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Lexicalization and Stuttering: Comments on Prins, Main, and Wampler (1997)

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Prins, Main, and Wampler (1997) examined whether people who stutter have slower lexical access time than people who do not stutter. Their study was based on the two-stage model of lexical access proposed by Kempen and Huijbers (1983). According to Kempen and Huijbers' model, lexicalization time (Lex) is divided into two separate non-overlapping stages: L1, lexicalization for retrieving semantic and syntactic information and L2, lexicalization for accessing the word form (articulatory plan). A picture-naming experiment was used to test the validity of their model. Kempen and Huijbers showed that the speech-onset time in naming an actor (a noun) was shorter than that in naming an action (a verb). This is shown in sections (a) and (b) of Figure 1 by the length of the lines along the time axis (the abscissa). The time to speech onset when naming both the actor and the action (noun plus verb), shown in Figure 1(c), was longer than that for naming just the actor. This showed that lexical access for the verb commenced before speech onset of the noun plus verb (N+V) utterance. The speech-onset time in naming both the actor and the action was, however, found to be approximately equal to that for naming just the action. Kempen and Huijbers argued that the L1 lexicalization time for both the noun and the verb overlapped, and the speech-onset time was dominated by the longer of the two, the L1 lexicalization time for the verb. This is shown in the L1-labelled sections on the left of Figure 1(c). When naming both the actor and the action, L2 lexicalization of the noun needs to be completed before speech onset. L2 lexicalization of the verb is assumed to occur in sequence after the L2 lexicalization of the noun, in parallel with the motor execution of the noun.

Prins et al. (1997) assumed that lexical access took place after picture recognition in a picture-naming task. Therefore, a picture-recognition task was carried out with each participant in which four pictures were presented visually on a computer screen after a word was heard. The word was either the actor or the action in one of the four pictures. The participant was asked to press the space bar on the computer keyboard when either the actor or the action in the picture matched the word. The picture naming task was then conducted in the same way as in Kempen and Huijbers' (1983) study. The participants were asked to name the actor (N), the action (V), or both (N+V) after seeing a picture. The reaction time taken from the picture onset to the button response made up the picture-recognition latency (PRL) in the picture-recognition task. The overall response time from picture onset to speech onset in the picture-naming task was the speech-onset latency (SOL). Prins et al. assumed that the lexicalization time before speech onset (Lex) was the difference between the speech-onset latency (SOL) and the picture-recognition latency (PRL); that is, $Lex = SOL - PRL$ for corresponding noun and verb conditions. For the N+V condition, picture-recognition latency was assumed to be that of the noun condition.

Prins et al.'s (1997) data showed that the lexicalization time before speech onset for the noun naming condition, Lex(N), was similar for both speakers who do and those who do not stutter. On the other hand, the lexicalization time before speech onset for the verb naming condition, Lex(V), and for the noun plus verb condition, Lex(N+V), were both longer for speakers who stutter in comparison to speakers who do not stutter. Both conditions in question involve planning a verb. Furthermore, according to Kempen and Huijbers' (1983) two-stage model, both lexicalization times, Lex(V) and Lex(N+V), are dominated by the L1 lexicalization time of the verb, L1(V), as is seen if sections (b) and (c) of Figure 1 are compared. Prins et al. concluded that dysfluencies arose because of the longer L1 lexicalization time for verbs in speakers who stutter compared to that in speakers who do not.

There are two major problems in Prins et al.'s (1997) study that this letter addresses. First, Prins et al.'s assumption that Kempen and Huijbers' (1983) model applied to their experiment is not supported by their own data. Second, the assumption that the lexicalization time before speech onset (Lex) is the difference between the speech-onset latency (SOL) and the picture-recognition latency (PRL) is debatable.

On the first point, Kempen and Huijbers' (1983) lexicalization time model is used to identify the composition of the total lexicalization time before speech onset, and it is pivotal to Prins et al.'s (1997) argument. Prins et al.'s data on control speakers, however, did not replicate Kempen and Huijbers' findings. Table 1 is based on Prins et al.'s data from their experiment I. The data for the control speakers show that mean Lex(V), 186 ms, is only half of the mean Lex(N+V), 368 ms, *and not approximately equal as in Kempen and Huijbers' experiment*. Prins et al. justified application of Kempen and Huijbers' two-stage model by pointing out that the lexicalization time before speech onset, Lex(N+V), was smaller than the sum of Lex(V) plus Lex(N). With Lex(V) roughly half that of Lex(N+V), Prins et al.'s data are only consistent with a partial-parallel processing model, at best.

Such a partial-parallel processing model has been suggested by Meyer (1996, p. 492) who argued that it is possible that L1 lexicalization of both words happen in parallel, but that they do not start at the same time. This is shown in Figure 2, in which the horizontal lines are offset along the time axis. This partial-parallel processing model can best account for Prins et al.'s (1997) data. Participants in their study might have adopted this strategy (in contrast with those in Kempen & Huijbers' experiment, 1983) because of a difference in the instructions given to the participants at the start of the test. Kempen and Huijbers imposed time pressure on the participants by instructing them to respond as soon as they could after seeing the picture stimulus, which would encourage a greater degree of parallel processing than Prins et al.'s experiment. Because Kempen and Huijbers' parallel model, presented in Figure 1, does not appear to apply to their control subjects, Prins et al.'s claim that L1 lexicalization time for verbs is longer for the speakers in the stuttering group cannot be established. According to the partial-parallel model, the longer lexicalization time before speech onset, Lex(N+V), for stuttering speakers could arise from less overlap between the L1 lexicalization time for the noun, L1(N), and the L1 lexicalization time for the verb, L1(V). The longer lexicalization time for a verb on its own, Lex(V), for people who stutter could be the result of a longer L2 lexicalization time of verbs for this speaker group. Such longer lexicalization time might reflect a deficit in accessing the articulatory plan.

There is another possible explanation for the longer lexicalization time before speech onset for the verb and the noun plus verb conditions. One cannot, at present, rule out that the planning process for fluent speakers differs from that of stuttering speakers. The stuttering speakers may opt to delay speech onset until after the completion of L2 lexicalization of the verb as well as the noun in the noun plus verb condition. That is, the lexicalization time

before speech onset for stuttering speakers would be the sum of the times for L1 lexicalization of the verb, the L2 lexicalization of the noun and the L2 lexicalization of the verb. By employing such a strategy, people who stutter can avoid the L2(V) lexicalization step occurring in parallel with the motor execution of the first noun. Under such an assumption, either a longer L1 or L2 lexicalization time for the verb could result in the longer lexicalization time before speech onset for the verb condition and the noun plus verb condition, as observed by Prins et al. (1997).

Not only are Prins et al.'s (1997) data not consistent with Kempen and Huijbers' (1983) model, as shown previously, but the assumptions underlying their reasoning differ from those of Kempen and Huijbers'. Prins et al. assumed that the lexicalization time before speech onset was the difference between the speech-onset latency and the picture-recognition latency. This assumption was based on their view that lexical access occurred after visual recognition ended (the duration of the latter was assumed to be measured by the picture-recognition latency). Kempen and Huijbers, on the other hand, suggested that the picture-recognition process and lexicalization took place in parallel. They suggested that the picture-recognition latency was the L1 lexicalization time, and the difference between the speech-onset latency and the picture-recognition latency was the L2 lexicalization time (pp. 207–208). By employing Kempen and Huijbers' assumption for L1 and L2 lexicalization time, Prins et al.'s data can be re-interpreted: L1 for stuttering speakers is almost identical to that of speakers in the control group, and L2 (time for accessing the articulatory plan) is responsible for the differences found between the two groups.

In the literature, there is no definite support for any particular method in the segmentation of speech-onset latencies into picture-recognition time, L1 and L2 lexicalization time. Levelt et al. (1991) used a picture-word interference experiment to show that semantic information was available on average 73 ms after picture onset, whereas the picture recognition averaged 573 ms. That is, L1 lexicalization overlapped with picture recognition. It is not known, however, if the picture recognition and L1 lexicalization start at the same time. Without an agreed-upon way to segment the speech-onset latency into the different timing units that occur before speech onset, Prins et al.'s (1997) explanation of L1 lexicalization of verb being the culprit of dysfluency may be questioned.

In conclusion, although Prins et al.'s (1997) study highlighted an important area of research in stuttering, their data were not consistent with Kempen and Huijbers' (1983) two-stage model of lexical access. There was also no basis for the comparison of lexicalization time by subtracting the picture-recognition latency from the speech-onset latency. Therefore, it calls into doubt their argument that L1 lexicalization for verbs is hindering the speech planning process for speakers who stutter. Alternative models of lexicalization timing have been proposed in this letter, and carefully planned experimental studies are needed to establish the relationship between lexical access and stuttering.

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Figure 1.

The time template of the two-stage models of lexicalization of (a) a noun (N), (b) a verb (V), and (c) a noun plus verb utterance (N+V); based on Kempen & Huijbers, 1983. For each type of word, L1 lexicalization time and L2 lexicalization time are shown. Lex is the total lexicalization time before speech onset (these are identified as N, V, and N+V by the symbol in parentheses).

Figure 2.
A partial-parallel processing model of lexicalization of a noun plus verb (N+V) utterance.

Table 1

Average group data based on Prins, Main, and Wampler (1997). PRL = Picture-recognition latency. SOL = Speech-onset latency.

Group	<u>mean PRL (ms)</u>		<u>mean SOL (ms)</u>			<u>mean SOL-PRL (ms)</u>		
	N	V	N	V	N+V	N	V	N+V
Stutterers	562	551	794	816	996	232	265	434
Control Speakers	516	540	746	726	884	230	186	368