is selected before writing onset.

In the following experiment, the participants were presented with pairs of pictures accompanied by auditory distractors. The pictures were presented next to each other on a computer screen. The participants had to write down the bare nouns of any given pair, always starting with the left picture, while hearing distractors that were either phonologically/orthographically related to the first picture name, related to the second name, unrelated to either, or neutral (a blank noise). The distractors were presented simultaneously with the picture onsets (SOA = 0 ms) or 150 ms after the picture onsets (SOA = +150 ms). These two SOAs were chosen in the light of Meyer's (1996) study in order to determine whether the effects of the type of distractor would be observed in the same temporal window as in spoken picture naming. They also stemmed from a written picture naming experiment (Experiment 3) conducted by Bonin and Fayol (2000) in which a phonological/orthographic facilitation effect was found at an SOA of 0 ms. The main dependent variables were written latencies and errors.

METHOD

Participants

Forty-four students from Blaise Pascal University were given course credits for their participation. All were native speakers of French, had normal or corrected-to-normal vision, and no known hearing deficits.

Material

Sixty line-drawings were used as the experimental pictures and 10 additional pictures as warm-ups. The drawings were selected from the Cycowicz, Friedman, Rothstein and Snodgrass (1997) corpus.

The targets in the first and second positions, appearing on the left and right side of the screen, were matched for name agreement, image agreement, conceptual familiarity, image complexity, image variability, estimated age of acquisition, log word frequency, log bigram frequency, and number of letters, phonemes and syllables. The mean values corresponding to these variables as well as the sources for these scores are presented in Table 1.

Table 1
Mean statistical characteristics of the picture targets

	First targets	Second targets
Name agreement (%)*	94	93
Image agreement*	3.4	3.3
Conceptual familiarity*	3.2	3.3
Image complexity*	3.0	2.9
Image variability*	3.1	3.2
Age of acquisition (estimated)*	2.0	1.9
Log frequency**	1.4	1.4
Log bigram frequency***	3.0	3.0
Nb of phonological neighbors	5.8	6.6
Nb of letters	5.5	5.5
Nb of phonemes	4.1	4.2
Nb of syllables	1.5	1.5

Notes. Nb = number; * from Alario & Ferrand (1999); ** word frequency values taken from Imbs (1971); *** from Content & Radeau (1988)

Care was taken to select pairs of pictures that were unrelated in both meaning and word form. The mean number of letters and phonemes shared at the same position between the two targets were 0.87 and 0.30 respectively.

For each target, a phonologically/orthographically related distractor was chosen. The distractors associated with targets in the first or in the second position were matched for number of letters (5.8 vs 5.9), phonemes (4.3 vs 4.5), and syllables (1.5 vs 1.6), log frequency (1.2 vs 1.0), uniqueness point (4.8 vs 4.9), number of phonological neighbors (5.4 vs 6.8), log diphoneme frequency (2.8), and acoustic duration (760 ms on average).

The related distractors shared the first two or three segments or letters with the targets. On average, the first targets (T1) shared 2.17 segments and 2.73 letters in common, i.e. at the same position, with the related distractors (R1), and the second targets (T2) shared 2.23 segments and 2.73 letters with the related distractors (R2). We were careful to ensure that T1 and R2 were not phonologically/orthographically related (the mean number of letters and phonemes shared were 0.60 and 0.27), as was also the case with T2 and R1 (the mean number of letters and phonemes shared were 0.63 and 0.17).

To create the unrelated distractors, the same distractors as in the related conditions were used, but these were combined with other targets appearing in the same position. The unrelated distractors used for the first (U1) and for the second (U2) targets were almost phonologically/orthographically unrelated to both members of the target pairs. The number of letters and phonemes shared by the first targets and the unrelated distractors were 0.67 and 0.18 respectively, and for the second targets, 0.38 and 0.20 respectively. In the neutral condition, the pictures were accompanied by a stretch of white noise whose duration corresponded to the mean acoustic duration of the word distractors, i.e., 760 ms.

The pairs of target picture names and their corresponding phonologically/orthographically related distractors are listed in the Appendix. The RT data can be obtained from the first author on request.

Design

The experimental design included two crossed within-subject factors, namely Distractor Type with three levels (white noise, phonologically/orthographically related, unrelated) and Position (First, Second), and one crossed between-subject factor, SOA with two levels (SOA = 0 ms and SOA = +150 ms). Each participant saw each picture five times, each time in combination with a different distractor. Five test blocks were created, in each of which all the pairs of pictures were presented once. The test blocks included 30 items each. Each picture was assigned to one of five item groups. The item groups included six items each. The order of the five blocks was balanced across participants using a latin square design. The order of the items within the blocks was random.

Apparatus

The experiment was run using PsyScope 1.2. (Cohen, MacWhinney, Flatt, & Provost, 1993) on a PowerMacintosh. A graphic tablet (WACOM) and a contact pen (SP-401) were used to record the graphic latencies. The distractors were recorded with SoundEditPro and presented via headphones.

Procedure

The participants were tested individually and randomly assigned to one of the two levels of the SOA factor. At the beginning of the session, they received a booklet showing the pictures with their names. They were told to study the names of the pictures and to use only those names to refer to the pictures. As soon as they said they had looked at all the drawings and studied their names, the participants were told that they would have to write down in sequence, as quickly as possible, the bare nouns of any given pair of pictures presented next to each other in the middle of the screen. They were told that the pictures would be accompanied by either a word or a noise presented via the headphones. They were required to pay no attention to the auditory distractors. The pictures were presented centered on the screen at a viewing distance of about 60 cm. The experimenter monitored the participants' responses and scored them for correctness. The entire session lasted about one hour.

A test trial had the following structure. A ready signal (+) was presented for 500 ms followed by a pair of pictures. Depending on the SOA condition, the onset of the distractor coincided with the picture onset (SOA = 0 ms) or followed it by 150 ms (SOA = +150 ms). The participants wrote down the names of the pictures as quickly as possible. The pictures were removed from the screen after the participant had initiated writing. The next trial was presented after a pause of 10 seconds. Such a delay ensured that all the participants could write down the two nouns before the next trial began.

Analyses

The participants sat with the stylus right above the tablet so that the latency was the time taken to make contact after picture onset. The timing was accurate to the nearest millisecond. In order to avoid any variability in the positioning of the stylus before each word was written, a line was drawn and the participant was obliged to position the stylus at the very start of the line at a height from the tablet which just touched the edge of the line.

Observations were discarded from the latency analyses whenever any of the following conditions applied: The participant did not remember the picture name, a technical problem occurred, an item other than the expected one was produced, a word was misspelled. Also, latencies exceeding 2.5 standard deviations above the participant and item means were discarded (less than 1 % of the data). The application of these criteria resulted in the exclusion of 5.3 % of the data.

An examination of the condition means revealed that the latencies were shortest in the Noise condition (and all other condition means differed significantly from this condition). A neutral condition, in which a nonlinguistic stimulus is presented, is frequently included in picture-word interference experiments to determine whether other types of distractors result in a facilitation or inhibition relative to this baseline. In line with Meyer's (1996) results, our results therefore clearly showed that all linguistic distractors resulted in an inhibition relative to this Noise condition. However, the results of the Noise condition are not crucial for the issue which we were addressing. Thus, as in Meyer's (1996) study, this condition was not included in the statistical analyses. Therefore, we subjected the latencies and errors to ANOVAs with SOA (0, +150), Distractor type (Related: REL, Unrelated: UNR), and Position (First, Second) as factors[1]. ANOVAs were carried out on the participant means (F1) and on the item means (F2). For all analyses, the level of .05 for statistical significance was adopted.

Results

The mean written latencies, their standard errors and the error rates per condition are presented in Table 2.

Table 2
Mean written latencies (WL, in ms), standard errors of these means (SE) and error rates (E, in percentages) as a function of Target position, Distractor type, and SOA

Target position		First		Second	
Distractor	Noise	Related	Unrelated	Related	Unrelated
SOA = 0 ms					
WL	1377	1426	1491	1526	1495
SE	57.7	70.9	74.0	78.1	74.1
E	4.2	3.8	2.6	4.6	3.5
SOA = +150 ms					
WL	1358	1394	1418	1417	1409
SE	39.3	42.9	43.9	43.9	42.3
E	3.0	3.9	4.1	2.7	3.3

Note. The Noise condition concerns both target positions

The main effect of SOA was significant on items, F_2 (1, 29) = 63.95, MSE = 4275.63, but not on participants, $F_1 < 1$. The main effect of Position was significant, F_1 (1, 42) = 11.18, MSE = 3484; F_2 (1, 29) = 11.74, MSE = 5473.26. The main effect of Distractor type was significant on participants, F_1 (1, 42) = 4.05, MSE = 1782.7, but not on items, F_2 (1, 29) = 1.83. Two interactions reached

1. Given that the pictures were repeated five times with each SOA, ANOVAs were also performed including Repetition as a factor. A significant main effect of Repetition was observed. However, none of the interactions involving Repetition as a factor was significant. Therefore, the data were collapsed across repetitions.

significance: SOA x Position, F_1 (1, 42) = 6.62, MSE = 3484; F_2 (1, 29) = 8.49, MSE = 3536.30, and Position x Distractor type, F_1 (1, 42) = 18.09, MSE = 2489.8; F_2 (1, 29) = 14.21, MSE = 4711.90. Most importantly, the interaction between SOA, Position and Distractor type was significant, F_1 (1, 42) = 4.64, MSE = 2489.8; F_2 (1, 29) = 5.54, MSE = 3049.36. Latencies were shorter when the distractors were related to the first noun and longer when they were related to the second noun, as compared to unrelated distractors, and this pattern of results was mostly observed at an SOA of 0 ms (see Table 2). Planned comparisons confirmed that at an SOA of 0 ms, REL distractors yielded significantly shorter latencies than UNR distractors for targets presented in the first position, whereas for targets presented in the second position, REL distractors yielded longer latencies than UNR distractors, this latter comparison was significant on participants and approached significance in the item analysis ($p < .07$). At an SOA of +150 ms, there was no significant difference between REL and UNR for the two target positions.

In the error analyses, no main effect or interaction was significant.

GENERAL DISCUSSION

The findings can be easily summarized. A form facilitation effect on onset written latencies was observed when the distractors were phonologically/orthographically related to the first noun of the pair. In contrast, no form facilitation effect was observed when the distractors were related to the second noun. Therefore, these findings extend to the field of writing those observed by Meyer (1996) in speaking. Nevertheless, there are two differences between Meyer's (1996) findings and ours. First, whereas Meyer (1996) found that facilitation effects spanned a wide range of SOAs (from 0 to +300 ms in Experiment 3 and from 0 to +150 ms in Experiment 4), we found a significant facilitation effect at an SOA of 0 ms, but not at a later SOA (+150 ms). This could be due to the fact that distractors presented +150 ms after picture onset in writing came too late to affect word form encoding. Second, while Meyer (1996) observed a small inhibitory effect that was not significant, we found evidence for a larger and significant inhibitory effect of distractors related to the second nouns at an SOA of 0 ms (though this effect only approached significance in the item analysis).

Meyer (1996) explained the phonological facilitation effects in spoken picture naming as follows. In her modelling of lexical access in speaking, when two words have to be produced from pictures, both lemmas are activated. In turn, both lemmas activate their sublexical units, but the first one initially activates them more strongly than the second. The sublexical units of the first word are thus selected first. In an interference paradigm situation, the effect of a phonologically related distractor is to provide additional activation to some of the relevant sublexical units corresponding to the to-be-produced noun, whereas the effect of an unrelated distractor is to add activation to some sublexical units that are not relevant for the encoding of the to-be-produced noun. Therefore, a phonologically related distractor accelerates the phonological encoding of a target item while an unrelated distractor impedes it. In keeping with this account, the inhibition effect observed by Meyer (1996) was interpreted as being due to the early activation of the second noun which itself interfered with the form encoding of the first one. In effect, the distractors that are related in form to the second nouns would give additional activation to some of the sublexical units corresponding to the second nouns, which would then interfere with the encoding of the first noun. Therefore, as claimed by Meyer (1996), this account implies that although only the first word form is selected, both word forms are activated to some extent (for related evidence see, Dell & O'Seaghdha, 1992). It is worth stressing that the finding of a (slight) phonological/orthographic inhibition effect for the second noun is an important one in the light of the fact that our experiment did not include semantically related distractors. In effect, if we had observed no effect for the second noun, then the lack of any semantic manipulation would have become somewhat puzzling because it would have been possible to argue that writing is a much more sequential activity than speaking on all the involved levels. However, the observation of this inhibition effect makes this latter interpretation highy implausible.

The striking similarity of word form effects in the two production modes in a well-defined production situation strongly suggests that similar processes are involved. Therefore, in written picture naming, words would appear to be formally encoded sequentially on the basis of the order established at a conceptual/grammatical level. The sequential nature of the linguistic planning process in the spoken production of pairs of objects has recently been confirmed in a study in which naming latencies and eye movements made by speakers during naming were recorded (Meyer, Sleiderink, & Levelt, 1998). In this study, objects were presented as ordinary line drawings or with partly deleted contours and had high or low-frequency names. The viewing times for the left objet were a function of both the contour type and name frequency of the objects. According to the authors, because it is assumed that word frequency effects arise during word form retrieval, the frequency effect found on the viewing times indicates that speakers did not look away from the the left object as soon as they had identified it but waited until they had retrieved the phonological form corresponding to its name. However, as acknowledged by these authors, these results do not rule out the possibility that participants might undertake some processing of the right object before initiating the verbal response as found in Meyer's (1996) study and the present study, because it was also found that contour type had a stronger effect on naming latencies that on viewing times. This suggests that part of the effect of contour type on the naming latencies arises after the eyes have moved away from the left object, i.e. during the processing of the right object.

One point deserves a brief comment. It might be asked whether the form effects observed were phonological or orthographic in nature. Our study was not designed to disentangle phonological from orthographic effects. Consequently, no compelling conclusions can be drawn. If the obligatory phonological mediation view is followed, that is to say if orthographic encoding requires the activation of phonological codes, then the form facilitation effect could be explained by assuming that the phonological codes corresponding to the first noun are selected first and, in turn, are converted into orthographic codes (Luria, 1970). In this case, the facilitation effect for the first noun would be located at the phonological encoding level. However, in recent years, the obligatory mediation view has been strongly challenged essentially by observations of brain-damaged patients who exhibited relatively well-preserved writing capabilities despite serious impairments in speaking (e.g. Bub & Kertesz, 1982; Shelton & Weinrich, 1997). According to the orthographic autonomy view, orthographic codes can be activated directly from semantic specifications (Rapp, Benzing, & Caramazza, 1997). Therefore, the form facilitation effect observed in our experiment would appear to be orthographic in nature and can be accounted for by claiming that the orthographic codes corresponding to the first noun are activated and selected first, while those corresponding to the second one receive only a certain amount of activation just before writing onset. However, we might ask how the facilitation and inhibitory effects can be orthographic in nature given that the distractors were presented auditorily? For the orthographic autonomy account to be correct, it must be assumed that orthographic codes are also activated from the speech perception of the word distractors. Indeed, there is evidence that orthographic codes are activated during speech perception (e.g. Ziegler & Ferrand, 1998). Thus, it is plausible to argue that orthographic codes activated from speech perception might be the source of the effects we found. Given the focused task — writing — one might argue that written distractors should have been used instead of, or in addition to, the spoken distractors. In the spoken picture naming literature, form facilitation effects have been found with the use of visually presented distractors (e.g. Starreveld & La Heij, 1995). In our experiment, the distractors were orthographically *and* phonologically related to the target picture names. Given the evidence in the word recognition literature that the processing of written words leads to the rapid activation of orthographic and phonological codes (e.g. Berent & Perfetti, 1995), the use of written distractors would not have provided us with an unambiguous interpretation of the source of the form facilitation effect which we found because, even in this case, the effect might have been due either to orthographic or phonological codes. An experiment in which visual distractors which are orthographically but not phonologically related to the picture names might shed some light on this issue.

The finding that a word facilitation effect occurs on the first noun but not on the second does not imply that the *whole process* of word form encoding is serial. In speech production, Roelofs (1997) has provided evidence that not only syllables but also segments (e.g.*b*/in/*bol*/) in words are encoded from left-to-right, whereas features (e.g. *+voiced, +labial, -nasal* and so forth) appear to be activated in parallel (Roelofs, 1999). Thus, we still need to determine in greater detail how the encoding of word units in writing is performed. Future research should be aimed at determining, for instance, whether the graphemes that comprise words are sequentially encoded and followed by a parallel activation of the strokes that comprise the graphemes.

We have shown that in a well-defined production situation, only the form of first word to be produced was selected. However, a crucial issue remains: Namely to determine to what extent this span of word form advance planning can be generalized to other production situations. Recently, Schriefers and Teruel (1999) showed that in the production of German two word utterances, i.e. no-determiner noun phrases, e.g. *red table*, reliable form facilitation effects were found for distractors that were identical to the first syllable of the first word of the noun phrase whereas only weak facilitation effects were obtained for the second syllable of the first noun. Furthermore, additional analyses showed that two groups of speakers could be distinguished, one exhibiting facilitation effects only for the first syllable of the first word and the other exhibiting an additional facilitation effect for the second syllable of the first word. According to Schriefers and Teruel (1999), the phonological advance planning unit in speech production would not be of some fixed size instead, the amount of phonological planning would vary as a function of the experimental paradigm, the to-be produced utterance and speaking demands.

To conclude, the strength of our study lies in the fact that it generalizes the findings obtained by Meyer (1996) in research into word form encoding in two words of speaking to the realm of writing. Experimental studies in written picture naming in normals are very scarce, and it is essential to gather empirical data if we are to succeed in elaborating a fully developed view of lexical access. We think that our study is valuable in bringing this aim one step closer to fruition.

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AUTHORS' NOTE

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APPENDIX

List of the target picture names in first (Target 1) and in second (Target 2) position and of the phonologically/orthographically related distractors corresponding to the pictures in first (PO1) and in second position (PO2). Approximate English translation is given in parentheses. Phonetic transcription of the stimuli is given into brackets.

Target 1	Target 2	PO1	PO2
Train (train) [trɛ̃]	Doigt (finger) [dwa]	Trait (line) [trɛ]	Dose (dose) [doz]
Plume (feather) [plym]	Boîte (box) [bwat]	Pluie (rain) [plywi]	Botte (boot) [bɔt]
Chien (dog) [ʃiɛ]	Jambe (leg) [ʒɑ̃b]	Chiffre (number) [ʃifrə]	Jante (rim) [ʒɑ̃t]
Règle (ruler) [rɛglə]	Verre (glass) [vɛr]	Rêve (dream) [rɛv]	Verge (yard) [vɛrʒə]
Arbre (tree) [arbrə]	Table (table) [tablə]	Arche (arch) [arʃə]	Tarte (pie) [tartə]
Chat (cat) [ʃa]	Banc (bench) [bɑ̃]	Char (tank) [ʃar]	Bar (bar) [bar]
Prise (plug) [priz]	Corde (rope) [kɔrd]	Prune (plum) [pryn]	Corne (horn) [kɔrnə]
Vache (cow) [vaʃ]	Pomme (apple) [pɔm]	Valse (waltz) [valsə]	Porte (door) [pɔrtə]
Gant (glove) [gɑ̃]	Vase (vase) [vaz]	Gare (station) [gar]	Vague (wave) [vag]
Veste (jacket) [vɛstə]	Tasse (cup) [tas]	Veine (vein) [vɛn]	Taupe (mole) [top]
Lion (lion) [liɔ̃]	Clou (nail) [klu]	Ligne (line) [liɲ]	Clef (key) [kle]
Fraise (strawberry) [frɛz]	Peigne (comb) [pɛɲ]	Frein (brake) [frɛ̃]	Pelle (shovel) [pɛl]
Tigre (tiger) [tigrə]	Poire (pear) [pwar]	Tige (trunk) [tiʒ]	Poivre (pepper) [pwavrə]
Scie (saw) [si]	Vélo (bike) [velo]	Scion (tip) [siɔ̃]	Verrou (bolt) [veru]
Lune (moon) [lyn]	Robe (dress) [rɔb]	Lustre (lustre) [lystrə]	Roche (rock) [rɔʃ]
Soleil (sun) [sɔlɛj]	Maison (house) [mɛzɔ̃]	Soldat (soldier) [sɔlda]	Mésange (titmouse) [mesɑ̃ʒ]
Couteau (knife) [kuto]	Poisson (fish) [pwasɔ̃]	Couronne (crown) [kuron]	Poignée (handle) [pwaɲe]
Mouton (sheep) [mutɔ̃]	Panier (basket) [panje]	Moulin (mill) [mulɛ̃]	Panneau (panel) [pano]
Serpent (snake) [sɛrpɑ]	Drapeau (flag) [drapo]	Serviette (towel) [sɛrviɛt]	Dragée (sugared almond) [draʒe]
Bougie (candle) [buʒi]	Cochon (pig) [koʃɔ̃]	Bouteille (bottle) [butɛj]	Colonne (pillar) [kolɔn]
Fromage (cheese) [fromaʒ]	Tambour (drum) [tɑ̃bur]	Frelon (hornet) [frelɔ̃]	Tampon (pad) [tɑ̃pɔ̃] Cigare
Cigare (cigar) [sigar]	Violon (violin) [violɔ̃]	Cigale (cicada) [sigal]	Violette (violet) [violet]
Fourmi (ant) [furmi]	Poupée (doll) [pupe]	Foulard (scarf) [fular]	Poumon (lung) [pumɔ̃]
Hibou (owl) [ibu]	Stylo (pen) [stilo]	Hiver (winter) [ivɛr]	Statue (statue) [staty]
Banane (banana) [banan]	Râteau (rake) [rato]	Balise (beacon) [baliz]	Rapace (raptores) [rapas]
Méduse (jellyfish) [medyz]	Toupie (top) [tupi]	Mégot (fag-end) [mego]	Touriste (tourist) [turistə]
Cravate (tie) [kravat]	Asperge (asparagus) [aspɛrʒə]	Cravache (riding-wip) [kravaʃ]	Asticot (maggot) [astiko]
Oreille (ear) [ɔrɛj]	Fenêtre (window) [fənɛtrə]	Ortie (nettle) [ɔrti]	Fenouil (fennel) [fənuj]
Chapeau (hat) [ʃapo]	Voiture (car) [vwatyr]	Chapelle (chapel) [ʃapɛl]	Voilage (net curtain) [vwalaʒ]
Avion (plane) [avjɔ̃]	Canon (cannon) [kanɔ̃]	Avare (miserly) [avar]	Canard (duck) [kanar]