Proceedings of DiSS'05, Disfluency in Spontaneous Speech Workshop.
10–12 September 2005, Aix-en-Provence, France, pp. 139–144.

Lexical bias re-re-visited. Some further data on its possible cause.

*Sieb Nooteboom**

*Utrecht Institute of Linguistics OTS, Utrecht University.

Abstract

This paper describes an experiment eliciting spoonerisms by using the so-called SLIP technique. The purpose of the experiment was to provide a further test of the hypothesis that self-monitoring of inner speech is a major source of lexical bias ([1; 10; 11; 14]. This is a follow-up on an earlier experiment in which subjects were explicitly prompted after each response to make a correction in case of a speech error. In the current experiment both the prompt and the extra time for correction were left out, and there was no strong time pressure for the subject in giving his response. It is shown that under these conditions many primed-for spoonerisms are replaced by other, mostly lexical, errors. These 'replacing' or 'secondary' errors are more frequent in the condition priming for nonword-nonword errors than in the condition priming for word-word errors. Response times obtained for replacing errors are considerably and significantly longer than response times for overtly interrupted errors, and also longer than response times for the primed-for spoonerisms. This suggests that a time-consuming operation follows the primed-for spoonerisms in inner speech, and replaces those with other speech errors, often to preserve lexicality of the error.

1. Introduction

Lexical bias is the phenomenon that phonological speech errors tend to create more real words than nonwords, other things being equal. For quite some time there have been two competing explanations for lexical bias. One explanation, the so-called feedback explanation, is that it results from immediate reverberation of neural activation between the phoneme and the word form level in the mental production of speech [e.g. 2; 16]. Another explanation, proposed by those who reject the existence of immediate feedback between different levels of speech production, is that lexical bias results from self-monitoring of inner speech, nonwords being rejected and repaired more often than real words before they are uttered [10; 11; 12; 14]. Of course, these explanations do not logically exclude each other. Recently it was argued on the basis of careful experimenting that under certain conditions lexical bias has two sources, both immediate feedback and self-monitoring of inner speech [7]. The current paper focuses on self-monitoring. It provides experimental evidence for a hidden self-monitoring of inner speech by which primed-for nonword errors are either early interrupted immediately after pronunciation has begun, or replaced by real words in a time-consuming operation before pronunciation has started. The issue whether or not the same predicted data could also be explained by immediate feedback will come back later in this introduction, and also in the discussion section.

Recently it was found [12; 14] in an experiment eliciting spoonerisms with the so-called SLIP technique [1] that when nonword-nonword spoonerisms are primed for, there are significantly more early interruptions than when word-word spoonerisms are primed for. This was interpreted as evidence that in inner speech nonlexical errors are more frequently detected and rejected than lexical errors. If so, this would support a self-monitoring account of lexical bias in phonological speech errors.

In that experiment (to be called Exp03 from now on) subjects were explicitly prompted after each response to correct themselves if they detected a speech error. Hundred ms after the offset of the to-be-spoken word pair, a visible prompt to speak the last word pair seen aloud was presented (during 900 ms) followed by a blank screen (during 110 ms). After this prompt another visible prompt was presented (also during 900 ms) and also followed by a blank screen (during 110 ms), meant to elicit a correction in case of error. This procedure was meant to provoke corrections of complete spoonerisms (or other speech errors). In this respect the technique was not successful: Very few corrections of complete spoonerisms were made. Possibly, however, the instruction to correct any detected speech error, combined with the time-pressure in the experiment caused the subjects to pay special attention to speech errors in their inner speech, and made them reject nonlexical errors in inner speech more easily than lexical errors, employing a quick and dirty criterion of lexicality.

It was decided to run another experiment (Exp05) with the SLIP technique, this time without the prompt and the extra time for making corrections, but also with less time pressure. In most other respects the experiment was similar to Exp03. In this new experiment there was no signal before which the response had to be given other than the next word pair to be read silently. The first two word pairs presented were never followed by the prompt to speak the last word pair seen aloud. This meant that subjects soon detected they could relax during these first two word pairs. It was thought, in line with a suggestion by Hartsuiker et al. [7], that the absence of a time limit would decrease the number of early interruptions and increase the time-consuming contribution of self-monitoring inner speech to lexical bias. The relevant question here is how this contribution of self-monitoring would surface, if not in the number of interrupted nonword-nonword spoonerisms. In Exp03 and many similar experiments described in the literature, there were many cases where the primed-for speech error was not made, but instead another speech error was made showing the same exchange of initial consonants, as when the stimulus BAD GOOF does not turn into GAD BOOF, but into GAS BOOK instead. From the self-monitoring account of lexical bias, one may predict that (a) in the condition priming for nonword-nonword errors such replacing errors are far more frequent than in the condition priming for word-word errors, and (b) that such replacing errors are much more often lexical than nonlexical. Within this view, there are two successive errors being made in inner speech. The first error made is the one which was primed for (GAD BOOF), which then is rejected and replaced either by the correct target, or by another error (like GAS BOOK). If this view is valid, one predicts that (a) response times for errors like GAS BOOK are longer than response times for interrupted errors like G..BAD GOOF, and (b) response times for errors like GAS BOOK are longer than response times for errors like GAD BOOF, because the first error derived from two successive operations, and the latter from only one.

The reader may note that models incorporating immediate feedback of activation between sounds and words as in [2; 16] would probably also predict that phonological errors like GAD BOOF might be replaced in inner speech by real word errors like GAS BOOK, because activation would not only reverberate between the fitting sounds and the correct targets BAD GOOF but also with these similar words, especially when the priming for the consonant exchange is strong. In the current view, however, there is supposed to be some kind of trade-off relation between early interruptions like G..BAD GOOF (that cannot be explained by immediate feedback and clearly result from self-monitoring inner speech), and errors like GAS BOOK, the former being made under time pressure, the latter being made instead of early interruptions like G..BAD GOOF, when subjects are more at ease and have more time. An important prediction from this view, as argued above, is that response times will be significantly longer for secondary errors like GAS BOOK than both for errors like G..BAD GOOF and for predicted, primed-for, exchanges like GAD BOOF. It is currently not clear what specific predictions could be derived with respect to these response times from models exhibiting immediate feedback. The reader may note, however, that if there is immediate feedback between sounds and word forms, this feedback is always there, and potentially affects response times of all reponses, also all correct and fluent responses. This is different from the effect of detecting and repairing speech errors in inner speech on response times. This effect should be only there when in inner speech a speech error has been made. This issue will come back in the discussion.

2. Method

The method used was basically the same as the one applied by Baars et al. [1]: Subjects were to read silently Dutch equivalents of word pairs like DOVE BALL, DEER BACK, DARK BONE, BARN DOOR, presented one word pair at the time, until a prompt told them to speak aloud the last word pair seen. However, there was no white noise applied to the ears of the subjects as in [1] and [7]. The reason white noise was not applied is that this would very likely make self-repairs of completed speech errors in overt speech rather scarce. I needed these errors, though, to support my claim that there are two classes of overt self-repairs, viz. self-repairs of errors in inner speech (G..BAD GOOF) and self-repairs in reaction to overt speech (GAD BOOF...BAD GOOF). In [14] it was demonstrated that two such classes can be separated on the basis of the distribution of offset-to-repair intervals. This issue will not return in this paper.

2.1. Stimulus material

Priming word pairs consisted of pairs of Dutch CVC words with a visual word length of 3 or 4 characters, visually presented in clear black capital print on a computer screen, in a white horizontally oriented rectangle against a greyish green background and intended to be read silently. In total there were 36 test word pairs, 18 potentially leading to word-word and 18 potentially giving nonword-nonword spoonerisms. The latter were derived from the first by changing only the final consonants (cf. [2]). Each word pair was either preceded by 3, 4, or 5 priming word pairs, chosen to prime a spoonerism, as in the sequence *give book, go back, get boot* preceding the test stimuli *bad goof*, or by 3, 4 or 5 non-priming word pairs, providing a base-line condition. In this experiment the priming word pairs were not preceded by additional non-priming word pairs, as was the case in Exp03 as an attempt to hide the purpose of the experiment from the subjects. Note also that the minimum number of precursor word pairs whether priming (preceding the test stimuli) or not (preceding the base-line stimuli) was 3, so that clever subjects could soon discover that they could relax during the first two precursor word pairs. The priming word pairs all had the reverse initial consonants as compared to the test word pair, and the last priming word pair always also had the same vowels as the test word pair. There were 2 stimulus lists, being complementary in the sense that the 18 word pairs that were primed for spoonerisms in the one list were identical to the 18 word pairs providing the base-line condition in the other list, and vice versa. In this experiment there were no fillers other than the base-line stimuli that were identical to the test stimuli in the other stimulus list.

The initial consonants of priming word pairs and test word pairs were chosen from the set /f, s, , v, z, b, d, p, t, k/. Each set of 18 word pairs was divided in 3 groups of 6 stimuli with equal phonetic distance between initial consonants, viz. 1 , 2 or 3 distinctive features. For example, /f/ versus /s/ differ in 1 feature, /f/ vs. /p/ differ in 2 features, and /f/ vs. /z/ differ in 3 features. After each test and each base-line stimulus word pair the subject saw on the screen a prompt consisting of 5 question marks: “?????” (cf. [2]). In addition to the set of test and base-line stimuli described so far there was a set of 7 stimuli with a variable number, on the average 4, of non-priming preceding word pairs to be used as practice for the subjects, and of course also followed by a prompt to speak.

2.2. Subjects

There were 102 subjects, virtually all being staff members and students of Utrecht University, all with standard Dutch as their mother tongue and with no self-reported or known history of speech or hearing pathology.

2.3. Procedure

Each subject was tested individually in a sound proof booth. The timing of visual presentation on a computer screen was computer-controlled. The order in which test and base-line stimuli, along with their priming or non-priming preceding word pairs were presented was randomized and different for each odd-numbered subject. The order for each even-numbered subject was basically the same as the one for the immediately preceding odd-numbered subject, except that base-line and test stimuli were interchanged. Each (non-) priming word pair and each “?????”-prompt was visible during 900 ms and was followed by 100 ms with a blank screen. The subject was instructed, on seeing the "?????" prompt to speak aloud the last word pair presented before this prompt. Fifty subjects were, after the practice word pairs, presented with list 1 immediately followed by list 2, the 50 other subjects were presented with list 2 immediately followed by list 1. This meant, of course, that each subject was presented with the same to-be-spoken word pair twice, once as a test stimulus and once as a base-line stimulus. The hope was that in this way more speech errors might be elicited than otherwise would be the case, and that there would be no significant difference in the data between the two stimulus lists. The advantage would also be that each subject would more or less serve as his or her own control, which is important because in this type of experiment subjects behave very differently. All speech of each subject was recorded, and digitally stored on one of two tracks of a DAT. On the other track of the DAT a tone of 1000 Hz and 50 ms duration was recorded with each test or base-line stimulus, starting at the onset of the visual presentation of the "?????" stimulus. These signals were helpful for orientation in the visual oscillographic analysis of the speech signals, and indispensable in measuring response times.

2.4. Collecting the data

Reactions to all test and stimulus presentations were transcribed either in orthography, or, where necessary, in phonetic transcription by the present author using a computer program for the visual oscillographic display and auditory playback of audio signals. Response times for all correct and incorrect responses, to both base-line and test stimuli were measured by hand in the two-channel oscillographic display from the onset of the 50 ms tone (coinciding with the onset of the presentation of the visual "?????" prompt) to the onset of the spoken response. The onset of the spoken response was in most cases defined as the first visible increase in energy that could be attributed to the spoken response. However, the voice lead in responses beginning with a voiced stop was ignored because in Dutch duration of the voice lead appears to be highly variable and unsystematic both between and within subjects (cf. [17]), within the current experiment showing a range from 0 to roughly 130 ms. In those cases where (interrupted or completed) responses were followed by a (correct or incorrect) self-repair, the duration of the offset-to-repair interval (the interval between first and second response) was measured.

3. Results

3.1. Analysis of spoonerisms

The current design with less time pressure and no urge to correct speech errors led to only half the number of speech errors per test stimulus found in Exp03. The previous design provided 56 (3.1%) completed spoonerisms and 371 (21%) speech errors in total as responses to 1800 test stimulus tokens (36 test stimuli x 50 subjects), the current design led to 56 (1.5%) completed spoonerisms and 317 (8.6%) speech errors in total as responses to 3672 test stimulus tokens (36 test stimuli x 112 subjects). The average response time for fluent and correct responses to test stimuli was 527 ms in the previous experiment and 489 ms in the current experiment, suggesting that the subjects in the current experiment were less plagued by conflicting production patterns probably because priming for spoonerisms was less effective. As the main difference between the two designs was the presence or absence of a prompt and extra time for correction, it seems that the explicit need to correct in Exp03 provided extra mental stress and led to relatively many speech errors.

The first issue in analyzing the results was if the rather unorthodox decision to present each subject two times with each stimulus word pair, once in the first stimulus list presented and once in the second stimulus list presented, albeit in different contexts (priming for a spoonerism or not), led to different patterns for the first and second presentation. This was not the case. There was no significant difference in the pattern of speech errors between the first and second presentation, neither was there a significant different in the pattern of response times between the first and second presentation. Therefore it was decided to analyze the results of the two presentations together.

Given the rather low number of speech errors, one could doubt whether the test conditions as compared to the base-line condition were effective enough. The relevant data are given in Fig. 1.

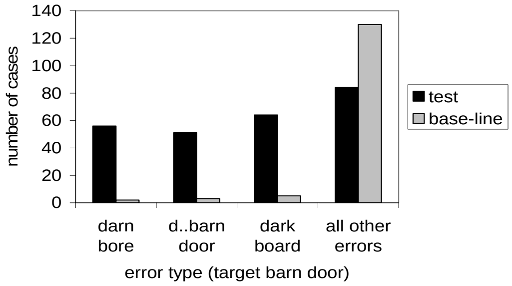

Fig. 1. Number of speech errors of different types separately for the test conditions and the base-line condition (df=3; $chi^2 = 140$; p<0.001)

Obviously the relative effectiveness of priming was good enough. In Exp03 there was a significant lexical bias, word-word complete spoonerisms being much more frequent than nonword-nonword spoonerisms. This was at least partly compensated by early interrupted spoonerisms being much more frequent in the condition priming for nonword-nonwords spoonerisms than in the condition priming for word-word spoonerisms. The data for both experiments are given in Fig. 2.

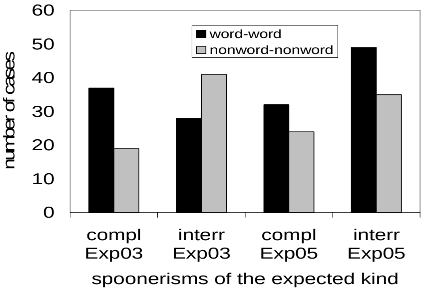

Fig. 2. Completed and interrupted spoonerisms of the primed-for kind in Exp03 and the current experiment. In Exp03 the distributions of completed and interrupted errors differed significantly between the test conditions, in Exp05 they do not.

Against expectations, in the current experiment there is no significant lexical bias, at least not in the spoonerisms that are fully identical with the primed-for spoonerisms, and no complementary distribution of interrupted errors. Also, it was expected that in Exp05 there would be relatively less interrupted exchanges than in Exp03, but there are more. However, these do not show the interaction with word-word versus nonword-nonword priming that was found in Exp03. It is also noteworthy that, if we take completed and interrupted responses together, in Exp ’05 there seem to be relatively few responses to stimuli priming for nonword-nonword. There are only 44 such responses whereas there are 63 responses to stimuli priming for word-word errors. In Exp03 this was 58 as compared to 65. This suggests that somehow responses to stimuli priming for nonword-nonword errors got lost in Exp05.

In Fig. 2 complete spoonerisms were considered to be only those spoonerisms that are fully identical with the primed-for spoonerisms, because it was thought that other exchanges of initial consonants were not controlled for lexicality. As mentioned in the introduction, in most such experiments described in the literature, in order to make up for low numbers of errors, to begin with Baars et al. [1], and recently in Hartsuiker et al. [7], complete spoonerisms include other full and partial exchanges of the two initial consonants. In Fig.

1 it became clear that the relative frequency of such other exchanges (the DARK BOARD responses to BARN DOOR) is controlled by the priming versus base-line conditions. Might it be the case that the missing responses in the nonword-nonword condition are hiding in these “other exchanges” that were removed from further analysis? Would there perhaps be significantly more lexical “other exchanges” in the nonword-nonword condition than in the word-word priming condition?

If in inner speech nonword errors are indeed more frequently replaced by other, possibly lexical, errors than real-word errors, according to the current argument, there should be more replacing exchange errors in the condition priming for nonword-nonword errors than in the condition priming for word-word errors. As the argument is about elicited speech errors in inner speech, the analysis checking its validity should be limited to those responses where one be can be reasonably sure that the attempt to elicit a consonant exchange was initially (that is in inner speech) successful. To that end we assume that all responses not being expected spoonerisms that start with the initial consonant of the second stimulus word fall in that category. This would include DARK BOARD and DARK DOOR for BARN DOOR, but not BARK DOG for BARN DOOR. Note that these cases are counted irrespective of the source of the replacing words. Also clear intrusions from earlier parts of the experiment are counted. What is relevant to the present argument is not the source of the replacing word (for the possible source of these secondary errors, see the discussion), but rather whether the number of replacing words is controlled by the priming condition. As it happens, in Exp05 such cases number 22 in the word-word and 50 in the nonword-nonword condition. Now we count the number of these cases where at least one word is replaced by a real word, and the number of these cases where at least one word is replaced by a nonword. This leads to the data in Fig. 3. These data include 3 cases, 2 in the word-word and 1 in the nonword-nonword condition, where 1 word was replaced by a real word and the other by a nonword. The comparable data for Exp03 are also given.

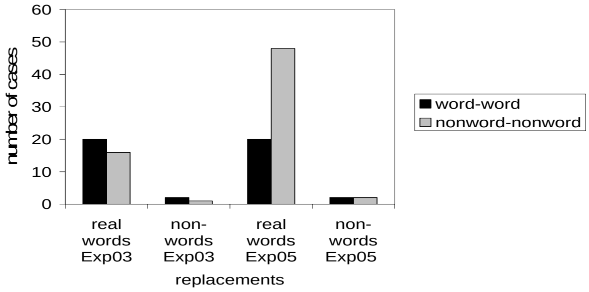

Fig. 3. Numbers of cases where a primed-for spoonerism is turned into another speech error by replacing 1 or 2 (non)words by other real or nonwords.

It seems that we have found here our missing responses in the nonword-nonword condition of Exp05. Whereas in Exp03 responses were significantly more often interrupted in the nonword-nonword than in the word-word condition, in Exp05 elicited speech errors are significantly more often replaced by other, lexical, speech errors in the nonword-nonword than in the word-word condition. If we only look at the number of replacements in the current experiment, 52 for the nonword-nonword condition and 20 for the word-word condition, this difference is highly significant on a simple sign test ($p<0.0001$), whereas in Exp03 the difference, if anything, goes the other way. If we look only at the numbers of replacing real words, and forget about the very low numbers of nonword replacements, the distributions are significantly different for the two experiments (df= 1; chi^2=6.797; $p<0.01$).

The strategy of subjects to interrupt and repair nonword-nonword spoonerisms more often than word-word spoonerisms in reaction to detecting such errors in inner speech, found in Exp03, seems to be replaced in the current experiment by a strategy to replace nonword speech errors in inner speech more often than real word errors by real words before any response is given. The combined data of the two experiments suggest that there is a trade-off between early interruption and replacement by real words of nonword errors. Possibly, this trade-off is controlled by the difference in the degree of time pressure in the task of the subjects.

3.2. Supporting evidence from response times

So far, the current analysis works from the assumption that if under the conditions of priming for spoonerisms, another (partial) exchange error than the primed-for spoonerism is found, this is the result from two successive processes, the first one creating the primed-for spoonerism in inner speech, the second rejecting this spoonerism or one of its words, replacing it by another error, before pronunciation is started.

This is different from what happens when the primed-for spoonerism is interrupted and overtly repaired after its overt production has started, as in G..BAD GOOF. In the latter case the repair takes place openly, so it cannot consume part of the response time before any overt speech act takes place (note also that the very fact that in cases like G..BAD GOOF speaking the erroneous form is initiated might indicate that speech production is started too hastily, before the self-monitoring of inner speech has had a chance to detect and repair the error).

It is also different from the situation where the primed-for spoonerism is actually made, and not replaced by another speech error, because here also only one of the two processes takes place before the response is given. If the current reasoning is valid, one thus expects that response times of errors like GAS BOOK for BAD GOOF are longer than response times for errors like G..BAD GOOF, or GAD BOOF for BAD GOOF, because the first case involves two consecutive error-producing processes and the last two cases only one. The relevant data are given in Fig. 4.

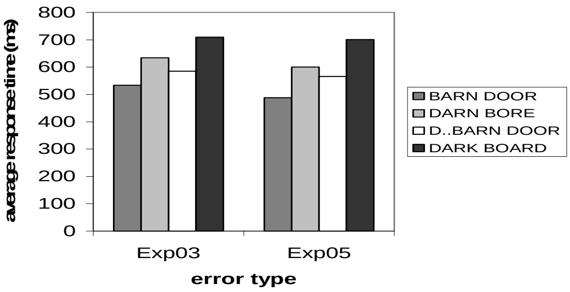

Fig. 4. Average response times for four types of responses, viz. fluent and correct responses (BARN DOOR), spoonerisms that are fully identical to the primed-for spoonerisms (DARN BORE), early interrupted spoonerisms (D..BARN DOOR), and full or partial exchanges that deviate from the primed-for spoonerisms (DARK BOARD). Data separately for Exp03 and Exp05.

Separately for each experiment response times were submitted to a univariate analysis of variance with type (BARN DOOR vs DARN BORE vs D..BARN DOOR vs DARK BOARD in response to BARN DOOR) and priming condition (word-word versus nonword-nonword) as fixed factors. There was no significant effect of priming condition, nor a significant interaction. There was however, in both experiments a significant main effect of error type (p<0.0001 for both experiments). Of course this main effect is mainly due to the fact that correct and fluent responses are faster than erroneous responses (Obviously, within the category of correct and fluent responses, there hide a number of cases where the primed-for spoonerism was made in inner speech and then corrected before pronunciation. In these cases, response times are potentially as least as long as for the replacing speech errors. But as speech errors are rare, these cases are not many, and do not contribute much to the average response time for correct and fluent responses). Apparently, making an error costs time. The main prediction is about differences in response times between erroneous responses. In Exp05 a Tukey test showed that correct and fluent responses (BARN DOOR) differed significantly from all other response types, predicted spoonerisms (DARN BORE) did not differ from interrupted spoonerisms, but did differ significantly from replacing errors (DARK BOARD), which had longer response times. In fact, replacing errors had significantly longer response times than all other error types. The pattern was very similar for Exp03, except that correct responses did not differ significantly from interrupted responses, and replacing errors did not differ significantly from predicted spoonerisms, but did differ significantly from both correct responses and interrupted spoonerisms.

These data suggest that the replacing speech errors (DARK BOARD) result from a time-consuming (on the average some 100 ms in Exp05 and some 80 ms in Exp03) self-monitoring operation in inner speech, during which the primed-for spoonerism is rejected and replaced with another speech error that is nearly always lexical. Rejection of the primed-for speech errors in inner speech, preceding the hidden replacement, obviously employs a criterion of lexicality in Exp05 but not in Exp03, whereas overt early interruption of the primed-for speech errors, as we have seen, employs a criterion of lexicality in Exp03 but not in Exp05. Note also that interrupted speech errors have relatively short response times as compared to the other error types, as if pronunciation was started too hastily, making interruption necessary for self-repair.

4. Discussion

The main findings of the present experiment are to some extent unexpected. In experiments employing the SLIP technique, lexical bias in phonological speech errors has been demonstrated to be a rather robust phenomenon, in most experiments leading to more full exchanges of initial consonants in word pairs when lexical spoonerism are primed for than when nonlexical spoonerisms are primed for (e.g. [1; 3; 7; 8; 14], but see [2]). It has also been shown that lexicality of the first error word is the main determinant of lexical bias [8]. Lexical bias has also been demonstrated in spontaneous speech errors ([4; 14] but see [5; 6]). Although the pattern of complete spoonerisms in the current experiment basically corresponds to the common pattern, the difference was not significant. Also, where in Exp.'03 the common pattern of lexical bias in completed spoonerisms was mirrored by a greater number of interrupted spoonerisms when nonlexical than when lexical spoonerisms were primed for, this pattern was completely absent from the current data.

The data of the current experiment, particularly when compared with the data of Exp03, strongly suggest that the strategies of the subjects in experiments with the SLIP technique are very sensitive to differences in design and task. Simply by removing the visible prompt and extra time for correction after each response, subjects reacted in general faster and made only half the number of speech errors they made in Exp03. Apparently, they were more at ease. Although subjects made more, not less interrupted spoonerisms, they obviously did not employ a criterion of lexicality in overtly interrupting speech errors, as they seemed to do in Exp03. The criterion of lexicality was definitely there, though. In the current, obviously more relaxed conditions, nonlexical spoonerisms were much more often rejected and "repaired" in inner speech than lexical spoonerisms, where "repaired" here refers to cases where the outcome is a new speech error, not identical to the target. A lexical bias in producing these secondary errors is overwhelmingly present, both in the sense that such "repairs" more often occur in the condition priming for nonlexical than in the condition priming for lexical spoonerisms, and in the sense that these secondary speech errors are virtually always lexical themselves. The assumption that these secondary errors are made only after the primed for spoonerism has been rejected is strongly supported by the considerable and significant difference in response times between interrupted spoonerisms and secondary speech errors.

The rejection of nonword-nonword spoonerisms in inner speech became observable in Exp03 in the distribution of early interrupted spoonerisms. In Exp05 the rejection of nonword-nonword spoonerisms in inner speech is observable in the number of primed-for spoonerisms that are replaced with alternative speech errors. This difference is also reflected in the much greater effect of error type on response times in Exp05 than in Exp03. Primed-for nonword-nonword spoonerisms that in Exp03 were interrupted under the time-pressure resulting from the prompt to correct, were under the more relaxed conditions of Exp05 replaced with alternative lexical errors. This finding provides further evidence for self-monitoring being the main cause of lexical bias.

Unavoidably, the question should be asked whether the same data could also be explained by immediate feedback of activation between phoneme level and word form level in speech production ([2, 4, 16]). Obviously, such feedback could in principle generate errors like GAS BOOK for BAD GOOF and DARK BOARD for BARN DOOR, as there would be reverberation between the active phonemes GA.. BOO or DAR...BO..(after the phoneme exchange has been made), and these words. That errors like GAS BOOK and DARK BOARD are more numerous in the condition priming for nonword-nonword spoonerisms than in the condition priming for word-word spoonerisms, might be explained in a feedback account by the presence or absence of competition with the elicited speech errors: In the nonword-nonword condition there is no such competition because nonwords are not represented in the lexicon. However, there are two arguments why the current data reflect self-monitoring rather than feedback. One argument is the trade-off between an effect of priming condition (nonword-nonword vs word-word) on early interruptions in Exp03 and on the number of secondary lexical errors in Exp05. This trade-off demonstrates that the strategies of the subjects are highly variable and influenced by the precise task structure. Such variability one rather expects from semi-conscious self-monitoring that is controlled by focus and level of attention than from immediate feedback of activation within the mental production of speech, that is supposed to be automatic and more or less indifferent to attentional control.

The other somewhat related argument is from the distribution of response times. Unfortunately, the models in

[2; 16] were not set up to predict response times. However, the distribution of response times shown in Fig. 4 strongly suggests that in these experiments response times are mainly a function of whether or not a speech error has been made in inner speech, and whether or not this speech error has been rejected and replaced by another speech error before speech is initiated. In the majority of cases, where responses are fluent and correct, response times remain much shorter and show no or hardly any effect of priming condition. The differences in Fig. 4 between fluent and correct responses on the one hand and secondary speech errors like DARK BOARD on the other are in the order of 200 ms. This seems to reflect the working of a repair strategy that only becomes operative when an error has been detected in inner speech. Of course, this does not exclude that there is immediate feedback of activation in speech production, nor that the current data are affected by such feedback. Note, however, that a potential effect of immediate feedback on response times would not be limited to cases where a speech error had been made in inner speech. Immediate feedback is supposed to be automatic and always present. Indeed, earlier a small but significant effect of priming condition on response times of correct and fluent responses was found, that could possibly be attributed to automatic feedback between sound level and word form level ([12]). But the current data supply a link between the detection and repair of speech errors in inner speech on the one hand, and differences in response times that are much greater than the differences discussed in [12] on the other. These findings can easily be accounted for by assuming that self-monitoring of inner speech for speech errors employs a criterion of lexicality, and that the choice of a repair strategy is strongly influenced by the task structure.

One point remains, however, bringing up the issue of feedback again. If subjects so frequently replace the words and especially the nonwords of an elicited speech error with other words, where do these other words come from? Many (but far from all) of these words used in secondary speech errors are words intruding from earlier parts in the experiment. Supposedly these are still relatively active (cf. [9]). In those cases, which are many, where these words share phonemes with the correct target and/or the elicited error in inner speech, possibly these phonemes contribute to provide extra activation, and, particularly in the absence of syntactic and semantic constraints, the words concerned may then “fire” and become rapidly available for pronunciation. However, in order for phonemes to contribute to the activation of intruding word forms, there must be some kind of feedback between phonemes and word forms. This would of course easily be accommodated by models like in [2; 16] incorporating immediate feedback. There is another way, however. Roelofs [15] has suggested that there may be feedback via the inner perceptual loop employed by self-monitoring. This would make it possible that the phonemes of rejected words in inner speech contribute to the selection of other, replacing, words. Such a mechanism would make a major contribution to lexical bias in speech errors.

Acknowledgement

Thanks are due to Theo Veenker for his help in setting up the experiment, to 112 subjects who suffered a bit from being forced to make speech errors, to Hugo Quené for his help in analyzing and interpreting the data, and to Hugo Quené and Anne Cutler for critical comments on an earlier version.

5. References

[1] Baars, Bernard B.J., Michael T. Motley & Donald G. MacKay. 1975. Output editing for lexical status in artificially elicited slips of the tongue. Journal of Verbal learning and Verbal Behavior 15, 382-391

[2] Dell, G.S., 1986. A spreading-activation theory of retrieval in sentence production. Psychological Review, 93, 283-321.

[3] Dell, G.S., 1990. Effects of frequency and vocabulary type on phonological speech errors. Language and Cognitive Processes, 5, 313-349.

[4] Dell, G.S., Reich, P.A., 1981. Stages in sentence production: An analysis of speech error data. Journal of Verbal learning and Verbal Behavior 20, 611-629.

[5] Del Viso, S., J. M. Igoa, J.E. Garcia-Albea, 1991. On the autonomy of phonological encoding: evidence from slips of the tongue in Spanish. Journal of Psycholinguistic Research 20, 161-185.

[6] Garrett, M. F., 1976. Syntactic process in sentence production. In: Wales, R.J. and E.C.T. Walker eds. New approaches to language mechanisms. Amsterdam: North-Holland Publishing Company pp. 231-256.

[7] Hartsuiker, Rob, Martin Corley & Heike Martensen,2005. The lexical bias effect is modulated by context, but the standard monitoring account doesn’t fly: Related Beply to Baars, Motley, and MacKay 1975. Journal of Memory and Language 52, 58–70.

[8] Humphreys, Karin. 2002. Lexical bias in speech errors. Unpublished doctoral dissertation, University of Illinois at Urbana-Champaign.

[9] Kolk, H.H.J., 1995. A time-based approach to agrammatic production. Brain and Language 50, 282-303.

[10] Levelt, Willem J.M.. 1989. Speaking. From intention to articulation. Cambridge Massachusetts: The MIT Press.

[11] Levelt, Willem J.W., Ardi Roelofs, Antje S. Meyer, 1999. A theory of lexical access in speech production. Behavioral and brain sciences 22, 1-75.

[12] Nooteboom, Sieb G., 2003. Self-monitoring is the main cause of lexical bias in phonological speech errors. In: Eklund, R. (Ed.), Proceedings of DiSS’03, Disfluency in Spontaneous Speech Workshop. 5–8 September 2003, Göteborg University, Sweden. Gothenburg Papers in Theoretical Linguistics 89, ISSN 0349–1021, pp. 25–28.

[13] Nooteboom, Sieb G., 2005. Listening to one-self: Monitoring speech production. in Hartsuiker, R, Bastiaanse, Y, Postma, A., Wijnen, F. (Eds.), Phonological encoding and monitoring in normal and pathological speech, Hove: Psychology Press.

[14] Nooteboom, Sieb G., in press. Lexical bias re-visited. Detecting, rejecting and repairing speech errors in inner speech. To appear in Speech Communication.

[15] Roelofs, Ardi. 2005. Planning, comprehending, and self-monitoring. In: Hartsuiker, R, Bastiaanse, Y, Postma, A., Wijnen, F. (Eds.), Phonological encoding and monitoring in normal and pathological speech, Hove: Psychology Press, pp. 42-63.

[16] Stemberger, Joseph P., 1985. An interactive activation model of language production. In: Ellis, A.W., (Ed.), Progress in the psychology of language Vol. 1, pp 153-186. London: Erlbaum.

[17] Van Alphen, P.M., 2004. Perceptual relevance of prevoicing in Dutch. Unpublkished doctoral thesis, Radboud university.