28 Pausal Behavior in the Writing Processes of Foreign and Native Language Writers: The Importance of Defining the Individual Pause Length

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This study aims to increase knowledge of pausal behavior in L1 and L2 writing during the online process of writing and to contribute to the field of L2 writing fluency. Previous research has shown that fluency is closely related to pause length and location, and that writing has much individual variation; this variation has been neglected when defining pauses. Here, however, the pause length is defined at a personal level by means of the Hidden Markov Model. The online data were gathered from eleven Finnish university students studying French and six French speaking Erasmus students. The results show language-related differences in the pausal behavior in L1 and L2 writing. The individual pausal behavior varied between students, which confirms the relevance of using individual pause lengths in experimental studies.

Cet article présente les résultats d'une étude de cas empirique portant sur les processus rédactionnels en temps réel, à savoir sur le comportement pausal en langue seconde (L2) et en langue première (L1). Il s'agit d'une recherche interdisciplinaire s'inscrivant dans le cadre des travaux sur l'activité rédactionnelle en tant que processus cognitif, des travaux sur l'écriture en langue seconde et des méthodes d'étude en temps réel. Pour recueillir le corpus, nous avons utilisé deux méthodes, notamment la méthode chronométrique (le logiciel ScriptLog) et la méthode de verbalisation rétrospective, à savoir le rappel stimulé. La longueur des pauses a été définie selon les critères

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individuels à l'aide du modèle de Markov caché (MMC). Le recours au modèle MMC nous a permis de définir pour chaque scripteur trois états de pause (état d'aisance, état de moindre aisance et état de non-aisance). Les textes étaient rédigés par onze finnophones étudiant le français au niveau universitaire et par six étudiants Erasmus français. Les résultats montrent que le comportement pausal des finnophones en finnois (L1) diffère de celui des francophones en français (L1). Nous avons discerné un seuil de signification hautement significatif ($c2(6) = 27.722$, $p < 0.000106$). Les scripteurs francophones semblent demeurer dans l'état d'aisance, tandis que les scripteurs finnophones passent plus facilement de l'état d'aisance à l'état de moindre aisance. Les pauses de non-aisance sont également en moyenne plus longues en finnois (L1) qu'en français (L1). Les apprenants finnophones rédigeant leur texte aussi bien en L2 qu'en L1 ont besoin de plus de temps pour leur rédaction en langue seconde mais certains font des pauses plus longues en L1 qu'en L2, d'où des résultats mitigés. La variation individuelle est relativement grande à l'intérieur des groupes, surtout celui rédigeant son texte en L2. La variation individuelle s'avère donc un facteur important dans l'activité rédactionnelle et de ce fait, il semble que l'on puisse plutôt déterminer un niveau seuil individuel de la longueur de pause. L'expérience confirme en effet que les scripteurs individuels expérimentent la lenteur relative des processus rédactionnels de manière dissemblable.

1. Introduction

In studies on writing fluency, verbal fluency is based on the relationships among three main cognitive processes, namely planning, formulation, and revision (Ellis & Yuan, 2004; Roca de Larios, Manchón, Murphy & Marín, 2008; Sasaki, 2000, 2004).[1] Pause analysis provides bases for interferences about these processes, especially in terms of pause location and pause duration location (Gunnarsson, 2006; Mutta, 2007; Spelman Miller, 2000; Wengelin, 2002). The main cognitive functions seem to overlap during the writing event, so the processes are of a cyclical nature, and thus dynamic (see Roca de Larios et al., 2008; Olive, 2014). According to Olive (2014), earlier studies, mainly described cognition in terms of sequential or serial processing steps, but various empirical findings argue for parallel and cascading writing processes like those in speech production (see also Piolat, 2011). Among others, the model proposed by Kellogg (1996) emphasizes the role of working

memory in writing processes, especially the importance of the central executive forming a multipurpose, limited-capacity system, which is responsible for, for instance, solving problems. The key term in Kellogg's model is the "limited capacity" of working memory, or more precisely of the central executive. The limited capacity forces the writer to choose which processes s/he favors when producing a text as quickly as possible under great pressure (see also McCutchen, 2011). The analysis of verbal fluency is thus closely related to the writer's textual organization at micro- and macrostructural levels. The writer tries to control the processes of conceptual, internal representations and ideas, and then converts these into language, which means that manifold ideas are converted into a linear text (cf. Olive, 2014). Writing on a computer affects the planning and editing part in such a way that writers plan and edit less or in a different way on a computer than they do when writing with pen and paper. Moreover, writing on a computer fragments the activity even more and enables the overlapping of the three main processes perhaps more often than when writing with pen and paper (see Pennington, 2006; van Waes, 1992; for technical rapidity on keyboard, see Gaonac'h & Larigauderie, 2000; Wengelin, 2002; Grabowski, 2008).

The pause is a basic unit in studies on temporal aspects of language-production processes. As pauses reflect the covert cognitive activity, pause length, frequency, and location interest writing-process researchers; the covert cognitive activity seems to become visible through pauses (Janssen, van Waes & van den Bergh 1996). The longer the pause, the more attention and reflection are paid to ongoing processes by the writer. The automaticized processes are produced with rather few short pauses, whereas high-level processes invite longer pauses. It has been found that pauses have a hierarchical order: the shortest pauses are within a word, then between words, between sentences, and finally between paragraphs (Fayol, 1997; Olive, 2002; Gunnarsson, 2006). In other words, the lower level processes, like orthography, should be automaticized in order to avoid overloading the central executive, and to leave sufficient cognitive resources for executing higher level processes, such as planning, generating ideas, and revising.[2] In this manner, the activity of writing is not interrupted by unnecessary pauses. Furthermore, it is assumed that writing in a foreign language (L2) makes the pauses even longer at every location, and that there are more pauses within words, which is supposed to be the most fluent position in writing (Coirier, Gaonac'h & Passerault, 1996; Spelman Miller, 2000).

A pause criterion is often stipulated to suit the aim of the research or to allow comparison with other research. Several studies have used the stipulated criterion of two, three, or five seconds. Among others, Severinson,

Eklundh, and Kollberg (1996), Spelman Miller (2000), Wengelin (2002) and Mutta (2007) have set the minimum criterion at two seconds because the tool they used to collect their corpus automatically gives this threshold level. This stipulated criterion seems thus to cover all pauses that should really be considered as pauses, and exclude, for instance, so-called "technical pauses," which are due to correcting typographical errors. To measure the reactivity effect of think aloud protocols in writing processes, Janssen et al. (1996) used a minimum pause length of three seconds "for practical reasons," because in a one-hour writing session there would have been too much data to analyze. They used a software program called Keytrap. For her part, Sasaki (2000, 2004) considered a three second minimal level of inactivity as a pause because of her corpus collection method, namely, videotaped sessions of writing processes. She used a stimulated recall verbalization, and asked the participants to comment on all the pauses that were longer than three seconds on the tape. The mean pause duration is often even longer (Janssen et al., 1996; Spelman Miller, 2000), and thus the stipulated criterion is set at the five second level in some studies. Ransdell, Arecco, and Levy (2001) used a five second criterion in their two experiments studying the effects of working memory load (i.e. irrelevant speech and concurrent 6-digit load) in bilingual writers. They used a program called FauxWord. They were especially interested in pauses located at clause or sentence boundaries. A pause that is ≥ 5 seconds long can be treated as a long pause; it manifests the working memory load, which seems to be related to cognitive writing processes such as planning or revising.

Another way of analyzing pausal behavior is to set an individual pause criterion for each participant. Since writing processes have a great deal of individual variation (see e.g. Coirier et al., 1996; Fayol, 1997; Janssen, et al., 1996; Olive, 2002; Spelman Miller, 2000), so does pause length. If we take this supposition into account, it seems quite normal to set an individual pause criterion. This has been done in some studies; for instance, the study on writing apprehension by Madigan, Linton, and Johnson (1996) measured a pause as the time from the end of the previous word to the first letter of the next word. According to Wengelin (2002: 235), this is a good solution for counting pauses, but can make the comparison of durations and the analysis of the reasons for pauses more difficult, and therefore the stipulated pause criterion is more commonly used. However, when the stipulated pause criterion is used, some valuable information on individual pausal behavior can be excluded from the analysis (e.g. it can leave out some pauses or include some transitions that are not pauses; Wengelin, 2002), and the results might present an overgeneralized picture of a complex phenomenon.

In this chapter, we report on the attempt to define the individual pause

length for each writer and give some examples of how it is manifest in the writer's profile and pausal behavior. The following research question was formed to shed light on this issue: How is the writers' individual pause length manifest in their pausal behavior?

This chapter strives to gain insight into the complexity of pausal behavior in the process of online writing. Its originality lies in the fact that we attempt to clarify this phenomenon from a new angle. The starting point is to define three kinds of pauses illustrating fluent, thinking, and reflective writing states and to set individual pause thresholds; the Hidden Markov Model is utilized to do so. The research method provides a more detailed analysis of pauses and thus enlightens the variability necessary to observe the individual pausal behavior. Some of the participants wrote in both L2 and L1, which enables a comparison of these pausal behaviors and their relationship. As the article strives to open up this complexity, it contributes to the field of L2 writing fluency.

2. This Study

The possibility of defining the pause length at a personal level was explored in order to study the pausal behavior of writers either in their first language (L1) or in a foreign language (L2). As several median pause lengths were over seven seconds in the corpus, a third criterion was added to study three different pause lengths: short, medium, and long pauses. In this study, short pauses manifest normal writing fluency (see also Olive, 2014: 176), whereas medium and long pauses reveal increased working memory load. This gives more detailed information on individual pausal behavior than the stipulated pause criteria do. Therefore, we ran an experiment to define these three pause lengths. The Hidden Markov Model (HMM), which is often used in speech recognition (Rabiner, 1989), was relied on.[3] The HMM is a statistical model that describes the finite states of a phenomenon and its purpose is to distinguish the hidden parameters of a phenomenon from the observable parameters. Each state has a probability distribution referring to the transitions between the hidden states, i.e. transition probabilities (MacDonald & Zucchini, 1997; Uusipaikka, 2006). The number of states depends on the phenomenon under study; here we decided to use a three-level scale: short, medium, and long pauses, and thus three states, respectively. The argument for using this model is based on several assumptions: firstly, HMMs are known for their application in temporal pattern recognition such as speech, and, as mentioned above, writing processes resemble speech processes (Ellis & Yuan, 2004; Fayol, 1997; Olive, 2014). Therefore, HMM could be used in

describing the hidden states in a writing activity. In this case, the pauses represent the observable finite states, whereas the hidden sequences of the states represent other cognitive processes behind the pauses. Secondly, the model takes into account the context around the phenomenon, which diminishes fortuitous results, in accordance with the principals of statistical logic. Thirdly, the model is used here to represent the states of pauses, which reflect the cognitive processes behind these pauses (see e.g. Janssen et al., 1996; Fayol, 1997; Olive, 2002). They describe the switch between a fluent and less fluent writing activity. Finally, these three states of pauses were named: 1) state of fluent writing (state 1, short duration), 2) state of thinking writing (state 2, medium duration), and 3) state of reflective writing (state 3, long duration). The state of fluent writing consists of short pauses and, hence, together with the actual writing, i.e. typing ideas, they create the general fluency of the writing activity. This means that the fluent writing activity contains pauses in the same way that normal speech is interrupted by pauses (see also Olive, 2014).

3. Method

3.1. Data Collection and Participants

The participants were eleven Finnish students of French language and six French ERASMUS students. All the Finnish students were female, with ages varying between 20 and 23 (mean age = 21.6 years). Ten of the students studied French as their major subject, while one had Swedish as her major and French as a minor subject. They were mainly third-year students. The French ERASMUS students included four female and two male students between 20 and 24 years of age (mean age = 21.7 years). Their main subjects varied from political science to SLA studies so the group was very heterogeneous and they were recruited from several departments in the university. All students participated in the test voluntarily, and furthermore, the Finnish students received feedback on their end product from native French teachers.

The data were collected through two sessions: a writing session which was carried out by means of the ScriptLog computer program which allows one to carry out research on the on-line process of writing (Strömqvist & Ahlsén 1999); and a stimulated recall verbal protocol. This means that the writing activity was recorded by the tool so that afterwards we could analyze the writers' pausal behavior, as well as the end product. The recorded activity was used as a stimulus during the audiotaped and transcribed verbalization sessions. The data collection is presented in Figure 28.1.

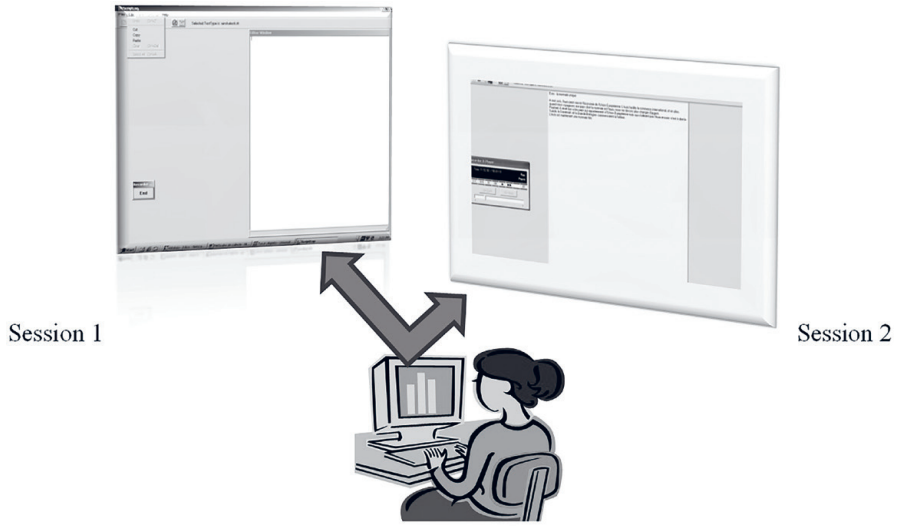

Figure 28.1. Data collection

Each participant wrote one French essay (L2 or L1) and in addition to this, five of the Finnish students wrote one essay in Finnish (L1). Moreover, these Finnish students and all the French students verbalized retrospectively on the task they had just completed. The verbalizations took place in the students' mother tongues. Eleven students wrote in their L2 (French) and eleven in their L1 (French 6, Finnish 5). Although the number of participants reveals that the study was a small-scale experiment, the amount of data collected on pausal behavior by means of the ScriptLog tool was sufficiently large to allow for some conclusions regarding L2 and L1 pausal behavior in this corpus.

3.2. Procedure and Analysis

The participants wrote an expository essay in French on the topic of the single European currency, the Euro, which had just been introduced in several European countries at the time of the test. They were asked to write approximately 150 to 200 words on the topic, and the time was limited to one hour. They were not allowed to use dictionaries or other resources. Five Finnish students also wrote an essay in Finnish on a different topic, namely, their voice as an image of their personality. We were aware that it would be ideal to use the same topic in both tasks (Manchón, Murphy & Roca de Larios, 2005; Roca de Larios, Manchón & Murphy, 2006), but in order to avoid any topic effect we decided to use different topics in the L2 and L1 writing as some other researchers have done (Sasaki, 2000, 2004; Whalen & Ménard, 1995;

Wengelin, 2002). We used a similar task with a different topic, but nevertheless, chose a topic that is real and familiar to the writers (cf. Wengelin, 2002). Nevertheless, according to the verbalizations, both the topics proved to be quite difficult for the writers both in L1 and L2. We must acknowledge that a confounding topic and language may provide an alternative interpretation of the results.

After the writing session, some of the participants spoke retrospectively in their mother tongue about what they had just written (see Figure 28.1 above, session 2). Several other researchers have used concurrent protocols in the belief that they would obtain a more accurate picture of the writing activity (Gunnarsson, 2006; Hayes & Flower, 1980; Manchón et al., 2005, 2009; Roca de Larios et al., 2006, 2008; Sasaki, 2000, 2004; Spelman Miller, 2000; Wengelin, 2002). Ericsson and Simon (1993) especially used this kind of "think-aloud" protocol, but this procedure has been criticized by, among others, Bowles (2010) because of the phenomenon of reactivity, i.e. the act of thinking aloud acts as an additional task and potentially influences the participants' cognitive processes while performing the main task, for instance a writing task (see also Ericsson & Simon, 1993; Olive, 2002; Schooler, Ohlsson & Brooks, 1993). On the other hand, the retrospective protocol produced after the task has been criticized because participants may not accurately remember their states of mind during the task, and thus the veridicality of the thought processes is at stake. Bowles (2010: 14) thus concludes that the retrospective verbal reports may not be accurate reflections of thought processes (see also Gufoni, 1996: 26; Olive, 2002: 140). In order to avoid the concurrent verbal protocol's interference with the main task and the oblivion of earlier heeded information in retrospective verbalization, we used a stimulated recall protocol, where the participants' own writing appeared on the screen immediately after they finished the writing activity; this acted as a stimulus (cf. Gufoni, 1996; Mutta, 2007; Mutta & Johansson in press; Turcotte & Cloutier, 2014; see also Bowles, 2010: 10-11). The verbalization took place directly after the writing session; the participants were left alone in the testing site, and could manipulate the recorder buttons themselves (i.e. stop, pause, fast forward). They were asked to say what they were doing during the writing session and to comment on any relevant items. They could choose which part of the text they wished to comment on; that is, they could select sections that received their conscious attention in the writing process. Verbalizations were intended to reveal some hidden cognitive processes during the writing activity, even if not all processes are verbalizable, for instance, automaticized processes, i.e. implicit knowledge and cognitive operations leading to another operation cannot be detected (Schooler & Fiore, 1997; see also Ericsson & Simon, 1993; Olive, 2002).

The individual pause lengths were defined by means of the Hidden Markov Model, the state of fluent writing, the state of thinking writing, and the state of reflective writing, and each writer's individual pause behavior and typical state of pause were studied. The transition matrix (Markov chain) of the different language groups was estimated, and individual writing profiles were created according to a modified classification of van Waes (1992), i.e. initial planners, fragmentary first-phase writers, second-phase writers, and non-stop writers.[4]

4. Results: Individual Pause Lengths

To study the writers' pausal behavior, individual pause states were defined according to the Hidden Markov Model (see Section 2 and Table 28.2); the three states were state of fluent writing (state 1), state of thinking writing (state 2), and state of reflective writing (state 3). This was done because several of the participants' median pause lengths were over seven seconds in the corpus, and the stipulated pause values (≥ 2 and ≥ 5 seconds) given automatically by ScriptLog seemed to exclude some important information on their pausal behavior. Furthermore, we decided to use median values of these states because, for instance, the participant Fi8 had a mean pause length of 15.85 seconds, and a median pause length of 7.11 seconds. It is supposed that the median value gives a more accurate picture of phenomena under study. Before presenting the individual pause states, in order to illustrate differences in L2 and L1 writing processes, average values of the states of pauses at group level are shown in Table 28.1.

Table 28.1. Average values of states of pauses according to the Hidden Markov Model

Writing language	**State 1**		**State 2**		**State 3**	
	M	S. D.	M	S. D.	M	S. D.
L1	3.08	0.21	7.47	0.54	25.30	6.55
L2	3.09	0.42	7.48	1.76	23.69	9.56
L1 Fr	2.94		6.98		18.58	
L1 Fi	3.27		8.08		29.82	

Notes: State 1 = state of fluent writing (short pauses), state 2 = state of thinking writing (medium pauses), and state 3 = state of reflective writing (long pauses). Time is indicated in seconds. Fr = writing in French, Fi = writing in Finnish.

The estimation of the transition matrix (Markov chain) of the state values of the different language groups was calculated. The calculations showed that the observed significance level was statistically significant between L2 and

L1 writers in French [$c2(6) = 28.711$, $p < 0.000069$], indicating that the writers' pausal behavior diverged in L2 and L1 French: the L1 writers in French were more likely to remain in a fluent state of writing, whereas L2 writers in French passed more easily from the fluent state to the reflective state of writing. Moreover, the pauses of this state were on average longer in L2 than in L1 [the 0.95-level confidence interval (1.12, 13.81)]. The calculations also showed that the observed significance level was statistically highly significant between L1 writers (Finnish and French) [$c2(6) = 27.722$, $p < 0.000106$], which means that the writers' pausal behavior diverged in L1 Finnish and in L1 French. The L1 French writers were more likely to stay in the fluent writing state, whereas the Finnish L1 writers passed more easily to the state of thinking writing. The pauses in the reflective writing were on average longer in L1 Finnish than in L1 French [the 0.95-level confidence interval (2.60, 20.36)]. However, the small number of participants could have affected this result. The individual states of pauses are shown in Table 28.2.

Table 28.2. Individual states of pauses according the Hidden Markov Model

L2				**L1**			
Participant	**State 1**	**State 2**	**State 3**	**Participant**	**State 1**	**State 2**	**State 36**
1. Fi1	3.10	7.68	23.56	1. Fr1	3.07	8.25	16.38
2. Fi2	3.09	7.22	42.61	2. Fr2	2.95	7.02	21.75
3. Fi3	2.83	8.19	24.26	3. Fr3	2.85	6.83	15.33
4. Fi4	2.65	6.77	25.29	4. Fr4	2.83	6.60	16.89
5. Fi5	3.07	7.02	19.14	5. Fr5	2.89	6.41	28.05
6. Fi6	3.47	8.32	21.10	6. Fr6	3.03	6.80	13.07
7. Fi7	3.22	7.09	18.83	7. Fi7	2.79	6.92	24.36
8. Fi8	3.08	8.10	29.85	8. Fi8	4.24	12.59	46.83
9. Fi9	3.05	7.62	22.87	9. Fi9	2.91	6.95	28.03
10. Fi10	3.12	7.07	26.31	10. Fi10	2.98	7.09	29.95
11. Fi11	3.23	7.04	24.52	11. Fi11	3.42	6.83	19.91

Notes: State 1 = state of fluent writing (short pauses), state 2 = state of thinking writing (medium pauses), and state 3 = state of reflective writing (long pauses). Pause durations are indicated in seconds. Fr = French, Fi = Finnish.

As shown in Table 28.2, the fluent state pauses ranged from 2.65 to 4.24 seconds, the thinking state pauses from 6.41 to 12.59 seconds, and finally, the reflective state pauses from 13.07 to 46.83 seconds. At the individual level, for instance, Fi8 seemed to think for quite a long time during the writing activity, especially in L1, when compared with the others. According to our definition,

the state of fluent writing consists of short pauses and hence, together with the actual writing, i.e. typing ideas, they create the general fluency of the writing activity. On the basis of these results, it was evident that fluency varied at an individual level.

In order to find out how these individual pause lengths influenced the writer's pausal behavior, the typical pause states of each writer were studied. These new values of states of pauses were run with the ScriptLog tool; all the values were rounded downwards to whole numbers, e.g. 7.68 and 23.56 seconds to 7 and 23 seconds respectively. The percentages of the individual states are presented in Table 28.3.

Table 28.3. Percentages of individual states

L2				**L1**			
Participant	**State 1**	**State 2**	**State 3**	**Participant**	**State 1**	**State 2**	**State 3**
1. Fi1	45	38	17	1. Fr1	68	25	7
2. Fi2	43	42	15	2. Fr2	71	21	8
3. Fi3	57	29	14	3. Fr3	73	22	5
4. Fi4	52	33	15	4. Fr4	73	20	7
5. Fi5	56	29	15	5. Fr5	60	26	14
6. Fi6	42	34	24	6. Fr6	32	36	32
7. Fi7	60	32	8	7. Fi7	73	25	2
8. Fi8	60	34	6	8. Fi8	50	35	15
9. Fi9	42	39	19	9. Fi9	55	37	8
10. Fi10	41	40	19	10. Fi10	61	28	11
11. Fi11	48	39	13	11. Fi11	45	40	15

Notes: Values correspond to the percentages of each state frequency. Fr = French, Fi = Finnish.

As shown in Table 28.3, some writers remained almost continuously in a fluent state of writing, whereas others spent almost as much time in the fluent state as in the thinking state. For instance, Table 28.2 illustrated that Fi8 seemed to think for quite a long time during the writing activity, especially in L1, when compared with the others. Nevertheless, on the basis of percentages of pauses in these states, 60% of her pausing time in L2 was in the fluent writing state, 34% in the thinking, and 6% in the reflective state. On the other hand, in L1, the percentages were 50%, 35%, and 15%, respectively. The comparison of her state values with, for example, those of Fi7 in Table 28.3 reveals that her states of pauses were lower in general, but even so, the percentages of states were similar in L2 (60%, 32%, and 8% respectively), while they differed in L1 (73%, 25%, and 2% respectively). The calculations indicate that even though Fi8 had high state values, the pause frequencies manifest a different kind of profile.

This means that her fluent, thinking and reflective states might be longer than those of the others, but they correspond to her own individual pausal behavior, which is a part of her overall writing profile and style. In van Waes' terms (1992), on the basis of all the fluency values studied, Fi8 is a fragmentary first-phase writer in L2 and a second-phase writer in L1, whereas Fi7 is a non-stop writer in both languages (see footnote 4).

The pauses made during the writing activity varied considerably in length, but the writers did not experience them in the same way according to their verbalizations. Some writers were quite stressed as the time passed (e.g. Fi10: I am in a hurry as time is ending / and as always / I panic / which ends up so that my brain stops functioning and / my head is like a tabula rasa); others knew their own writing style and could organize their writing in a suitable way (e.g. Fr5: I often have to / write / something that hasn't got anything to do with / which doesn't mean much anyway / just to / I don't know really / I can't really explain that / it's just not to pay attention / not to pay attention it's / like to put my ideas in order), while yet others used strategies that they had found to be functional before (e.g. Fr3: and as I don't manage to write the word barrières in the right way I change the word / it's a technique that I adapt a lot / when I don't know / I'm not sure about a word's orthography). Some writers perceived themselves as slow writers afterwards during the verbalization when they saw their text appearing on the screen in real time, even if this was not manifest in their pausal behavior compared with other writers; e.g. Fi9: Here is a lot of reflection again / I'm quite a slow writer even in Finnish / too careful perhaps; Fr3: it's a question of having two or three ideas for all that / not necessarily in order . . . well I've reflected for a long time). As an example, these cases of Fi9 and Fr3 are presented in Table 28.4.

Table 28.4. Example of pausal behavior

Value	**L2**	**L1**	
	Fi9	**Fi9**	**Fr3**
Number of words[8]	275	218	519
Total writing time	47.18	32.43	54.18
Number of pauses	130	105	277
Number of state 1	54 / 42%	58 / 55%	202 / 73%
Number of state 2	51 / 39%	39 / 37%	60 / 22%
Number of state 3	25 / 19%	8 / 8%	15 / 5%
Longest pause	1.45	3.21	0.38

Notes: Number of words in final product. Number of individual pauses. State 1 = state of fluent writing, state 2 = state of thinking writing, state 3 = state of reflective writing. Number of pauses per states and their percentages. The longest pause is indicated in minutes and seconds.

It can be seen from Table 28.4 that Fi9 is clearly a slower writer than Fr3 according to the values presented: she produces fewer words relative to the time allocated to the writing activity, she pauses less frequently than Fr3 but her pauses are longer, and she remains more in her thinking and reflective state than Fr3 does, especially when writing in L2, although her longest pause is during her L1 writing process. Fi9 was considered an initial planner in both languages (van Waes, 1992); her longest pause in L2 (1 minute 45 seconds) was situated at the junction of two sentences. In other words, it formed part of the formulation phase of the writing activity, which demonstrates the formulation difficulties in L2 (cf. Roca de Larios et al., 2006). Her longest pause (3 minutes 21 seconds) in L1 was situated between two clauses in the penultimate sentence. She reflected on how to end her text in a satisfactory way (i.e. planning the global structure of the text). For his part, Fr3 paused a lot, but he was almost always in his fluent state (73%), which is also manifest in the length of his pauses: his longest pause was 38 seconds in the middle of the text at the junction of two sentences, where he reflected on the global structure of his text (i.e. planning). He was classified as a fragmentary first-phase writer despite the long initial phase (van Waes, 1992). According to their verbalizations, Fi9 seemed to accept her slowness in writing: "I'm quite a slow writer even in Finnish," whereas Fr3 seemed to find the slowness noteworthy and commented several times during verbalization that "it took a long time to write."

5. Discussion and Conclusion

The aims of our empirical study were to increase knowledge of pausal behavior in online processes of writing, and to highlight the complexity of this phenomenon by means of defining individual pause lengths for each writer. The stipulated pause criterion is more commonly used in earlier studies because it allows for a comparison between the results of these studies; however, we supposed that by doing so, some valuable information on individual pausal behavior would be excluded from the analysis, and the results would overgeneralize the picture of the writing process. This study thus fills a gap in existing research by defining individual pause lengths for writers. The research method provides new information on the variability of individual pausal behavior. Some of the participants wrote a piece of text in both L2 and L1, which allowed for a comparison between these pausal behaviors and illustrated their relationship. As the article strived to reveal this complexity, it contributes especially to the field of L2 writing fluency. In this study, the research design and the empirical finding are closely related, which impacts the results;

however, it shows the relevance of using individual pause lengths, at least in experimental studies.

By means of the Hidden Markov Model, individual pause lengths were also calculated for each writer (MacDonald & Zucchini, 1997; Uusipaikka, 2006). Compared with the stipulated pause lengths generally used in studies on temporal aspects of language production processes (Ransdell et al., 2001; Sasaki, 2000, 2004; Severinson Eklundh & Kollberg, 1996; Spelman Miller, 2000; Wengelin, 2002), the thinking and reflective state pauses were essentially longer than the fixed values of two, three, or five seconds. The median lengths of the fluent state pauses ranged from 2.65 to 4.24 seconds, the thinking state pauses from 6.41 to 12.59 seconds, and finally, the reflective state pauses from 13.07 to 46.83 seconds. This means that the stipulated pause lengths of two, three, or five seconds related to the used software program (e.g. ScriptLog, Keytrap, or FauxWord) cannot reveal an exact picture of a writer's pausal behavior and profile, even if they contribute in another way to the field by allowing comparisons between studies. Furthermore, the obtained values did not follow language boundaries (i.e. L2 vs. L1), but instead varied individually, thus supporting the idea of defining individual pause lengths for each writer. It would be interesting to examine this finding in a replicated study with a similar study design. In order to study pausal behavior and its relationship to fluency in writing processes, it might also be promising to define pauses using a criterion even shorter than two seconds and thus arrive at individual states of pauses, taking into account the fact that some writers practice profound reflection even during the so-called fluent state of writing. The experimental design could also compare think-aloud and retrospective protocols in order to shed light on hidden writing processes.

Cognitive fluency, that is the ease of allocating resources among different processes simultaneously, could help the writer to translate ideas into words during the writing activity, and thus improve verbal fluency as defined in this chapter. This capacity relies on the limits of working memory capacity (Kellogg, 1996; Olive, 2014; Olive & Piolat, 2005; McCutchen, 2011). Some writers paused many times, but their pauses were quite short, others had longer but fewer pauses, whereas other writers may have had longer pauses than others, but from the point of view of their total pausal behavior, they were not necessarily very long. Their pausal behavior is a part of their overall writing profile and their individual writer's profile (van Waes, 1992). In other words, some writers had longer pauses than others, but inside their pausal behavior those pauses might be of short or medium length. These differences were not always shown in their verbalizations: when they saw their text appearing on the screen in real time, writers with shorter pauses commented equally on the

length of their pauses as those pausing a longer time did. Writers seemed to compare their writing fluency during the writing activity to the experience of their verbal fluency afterwards. The experience of relative slowness in their writing processes seemed noteworthy to some writers during the verbalization session, especially the French writers. However, on the basis of this study, we cannot say anything conclusive about cultural differences; it should be further investigated in future studies. Despite the large amount of data collected, the number of participants in this study was quite small. The results should therefore be replicated with other populations with different L2 and L1, and/or with a larger number of participants. The writing profiles could also be defined according to a different categorization (see e.g. Tillema, van den Bergh, Rijlaarsdam, & Sanders, 2011).

In this study, the pausal behavior was related to the first language (i.e. the mother tongue) in question: the estimation of the transition matrix (Markov chain) of the different language groups showed that on average the Finns had longer pauses both in French (L2) and Finnish (L1) than the French had in L1. The experimental design might, however, have had an impact on the results. First, the small number of writers may have affected the results, and second, the topic of the essays may have influenced the time allocated to the writing activity, especially the difference in topics in L1 French and L1 Finnish (see e.g. Schoonen, Snellings, Stevenson & van Gelderen, 2009, p. 78). Third, the test situation might have influenced the results, for instance, the lack of supporting material during the test.

We must end by acknowledging that we have not been able to take into account L1 writing ability. Sasaki (2000, 2004) came to the conclusion, on the basis of several multiple-regression analyses, that three factors, L2 proficiency, L1 writing ability, and metaknowledge of the task expectations, were significant in explaining the differences among foreign language writers. She found that more proficient writers planned more on a global level in comparison to less proficient writers who used a more local online planning strategy (see also Roca de Larios et al., 2008). Sasaki emphasized the L1 writing ability, which seems to be an important background indicator, because this might explain differences among foreign language writers in their translating phase, i.e. when putting ideas into words (Roca de Larios et al., 2006). On the other hand, Schoonen et al. (2009: 94) found that proficiency in L2 writing "is more strongly associated with the linguistic resources than proficiency in L1." They admit, nevertheless, that there is a link between proficient writing in L1 and L2, and that is probably the general metacognitive knowledge about the writing processes. Furthermore, another important aspect is to study L1 competence in general in more detail and, moreover, the socio-cultural educational

background of writers (Kobayashi & Rinnert, 2008; Roca de Larios et al., 2006; Smagorinsky, 2001; Kobayashi & Rinnert, 2013) in order to understand the complex phenomenon of fluency and pausal behavior in the writing processes of foreign and native language writers.

Notes

1. The basic cognitive model of writing by Hayes and Flower (1980) contained these three main processes. Although their model was later criticized (see for instance Hayes, 1996), the subsequent models continue to contain three main categories with alternative labels (cf. Mutta, 2007: 41; Piolat, 2011).
2. In his study on effects of handwriting skills, Olive (2014, p. 175) presents the distinction between peripheral vs. central processes; the former refers to processes like transcription of the text by typing and the latter to processes involved for instance in problem solving reasoning.
3. Esa Uusipaikka, Emeritus Professor of Statistics in the Department of Statistics at the University of Turku, ran the calculations concerning the HMM model. We would like to thank him for making the experiment possible.
4. According to van Waes (1992), *initial planners* make a rather small number of revisions, most of them occurring in the second phase. They have the relatively longest initial planning phase, and their average pause length is relative, since the longest and total pause times are significantly higher than the average. *Fragmentary first-phase writers* have a revision attitude that heavily concentrates on the first phase. The total number of revisions is higher than that of other groups, but the second phase contains few revisions, the time for initial planning is restricted, and pauses are manifold and relatively short, thus making the process strongly fragmented. For their part, s*econd-phase writers*' revision is concentrated in the second writing phase, and this allows for ample attention to changes above word level. They have a long initial planning phase but once they start writing, they pause relatively little, even if the pauses are relatively long. *Non-stop writers*, on the other hand, revise least of all the groups, pause less than others, so the total pause time clearly lies below the average, their processing time is shorter, and they spend little time on initial planning. Van Waes also had a category of *average writers*, i.e. those closest to the average values of each of the variables of the total group; we excluded this category from the analysis.

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