The Relationship Between Cognitive Proficiency and Oral Fluidity in Second Language Mastery

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ABSTRACT

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This study investigated the relationships between cognitive proficiency and oral fluidity in the domain of second language (L2) mastery. Previous research has demonstrated that both automaticity and attention control are factors that contribute to L2 mastery. Given that the fundamental purpose of language is communication, the study aimed at examining the relationship between these cognitive factors and productive elements of speech within a social context. The study also examined if controlling for first language (L1) skill on measures of oral fluidity would yield different results from when L1 skill was not controlled, and if differences existed between the relationships between cognitive proficiency and oral fluidity after dividing the sample into higher versus lower fluent participants. Twenty-four bilingual adults (L1=English; L2 =French) who varied in L2 skill performed a lexical categorization task and an attention-shifting task in order to provide measures of speed and efficiency of cognitive proficiency. Participants also performed a socially interactive story telling task in order to provide speech samples from which measures of vocabulary richness, speech rate, and fluid run length were derived as indices of oral fluidity. Hierarchical multiple regression analyses revealed that although controlling for L1 performance on measures of oral fluidity did not significantly contribute to our understanding of the relationships between cognitive proficiency and oral fluidity, there was strong relationship between L1 and L2 oral fluidity performance. In addition, those participants that showed evidence for better oral mastery also showed evidence for better automaticity of lexical categorization.

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Introduction

Due to an increasingly global economy, many nations have begun to acknowledge that mastery of more than one language is an invaluable asset (Crystal, 1997). In fact, moderate to high-level mastery in a second language is quickly becoming the norm rather than the exception throughout the world (Dewaele, 2003). Despite this reality, many if not most second language speakers are familiar with the difficulties that can arise when attempting to master a second language (L2). As such, identifying and understanding the factors that contribute to the development of L2 mastery has become an important topic of investigation for cognitive psychologists and L2 acquisition specialists.

Identifying and understanding these factors is no simple task however. The complex and interwoven psycholinguistic issues involved in L2 acquisition have made investigating these factors problematic (Kroll & Sunderman, 2003). Factors such as possible critical periods in language development (Birdsong, 1999), the variety of cognitive resources that are recruited in L2 learning and production (De Groot & Kroll, 1997), the influence of an existing first language (Odlin, 2003), motivation (Masgoret & Gardner, 2003), individual differences in level of skill, and learning environment are all factors that contribute to the complexity of this important issue. One way in which researchers have confronted these difficulties has been by turning their attention to the skill acquisition literature.

Bilingualism, as a domain of expertise, is ideal for the study of skill acquisition, as it allows for the arguably unique opportunity to study both expert and novice skill within the same individual. Few would argue that first language speakers are not functioning at an expert level in the domain of language acquisition; however, as previously mentioned, many of these "experts" only reach a low to moderate level of skill in their L2. According to Segalowitz and Frenkiel-Fishman (in press) this combination of both expert and novice skill within the same domain allows for the possibility to distinguish between, for example, differences in level of L2 mastery that are attributable to domain specific factors, or to pre-existing individual differences in ability.

Research in skill acquisition has repeatedly demonstrated that an enhanced ability to manage attentional resources, as well as the ability to better exercise cognitive control (automaticity) are what make the distinction between experts and novices in a given domain (Chase & Simon, 1973; De Groot, 1978; Feltovich, Spiro & Coulson, 1997; Reingold, Charness, Schultetus & Stampe, 2001), and bilingualism is no exception. Studies investigating elements of cognitive proficiency in bilinguals have demonstrated that mastery of an L2 is associated with better automaticity and attention control (Favreau & Segalowitz, 1983; Houde, 2001; Segalowitz & Frenkiel-Fishman, in press; Segalowitz, O'Brien, & Poulsen, 1998).

While cognitive proficiency, as defined by the ability to better exercise cognitive control and attentional resources, has been shown to be associated with better mastery of an L2, the fundamental purpose of language is communication. It is therefore important to also consider elements of language production when discussing factors related to L2 mastery. Studies investigating productive elements of L2 speech have found that both speech rate and number of pauses in L2 are associated with expert oral fluency ratings (Freed, 1995; Lennon, 1990; Riggenbach, 1991). In addition, lexical richness (the variety of words used) has long been considered an important reflection of L2 oral mastery (Cummins, 1991; Daller, 1999; Freed, 1995). The current study addresses the relationship between elements of cognitive proficiency and oral fluidity as indications of L2 mastery.

Given the richness of research from both the skill acquisition and linguistic literature on factors related to L2 acquisition, as well as the breadth and scope of what could be considered "mastery" of an L2, it becomes important at this point to draw a distinction between *cognitive proficiency* and *oral fluidity*. For our purposes, cognitive proficiency refers to the speed and efficiency of cognitive factors associated with L2 mastery, while oral fluidity is largely concerned with the productive elements of speech such as lexical richness and smoothness of speech production.

Cognitive Proficiency

Automaticity. Before understanding the processes involved in becoming a skilled bilingual, one must first have an understanding of how one moves from becoming un-skilled to skilled within any given domain. One framework that has been used to understand this transition is Anderson's adaptive control of thought, which posits that skill acquisition involves a transition from declarative knowledge to procedural knowledge (Anderson, 1983; Anderson & Lebiere, 1998). According to this model, declarative knowledge is explicit, conscious, and describable, while procedural knowledge is implicit, unconscious, and non-describable. For example, when a novice driver approaches a stop sign, she must make a conscious effort to retrieve and use her declarative knowledge to execute the sequence of tasks involved to properly bring the vehicle to a stop. With repetition the novice driver becomes more skilled, and the declarative knowledge becomes procedural knowledge in that the driver no longer has to think about the various steps involved in order to bring the vehicle to a stop. The cognitive task of executing these steps involves applying production rules to the declarative knowledge. With repetition, the production rules become chunked and routinized, and declarative knowledge transforms into procedural knowledge. Thus, within this framework, it can be said that someone is skilled within a given domain when the execution of a skill has become implicit and fast due to production rules having become routinized or automatic.

Within the domain of second language acquisition, automaticity refers to the speed, efficiency, and fluidity of language application (Segalowitz, 2000). The task of reading a second language, which involves many sub-tasks, may better illustrate how automaticity develops within this domain. The ability to read a second language will involve not only recognizing and understanding words, but also combining the words into sentences, and then integrating the words and sentences in such a way as to reach the underlying thoughts and ideas. Novice readers, like novice drivers, exert a great deal of conscious effort to execute these tasks. For example, when reading a word in a second language, the novice reader may expend a considerable amount of conscious effort to retrieve the meaning of a given word; however, with practice, words become recognized automatically. As such, automatic word recognition can be considered one of many possible skills a proficient second language learner will posses.

In order to examine the hypothesis that automaticity of word recognition underlies second language mastery, Favreau and Segalowtiz (1983) compared the performance of bilinguals on a single word recognition task in both their L1 and L2. In addition to comparing performance between their L1 and L2, the study also compared performance on this task as a function of level of L2 mastery, by dividing the participants into a very fluent group and a less fluent group based on reading ability. Automaticity was operationally defined in terms of ballistic (un-stoppable) processing of a word's primary meaning despite an intention to think about the word in a different way (Neely, 1977). The authors found that those participants who were in the very fluent group showed automatic word recognition in both their L1 and L2, whereas those in the less fluent group showed automatic word recognition in the L1 only. Favreau and Segalowtiz went on to conclude that automaticity of word recognition was associated with mastery of an L2.

Interestingly, the above-mentioned study parted with popular convention by choosing to focus on the ballistic nature of automatic processing rather than the more popular fast processing speed that is assumed to underlie automaticity. Automatic processes may indeed be faster than non-automatic processes; however, individual differences in speed of processing make "fast" processing a relative term. Segalowitz and Segalowitz (1993) have pointed out that one can still speak of faster and slower control processing, so speed alone cannot be sufficient to define automaticity. They proposed the coefficient of variation (CV) of response time as a means by which one can evaluate the existence of automaticity within a given process while still controlling for speed. In this situation, the CV is defined as the standard deviation of an individual's mean reaction time divided by the same individual's mean reaction time. This measure can discriminate between faster responding that is related to automaticity versus faster responding that is due to non-automatic related processes.

The principle behind the CV is as follows: when the underlying component processes of a given task operate faster as a result of practice rather than increased automaticity, both the overall response time and the standard deviation of that response time will be lower. This is the result of a faster response time for all individual components, which also reduces the standard deviation of the response times for each component in question. For example, if the overall response time is cut in half, then the standard deviation of that response time is also cut in half. Given that the CV is defined as the standard deviation of an individuals' mean reaction time divided by the same individuals' mean reaction time, it provides a ratio of the standard deviation to reaction time. This ratio should not be affected if faster responding is only the result of faster response time of individual components rather than of some reorganization of underlying processes related to automaticity.

In contrast, when faster responding is the result of more automatic processing, the CV should in fact decrease. Over time and with practice, the slower and more variable component processes involved in executing a complex cognitive task or skill will be eliminated from the overall sequence, thus making for a faster overall response time. In addition to the faster response time due to the elimination of certain control processes, the more variable processes involved will have been selectively removed. As a result, the overall standard deviation of the response time will be more than proportionally reduced, as would be the case if faster responding was due to practice only. Thus, the CV will decrease as a function of decreased response time. Segalowitz and Segalowtiz go on to suggest that a decrease in the CV is the result of a qualitative change in performance, and as such can be used as an indication that automaticity is occurring and greater cognitive efficiency has been achieved by the elimination of components that previously contributed to a large proportion of variability. As such, the CV can be considered an index of automaticity in that a change in the CV allows one to assume that there has been a re-organization of the underlying component processes of a given skill rather than simply an overall speed-up of these processes resulting form practice. Following from this logic, the CV can be used as an index of processing efficiency, where a change to a lower CV can be taken as an indication that processing has become automatic rather than simply fast.

When considering processing efficiency in a second language, it becomes important to control for individual variation in processing ability that may cloud our understanding of an individuals' level of mastery in their L2. One way this can be achieved is by partialling out CVs obtained in the first language from those in the second language. The remaining residuals can then be used as indicators of L2-specific processing efficiency (automaticity). This can be accomplished statistically by using the CV in the first language as a baseline against which the second language CV is regressed. The current study used this procedure in order to obtain a measure of L2-specific automaticity of word recognition as one index of second language mastery.

While speed and efficiency of cognitive processing have been shown to be associated with L2 mastery, it would be unwise to claim that these are the only factors that underlie cognitive proficiency within the domain of L2 mastery. Another important factor that has been identified in the skill acquisition literature as contributing to L2 mastery is that of attention control in language processing.

Attention Control. The ability to allocate attentional resources and exercise cognitive control has long been considered an important element within the domain of skill acquisition (De Groot, 1965; Chase & Simon, 1973; Kahneman, 1973; Reingold, Charness, Schultetus, & Stampe, 2001), and has in fact been an important topic of consideration within the areas of consciousness and cognitive science since the days of James (1890) and Helmholtz (1896). Kahneman (1973) has suggested that the cognitive resources necessary to execute a given task are of limited capacity, and that these resources may be allocated in a flexible manner according the demands of the task. In other words, when carrying out complex cognitive tasks, one is often faced with the necessity of shifting attention from one element of the task to another, either as a result of the changing demands of the unpredictable environment in which the task is being carried out or because the task itself requires shifting focus from one element of the task to another. Thus, the ability to successfully and efficiently shift attention from one element of a task to another can be considered a key factor in masterful performance of a given skill.

When considering language use, it becomes clear that the ability to focus and direct attention may be of particular importance to the second language learner. In order to be effective in communicating, people must be able to focus their attention on the important, relevant information they wish to convey and/or understand, as well as be able to identify and adapt to the unexpected changes within the communicative environment such as changes in the tone of voice, or the introduction of an unexpected idea. In addition, language itself is an attention-directing medium in that words direct an individuals' attention towards object, events, ideas, and the conceptual relationships between these elements.

In order to investigate how individual differences in attention control might underlie second language mastery, Segalowitz, O'Brien, and Poulsen (1998) devised a means by which they could measure participants' ability to shift attention in both their first and second languages respectively. Participants in this study completed four tasks, which included a first language attention-shifting task, a second language attention-shifting task, a second language control task and a second language reading speed test. A linguistic adaptation of the Wisconsin Card Sorting Task was used for the attention-shifting tasks in which participants were required to figure out the matching rule by trial and error. In the control task the participants were provided with the matching rule in advance. The authors reasoned that the changing demands of the attention-shifting task would tap into participants' ability to adapt to the changing linguistic environment after taking into account performance in the first language and on the control task.

A methodological shortcoming of the above mentioned study was that generally, some participants received more practice with the task than others. This led Segalowitz and Frenkiel-Fishman (in press) to further examine the possible relationship between second language mastery and linguistic attention control by using a modified version of an alternating runs procedure. For this study, participants were required to complete separate blocks of both non-matching and matching trials in both their first and second language respectively in order to obtain a switch-cost measure in each language. Research using the alternating runs procedure has typically shown that participants perform faster on matching trials than on non-matching trials (Monsell, Sumner, & Waters, 2003; Rogers & Monsell, 1995; Wylie & Allport, 2000). This difference between RTs on non-matching and matching trials is referred to as the *shift cost* and represents the burden placed on cognitive processing resources when having to shift attention from one element to another. For the Segalowitz and Frenkiel-Fishman study, participants were required to shift attention to and from time words (*now*, *next*, *after, later*) and casual connection words (*because*, *consequently*, *although*, *but*). The attention-shifting procedure allowed the researchers to assess participants' ability in shifting their attention in response to these categorically different word stimuli as an indication of attention flexibility. By using the shift-cost as an index of attention control, the authors found that flexibility of attention-shifting was correlated with second language mastery as measured by efficiency of lexical categorization (CV).

The above-mentioned studies review the research literature on factors related to cognitive proficiency within the domain of second language mastery. As previously mentioned, mastery of a second language, by definition, should also involve skillful language production. As such, we now turn our attention to research investigating productive elements of second language use.

Oral Fluidity

In terms of oral fluidity, second language mastery can be seen to represent "the highest point on a scale that measures spoken command of a second language" (Lennon, 1990; p.389), and in many cases constitutes the overriding determiner of what is perceived as mastery of an L2. To illustrate this point, we turn our attention to a study conducted by Freed (1995) in which undergraduate students were asked to define the term "fluency". Responses included such definitions as "speaking quickly and smoothly", and "speaking without hesitations". In addition, when asked what characteristics of speech influence their assessment of students' oral fluency, "expert" judges pointed to such characteristics as "lack of hesitations", "faster rate of speech", and "richness of vocabulary". As such, oral command of an L2 has traditionally been the criterion by which mastery is assessed both within popular culture and foreign language teaching research.

One of the first attempts to quantify characteristics of oral fluidity was conducted by Lennon (1990). In this study, four L2 speakers of English provided speech samples based on a six-picture sequence. The speech samples were later rated by a panel of native speaking teachers of English as a foreign language who provided an overall fluency rating for the speech samples. The panel was instructed to base their ratings on both temporal elements such as speech rate, and degree of freedom from dysfluency markers such as hesitations. The speech samples were later transcribed and a battery of 12 quantifiable measures of speech was derived. These measures included, but were not limited to, speech rate, mean length of "runs" (in words) between pauses, and hesitations (um, err, uh). Overall, the results of this study found that temporal elements such as speech rate and mean length of fluid run, as well as dysfluency markers such as filled pauses corresponded to expert fluency ratings. These measures have since been used in other studies to investigating characteristics of oral fluidity in relation to L2 mastery (Cucchiarini, Strik, & Boves, 2000; Derwing, Rossiter, Munro, & Thomson, 2004; Freed, Segalowitz, & Dewey, 2004; Riggenbach, 1991; Segalowitz & Freed, 2004).

As previously mentioned, lexical richness has long been considered an important factor in the attainment of L2 oral mastery (Cummins, 1991; Daller, 1999; Freed, 1995). Despite agreement that lexical richness is an important factor in L2 mastery, there is currently little consensus as to how to accurately measure this element (Daller, Van Hout, & Treffers-Daller, 2003). In light of this, Daller, et al. (2003) conducted a study in order to assess various means of measuring lexical richness in association with L2 mastery.

While the different measures of lexical richness yielded varying results, overall, the authors found that lexical richness was associated with L2 mastery.

Interestingly, most of the studies that have investigated productive elements of L2 speech have obtained measures of oral fluidity without obtaining these same measures in L1. As such, there has been no way to control for the individual variation that may exist L1 speech. For example, within a given group of L1 speakers, there will be variability in speech production such that some individuals may naturally speak faster than others, or use more or less fillers than others. In addition, there may be variability in the richness of vocabulary used from one L1 speaker to another. It is not unlikely that this same kind of variability exists in L2 speech as a function of individual differences, as it does in L1, rather than as a function of L2 mastery. Segalowitz and Frenkiel-Fishman (in press) found that controlling for L1 attention-control revealed that L2-specific attention control accounted for a significant amount of variance in L2 performance. In other words, accounting for L1 performance on measures of cognitive proficiency revealed significant relationships that may not have been apparent had this not been done. In light of this, it is possible that controlling for L1 oral fluidity may reveal significant relationships that would otherwise be not be detected.

The Present Study

The sections above review the relevant literature concerning cognitive proficiency and oral fluidity in relation to L2 mastery. While both these factors contribute independently to our understanding of L2 mastery, considering them in isolation can only provide us with a limited understanding of the factors involved in L2 mastery. It is therefore important to consider how these two separate but interrelated factors underlie L2 mastery by examining them in conjunction.

To our knowledge, only one study to date has attempted to investigate how both cognitive proficiency and oral fluidity underlie L2 mastery. Segalowitz and Freed (2004) conducted a study investigating the role of learning context in L2 mastery, and measured L2 oral fluidity gains as a function of at home and study abroad contexts. In addition, they examined the relationship between the oral fluidity gains after a 13-week period and the measures of cognitive proficiency mentioned above. In order to obtain quantifiable measures of oral fluidity, speech samples were obtained from The Oral Proficiency Interview (OPI) (Breiner-Sanders, Lowe, Miles, & Swender, 2000), and measures such as speech rate, hesitations, and mean length of run were calculated. The authors found that speed and efficiency of L2-specific cognitive processing was associated with oral fluidity. More specifically, the results indicated that gains in oral fluidity (as measured by number of hesitations) after a 13-week period was associated with baseline measures of L2-specific speed and efficiency of lexical categorization. Interestingly, speech rate was negatively correlated with gains in efficiency of attention control.

While the study conducted by Segalowitz and Freed (2004) was an important first step in understanding how cognitive proficiency and oral fluidity are related when considering L2 mastery, there were some important drawbacks to this study. Measures of oral fluidity were obtained in L2 only, and as such it was not possible to control for individual variation in level of skill in the L1. In addition, the speech samples obtained from the OPI varied greatly. Although the questions of the interview remained more or less constant, participants were free to respond in any way they wished. As such, the conversation between interviewee and interviewer, and thus speech samples, unfolded quite differently from one participant to the next.

In light of these drawbacks, the general research questions of the present study were the following: (a) What relationships exist between measures of cognitive proficiency and oral fluidity? and (b) Does a measure of L2 oral fluidity that controls for L1 oral fluidity performance yield different results from when L1 performance is not controlled for? In addition, we were also interested in knowing if obtaining speech samples in a relatively more controlled manner than the OPI would provide a better means in which to assess oral fluidity.

In order to address this last question, we obtained speech samples by means of a story telling task using three children's wordless picture books (Mayer, 1967; 1969; 1971). One of these stories (Mayer, 1967) has been used extensively in the comparative study of narratives across a variety of languages, cultures, modalities and settings (Berman & Slobin, 1994; Stromqvist & Verhoeven, 2004). No studies to date have investigated whether other stories in the same series as the Mayer (1967) story yield comparatively similar speech samples. Although participants are free to vary the story line somewhat, the characters and setting of the three books are the same, allowing for the possibility of obtaining relatively similar speech samples for comparison. The expectation was that there would be no significant differences between speech samples, and thus allow for the possibility to compare speech in different languages in a relatively controlled manner. As such, a third general question of the present study was (c) Do story tellings involving different stories that are generally similar to each other overall, yield similar speech samples both within and across languages?

As previously mentioned, Favreau and Segalowitz (1983) found that automaticity of lexical categorization was associated with reading speed in the L2; the group of high fluent participants gave evidence of automatic (ballistic) access to word meaning in the L2, but not the low fluent participants. The authors went on to conclude that automaticity or word recognition was associated with better mastery of an L2. Further evidence supporting the usefulness of making a distinction between more or less fluent participants comes from Segalowitz and Segalowitz (1993). While investigating practice effects in skilled performance, the authors found that automaticity of word recognition was stronger for those participants considered more skilled compared to those considered less skilled. As such, it is possible that the relationship between cognitive proficiency and oral fluidity might vary as a function of level of mastery as it was seen in the Favreau and Segalowitz study, or, at the very least, vary as a function of automaticity of word recognition. In light of this, the sample in the current study was divided into higher and lower fluent participants on the basis of performance on the oral fluidity measures for certain statistical analyses. The general research question asked here was (d) Will the relationships between cognitive proficiency and oral fluidity vary as a function of L2 mastery?

The four general research questions listed above were translated into the following specific research hypotheses: (1) There will be no statistically significant differences between stories that are generally similar to each other when told in L1 versus L2. (2) There will be statistically significant relationships between measures of L2-specific cognitive proficiency (speed and efficiency of lexical categorization, and speed and efficiency of attention control) and L2 oral fluidity measures (vocabulary richness use, speech rate, and fluid run length). (3) Controlling for L1 performance on the measures of oral fluidity will strengthen the relationships between measures of cognitive proficiency and oral fluidity. (4) The relationships between measures of cognitive proficiency and oral fluidity will be stronger in the group of high fluent participants versus low fluent participants.

Method

Participants

The sample consisted of 24 adults (6 men and 18 women) aged 19 to 34 years (mean age = 24.4 years). Participants were recruited through a combination of personal contact and recruitment lists generated from undergraduate classrooms. Participation was on a voluntary basis, and a remuneration of $10 or course credit was given to each participant. Eligibility for participation was determined by participants' self-reported first and second languages, such that all participants reported English as their first language and French as their second language. Average self-report rating for L1 skill were for native-like ability, while those for L2 skill were for moderate skill. Participants also reported using their L1 as their main language for communication, while they reported on average using the L2 one to three times per week. Nine participants reported a third language used and three reported a fourth language used. All participants reported normal or corrected-to-normal visual acuity and none reported any reading disabilities.

Apparatus

For the computer tasks, stimuli were presented via HyperCard Version 2.3 software and run on a Macintosh G4 iBook computer (12-inch screen set to 640x480 pixel resolution) fitted with an external keypad that served as a response panel. Visual stimuli were presented in uppercase 24-point Palatino font for all tasks. Participants sat approximately 60 cm from the screen. The participants' story telling was recorded using a digital recorder and recorded onto TDK 80 minute 700mb writable CDs.

Materials

Lexical Categorization Task. Stimuli for training blocks were constructed using 8 letters (F, J, K, P, T, V, X, Z) and 8 digits (2, 3, 4, 5, 6, 7, 8, 9). For the experimental blocks, stimulus words for the two language conditions were the names of 32 familiar living and 32 familiar nonliving objects (e.g., English "dog" and French "chien"). French words were for the most part translation equivalents of the English words. (see Appendix A).

Attention-shifting task. The neutral stimuli used in the training phase of the attention-shifting task were taken from the following four categories: brackets, digits, letters, and non-alphanumeric symbols. English word stimuli used in the experimental phase were 16 gramaticized words from four categories based on spatial orientation (*over*, *under*, *near*, *far*). French word stimuli were drawn from the same categories. (See Appendix B)

Story telling task. Three children's wordless picture books (Mayer, 1967; 1969; 1974) were used to elicit speech samples from participants. Each book consisted of a series of different black and white sketches to illustrate a story in which the reader is free to focus on whatever details he or she wishes to emphasize (See Appendix C). In order to maintain uniformity of shading and image size, all images were scanned and then printed onto individual 8.5 x 11 sheets of paper and inserted into clear plastic sheets for protection.

Design

The design conformed to a complete within-subjects design. As such, all participants completed all tasks. For all tasks, the order of languages tested (L1 before L2 or vice versa) was counterbalanced (see Appendix D).

Performance on the lexical categorization tasks was used to derive a measure of proficiency in each language based on speed and efficiency of lexical categorization. The second measure of L2 proficiency was based on performance on the attention-shifting task and specifically provided a measure of L2 attention control. This task conformed to a 2 (L1, L2) x 2 (non-matching, matching) within-subject factorial design. The measures of language fluency were derived from the speech samples obtained from the story-telling task. Participants generated four stories, two in English and two in French. Participants were asked to tell one of the three stories in English and in French in order to compare elements of language production in both their first and second language in a similar context (same story condition). Participants were also asked to tell the two other stories, one in English and the other in French in order to compare their language production in different contexts and to control for any carry over effect in the repeat story condition (different story condition). In addition to the counterbalancing of language order used for all tasks, story presentation order (e.g., Story "A" before Story "C" or vice versa), as well as condition (repeat tellings before non-repeat tellings, or vice versa) was counterbalanced for the story telling task (Appendix E).

Procedure

All participants were initially contacted by phone and given a brief description of the study. Once participants agreed to take part in the study a suitable time was established for them to come to the research laboratory. Upon arrival, participants were presented with and asked to sign a consent form describing the study, its purpose, duration (approximately one hour) and confidentiality of participation (see Appendix F).

Once consent was obtained, participants were given verbal instructions by the researcher for the computer tasks and general testing procedures. All participants then performed the computer-based tasks measuring cognitive proficiency followed by the story telling tasks as described below.

There were two cognitive proficiency tasks, one measuring lexical categorization and the other linguistic attention control. For both sets of tasks, the screen was viewed from a distance of 60 cm, and all observations were binocular. Participants were encouraged to work as accurately and quickly as possible, and the computer recorded accuracy and reaction times. For this portion of the experiment, participants were seated at a desk in front of the computer generating the stimuli, and the experimenter left the room while participants worked on the tasks.

Lexical categorization task. Each block of trials on this task was preceded by a message instructing participants to "Press any key when ready to start". The first stimulus appeared approximately 450 ms after the initial button press. All stimuli remained on the screen until either a response was noted or a delay of 5000 ms had passed. When a correct response was noted, a delay of approximately 450 ms occurred before the next stimulus presentation. When incorrect responses were noted, the participants were notified via a computer generated "boing" and given an additional 150 ms before the following stimulus presentation in order to allow for recovery from the error.

Participants were first presented with a block of training trials in order to familiarize themselves with the task procedures. In this block, they had to indicate whether a stimulus was a letter or digit by pressing the appropriate key on the response panel. Training blocks were constructed using 8 letters and 8 digits, for a total of 72 training trials (8 warm-up and 64 experimental trials). The stimuli were presented in a pseudo-random order from the set, and no stimulus was repeated on two-consecutive trials.

Once participants had been successfully trained on the task, they were then presented with two experimental blocks of trials, one in English and the other in French. For the experimental trials, a total of 64 critical English words and 64 French words were presented. For both language conditions, blocks consisted of 8 warm-up trials and 64 experimental trials. Words were presented with the English articles "the" and "a" and the French articles "le" "la", "un", and "une" to help ensure that the English nouns were interpreted as nouns and to emphasize the English or French character of the stimuli. The stimuli were presented in one of four pre-set, fixed pseudo-random orders.

Participants responded to stimuli using a numeric keypad, where the 4 key represented a left button press and the 6 key a right button press (buttons on the key-pad were relabelled as "Left" or "Right"). The participant was instructed to press the right button for letters and the left button for digits in the training phase. They were instructed to press the right button for living objects and the left button for non-living objects in the experimental phase. A reminder remained on the screen for all trials indicating to participants what left or right button presses represented. There were no filler trials.

Attention-shifting task. The attention-shifting task was a matching/non-matching-to-sample design. Participants first studied 16 stimulus cards that contained the stimuli for each of the neutral, English and French conditions respectively before beginning each block of trials (see Appendix B). From this they learned which four items were assigned to each of the four categories. Then they proceeded to the main task itself consisting of a training phase followed by two separate experimental language blocks. On a given trial, participants saw a sample stimulus at the bottom of the screen and four alternatives at the top of the screen. Two of the alternatives came from the same category as the sample and two came from two other categories. On matching trials, participants had to choose one stimulus visible at the top of the screen that came from the same group as the sample. They did this by pressing one of four buttons on the keypad representing the appropriate position (leftmost, next to leftmost, next to rightmost, rightmost) on the screen. On non-matching (shift) trials participants had to choose the stimulus that came from a different category than the sample stimulus. Two-blocks (one non-matching and one matching) of 56 trials were presented in each block. Once participants were adequately trained with the neutral stimuli, they were then presented with two experimental blocks, one consisting of English word stimuli and the other of French word stimuli. As with the neutral block of trials, the experimental blocks consisted of 16 warm-up trials and 40 experimental trials.

Story telling tasks. Once participants had completed the lexical categorization and attention-shifting task respectively, they were then asked to read instructions for the story telling portion of the experiment (see Appendix G). The experimenter remained in the room for this portion of the experiment in order to serve as a listener and thus create a natural communicative context. When participants had finished reading all instructions the experimenter re-iterated the instructions for story telling and encouraged participants to tell the stories to the experimenter as naturally as possible. Participants were given the opportunity, if they wished to take a short break (approximately 5 minutes) after telling the first two stories. All participants were tested individually.

Data Transcription and Analysis. Native speakers of English and French transcribed all recorded speech samples respectively. A fluent speaker of French for the French transcriptions, and a native speaker of English for the English transcriptions then verified the transcriptions for accuracy. Only minor discrepancies were found in the transcriptions, and these were resolved by consensus. Analysis of all fluency measures was based on a 120-second sample extracted from the total speech protocol. The 120-second speech sample began 15 seconds from the initial onset of speech in a given language. The initial 15-seconds were considered to be a warm-up period in which participants became used to the story telling task. Given that there were no significant differences among the various story-telling conditions, the 120-second sample used for analysis was the first telling of a story in a given language that was not a repeat telling of a story.

Results

The alpha level of significance was set at .05 for all analyses. For each participant, scores that were 2 or more standard deviations above or below the mean on a given measure for that participant were treated as outliers and brought in to the next closest score, +/- 1 unit. All t-tests were for paired samples and two-tailed, and $N = 24$ for all statistical tests reported, unless otherwise indicated.

The results reported below are organized as follows. First, the results of the cognitive proficiency measures are reported, followed by the results of oral fluidity measures. In the third section, results describing the relationships between the cognitive proficiency and oral fluidity measures are reported. Lastly, the results describing the relationship between the cognitive proficiency and oral fluidity measures after dividing the sample into high versus low fluent speakers are reported.

Cognitive Proficiency Measures

The measures of cognitive proficiency are based on the RT and CV data from the lexical categorization and attention-shifting tasks respectively.

Lexical categorization. See Table 1 for descriptive data from the Lexical categorization task. As expected, participants displayed significantly faster mean RTs on correct trials in their L1 than in their L2 ($t(23) = -7.106, p < .001$). There was also a significant difference in participants' mean CV on correct trials between L1 and L2 ($t(23) = -3.862, p < .001$). The mean error rate for this task was 2.88% in L1 and 8.95% in L2 ($t(23) = -3.33, p < .05$), indicating that participants performed significantly better in the L1 than in their L2. Taken together, these results demonstrate that participants in this study were both faster and more efficient at lexical processing in L1 than in their L2.

Table 1

Mean Reaction Times (ms) and Mean Coefficients of Variation for First Language and Second Language on the Measure Lexical Categorization (N = 24)

	Reaction Time		Coefficient of Variability	
	First Language	Second Language	First Language	Second Language
Lexical Categorization				
M	783	917	.219	.276
SEM	24.88	24.45	.009	.015

A correlation was then computed in order to assess the relationships between speed and efficiency of lexical categorization in L1 compared to L2. Results indicated that there was a significant correlation between mean RTs in L1 and L2 on the lexical categorization task ($r = .707, p < .001$), indicating that approximately 50% of the variance of L2 performance speed was shared with performance in L1. In contrast, there was no significant correlation between mean CVs in L1 and L2 ($r = .342$, n.s.), suggesting that efficiency of lexical categorization in one language did not predict this kind of efficiency in the other language.

RT and CV measures in the L1 were used as baseline measures against which to understand performance in L2. L2-specific measures of lexical categorization (RT and CV) were computed by regressing the L2 measures against the L1 measures and using the residuals. There was a significant correlation between the L2 residualized RT and residualized CV for the lexical categorization task ($r = .642, p < .001$), indicating that in general, the faster participants were in L2 lexical categorization, the more efficient or automatic they were, after taking into account performance in L1.

Attention control. See Table 2 for descriptive data from the attention-shifting task Results are based on correct trials not following an incorrect response. The RT data from the attention-shifting task were submitted to a 2 (L1, L2) x 2 (non-matching, matching) within-subject analysis of variance (ANOVA), in order to determine if significant shift-costs existed in either language (i.e. faster responding on matching versus non-matching trials). The results revealed a significant main effect for language ($F(1,23) = 14.97$, $MSE = 51274.51$, $p = .001$), indicating that overall, participants were significantly faster at responding in their L1 versus their L2. There was also a significant main effect for condition (non-matching, matching)

Table 2

Mean Reaction Times (ms) and Mean Coefficients of Variation for First Language and Second Language on the Measures of Attention Control on Experimental Trials (N = 24)

	Reaction Time		Coefficient of Variability	
	First Language	Second Language	First Language	Second Language
Non-matching Trials				
M	2088	2173	.285	.300
SEM	60.04	77.38	.009	.010
Matching Trials				
M	1773	2045	.358	.367
SEM	54.66	51.63	.010	.011

($F(1,23) = 19.83$, $MSE = 59129.89$, $p < .001$), indicating that overall the participants responded significantly faster on matching versus non-matching trials. Lastly, a significant Language x Condition interaction effect was noted ($F(1,23) = 9.95$, $MSE = 21122.22$, $p = .004$). Post-hoc Bonferroni corrected t-tests revealed that, unexpectedly, this interaction effect was due to a significant shift-cost in the L1 ($t(23) = 6.16$, $SE = 51.07$, $p < .001$ after Bonferroni correction) while there was no significant shift-cost in L2 ($t(23) = 1.99$, $SE = 63.87$, n.s. after Bonferroni correction). Further post-hoc analyses revealed that, unexpectedly, there was a significantly greater shift-cost in L1 ($t(23) = -5.66$, $SE = 48.13$, $p < .001$ after Bonferroni correction) than in L2 ($t(23) = -1.40$, $SE = 60.97$, n.s. after Bonferroni correction). The CV data from the attention-shifting task were then similarly submitted to a 2 x 2 ANOVA. Results revealed a significant main effect of condition (non-matching, matching) ($F(1,23) = 57.96$, $MSE = .002035$, $p < .001$). Surprisingly, participants displayed higher CVs on matching versus non-matching trials. There was neither a significant main effect of language ($F(1,23) = 1.32$, $MSE = .002552$, n.s.), nor a significant interaction effect between Language x Condition ($F(1,23) = .252$, $MSE = .001297$, n.s.).

Relationships between measures of lexical categorization and attention control. In order to determine if a relationship existed between mastery of L2 and speed and efficiency of attention control, a correlation was computed between the residualized CV of the lexical categorization task, as an index of L2 mastery, and the L2 attention-shift cost RTs (obtained by residualizing L2 non-matching RTs onto L2 matching RTs). There was no significant correlation between these measures ($r = .352$, n.s.) indicating that there was no relationship between L2 speed of attention control and L2 efficiency of lexical categorization. In addition, there was no significant correlation between the residualized bilingual CV of the lexical categorization task and the L2 attention-shift cost CV ($r = .233$, n.s.), indicating that there was no relationship between L2 efficiency of lexical categorization and L2 efficiency of attention control.

Oral Fluidity Measures

Several different measures of oral fluidity were obtained from the story telling tasks. These were: (1) vocabulary richness use, as defined by the ratio of types to tokens (2) rate of speech, as defined by words per minute and (3) length of a fluid run, as defined by the number of words in the longest run of speech a participant was able to speak without using fillers. Below are the results of the different story telling conditions, followed by the results from the oral fluidity measures mentioned above.

Story telling task. In order to address the hypothesis that no statistically significant differences would be found between stories that are generally similar to each other when told in L1 versus L2 paired samples t-tests were conducted to compare performance on the stories to one another using the speech rate measure. Results indicated that, in both the L1 and L2, there were no significant differences between the three stories used to elicit the speech samples (Table 3). Tests were also conducted to see whether the telling of a story in L2 that had previously been told in L1 would produce different results from telling a story in L2 that had not previously been told in the L1 (repeat vs. non-repeat). For this, a 2 (repeat, non-repeat) x 2 (L1, L2) within-subjects ANOVA was conducted using the measure of speech rate as the dependant variable. Results indicated no significant differences between repeat and baseline (non-repeat) story tellings in either L1 or L2 (Table 4).

Vocabulary richness use. In order to assess vocabulary richness use, it was first necessary to obtain a measure of participants' use of vocabulary. For this, a measure of vocabulary richness use was calculated based on a type-token ratio. Tokens represented

Table 3

Mean Words Per Minute for the Three Stories used in the Story Telling Task (N = 12)

	First Language		Second Language	
	M	*SEM*	*M*	*SEM*
Story A	271	47.87	199	41.16
Story B	306	56.39	252	230.49
Story C	298	66.81	181	39.35

Table 4

Analysis of Variance for Mean Words per Minute for Baseline and Repeat Tellings of a Story

Source	*df*	*MS*	*F*	*p*
Within Subjects				
Condition (Repeat, Non-repeat)	1	326.24	2.03	.168
Error	22	160.68		
L1, L2 (L)	1	35869.74	35.53	.001
C x L	1	96.72	.602	.446
Error	22	1009.43		

the total number of words spoken, while types represented the number of different individual words spoken only once in a given token set. For this study the type-token ratio was based on a 50 word token set. The first 50 words spoken, excluding fillers (um, ah, etc.), from the onset of the 2-minute speech sample formed the token set. The number of types for the set was then counted (each different word being counted only once). The number of types was then divided by 50 (number of tokens) to obtain the type-token ratio that was used in these analyses (Table 5). The greater the type-token ratio the richer the use of vocabulary.

As would be expected, participants displayed a significantly richer use of vocabulary in L1 versus L2 ($t(23) = 4.00, p < .001$). There was a significant correlation between vocabulary richness in L1 and L2 ($r = .684, p < .001$), indicating that participants who used a rich vocabulary in one language tended to do so in the other and that approximately 47% of the variance of vocabulary richness use in L2 was shared with L1.

Speech rate. In order to assess speech rate, it was first necessary to obtain a measure of participants' rate of speech. For this, a speech rate measure was calculated based on the average number of words spoken per minute in L1 and L2 respectively. This was obtained by counting the total number of words spoken in the 2-minute speech sample, minus fillers (ums, ahs, and English words in the French condition). The total number of words (minus fillers) spoken in the 120-second period was then divided by 2, in order to obtain an average number of words per minute (Table 5).

As would be expected, participants spoke significantly more words per minute in L1 versus L2 ($t(23) = 9.60, p < .001$). There was a significant correlation between speech rate in L1 and L2 ($r = .406, p < .05$), indicating that participants who spoke quickly in one

Table 5

Mean Type-Token Ratio, Words per Minute, and Length of Fluid Run for the Measures of Oral Fluidity Obtained from the Story Telling Task (N = 24)

	First Language		Second Language	
	M	*SEM*	*M*	*SEM*
Type-Token Ratio	.690	.016	.636	.018
Words Per Minute	144.99	5.74	91.16	4.30
Length of Fluid Run	146.44	24.26	36.33	6.32

language also did so in the other, and that approximately 16% of the variance of words spoken per minute in L2 was shared with L1.

Fluid run length. In order to determine the mean length of a fluid it, it was necessary to obtain a measure of the mean number of words spoken between filled pauses. This was calculated by dividing the total number of words by the total number of filled pauses. For the French story condition, English words were treated as filled pauses (Table 5).

As would be expected, mean length of fluid runs was significantly longer in L1 versus L2 ($t(23) = 4.96, p < .001$). There was a significant correlation between fluid run length in L1 and L2 ($r = .440, p = .031$), indicating that the longer participants could speak without hesitation in one language, the longer they could also do so in the other, and that approximately 19% of the variance of the length of an L2 fluid run was shared with that L1.

Relationships Between Cognitive Proficiency and Oral Fluidity

For the following analyses, the measures of cognitive proficiency were the residualized L2 RT (speed) and CV (efficiency) scores from the lexical categorization task, and the residualized L2 RT and CV scores from the attention-shifting task. These L2-specific cognitive proficiency measures take into account L1 performance. The measures of oral fluidity were based on the residualized L2 measures of vocabulary richness use, speech rate, and length of fluid run.

In order to address the hypothesis that cognitive proficiency measures would be significantly associated with measures of oral fluidity, hierarchical multiple regressions were conducted. Separate analyses were done for the measures lexical categorization and attention control. The L2 oral fluidity measures residualized against L1were entered as the criterion measure for all analyses. The RT and CV measures from the cognitive tasks were entered separately as predictors. Table 6 shows the results of the RT measure of lexical categorization and Table 7 shows the results from CV measure of lexical categorization. Tables 8 and 9 show the results of the RT and CV measures from the attention-shifting task. The results revealed that none of the L2 oral fluidity measures could be predicted by speed or efficiency of lexical categorization or attention control.

In order to determine if controlling for L1 performance on a given oral fluidity measure would improve the predictive power of speed and efficiency of lexical categorization or attention control respectively, the above-mentioned regression analyses were again conducted. For these analyses, the L1 oral fluidity measures were entered first to control for L1 performance on a given oral fluidity measure, followed by either the RT or CV measures.

Vocabulary richness use. In order to determine if L2 vocabulary richness use could be predicted by cognitive proficiency, the above mentioned hierarchical multiple regression was conducted separately for the measures of lexical categorization and attention control. For the measures of vocabulary richness use and *lexical categorization*, results indicated that after controlling for both L1 vocabulary use richness and L1 speed of lexical categorization, L2 vocabulary use richness could not be predicted by efficiency of lexical categorization (Table 10). For vocabulary richness use and *attention control*, results indicate that after controlling for L1 vocabulary richness use and speed of L2 attention control, efficiency of L2 attention control ($F(1,20) = 4.432, p = .048$) accounted for a significant 9.6% unique variance in L2 vocabulary richness use (Table 11).

Table 6

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) of Lexical Categorization as a Predictor of L2 Oral Fluidity (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use	.037	.001	-.044	.001	.030	1, 22	.864
Speech Rate	.140	.019	-.025	.019	.437	1, 22	.516
Fluid Run Length	.272	.074	.032	.074	1.76	1, 22	.198

Table 7

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Lexical Categorization as a Predictor of L2 Oral Fluidity (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use	.104	.011	-.034	.011	.238	1, 22	.630
Speech Rate	.075	.006	-.040	.006	.126	1, 22	.726
Fluid Run Length	.004	.000	-.045	.000	.000	1, 22	.985

Table 8

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) of Attention Control as a Predictor of L2 Oral Fluidity (N = 24)

Variable	*R*	R^2	Adjusted R^2	R^2 Change	*F* Change	*df*	*p*
Vocabulary richness use	.006	.000	-.045	.000	.001	1, 22	.978
Speech Rate	.177	.032	-.013	.032	.716	1, 22	.407
Fluid Run Length	.077	.006	-.039	.006	.132	1, 22	.719

Table 9

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Attention Control as a Predictor of L2 Oral Fluidity (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use	.388	.150	.112	.150	3.89	1, 22	.061
Speech Rate	.033	.001	-.044	.001	.024	1, 22	.879
Fluid Run Length	.226	.051	.008	.051	1.179	1, 22	.289

Table 10

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) and Efficiency (CV) of Lexical Categorization as Predictors of L2 Lexical Richness (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Step 1							
L1 Vocabulary richness use	.684	.468	.444	.468	19.38	1, 22	.001
Step 2							
Speed of lexical categorization	.684	.468	.418	.000	.003	1, 21	.957
Efficiency of lexical categorization	.684	.468	.389	.000	.001	1, 20	.974

Table 11

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) and Efficiency (CV) of Attention Control as Predictors of L2 Lexical Richness (N = 24)

Variable	*R*	R^2	Adjusted R^2	R^2 Change	*F* Change	df	*p*
Step 1							
L1 Vocabulary richness use	.684	.468	.444	.468	19.38	1, 22	.001
Step 2							
Speed of attention control	.685	.469	.419	.001	.041	1, 21	.842
Efficiency of attention control	.752	.566	.500	.096	4.43	1, 20	.048

Speech Rate. In order to determine if L2 rate of speech could be predicted by cognitive proficiency, the above mentioned hierarchical multiple regression was conducted separately for the measures of *lexical categorization* and *attention control*. For the measures of speech rate and *lexical categorization*, results indicated that after controlling for both L1 speech rate and speed of lexical categorization, L2 speech rate could not be predicted by L2 efficiency of lexical categorization (Table 12). In addition, for the measures of speech rate and *attention control*, results indicated that after controlling for L1 speech rate and speed of L2 attention control, efficiency of L2 attention control was not associated with L2 speech rate (Table 13).

Fluid run length. In order to determine if L2 fluid run length could be predicted by cognitive proficiency, the above mentioned hierarchical multiple regression was conducted separately for the measures of lexical categorization and attention control. For the measures of fluid run length and *lexical categorization*, results indicated that after controlling for both L1 length of fluid run and speed of lexical categorization, L2 fluid run length could not be predicted by L2 efficiency of lexical categorization (Table 14). In addition, for the measures of fluid run length and *attention control*, results indicated that after controlling for L1 fluid run length and speed of L2 attention control, efficiency of L2 attention control was not associated with L2 fluid run length (Table 15).

Additional multiple regression analyses were conducted in order to determine if either speed or efficiency of cognitive proficiency alone would predict L2 oral fluidity. For these analyses, the residualized L2 oral fluidity measures were entered as the criterion measure. The L1 oral fluidity measures were entered first to control for L1 performance on a given oral fluidity measure followed by either the RT or CV measures

Table 12

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) and Efficiency (CV) of Lexical Categorization as Predictors of L2 Speech Rate (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Step 1							
L1 Speech Rate	.406	.165	.127	.165	5.29	1, 22	.049
Step 2							
Speed of lexical categorization	.437	.191	.114	.026	2.70	1, 21	.417
Efficiency of lexical categorization	.449	.202	.082	.011	.585	1, 20	.612

Table 13

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) and Efficiency (CV) of Attention Control as Predictors of L2 Speech Rate (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Step 1							
L1 Speech rate	.406	.165	.127	.165	4.35	1, 22	.049
Step 2							
Speed of attention control	.443	.196	.119	.031	.812	1, 21	.378
Efficiency of attention control	.472	.223	.106	.027	.685	1, 20	.418

Table 14

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) and Efficiency (CV) of Lexical Categorization as Predictors of L2 Fluid Run Length (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Step 1							
L1 Fluid run length	.440	.194	.157	.194	5.29	1, 22	.031
Step 2							
Speed of lexical categorization	.535	.286	.218	.092	2.70	1, 21	.115
Efficiency of lexical categorization	.553	.306	.202	.020	.585	1, 20	.453

Table 15

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) and Efficiency (CV) of Attention Control as Predictors of L2 Fluid Run Length (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Step 1							
L1 Fluid run length	.440	.194	.157	.194	5.29	1, 22	.031
Step 2							
Speed of attention control	.440	.194	.117	.000	.000	1, 21	.999
Efficiency of attention control	.457	.209	.090	.015	.372	1, 20	.549

from the lexical categorization or attention-shifting tasks respectively. Results revealed that neither speed of lexical categorization (Table 16) nor speed of attention control (Table 17) predicted L2 oral fluidity. Similarly, efficiency of lexical categorization (Table 18) did not predict L2 oral fluidity. Interestingly, efficiency of attention control predicted L2 vocabulary richness use, but none of the other oral fluidity measures (Table 19).

The above-mentioned results reflect the relationship between the cognitive proficiency measures and the oral fluidity measures for the sample as a whole. Following from the previously mentioned utility of making a distinction between more and less fluent participants, below are the results of the above-mentioned relationships after the sample was divided into high versus low fluent participants on a given oral fluidity measure.

High Versus Low Fluent Participants and Measures of Cognitive Proficiency

Vocabulary richness use. In order to determine if speed and efficiency of lexical categorization differed between groups of high and low fluent participants, the sample was divided by median split on the basis of L2 vocabulary use richness (obtained by residualizing L2 vocabulary richness use against L1 vocabulary richness use, in order to partial out baseline individual differences in vocabulary richness use). Correlations were then conducted between the L2-specific RT and CV from the lexical categorization task for each of the high and low fluent groups. For the high fluent group there was a significant correlation between the L2-specific RT and CV from the lexical categorization task ($r = .825$, $p = .001$ but not for the low fluent group ($r = .415$, $p = .180$), indicating that for the group of participants that displayed higher vocabulary

Table 16

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) of Lexical Categorization as a Predictor of L2 Oral Fluidity (N = 24)

Variable	*R*	R^2	Adjusted R^2	R^2 Change	*F* Change	*df*	*p*
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.684	.468	.444	.468	19.38	1, 22	.000
Step 2 Speed of lexical categorization	.684	.468	.418	.000	.003	1, 21	.957
Speech Rate							
Step 1 L1 Speech rate	.406	.165	.127	.165	4.35	1, 22	.049
Step 2 Speed of lexical categorization	.437	.437	.191	.026	.686	1, 21	.417
Fluid Run Length							
Step 1 L1 Fluid run length	.440	.194	.157	.194	5.29	1, 22	.031
Step 2 Speed of lexical categorization	.535	.286	.218	.092	.092	1, 21	.115

Table 17

Summary of Hierarchical Multiple Regression Analysis for Speed (CV) of Attention Control as a Predictor of L2 Oral Fluidity (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1	.684	.468	.444	.468	19.38	1, 22	.000
L1 Vocabulary richness use							
Step 2	.685	.469	.419	.001	.041	1, 21	.842
Speed of attention control							
Speech Rate							
Step 1	.406	.165	.127	.165	4.35	1, 22	.049
L1 Speech rate							
Step 2	.443	.196	.119	.031	.812	1, 21	.378
Speed of attention control							
Fluid Run Length							
Step 1	.440	.194	.157	.194	5.29	1, 22	.031
L1 Fluid run length							
Step 2	.440	.194	.117	.000	.000	1, 21	.999
Speed of attention control							

Table 18

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Attention Control as a Predictor of L2 Oral Fluidity (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.684	.468	.444	.468	19.38	1, 22	.000
Step 2 Efficiency of lexical categorization	.684	.468	.418	.000	.003	1, 21	.993
Speech Rate							
Step 1 L1 Speech rate	.406	.165	.127	.165	4.35	1, 22	.049
Step 2 Efficiency of lexical categorization	.407	.166	.086	.001	.019	1, 21	.892
Fluid Run Length							
Step 1 L1 Fluid run length	.440	.194	.157	.194	5.29	1, 22	.031
Step 2 Efficiency of lexical categorization	.449	.201	.125	.007	.191	1, 21	.666

Table 19

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Attention Control as a Predictor of L2 Oral Fluidity (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1	.684	.468	.444	.468	19.38	1, 22	.000
L1 Vocabulary richness use							
Step 2	.749	.561	.519	.093	4.44	1, 21	.047
Efficiency of attention control							
Speech Rate							
Step 1	.406	.165	.127	.165	4.35	1, 22	.049
L1 Speech rate							
Step 2	.429	.184	.107	.019	.500	1, 21	.487
Efficiency of attention control							
Fluid Run Length							
Step 1	.440	.194	.157	.194	5.29	1, 22	.031
L1 Fluid run length							
Step 2	.456	.208	.133	.014	.379	1, 21	.545
Efficiency of attention control							

richness use, individual differences in speed of lexical categorization was correlated with individual differences in efficiency of categorization (faster responders were more automatic) whereas this was not true for the low fluent group.

In addition the same analyses were conducted using the L2 attention-shift cost RT and CV in order to determine if high and low fluent participants differed in speed or efficiency of attention control. Results revealed that there was no significant correlation between the measure of L2 vocabulary richness use and the L2 attention-shift cost RT or CV for either the high or low fluent group ($r = -.090$, n.s., and $r = .318$, n.s., respectively), indicating that the groups of high and low fluent participants did not differ in speed or efficiency of attention control.

Speech rate. In order to determine if speed and efficiency of lexical categorization differed between groups of fast and slow fluent participants, the sample was divided on the basis of the residualized bilingual speech rate measure (obtained by residualizing L2 speech rate against L1 speech rate). The L2 fastest speakers after controlling for L1 speech rate were considered "Fast" fluent participants, while the remaining L2 participants were considered "Slow" fluent participants. Correlations were then conducted between the L2-specific RT and CV from the lexical categorization task for each of the high and low fluent groups in order to determine if automaticity of word recognition differed between fast and slow fluent participants. For the fast fluent group there was a significant correlation between the language specific RT and CV from the lexical categorization task ($r = .751, p = .05$), but not for the slow fluent group ($r = .575$, n.s.), indicating that for the fast fluent group, individual differences in speed of lexical categorization was correlated with individual differences in efficiency of lexical categorization (faster responders were more automatic) whereas this was not true for the slow fluent group.

In addition the same analyses were conducted using the L2 attention-shift cost RT and CV in order to determine if fast and slow fluent participants differed in speed or efficiency of attention control. Results revealed that there was no significant correlation between the measure of L2 speech rate and the L2 attention-shift cost RT or CV for either the fast or slow fluent group ($r = .048$, n.s., and $r = .221$, n.s., respectively), indicating that there was no significant difference between these groups in either speed or efficiency of attention control.

Fluid run length. In order to determine if speed and efficiency of lexical categorization differed between groups of high and low fluent participants, the sample was divided on the basis of the residualized bilingual fluid run measure (obtained by residualizing L2 fluid run length against L1 fluid run length). The 10 participants that displayed the longest fluid runs after controlling for L1 fluid run length were considered "high" fluent participants, while the remaining 14 participants were considered "low" fluent participants. Correlations were then conducted between the L2-specific RT and CV from the lexical categorization task for each of the high and low fluent groups in order to determine if automaticity of word recognition differed between high and low fluent participants. For the fast fluent group there was no significant correlation between the language specific RT and CV from the lexical categorization task ($r = .594$, n.s.). Unexpectedly, there was a significant correlation between the language specific RT and CV from the lexical categorization task for the low fluent group($r = .736, p < .05$), indicating that for the slow fluent group, individual differences in speed of lexical categorization was correlated with individual differences in efficiency of lexical categorization (faster responders were more automatic) whereas this was not true for the slow fluent group.

In addition the same analyses were conducted using the L2 attention-shift cost RT and CV in order to determine if fast and slow fluent participants differed in speed or efficiency of attention control. There was no significant correlation between the measure of L2 fluid run length and the L2 attention-shift cost RT or CV for either the high or low fluent group ($r = -.140$, n.s., and $r = .378$, n.s., respectively), indicating that there was no significant difference in speed or efficiency of attention control for these groups.

High Versus Low Fluent Participants and the Association Between Cognitive Proficiency and Oral Fluidity.

Above are the results of the cognitive proficiency measures after the group of participants was divided into high and low fluent participants based on the measures of oral fluidity. Next we report the results of the association between cognitive proficiency and oral fluidity after the participants were divided into the aforementioned groups.

In an attempt to answer the fourth hypothesis, hierarchical multiple regressions were conducted in order to determine if the oral fluidity measures were associated with the measures of cognitive proficiency after dividing the group into high versus low fluent participants. Separate analyses were done for the measures lexical categorization and attention control. The residualized L2 oral fluidity measures were entered as the criterion measure for all analyses, and the RT and CV measures from the cognitive tasks were entered separately as predictors. The L1 oral fluidity measures were entered first to control for L1 performance on a given oral fluidity measure, followed by the RT and CV measures respectively. For the high fluent group, neither speed (Table 20) nor efficiency (Table 21) of lexical categorization predicted L2 oral fluidity after controlling for performance on these measures. The same held true for the low fluent group (Table 22 and Table 23). Inaddition, when considering speed (Table 24) and efficiency (Table 25) of attention control, for the high fluent group there was no relationship between L2-specific measures of attention control and L2 oral fluidity. The same held true for the low fluent group Table 26 and Table 27).

Table 20

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) of Lexical Categorization as a Predictor of L2 Oral Fluidity for the High Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.900	.810	.791	.810	42.63	1, 10	.000
Step 2 Speed of lexical categorization	.924	.854	.822	.044	2.70	1, 9	.134
Speech Rate							
Step 1 L1 Speech rate	.757	.572	.530	.572	13.38	1, 10	.004
Step 2 Speed of lexical categorization	.757	.573	.478	.001	.017	1, 9	.898
Fluid Run Length							
Step 1 L1 Fluid run length	.762	.581	.529	.581	11.10	1, 8	.101
Step 2 Speed of lexical categorization	.802	.643	.541	.062	1.22	1, 7	.307

Table 21

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Lexical Categorization as a Predictor of L2 Oral Fluidity for the High Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.900	.810	.791	.810	42.63	1, 10	.000
Step 2 Efficiency of lexical categorization	.906	.821	.781	.011	.543	1, 9	.480
Speech Rate							
Step 1 L1 Speech rate	.757	.572	.530	.572	13.38	1, 10	.004
Step 2 Efficiency of lexical categorization	.763	.583	.490	.010	.223	1, 9	.684
Fluid Run Length							
Step 1 L1 Fluid run length	.762	.581	.529	.581	11.10	1, 8	.010
Step 2 Efficiency of lexical categorization	.800	.640	.537	.059	1.13	1, 7	.322

Table 22

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) of Lexical Categorization as a Predictor of L2 Oral Fluidity for the Low Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.844	.713	.684	.713	24.82	1, 10	.001
Step 2 Speed of lexical categorization	.849	.721	.659	.008	.274	1, 9	.613
Speech Rate							
Step 1 L1 Speech rate	.325	.106	.016	.106	1.18	1, 10	.302
Step 2 Speed of lexical categorization	.508	.258	.094	.153	1.85	1, 9	.207
Fluid Run Length							
Step 1 L1 Fluid run length	.788	.621	.590	.621	19.70	1, 12	.001
Step 2 Speed of lexical categorization	.805	.647	.583	.026	.811	1, 11	.387

Table 23

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Lexical Categorization as a Predictor of L2 Oral Fluidity for the Low Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.844	.713	.684	.713	24.82	1, 10	.001
Step 2 Efficiency of lexical categorization	.850	.722	.660	.009	.287	1, 9	.605
Speech Rate							
Step 1 L1 Speech rate	.325	.106	.016	.106	1.18	1, 10	.302
Step 2 Efficiency of lexical categorization	.468	.219	.045	.113	1.30	1, 9	.283
Fluid Run Length							
Step 1 L1 Fluid run length	.788	.621	.590	.621	19.70	1, 12	.001
Step 2 Efficiency of lexical categorization	.819	.670	.610	.048	1.62	1, 11	.230

Table 24

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) of Attention Control as a Predictor of L2 Oral Fluidity for the High Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1	.900	.810	.791	.810	42.64	1, 10	.000
L1 Vocabulary richness use							
Step 2	.916	.838	.802	.028	1.57	1, 9	.242
Speed of attention control							
Speech Rate							
Step 1	.757	.572	.530	5.72	13.39	1, 10	.004
L1 Speech rate							
Step 2	.775	.601	.513	.029	.653	1, 9	.440
Speed of attention control							
Fluid Run Length							
Step 1	.762	.581	.529	.581	11.10	1, 8	.010
L1 Fluid run length							
Step 2	.765	.585	.466	.004	.065	1, 7	.807
Speed of attention control							

Table 25

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Attention Control as a Predictor of L2 Oral Fluidity for the High Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.900	.810	.791	.810	42.64	1, 10	.000
Step 2 Efficiency of attention control	.912	.831	.794	.021	1.13	1, 9	.314
Speech Rate							
Step 1 L1 Speech rate	.757	.572	.530	5.72	13.39	1, 10	.004
Step 2 Efficiency of attention control	.838	.703	.637	.130	3.95	1, 9	.078
Fluid Run Length							
Step 1 L1 Fluid run length	.762	.581	.529	.581	11.10	1, 8	.010
Step 2 Efficiency of attention control	.809	.654	.556	.073	1.48	1, 7	.263

Table 26

Summary of Hierarchical Multiple Regression Analysis for Speed (RT) of Attention Control as a Predictor of L2 Oral Fluidity for the Low Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1	.844	.713	.684	.713	24.82	1, 10	.001
L1 Vocabulary richness use							
Step 2	.844	.713	.649	.000	.000	1, 9	.939
Speed of attention control							
Speech Rate							
Step 1	.325	.106	.016	.106	1.18	1, 10	.302
L1 Speech rate							
Step 2	.497	.247	.080	.141	1.69	1, 9	.226
Speed of attention control							
Fluid Run Length							
Step 1	.788	.621	.590	.621	19.70	1, 12	.001
L1 Fluid run length							
Step 2	.797	.635	.568	.013	.400	1, 11	.540
Speed of attention control							

Table 27

Summary of Hierarchical Multiple Regression Analysis for Efficiency (CV) of Attention Control as a Predictor of L2 Oral Fluidity for the Low Fluent Group (N = 24)

Variable	R	R^2	Adjusted R^2	R^2 Change	F Change	df	p
Vocabulary richness use							
Step 1 L1 Vocabulary richness use	.844	.713	.684	.713	24.82	1, 10	.001
Step 2 Efficiency of attention control	.868	.753	.698	.040	1.47	1, 9	.256
Speech Rate							
Step 1 L1 Speech rate	.325	.106	.016	.106	1.18	1, 10	.302
Step 2 Efficiency of attention control	.427	.183	.001	.077	.845	1, 9	.382
Fluid Run Length							
Step 1 L1 Fluid run length	.788	.621	.590	.621	19.70	1, 12	.001
Step 2 Efficiency of attention control	.804	.647	.583	.025	.791	1, 11	.393

Discussion

The present study addressed four main questions. These were: (1) what relationships exist between cognitive proficiency and oral fluidity, (2) would controlling for L1 performance on measures of oral fluidity yield more interesting results than when L1 performance was not controlled for, (3) would the different story telling conditions of the story telling task yield similar results, and (4) would the relationships between cognitive proficiency and oral fluidity differ between more and less fluent bilinguals.

The first hypothesis of the current study was that there would be no statistically significant differences between stories that are generally similar to each other when told in L1 versus L2. The findings suggest that the stories were in fact essentially equivalent in their elicitation of speech samples across languages. In addition, our results suggest that the stories elicit relatively similar speech samples within the same language. There was no difference detected between a repeat telling and a non-repeat telling of a story, suggesting that it is possible to use these stories to obtain similar speech samples across languages. This finding is particularly useful in that it may point to methodology that allows researchers to obtain relatively similar speech samples in both L1 and L2. As such, it may be possible to use the story telling task as a means to obtain L2-specific measures of productive speech.

The second hypothesis was that there would be statistically significant relationships between measures of L2-specific cognitive proficiency and L2 oral fluidity measures. The current findings did not support this hypothesis. Both for the sample as a whole, and after dividing the sample into higher and lower fluent participants, there were no significant relationships between the cognitive proficiency and oral fluidity measures.

These results are surprising given both previous research (Freed & Segalowitz, 2004) and what would intuitively be expected. Possible reasons for this are addressed below.

The third hypothesis was that controlling for L1 performance on the measures of oral fluidity would strengthen the relationships between L2 measures of cognitive proficiency and oral fluidity. The findings of the current study did not support this hypothesis. After controlling for L1 performance, only efficiency of attention control was associated with one of the oral fluidity measures – efficiency of attention control was significantly related to L2 vocabulary richness use. Given that this was the only significant relationship noted, it is likely that this was due to a chance finding. In addition, after dividing the group into higher versus lower fluent bilinguals, there were no significant relationships between our measures of cognitive proficiency and oral fluidity after controlling for L1 performance.

Interestingly, the results revealed a strong relationship between L1 and L2 performance on the measures of oral fluidity. As such, it may be that factors that contribute to L1 oral fluidity also contribute to L2 oral fluidity. This suggests that controlling for L1 performance when measuring L2 oral fluidity is important. By taking into account L1 oral performance, we improve the chances of detecting L2-specific factors that contribute to L2 oral fluidity. Future research may better identify the underlying factors that contribute to oral fluidity, particularly those that are L2-specific. In doing so, it may be possible to capitalize on these factors in order to improve L2 apprenticeship and thus mastery. It is possible that through practice and training, these as yet unidentified factors might be maximized during the learning process (Gatbonton & Segalowitz, 2005).

Lastly, the fourth hypothesis was that relationships between measures of cognitive proficiency and oral fluidity would be stronger in the group of high fluent participants versus low fluent participants. The findings of the current study support previous research demonstrating that participants who show a higher level of L2 mastery also show evidence for automaticity of lexical categorization (Favreau & Segalowitz, 1983). In the current study, participants that used a richer vocabulary and spoke comparatively quickly also showed evidence for greater automaticity of lexical categorization in the L2 than their less fluent counterparts. Interestingly, contrary to what was expected, the participants in the present study who spoke in shorter fluid runs showed greater automaticity, and were therefore more efficient in their cognitive processing of language than their apparently more fluent counterparts.

In retrospect, it is possible that the story telling task did not provide data sensitive to oral fluency. The task was conducted quite informally, as participants were asked to tell the stories as freely and naturally as possible. In addition, it is conceivable that given the child like nature of the stories, as well as the relaxed atmosphere of the task, that participants were not required to push the limits of their L2 skill. An informal analysis of the speech samples suggests that participants stayed relatively close to the confines of the pictures, often describing what they saw rather than elaborating on a story per se. As such, the task may have been so simple as to not tap into L2 ability sufficiently well to reveal consistent individual differences as a function of level of ability. Another interesting aspect of this task was that participants were aware that the researcher they were telling the stories to was a native speaker of their L1. Speaking to a native speaker of your own L1 in your L2 is, for the most part, rather unnatural. It is possible that this unnatural element of the task influenced how the participants used their L2. Another possible explanation might be that given that the stories were in fact intended for children, and that this fact was easily discernable, it is possible that the participants used more simplistic speech in their story tellings, much as they would have they been telling the stories to a child. Future research intending to use this task as a means to elicit speech sample may want to consider these and other possibilities in order to maximize it's usefulness.

Interestingly, the findings in relation to the attention-shifting task were not consistent with previous research (Monsell, Sumner & Waters, 2003; Rogers & Monsell, 1995; Wylie & Allport, 2000). Participants in the current study showed significant RT shift-costs in the L1, but not in L2, and these same RT shift-costs were significantly greater in L1 than in L2. It is unclear why the results on this task differed from what was expected. Segalowitz and de Almeida (2002) have speculated that repeated presentation of a relatively small set of stimuli may lead to an increase in perceptual fluency for the stimuli in question. As such, any perceptual advantage for the L1 might have been removed. It is thus possible that these unexpected findings clouded the relationships between oral fluidity and attention control.

The current study set out to accomplish three main tasks. The first of these was to explore the relationships between cognitive factors known to be associated with L2 mastery and elements of productive speech. This is an important question to address given that it is possible that cognitive factors associated with L2 mastery may or may not translate into communicative competence. As previously mentioned, the fundamental purpose of language is communication between individuals, and it was assumed that the measures of oral proficiency would tap into this communicative competence. Unfortunately the current findings do not support this assumption; however, further research that takes into consideration the methodological shortcomings of the story telling task may help elucidate these relationships.

Lastly, although the current study did not find clear support for the idea that controlling for L1 oral fluidity would strengthen the relationships between cognitive proficiency and oral fluidity, there was a strong relationship between L1 and L2 measures of oral fluidity, which points to the importance of taking L1 performance into account when considering L2 oral fluidity. In doing so future research may be able to identify L2-specific factors that contribute to L2 oral fluidity, and as such assist in the development of teaching programs and strategies designed that maximize these factors, and this L2 mastery.

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APPENDIX A

Word stimuli for the lexical categorization task

English word stimuli

AN ANT
THE TURTLE
THE HANDKERCHIEF
THE CHINA
A BROTHER
A BEAR
THE DUCK
A CHOCOLATE
A COAT
THE ROBIN
A WOLF
A KETTLE
THE SPOON
THE FELLOW
A SWEATER
THE ROOSTER
THE KITCHEN
THE TIRE
THE RABBIT
A MAN
A FATHER
THE BUTTON
A PLANE
A DOG
THE NAPKIN
AN ENTRANCE
A TAPE
THE TEACHER
THE KING
AN UNCLE
A DISH
THE TIGER
THE GRANDFATHER
A POCKET
THE SHIRT
A DONKEY
THE SALMON
A BIRD
THE PAN
AN AIRPORT
A BANK
THE CAT

A CLOCK
THE TOY
THE GLASS
AN INSECT
A STUDENT
A NURSE
A CHILD
A SUBWAY
THE SWAN
THE BELT
THE CANOE
A DRINK
THE WORM
A NEPHEW
AN INN
THE MILK
A STAMP
THE BUTTERFLY
A HEN
THE TIE
THE MOTHER
THE HILL

French word stimuli

UNE	FOURMI
LA	TORTUE
LE	MOUCHOIR
LA	PORCELAINE
UN	FRÈRE
UN	OURS
LE	CANARD
UN	CHOCOLAT
UN	MANTEAU
LE	ROUGE-GORGE
UN	LOUP
UNE	BOUILLOIRE
LA	CUILLÈRE
LE	COPAIN
UN	CHANDAIL
LE	COQ
LA	CUISINE
LE	PNEU
LE	LAPIN
UN	HOMME
UN	PÈRE
LE	BOUTON
UN	AVION
UN	CHIEN
LA	SERVIETTE
UNE	ENTRÉE
UN	RUBAN
LE	PROFESSEUR
LE	ROI
UN	ONCLE
UNE	ASSIETTE
LE	TIGRE
LE	GRAND-PÈRE
UNE	POCHE
LA	CHEMISE
UN	ÂNE
LE	SAUMON
UN	OISEAU
LE	POÊLE
UN	AÉROPORT
UNE	BANQUE
LE	CHAT
UNE	HORLOGE
LE	JOUET
LE	VERRE
UN	INSECTE
UN	ÉTUDIANT
UNE	INFIRMIÈRE
UN	ENFANT
UN	METRO
LE	CYGNE
LA	CEINTURE
LE	CANOT
UNE	BOISSON
LE	VER
UN	NEVEU
UNE	AUBERGE
LE	LAIT
UN	TIMBRE
LE	PAPILLON
UNE	POULE
LA	CRAVATE
LA	MÈRE
LA	COLLINE

APPENDIX B

Stimuli for the attention-shifting task

Neutral stimuli

Brackets	Symbols	Letters	Digits
[	%	P	5
]	!	T	6
{	?	X	7
}	&	Y	9

English stimuli

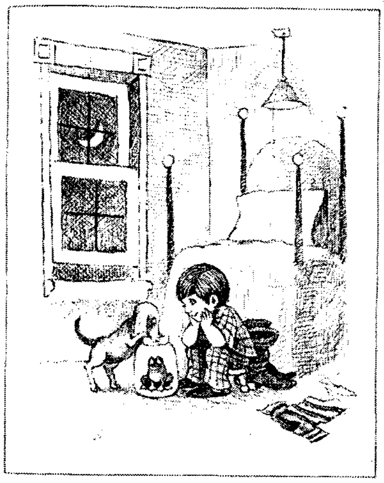
Category 1	Category 2	Category 3	Category 4
Near	Far	Over	Under
Near by	Farther	On top of	Below
Close	Further	Above	Beneath
Close by	Beyond	High above	Underneath

French stimuli

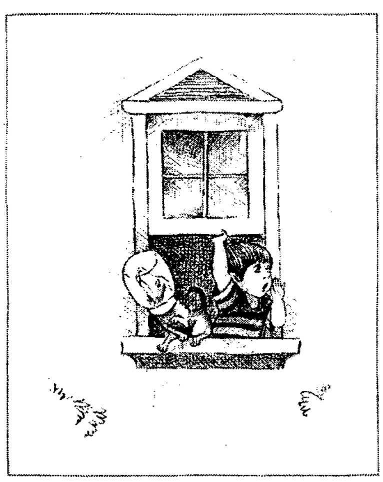
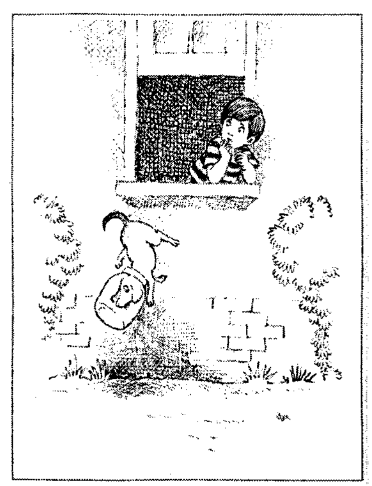
Category 1	Category 2	Category 3	Category 4
Proche	Loin	Dessus	Dessous
Près	Lointain	Sur	Sous
Tout près	Éloigné	En haut	En bas
À côté	Au delà	Au-dessus	Au-dessous

APPENDIX C

Sample Images from the Story Telling Task





APPENDIX D

Language order counter-balancing for the lexical categorization and attention-shifting tasks

Ss ID	Lexical-categorization task	Attention-shifting task	Story-telling task
1	L1 – L2	L1 – L2	L1 – L2
2	L1 – L2	L1 – L2	L1 – L2
3	L1 – L2	L1 – L2	L1 – L2
4	L1 – L2	L1 – L2	L1 – L2
5	L2 – L1	L2 – L1	L2 – L1
6	L2 – L1	L2 – L1	L2 – L1
7	L2 – L1	L2 – L1	L2 – L1
8	L2 – L1	L2 – L1	L2 – L1
9	L1 – L2	L1 – L2	L1 – L2
10	L1 – L2	L1 – L2	L1 – L2
11	L1 – L2	L1 – L2	L1 – L2
12	L1 – L2	L1 – L2	L1 – L2
13	L2 – L1	L2 – L1	L2 – L1
14	L2 – L1	L2 – L1	L2 – L1
15	L2 – L1	L2 – L1	L2 – L1
16	L2 – L1	L2 – L1	L2 – L1
17	L1 – L2	L1 – L2	L1 – L2
18	L1 – L2	L1 – L2	L1 – L2
19	L1 – L2	L1 – L2	L1 – L2
20	L1 – L2	L1 – L2	L1 – L2
21	L2 – L1	L2 – L1	L2 – L1
22	L2 – L1	L2 – L1	L2 – L1
23	L2 – L1	L2 – L1	L2 – L1
24	L2 – L1	L2 – L1	L2 – L1

APPENDIX E

Counter-balancing schedule for the story-telling task

Story
A = Frog Where are You?
B = A Boy, a Dog, and a Frog
C = A Boy, a Dog, a Frog, and a Friend

Language
E = English
F = French

Subject	Story	Story	Story	Story
1	A-E	A-F	B-E	C-F
2	A-E	A-F	C-E	B-F
3	A-E	A-F	B-E	C-F
4	A-E	A-F	C-E	B-F
5	B-F	B-E	C-F	A-E
6	B-F	B-E	A-F	C-E
7	B-F	B-E	C-F	A-E
8	B-F	B-E	A-F	C-E
9	C-E	C-F	A-E	B-F
10	C-E	C-F	B-E	A-F
11	C-E	C-F	A-E	B-F
12	C-E	C-F	B-E	A-F
13	B-F	C-E	A-F	A-E
14	C-F	B-E	A-F	A-E
15	B-F	C-E	A-F	A-E
16	C-F	B-E	A-F	A-E
17	C-E	A-F	B-E	B-F
18	A-E	C-F	B-E	B-F
19	C-E	A-F	B-E	B-F
20	A-E	C-F	B-E	B-F
21	A-F	B-E	C-F	C-E
22	B-F	A-E	C-F	C-E
23	A-F	B-E	C-F	C-E
24	B-F	A-E	C-F	C-E

APPENDIX F

Consent form

CONSENT FORM

This is to state that I agree to participate in a program of research being conducted by Angela Ring of the Department of Psychology at Concordia University as a requirement for completion of the Master's degree, under the supervision of Professor Norman Segalowitz.

A. PURPOSE

I have been informed that the purpose of this research is to study processes underlying attention and fluency development in a second language.

B. PROCEDURES

I have been informed that this study will take place at Concordia University, in the laboratory of Dr. Segalowitz. I have been informed that the tasks I will be asked to accomplish consist of identifying stimuli which will appear on a computer screen by responding on a keypad; providing four speech samples, and filling out a questionnaire. I am aware that my responses will be timed. The total testing time will be approximately one hour.

C. CONDITIONS OF PARTICIPATION

- ✓ I understand that I may decline to participate in the experiment without negative consequences.
- ✓ I understand that I am free to withdraw my consent and discontinue my participation at any time without negative consequences.
- ✓ I understand that my participation in this study is confidential (i.e., the researcher will know but will not disclose my identity).
- ✓ I understand that the data from this study may be published or presented at a scientific conference, and that the data will be reported in a way that protects each participant's identity.
- ✓ I understand the purpose of this study and know that there is no hidden motive of which I have not been informed.
- ✓ I will receive 1 course credit or $10 per hour of study upon completion of my participation.
- ✓ I understand that I may request a copy of the final research report once the study has been completed (August 2005) by writing to Professor Segalowitz at *norman.segalowitz@concordia.ca* .
- ✓ I may have a copy of this agreement.

I HAVE CAREFULLY STUDIED THE ABOVE AND UNDERSTAND THIS AGREEMENT. I FREELY CONSENT AND AGREE TO PARTICIPATE IN THIS STUDY.

Participant's Name (please print) ______________________________

Participant's Signature: ______________________________

Researcher's Signature: ______________________________

Date: ______________________________

For inquiries about this research please contact Dr. Norman Segalowitz at 514.848.2424, extension 2239.

If you have any questions about your rights as a research participant you may contact Michelle Hoffman, Compliance Officer, Concordia University, at *michelle.hoffman@concordia.ca* or by calling 514.848.2424, extension 7481

APPENDIX G

Instructions for story-telling task

INSTRUCTIONS

We are in the process of gathering story-telling samples as part of a study on how people pay attention to, perceive and interpret stories told both in their first and second language. You will be given three storybooks that consist of pictures only, and asked to tell the stories to a bilingual researcher based on these pictures. Please think of these as three separate stories. Sometimes the researcher will ask you to tell the story in English, and sometimes in French. We ask that you try to tell the stories as naturally as possible. *There is no right or wrong way to tell these stories*; just tell them in the most natural way you can.

We are mostly interested in the content of the stories, and so we ask that you focus on telling the story as freely and as naturally as possible. Should you come across a picture that you are unsure of how to describe, we ask that you simply do your best, and continue telling the story as best you can.

We are most interested in WHAT you say, not HOW you say it.