

IWONA KOWAL

Jagiellonian University in Krakow

iwona.kowal@uj.edu.pl

FLUENCY IN SECOND LANGUAGE WRITING: A DEVELOPMENTAL PERSPECTIVE

Keywords: writing fluency, second language development, Dynamic Systems Theory

Abstract

The paper presents a longitudinal study of writing fluency in second language students. The aim was to follow the development of the students' fluency during a three-year period in which they studied Swedish as a second language. Fifteen Polish university students participated in the study. The analysis shows that fluency develops non-linearly with some peaks in the average developmental curve. Furthermore, we observed both between- and within-individual variability in fluency in text production. The development of fluency is unpredictable and no one subject mirrors in their development the average curve. Individual differences were observed at every step of second language development. The analysis shows that writers who are slow at typing are not automatically less fluent and that subjects who develop more slowly can achieve a high level of fluency in writing. In general, writers who were slower and less fluent at the beginning made the greatest progress in fluency during the three-year period, compared with those who were more skilled with regard to both language and typing, who achieved a certain level of fluency faster than their fellow students.

1. Introduction

Fluency is a commonly applied indicator of foreign language proficiency. Although many scholars have employed this notion in their studies no single definition of fluency exists. Segalowitz (2010: 5) explains it with the assumption that researchers “have had to find practical ways to define fluency so that it can be precisely measured.” Furthermore, the use of the common expression “he/she speaks a language X fluently” cannot, it seems, be applied to all contexts in which fluency is considered.

In earlier studies fluency was defined as a complex phenomenon that encompasses the rapidity of text production, the coherence and complexity of an utterance and the appropriateness and creativity in speech (Fillmore 1979). Crystal (1987: 421) defines the term as a “smooth, rapid, effortless use of language.” Lennon (1990: 391) treats fluency as a phenomenon of performance and a subjective impression: “fluency is an impression on a listener’s part that the psycholinguistic processes of speech planning and speech production are functioning easily and efficiently.” In turn, Schmidt (1992: 358) describes fluency as “the processing of language in real time” and also as an “automatic procedural skill that is relatively free from conscious attention.” The same components have been taken into account even when referring to fluency in writing. Wolfe-Quintero et al. (1998) write about fluency in terms of rapidity and ease within text execution. Skehan (2003: 7), however, calls for a more complex view of all these factors. He argues: “It is now increasingly accepted that finer grained analyses of fluency require separate measures for (a) silence (breakdown fluency), (b) reformulation, replacement, false starts, and repetition (repair fluency), (c) speech rate (e.g. words per syllables per minute), and (d) automatization, through measures of the length of run.” Skehan sees undisrupted chunks of text flow as an indicator of automatization. Other researchers, however, take a broader view of automaticity. Schneider, Shiffrin (1977) describe automatic processing as the activation of a sequence of elements that proceeds without control or attention. In many studies automaticity is often associated with fast, ballistic, load independent, effortless and unconscious processing (Segalowitz 2003, 2010) and this may explain why automaticity is often connected with fluency. From this point of view, automaticity can be seen as an output condition for fluency. If the processes in a learner’s working memory have been automatized, they can speak fluently. Automaticity, however, is not the only prerequisite for fluency. Fluency in a second language can even be seen as a result of the transition from declarative to procedural knowledge. Fluent speakers use procedural knowledge, which activates their memory in a shorter time and therefore they are able to produce longer chunks of texts (Towell et al. 1996). The cognitive processes underlying fluency are thus complex. With regard to this, Segalowitz (2010) distinguishes three senses of fluency which he calls cognitive fluency, utterance fluency and perceived fluency. Cognitive fluency requires the mobilisation, coordination and then integration of several cognitive processes activated for text production, such as e.g. conceptual preparation, grammatical and morpho-phonological encoding and articulation. Utterance fluency refers to the general features that characterise an utterance, such as the length of the speech, the repairs the speaker makes and the pauses they make and it thus focuses on utterance as a product. In turn, perceived fluency can be understood to mean the impression of the listener in relation to the text that the interlocutor has produced. Based on the utterance, the speaker can also infer how cognitive and utterance fluency are interconnected with each other.

Due to the different definitions of fluency several differing methods of measurement have been adopted. The most common, used to analyse spoken texts, are those adopted by Möhle (1984) in her study of German students of French and French students of German:

1. *speech rate* – number of syllables per second
2. *articulation rate* – number of syllables per second of time of articulation
3. *pause length*
4. *length of run* – mean number of syllables between pauses.

This approach has been used by many researchers (Towell 1987; Towell et al. 1996; Lennon 1990; de Jong, Perfetti 2011). However, Housen et al. (2012) call for a three-dimensional view of fluency, i.e. speed fluency (rate and density of linguistic units in production), breakdown fluency (number, length and location of pauses) and repair fluency (false starts, misformulations, self-corrections and repetitions). These factors have been explored in a number of studies that have examined a variety of fluency-related variables, such as hesitation, repair, and the rate and amount of speech or interactivity (Riggenbach 1991; Freed 1995; Ellis, Yuan 2004; Kormos, Dénes 2004).

A description and evaluation of different fluency measures in second language writing can be found in Wolfe-Quintero et al. (1998), who compared 39 studies in order to find the most valid analytical methods which can then be linked to language proficiency. However, their study only compared the rate and length of production units. The assumption behind such a focus was that there is a positive correlation between fluency and writing time: the more words and features the writer produces in a given unit of time, the greater the fluency. Thus, frequency measurements, for example, the total number of words, the total number of verbs or the total number of sentences, were compared with ratio-measurements, i.e. the number of words per minute, the number of words per clause or the number of words per T-unit analysed. It turned out that the best measures of fluency are the number of words per T-unit, the number of words per error-free T-unit and the number of words per clause, because “these three measures consistently increased in a linear relationship with proficiency levels across studies, regardless of task, target language, significance of the results, or how proficiency has been defined” (Wolfe-Quintero et al. 1998: 29). The report compiled by Wolfe-Quintero et al. did not include any studies that take into account disturbances in fluency. As a consequence, such approaches to measuring fluency cannot be compared with those definitions of fluency where not only rapidity but also automaticity and smoothness, i.e. an infrequent occurrence of pauses and false-starts, are considered inseparable factors of fluency. Although the report covered a broad range of studies, these varied both in terms of the number of subjects investigated and in the levels of proficiency. Furthermore, the studies were cross-sectional in the sense that they did not reflect the development of proficiency in individual learners.

In a study focusing on written composition Kaufer et al. (1986) adopted a new analytical method that included both pauses and revisions within text production. The tool, called “sentence part”, was defined as a chunk of text between a pause of two or more seconds or a discontinuity regarding a revision. A comparison between expert L1-writers and novices showed that the more experienced writers wrote on average about 11 words between two disturbing elements while novices wrote on average 7 words. Instead of a “sentence part” as a unit of measurement, other researchers

have used the terms “burst” or “mean length of burst” in other studies on fluency in L1- and L2-writing (Chenoweth, Hayes 2001; Spelman Miller et al. 2008; Gunars-son 2012; Palviainen et al. 2012). Different units have been used depending on the analytical tool employed. In think-aloud protocols the word is the reference entity while in the case of computer-assisted tools the token is the main unit.

It is far easier for the listener to, in Lennon’s (1990) words, “have an impression” that a speaker is fluent than it is for a reader to determine whether a writer’s fluency is at a high level. As van Gelderen and Oostdam (2005) point out, written texts can be treated as an indirect indication of writing fluency because linguistic fluency facilitates the writer not only in writing down his ideas but also in reviewing them before they are transcribed. In most cases, we read the final text without knowing how fast the text was written, how often it was revised and how demanding it was for the writer to produce the text. In experimental settings there are many tools that enable the researcher to follow the entire writing process: the time spent producing the text as well as all the pauses and revisions. But even when such data is obtained a one-to-one comparison between fluency in writing and fluency in speaking is still not possible due to the divergent conditions in which the texts emerge. A spoken text arises in and disappears from a speaker’s mind much faster than a written one. The writer can still see what he or she has produced even if his thoughts are on another topic. Therefore, divergence is likely between a second language learner’s fluency in writing and speaking, and indeed a fluent second language speaker may be less fluent in producing a written text. Fluency in a second language is interconnected not only with the students’ general proficiency but also with their metalinguistic knowledge, which in turn can have an effect on fluency. The more a student knows about how the acquired language is constructed, the more attention they will pay to achieving an error-free text, which in turn can lead to an increase in self-revision. Even if this is evidence of an increased proficiency and metalinguistic knowledge, they lead to disruptions in the text flow and a decrease in the writing tempo and thus have a negative influence on the general smoothness of text production. Torrance and Nottbusch (2012) claim there are three main differences between managing language processing in speech and writing which explain why these two modes cannot be assumed to be driven by the same processes. The first is the relationship between output fluency and communicative effect, in which they concentrate on the listener’s reception of the utterance and point out that spoken language requires more focus on fluency than written language because the listener receives the message immediately, whereas the receiver of the written text is not faced with the process of creating the message. The second type of divergence between the processing of spoken and written utterances is the orthographic processing that exists only in the written mode and requires additional attention from the writer. Torrance and Nottbusch (2012) have even highlighted divergence in the mental representations of spoken and written language. The third difference in language processing is in feedback affordance, which can be slower in written language because the writer can still see their text and so the process of monitoring and revising may be longer than in the case of spoken language.

There are many studies concerning fluency in second language spoken texts but research on fluency in second language writing has only increased in the last few years. In studies on second language fluency researchers have pointed out the need to investigate the written mode of language, not only because high levels of fluency help second language learners to write texts quickly but also due to the fact that “a better understanding of the processes underlying fluent writing can have important implications for the field of composition” (Chenoweth, Hayes 2001: 80). Furthermore, there is a need to investigate writing fluency in university students who have to write their bachelor’s or master’s theses in a second language which, despite the fact that there will be a focus on several other skills such as academic writing, may require a great deal of effort from those who are less fluent in writing.

The present paper focuses on the development of fluency in second language writing at both the intra- and interindividual levels. This development and several aspects of it will be studied from the perspective of the Dynamic Systems Theory (DST), which treats second language development as a dynamic and complex process. The process proceeds non-linearly and is sensitive to the so-called beginning conditions, which means that even a small change at the beginning can lead to considerable differences at the end of the acquisition process. All components of the dynamic systems play a part in the development and interact with each other. Dynamic systems are also characterised by variability and they change all the time, which makes it impossible to predict the final state of the systems. The theory itself comes from the formal and logical sciences but in recent years it has been adopted for second language acquisition and multilingualism (Larsen-Freeman 1997; Herdina, Jessner 2002; Larsen-Freeman, Cameron 2008; Verspoor et al. 2008; Caspi 2010; de Bot, Larsen-Freeman 2011). Previous studies focusing on the development of several features of second language acquisition from the point of view of DST examined small groups of subjects. There are two reasons for this situation. Firstly, the focus on second language development from a DST perspective is mainly at the individual level. DST-researchers have investigated particular dimensions of second language performance, such as fluency, accuracy or complexity, and followed their interaction during the process of second language development. Secondly, in the case of longitudinal data, other than in cross-sectional research, it is often very difficult to follow a large group of subjects over a long period of time which means that there is a limited amount of material that the researcher can investigate. Because the present study was not only longitudinal in character (three years) but also covered a larger number of subjects (fifteen), it is possible to take a broader view of fluency development, i.e. both the average development of second language learners and the development of individuals are investigated.

2. Research questions

The objective of the present study is to investigate how writing fluency develops during L2-acquisition. This rather general question covers several sub-questions, which

focus both on individual and inter-individual development. In terms of individual developmental paths the study will try to find out if we can describe common patterns in fluency development. If they exist: can we speak about continuous improvement or are individual trajectories characterised by irregularities and up and downs? Considering the complexity of the phenomenon, the next question is whether the development of several features that characterise fluency (such as automaticity and smoothness) evolve concurrently or do these aspects develop independently from each other? When analysing fluency at the inter-individual level we will try to explore if there is variability between individuals, even if they are a homogenous group in terms of age, language background, social status and second language input. And if variability at the beginning of second language learning exists, does it lead to changes over a longer period?

3. Participants

The experiment conducted in the present study was longitudinal in character. Fifteen learners took part and all were Polish university students attending the Jagiellonian University in Krakow. They represented a homogeneous peer group in terms of their first (Polish), second (German) and third (Swedish) language backgrounds,¹ their age (19–21 at the beginning of the experiment), the foreign language input (only in a classroom environment) and their language skills in Swedish when they began their university education (no prior knowledge of the language). The gender of the participants was, however, not spread equally: there were three male and twelve female participants in the study, which at the same time reflects the general tendency within language studies at university level.

In fact thirty-two students participated in the first experimental sessions, but because of their mobility – many of them obtained scholarships to study in other European countries, while others interrupted their studies, and thus were unable to continue the project – only fifteen were able to take part in the whole study.

4. Design and procedures

The experimental sessions took place at the end of every semester. The first session was after the first semester, i.e. after 120–150 hours of Swedish classes, and the following five took place at equal intervals, that is at the end of each semester. The final data were collected after the sixth semester, when the subjects had completed

¹ Although Swedish is the third (or subsequent) language, the term “second language” will be used in the present study because no aspects of Third Language Acquisition will be discussed. Furthermore, I use “second language” even if the present study in fact focuses on foreign, not second, language learning with regard to the learning environment. In the study I do not focus on particular aspects of fluency development in the language classroom but treat it as a general, both linguistic and cognitive, ability to create a text in a new, rather than first, language.

810–840 hours of Swedish classes. The experimental sessions took place before or after ordinary classes and were facultative. The participants were given no time limit and were alone when they wrote, i.e. after providing instructions the experimenter left the student in the room where the experiment was being conducted in order not to disturb them or induce a sense of time pressure. The task was to write a narrative text that referred to personal experiences that were not necessarily true, so the subjects could even make up a fictional story. The topics were:

Experiment 1: “I will never forget it”

Experiment 2: “What a dream I had!”

Experiment 3: “I had never been so afraid”

Experiment 4: “An adventure on my holidays”

Experiment 5: “My greatest lie/my greatest crime”

Experiment 6: “I will never forget it”

The topics in the first and the final experiment were the same; however, no student re-told the same story. The texts were written on a laptop computer. The students often used computers and indeed both in secondary school and in their courses during the first semester, i.e. before the experimental sessions began, they had often written their homework on a computer. They also used computers every day for internet surfing or chatting. However, they were accustomed to a Polish keyboard and in the experiments a laptop with a Swedish keyboard was used. This may be an important factor that affected the development of their writing fluency, because the students used a Swedish keyboard only in the experimental sessions, i.e. twice a year. Even if it is also a QWERTY-keyboard, there are many differences in the placement of e.g. diacritics or punctuation marks, which in turn might influence learner fluency in text production.

5. Instruments

The writing sessions were recorded using ScriptLog (Strömqvist, Malmsten 1998). This is a tool that enables the user to follow every writing activity: not only the pressing of keys but also the movements of the mouse, pauses and deletions. The writer only sees the final text. The operations are, however, saved in a logbook from which they can be uploaded and analysed. Furthermore, the application offers numerous tools that facilitate data editing. ScriptLog has been widely used in writing research, both in studies of L1-writing (Strömqvist 1996; Wengelin 2002, 2007; Uppstad, Solheim 2007; Johansson 2009) and L2-writing (Kowal 2011; Gunarsson 2012; Palviainen et al. 2012). Because of the analysing tool the writing unit used in the present study is a token – not a word, a T-unit or a sentence. Such an approach was able to take into account a broad range of activities such as, for example, the replacement of a comma with a full stop or the deletion of a single token: a letter or a punctuation mark, which are important operations in the context of writing fluency. Furthermore, this unit often occurs in computer-assisted studies (Strömqvist, Ahlsén 1999;

Stevenson et al. 2006; Alves et al. 2007; Wengelin 2007; Spelman et al. 2008; Johanson 2009; Gunarsson 2012; Palvianen et al. 2012), which makes it possible to compare several written language studies.

In the present analysis two measurements were employed to explore L2-learners' fluency. The first is the mean transition time (TT), which reflects typing skills in general. ScripLog calculates how fast the writer is between keystrokes within a word, i.e. how many seconds (fractions of a second) pass before the next key is pressed. Slow writers will thus have a longer transition time than faster typists. This distinction was made by Strömquist (1999) who proposed it as being the most reliable indicator of typing proficiency. He argues that within-word strokes are familiar and fast and, therefore, less time is needed for planning or monitoring. A further assumption is that the execution is source demanding for less skilled writers, while it is virtually automatic for fast writers (Strömquist 1999). In the context of second language writing it can be used as the aspect of fluency that is interconnected with automaticity in writing, with the focus on within-word automaticity. The assumption is that a writer with high automaticity in a second language can retrieve second language items faster than a writer whose cognitive processes have not been automatised and thus they will spend more time retrieving information from their working memory, which in turn will lead to a slower production of text chunks.

The second measurement used in the present study is the mean length of burst (mlb). This value reflects the number of tokens between pauses or such editing activities as deletions or revisions and it can be seen as an indicator of smoothness in text production. Only online activities have been taken into account, i.e. pauses when reading the text after it has been produced or self-repairs that were the result of this re-reading were excluded from the analysis. For pauses the time criterion was 2 seconds, which is in line with previous studies on L2-writing (Levy, Ransdell 1995; Severinson Eklundh, Kollberg 1996; Strömquist, Ahlsén 1999; Wengelin 1999, 2002, 2007). Furthermore, corrections of typing errors were excluded from the analysis, according to Grabowski's (2008) assumption that fast typing can result in mistyping which, in turn, can lead to an increased deletion of such errors. Such an exclusion was even made in Gunnarsson's (2012) study on the development of complexity, accuracy and fluency of L2-learners of French in which the same tool (ScriptLog) was used.

In order to estimate the level of change between two collection points the growth rate is used. The formula for the index is:

$$PR = \frac{FV_{\text{exp}+1} - FV_{\text{exp}}}{FV_{\text{exp}}} \times 100$$

where

PR = Percent Rate (Growth Rate)

FV_{exp} = Fluency Value (in this case: mlb) in a given experiment

FV_{exp+1} = Fluency Value (mlb) in the following experiment.

The calculated value expressed as a percentage will reflect how much the fluency has changed and thus it serves as a relative rather than an absolute indicator of development. A positive result using the formula will provide information about improvement, while a negative value reflects how much the fluency has decreased. The rate can be used as a general indicator for measuring the progress in second language development.

In developmental studies conducted from the perspective of the Dynamic Systems Theory the correlation between several subsystems is an independent part of the analysis. In the present study the interconnectedness between automaticity in writing and smoothness in text production was measured using the Pearson correlation coefficient (r). The correlation can be expressed in values from -1 to 1, where 1 stands for full positive conformity between the changes in two variables. Thus, when the value of the first variable increases, the value of the second variable increases at the same rate. A value of -1 implies that the first value increases, while the second decreases. When $r = 0$ there is no correlation between the variables. In the present analysis the same cut-off points for Pearson's r were adopted as in Wolfe-Quintero et al.'s (1998) report: $r \geq 0.65$ means a high correlation, $r \in [0.45, 0.64]$ reflects a moderate correlation and $r \in [0.25, 0.44]$ is a weak positive correlation between the variables. When Pearson's r is lower than 0.25 the correlation is assumed to be low, which in fact can lead to the conclusion that both variables do not correlate with each other.

6. Results

A total of 90 narrative texts were collected during the six experimental sessions. As is shown in the figure below (Fig. 1a) the mean keystroke interval decreases over the three-year period from 0.27 s in the first experiment to 0.20 s after three years of learning. As might be expected, the learners became more automatic in writing as the acquisition process proceeded. The average development is non-linear but there is a general falling trend. The increase in writing automaticity (i.e. the decrease in the transition time between keystrokes within a word) can be described as a two-step development: the first considerable improvement (PR = -11%) was observed in the second semester (between the first and the second experiments) and the second occurs one year later. However, the later increase in writing rapidity continued over an entire year and is characterised by a somewhat higher rate of change (PR = -13%). At the end of the three-year period automaticity in the second language achieves its attractor point and remains stable.

As presented in Table 1, the variability between students is greatest at the beginning of the experiments and decreases steadily over the three years of the study. No one student reflects the average curve in their development (Fig. 1b). In the first experiment four learners were classified as slower ($M_{TT} > 0.30$ s) and three as faster writers ($M_{TT} \leq 0.20$ s) according to the mean transition time (0.27 s). Following the development of these students, it was observed that the slow writers varied the most during the three-year period ($cv = 13-20\%$) when compared with the other writers

($M_{cv} = 11\%$). Furthermore, their development is not only the most non-linear but they also made the most progress in automaticity between the first and the final experiment. On the other hand, the fastest writers showed only a slight acceleration in their typing skills during the three-year period.

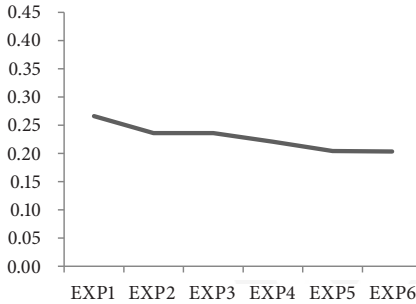


Figure 1a. Mean transition time for the entire group (in seconds)

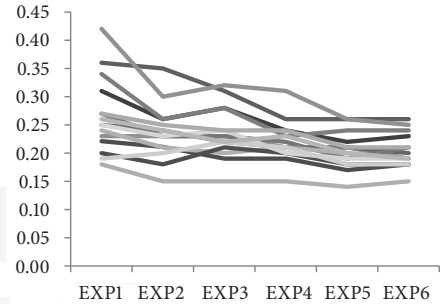


Figure 1b. Transition time in individuals

	n	TT (s)		mlb (tokens)	
		<i>M</i> (<i>SD</i>)	<i>cv</i>	<i>M</i> (<i>SD</i>)	<i>cv</i>
EXP1	15	0.27 (0.06)	24	8 (1.56)	20
EXP2	15	0.24 (0.05)	19	10 (2.21)	23
EXP3	15	0.24 (0.04)	19	11 (2.23)	20
EXP4	15	0.22 (0.03)	16	13 (4.64)	36
EXP5	15	0.20 (0.03)	15	13 (2.64)	20
EXP6	15	0.20 (0.03)	14	13 (4.52)	34

Table 1. Transition time (TT) and mean length of burst (mlb)

The mean length of burst can serve as an indicator of smoothness in text production. It informs us about the length of the chunks of text that the writer produces before they stop in order to reformulate their previous thoughts, to reflect about the form or the content, to correct something or to rewrite the same passage. As can be seen in Fig. 2, the development of this fluency indicator cannot be interpreted as a linear growth. The average development of fluency expressed as the mean length of undisrupted bursts can be described as a consistent increase in the first two years, which then evens out at a level of 13 tokens. This trajectory does not mirror the developmental path of automaticity. However, except for two subjects, there was a very strong negative correlation between the development of both features

($-0.7 \leq r \leq -1.0$), which means that an increase in writing automaticity speed occurs in parallel with improved smoothness in the flow of text production. Furthermore, this is confirmation of the assumption that the subsystems that build dynamic systems are interconnected with each other. In this case, a clear interconnectedness exists between automaticity and smoothness as two aspects of fluency.

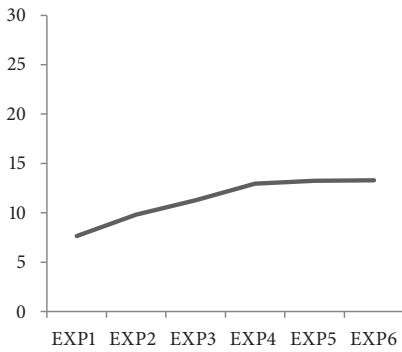


Figure 2a. Mean length of burst (in tokens) for the entire group

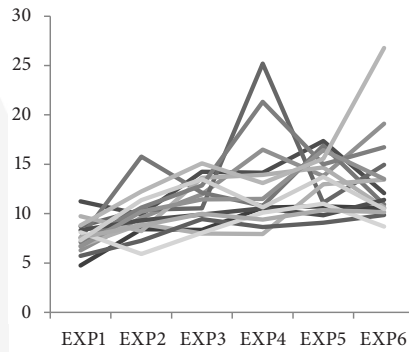


Figure 2b. Mean length of burst in individuals

Compared with the inter-individual variability in the transition time, there is a divergent tendency in the development of the mean length of burst: the least variability was seen in the first experiment ($cv = 20\%$). Afterwards it developed in the form of a wedge pattern but was generally greater than the transition time throughout the experimental period. This means that the students differ more in terms of their fluency when it is expressed as the mean length of burst than when their writing automaticity is analysed.

As with the previous results, no student develops in parallel with the average value. However, the dynamics² of the trajectory is greater at the intra-individual level than at the inter-individual level. The explanation of this phenomenon lies not only in the individual differences between learners but also in the complexity of the measurement. The value includes several hidden components, such as pauses and deletions which can have divergent lengths, and this in turn can influence the mean length of burst. Some students can have the same automaticity in writing but differ in terms of the frequency of pauses and deletions. The more subsystems that are included, the more dynamics they can trigger. This may explain why the spread between individuals is greater than in the case of writing automaticity and why the development of a greater number of students is so dynamic.

In the first experiment the four slowest typists were less fluent than the average even in terms of the mean length of burst, but their development was not more dynamic than that of other students. Nor is it possible to draw any general conclusions from the developmental patterns of the fastest writers or those learners who

² The term “dynamics” is here used as the degree of the change.

in the first experiment were less fluent than their fellow students or those students with a high level of fluency at the beginning who could be called “quick starters”.

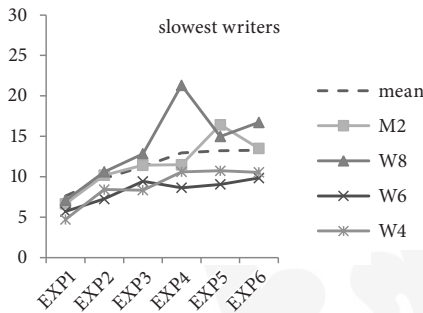


Figure 3a. Mean length of burst in writers with the highest transition time at EXP1

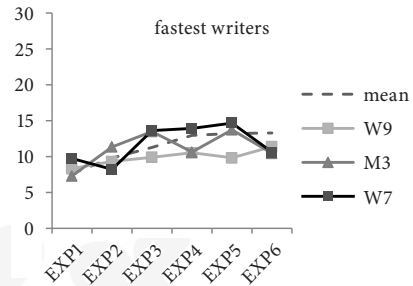


Figure 3b. Mean length of burst in writers with the lowest transition time at EXP1

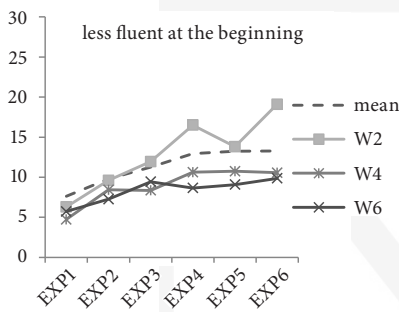


Figure 3c. Mean length of burst in writers with the smallest mean length of burst at EXP1

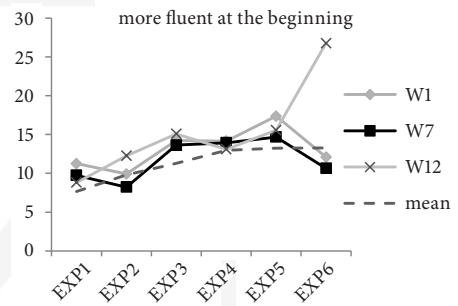


Figure 3d. Mean length of burst in writers with the greatest mean length of burst at EXP1

Figures 3a–3d show the developmental trajectories of these particular groups of learners. The four slowest writers are indeed less fluent in terms of their mean length of burst in the first experiment, but only two of them were below the mean value over the entire experimental period. One (M2) may be described as an averagely fluent writer while the fourth (W8) can be classified as fluent learner who peaked in the fourth experiment. The three fastest writers, on the other hand, (Fig. 3b) are neither more nor less fluent than the average and their mean length of burst does not increase noticeably. Three of the students in the experimental group were less fluent than the others at the beginning of the experiments (Fig 3c) but the fluency of one (W2) developed considerably and even if this development did not involve a steady improvement in the mean length of burst the student can be characterised as a very fluent second language writer after three years. The other two rather less fluent writers in this group (W4 and W6) were also the slowest writers (Fig. 3a) and this finding suggests that these students

could be described as the least fluent in the group as a whole. It should be pointed out that even if they did not achieve the average level of fluency, either in terms of automaticity or smoothness, they did in fact develop and became more and more fluent. Three other writers were more fluent than their fellow students even at the beginning (Fig. 3d) and thus could be labeled as “quick starters”. One of them (W7) was also the fastest writer in the entire experimental group ($M_{TT} = 0.18$ s at EXP.1). However, in the case of this student, as described above, her fluency did not increase noticeably over the three-year period. There was, however, one writer who was definitely more fluent than the others from the beginning and even if she was neither the most fluent learner all the time, nor developed linearly, she did achieve the highest absolute mean length of burst in the last experiment ($mlb = 27$ tokens).

As the comparison has shown, we cannot conclude that slow writers with low writing automaticity will never be more fluent than other writers. On the other hand, some students did not achieve the average level of fluency. Does this mean that they were incapable of becoming more fluent? How much did they really develop and what was the level of development of the other students, whose fluency developed earlier than the remainder? In order to estimate the degree of change between the experimental sessions the percentage growth rate was used.

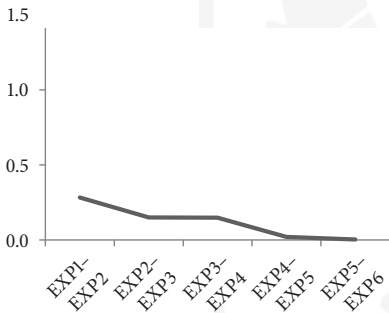


Figure 4a. Mean growth rate of fluency for the entire group

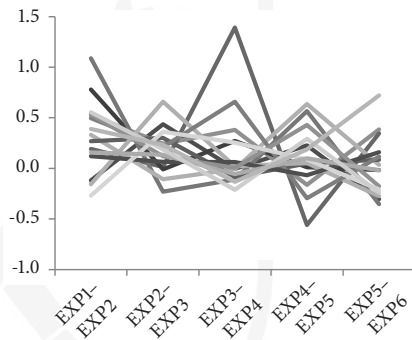


Figure 4b. Growth rate of fluency in individuals

As presented in Fig. 4, average fluency, measured as the mean length of burst, increases most at the beginning of the learning period, with the growth rate between the first and the second experiment being 28%. Subsequently, the rate of increase slows down and between the last two experiments, i.e. at the end of the third year of learning, the students’ fluency hardly changes at all (2%). This conclusion cannot be generalised when compared with the individual data (Fig. 4b). The fluency of individual learners changes very dynamically although no developmental patterns could be observed. The degree of the increase or decrease in fluency at half year intervals is very irregular and unpredictable. A comparison of the increase in fluency between the first and the last experiment (Table 2.), carried out to estimate which students made the greatest progress in fluency after three years of learning Swedish, showed that two students achieved significant progress, recording an

increase of over 200%. And these two students were from the group of less (W₂) and more (W₁₂) fluent learners in the first experiment. This means that it is not possible to predict how fluency will develop during second language acquisition, especially if those who are less fluent at the beginning are able to achieve significant outcomes at the end.

Student	Growth rate (%)	Student	Growth rate (%)
W1	7	W8	136
W2	204	W9	37
W3	71	M2	103
W4	123	W10	7
M1	45	W11	34
W5	100	M3	43
W6	72	W12	204
W7	9	Mean	80

Table 2. Growth in fluency between the first and the last experiment

At the same time, the writers who were initially less fluent (W₂, W₄, W₆) made far greater progress with regard to fluency development over the three-year period than their fellow students who were more fluent at the beginning of the experiments (W₁, W₇), with the fluency of the fastest students increasing only slightly.

7. Discussion

The natural expectation is that skills will improve during a three-year period of second language acquisition and overall the present study confirms this expectation. An increase in average fluency was observed both in terms of automaticity in writing, measured as the mean transition time, i.e. the time spent moving between keys within a word, and smoothness, measured as the mean length of burst, which reflects the length of undisrupted chunks of text between pauses or revisions.

The development of fluency in writing confirms all the assumptions of the Dynamic Systems Theory. Firstly, the increase in fluency proceeds non-linearly. This non-linearity in development could be observed both in the mean and at the individual level. From the point of view of average development, the process of writing at a greater speed could be described as a two-step progress. Automaticity increases considerably at the beginning, and afterwards there is a period of stability, followed by a longer period in which it increases until the learners appear to achieve a certain level in their writing skills. The average writing smoothness increases

continuously during the first two years and afterwards it remains at the same level. However, the development of no learner coincides with the average developmental curve and there is not a straight linear increase in fluency.

Furthermore, there is significant variability both within- and between individuals, which confirms the next foundation of the DST. In terms of automaticity in writing, variability between students is greater at the beginning, after which it decreases. This does not, however, also hold true for the mean length of burst. In this case, the students differ least at the beginning of acquisition and the divergence between them increases (non-linearly) over the three-year period. This discrepancy can be explained by the specificity of both features. Automaticity in writing is connected with typing skills in general, which are more mechanical in nature, less complex and less demanding for an individual than the ability to retrieve and process longer chunks of information. There can be thus greater differences between learners at the beginning in terms of writing automaticity than with regard to the overall smoothness of production. During the acquisition period divergence in typing skills become less marked as individuals become more skilled writers, but at the same time they may differ more and more in their ability to process longer information units stored in their working memory.

Variability occurs even at an individual level. Learners develop dynamically with no definable pattern, and therefore it is not possible to predict what level of fluency they will achieve after three years of learning. Nor can we determine through which stages their fluency will progress. In some students fluency develops faster and they are more fluent than others during the entire process of second language acquisition. However, slow writers, with a low level of fluency in the first months of second language learning can achieve a very high level after three years. On the other hand, students who master their fluency earlier than others will not automatically continue to outpace their fellow students. Between the so-called “quick starters” there are both writers who achieve outstanding levels and others with fairly average fluency that does not change dynamically. A slight increase in fluency does not mean that these learners are not progressing overall or are progressing less than the others. Due to the interconnectedness of the subsystems that are included in second language development it is likely that after achieving a certain level of fluency, they focus on developing other skills, such as complexity or accuracy. Such an assumption, however, requires a separate study.

Among the slow writers, on the other hand, there are some whose writing fluency over the three-year period as whole is weaker than that of their fellow students. With regard to their own individual development, however, they make greater progress than other, more fluent writers. In fact, the slowest, least fluent learners' fluency increases the most, i.e. they have the highest growth rate, when compared with the more skilled typists and those whose fluency developed earlier. These outcomes will maybe help second language teachers to understand that even if a learner achieves a lower level of fluency after a certain period of learning this has required much more effort for them than it did for other learners and that this development is in fact more dynamic and progressive.

The development of fluency in second language writing is a complex process that involves both the ability to write fast, or without great effort, and the skill to produce longer text units without many pauses or revisions that may affect the flow of text creation and transcription. One of limitations of the present study is that the focus was on two aspects of fluency only, i.e. automaticity and smoothness in writing. However, there is a need for a broader investigation of this phenomenon, first of all from the point of view of individual differences. Bearing in mind the variability observed between students, we can assume that such divergences are related to different ways of producing a written text. Some students may, for example, prefer to plan online in longer chunks, which can lead to the occurrence of longer pauses while others stop less frequently but instead make more online revisions. In order to explore this, a more detailed analysis of pauses should be made – their length and distribution. Furthermore, general writing patterns in individual students could be determined by collecting more writing samples at the same time (at the same level of language proficiency), which could then be compared with the students' writing abilities in their L1. Because in the present analysis only the transcription process has been analysed, it could not be discovered when the disruptions (both revisions and pauses) were the result of the learners' metalinguistic awareness and an attempt to achieve a more interesting, better and faultless text or whether they were a sign of a disturbed flow in the text production in a new language. In order to explore this, other tools, such as a think-aloud protocol, could be used as a complementary instrument in further studies.

Since fluency is a complex phenomenon and should be treated as both a complex and dynamic system comprising a variety of interconnected subsystems, it is an almost natural consequence that its development is characterised by variability, non-linearity and unpredictability. Longitudinal research can provide a platform for exploring the complexity of this skill and further studies should focus on other aspects/other subsystems, such as complexity and accuracy, in order to understand the cognitive mechanisms underlying the development of fluency in second language writing interact with other dynamic subsystems.

References

- Alves R.A., Castro S.L., de Sousa L., Strömqvist S. 2007. Influence of typing skill on pause-execution cycles in written composition. – Torrance M., van Waes L., Galbraith D. (eds.). *Writing and cognition. Research and applications*. Amsterdam: 55–66.
- Caspi T. 2010. *A dynamic perspective on second language development*. [Ph.D. diss.; retrieved from <http://irs.ub.rug.nl/ppn/329338412>].
- de Bot K., Larsen-Freeman D. 2011. Researching second language development from a Dynamic Systems Theory perspective. – Verspoor M.H., de Bot K., Lowie W. (eds.). *A dynamic approach to second language development. Methods and techniques*. Amsterdam (Philadelphia): 5–23.
- Chenoweth N.A., Hayes J.R. 2001. Fluency in writing: Generating text in L1 and L2. – *Written Communication* 18: 80–98.

- Crystal D. 1987. *The Cambridge encyclopedia of language*. Cambridge.
- de Jong N., Perfetti C.A. 2011. Fluency training in the ESL classroom: An experimental study of fluency development and proceduralization. – *Language Learning* 61: 533–568.
- Ellis R., Yuan F. 2004. The effects of planning on fluency, complexity and accuracy in second language narrative writing. – *Studies in Second Language Acquisition* 29: 59–84.
- Fillmore C.J. 1979. On fluency – Fillmore C.J., Kempler D., Wang W.S.-Y. (eds.). *Individual differences in language ability and language behaviour*. New York: 85–101.
- Freed B.F. 1995. What makes us think that students who study abroad become fluent? – Freed B.F. (ed.). *Second language acquisition in a study abroad context*. Philadelphia: 123–148.
- Grabowski J. 2008. The internal structure of university students' keyboard skills. – *Journal of Writing Research* 1: 27–52.
- Gunnarsson C. 2012. The development of complexity, accuracy and fluency in the written production of L2 French. – Housen A., Kuiken F., Vedder I. (eds.). *Dimensions of L2 performance and proficiency. Complexity, Accuracy and fluency in SLA*. Amsterdam (Philadelphia): 247–276.
- Herdina P., Jessner U. 2002. *A dynamic model of multilingualism. Changing the psycholinguistic perspective*. Clarendon.
- Housen A., Kuiken F., Vedder I. 2012. Complexity, accuracy and fluency. Definitions, measurements and research. – Housen A., Kuiken F., Vedder I. (eds.). *Dimensions of L2 performance and proficiency. Complexity, Accuracy and fluency in SLA*. Amsterdam (Philadelphia): 1–20.
- Johansson V. 2009. *Developmental aspects of text production in writing and speech*. Lund.
- Kaufer D.S., Hayes J.R., Flower L. 1986. Composing written sentences. – *Research in the Teaching of English* 20: 121–140.
- Kormos J., Dénes M. 2004. Exploring measures and perceptions in the speech of second language learners. – *System* 32: 145–164.
- Kowal I. 2011. Online revisions in FL writing. General rules and individual differences. – Arabski J., Wojtaszek A. (eds.). *Individual learner differences in SLA*. Bristol: 309–320.
- Larsen-Freeman D. 1997. Chaos/complexity science and second language acquisition. – *Applied Linguistics* 18: 141–165.
- Larsen-Freeman D., Cameron D. 2008. Research development on language development from a complex systems perspective. – *The Modern Language Journal* 92: 200–213.
- Lennon P. 1990. Investigating fluency in EFL: A quantitative approach. – *Language Learning* 40: 387–417.
- Levy C.M., Ransdell S. 1995. Is writing as difficult as it seems? – *Memory and Cognition* 23:767–779.
- Möhle D. 1984. The comparison of the second language speech production of different native speakers. – Dechert H.W., Möhle D., Raupach M. (eds.). *Second language productions*. Tübingen: 26–49.
- Palviainen Å., Kalaja P., Mäntylä K. 2012. Development of L2-writing: Fluency and proficiency. – Meriläinen L., Kolehmainen L., Nieminen T. (eds.). *AFinLA-e Soveltavan kielitieteen tutkimuksia* 4: 47–59.
- Riggenbach H. 1991. Toward an understanding of fluency: A microanalysis of nonnative speaker conversation. – *Discourse Processes* 14: 423–441.
- Schmidt R. 1992. Psychological mechanism underlying Second Language Fluency. – *Studies in Second Language Acquisition* 14: 357–385.
- Schneider W., Shiffrin R.M. 1977. Controlled and automatic human information processing: I. Detection, Search and attention. – *Psychological Review* 84: 1–66.

- Segalowitz N. 2003. Automaticity and second languages. – Doughty C.J., Long M.H. (eds.). *The handbook of second language acquisition*. Oxford: 382–408.
- Segalowitz N. 2010. *Cognitive bases of second language fluency*. New York.
- Severinson Eklundh K., Kollberg P. 1996. A computer tool and framework for analysing on-line revisions. – Levy M., Randsell S. (eds.). *The Science of Writing*. New Jersey: 163–188.
- Skehan P. 2003. Task-based Instruction. – *Language Teaching* 36: 1–14.
- Spelman Miller K., Lindgren E., Sullivan K.P.H. 2008. The psycholinguistic dimension in second language writing: Opportunities for research and pedagogy using computer keystroke logging. – *TESOL Quarterly* 42: 433–453.
- Stevenson M., Schoonen R., de Glopper K. 2006. Revising in two languages: A multi-dimensional comparison of online writing revisions in L1 and FL. – *Journal of Second Language Writing* 15: 201–233.
- Strömquist S. 1996. *Discourse flow and linguistic information structuring: Explorations in speech and writing*. Göteborg.
- Strömquist S. 1999. Production rate profiles. – Strömquist S., Ahlsén E. (eds.). *The process of writing: A progress report*. Göteborg: 53–70.
- Strömquist S., Ahlsén E. (1999). *The process of writing: A progress report*. [Gothenburg Papers in Theoretical Linguistics]. Göteborg.
- Strömquist S., Malmsten L. 1998. *Scriptlog pro 1.04 – user's manual. Technical report*. Göteborg.
- Torrance M., Nottbusch G. 2012. Written production of single words and simple sentences. – Berninger V.W. (ed.). *Past, present, and future contributions of cognitive writing research to cognitive psychology*. New York, Sussex: 402–422.
- Towell R. 1987. Variability and progress in the language development of advanced learners of a foreign language. – Ellis R. (ed.). *Second Language Acquisition in Context*. Toronto: 113–127.
- Towell R., Howkins R., Bazergui N. 1996. The development of fluency in advanced learners of French. – *Applied Linguistics* 17: 84–119.
- Uppstad P.H., Solheim O.J. 2007. Aspects on fluency in writing. – *Journal of Psycholinguistic Research* 36: 79–87.
- Van Gelderen A., Oostadam R. 2005. Effects of fluency training on the application of linguistic operations in writing. – *L1 – Educational Studies in Language and Literature* 5: 215–240.
- Verspoor M., de Bot K., Lowie W. 2008. Variability in second language development from a dynamic systems perspective. – *The Modern Language Journal* 92: 214–231.
- Wengelin Å. 1999. Pauses and editings in the written language production of adults with and without severe reading and writing difficulties. – Strömquist S., Ahlsén E. (eds.). *The process of writing: A progress report*. Göteborg: 71–86.
- Wengelin Å. 2002. *Text production in adults with reading and writing difficulties*. [Ph.D diss.]. Göteborg.
- Wengelin Å. 2007. The word-level focus in text production by adults with reading and writing difficulties. – Torrance M., van Waes L., Galbraith D. (eds.). *Writing and cognition. Research and applications*. Amsterdam: 67–82.
- Wolfe-Quintero K., Inagaki S., Kim H.-Y. 1998. *Second language development in writing: Measures of fluency. Accuracy and complexity*. Hawaii.

Acknowledgment

This publication is part of my research work at Lund University, thanks to a Swedish Institute scholarship.