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Individual differences in susceptibility to the effects of speech on reading comprehension

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Abstract

Previous research has indicated that meaningful background speech affects individuals reading comprehension performance differently and that this difference is related to working memory capacity. But what mechanism in working memory that is involved is not well understood. The present study’s main purpose was to investigate if individual differences in susceptibility to effects of speech on reading comprehension are moderated by working memory capacity as measured by the number updating task and two different mechanisms within this construct; delayed suppression (i.e. the inhibition of information that once was task-relevant but no longer is) and immediate suppression (i.e. the inhibition of processed but irrelevant information, while withholding attention focused on the to-be-recalled task-relevant items). Forty participants performed a number updating task and a reading comprehension task in silence and with meaningful background speech. The results indicated that the immediate suppression mechanism moderates the effects of background speech on reading comprehension. Those who can’t handle the interference from the background speech let the task-irrelevant information interfere with the ongoing cognitive task and therefore are more likely to be distracted by the background speech while reading a text.

Keywords: individual differences, reading comprehension, number updating, background speech, working memory.
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Introduction

Imagine that you are sitting in a quiet place reading a passage in a text when two people pass by talking to each other. Their conversation enters your mind and suddenly you have lost track of what the passage was all about. Studies have shown that meaningful background speech can impair performance of a reading comprehension task (Martin, Wogalter & Forlano, 1988; Oswald, Trembley & Jones, 2000). Even though it is firmly established that speech disrupts reading comprehension, the magnitude of the disruption is not equal for all individuals. The nature of these differences is at present not well understood.

Background speech has also proved to impair the performance of a serial recall task. When short-term memory was tested in the presence of background speech an increased number of errors occurred and errors made by the participants varied widely between individuals (Ellermeier & Zimmer, 1997). However, Ellermeier and Zimmer couldn’t explain why some individuals were more susceptible to background speech than others, only that it wasn’t related to the performance of the short-term memory task.

In general participants with a high working memory capacity (WMC) are less distracted by noise than participants with low WMC (Beaman, 2004; Conway, Cowan, & Bunting, 2001; Elliot, Barrilleaux, & Cowan, 2006; Kjellberg, Ljung & Hallman, 2008). This may suggest that some aspect of working memory processing underlies differences in susceptibility to effects of speech on cognitive processes. The main objective of the present investigation was to examine if individual differences in susceptibility to effects of speech on reading comprehension is moderated by WMC.

That WMC somehow is involved in the process of inhibiting irrelevant information was showed by Conway et al. (2001). In a dichotic listening task (i.e. repeating relevant words presented in one ear while ignoring irrelevant words presented in the other ear) participants with low working memory span (low-span participants) more often reported hearing their own name in the stream of irrelevant words and made more shadowing errors (i.e. repeating a irrelevant word) when their own name was presented than high-span participants did. The own-name-presentation thus caused more distraction for the low-span participants. This indicates that high-span participants are better at suppressing the irrelevant stream of words (Beaman, 2004; Redick, Heitz & Engle, 2008).

Conway et al. (2001) used an Operation span (OSSPAN) task to differentiate their participants as either having low or high working memory span. OSPAN is a two-folded task. In the first step the participants have to determine if a simple mathematical expression is
correct or not. Secondly a high-frequency, one-syllable word is presented (e.g. IS 10-(2/4) = 2? CAT). The participant’s task is to remember the presented words in serial order. Commonly, they have to recall two to seven words per trial and the score is often based on complete series (i.e. you have to remember all of the words in a series to be correct) instead of single words as in the short-term memory paradigm (Conway & Engle, 1994). Based on Conway et al.’s (2001) findings Beaman (2004) investigated if individual differences in susceptibility to auditory distraction are related to WMC as measured by OSPAN. But, in a series of experiments he couldn’t find support for that hypothesis. However when a meaningful background speech was semantically related to the to-be-recalled words low-span participants made more intrusion errors than the high-span participants. Those intrusion errors occurred when participants reported a word they had heard from the background speech instead of the visually presented items. Low-span individuals thus failed to inhibit items presented in the irrelevant speech. Conway et al. (2001) and Beaman’s (2004) observations suggest that high WMC could work as a stronghold against meaningful background speech while reading a text. Participants that are good at inhibiting task-irrelevant information should therefore also be better at inhibiting a meaningful background speech. It's unclear why OSPAN is related to inhibition of background speech and hence may not be the appropriate task to use when trying to pinpoint these inhibition mechanisms. The present study will therefore use another way to measure WMC than OSPAN, namely a number updating task. The number updating task and its advantage is presented below.

Updating information in working memory is a critical process that makes it possible for us to maintain information that is relevant for an ongoing cognitive operation. In our daily life this can be translated to ordinary actions like comparing prices in the grocery store or solving a Sudoku puzzle. For example, when you’re looking for the cheapest chocolate bar in the store you have to keep the chocolate bar with the lowest price in memory and continuously compare it with the prices of other chocolate bars. During this process stored information has to be modified when new relevant information is in conflict with the old one. But it is also crucial when no longer relevant information (i.e. a chocolate bar that is more expensive than the cheapest chocolate bar) has to be suppressed so it doesn’t interfere with new relevant information or when we prevent task-irrelevant information (i.e. prices on lollipops) to interfere with an ongoing cognitive task (Carretti, Cornoldi, & Pelegrina, 2007; Palladino, Cornoldi, De Beni, & Pazzaglia, 2001).

In the number updating task, developed by Carretti et al. (2007), lists with ten different two-digit numbers are presented sequentially. The task is to remember the three lowest
numbers in their order of presentation. For example in the sequence 42, 30, 37, 51, 62, 34, 89, 25, 46 and 72 – the correct answer is 30, 34 and 25. This task forces the participants to continuously compare new information with stored information and it captures two different suppression mechanisms. A suppression error is made when a participant answers with a number that belong to the presented list, but isn’t one of three lowest numbers. This intra-list intrusion is either delayed (i.e. the number was one of the three lowest numbers when it was presented and therefore had to be stored for while, in the example above this considers the numbers 42 and 37) or immediate (i.e. the number wasn’t any of the three lowest numbers when it was presented and should therefore have been excluded immediately, in the example above this considers the numbers 51, 62, 89 46 and 72). These two different cognitive mechanisms are at work in the process of updating information in working memory. Delayed suppression is involved when no longer relevant information has to be inhibited so it doesn’t interfere with information that is relevant at the moment and immediate suppression is the inhibition of processed but irrelevant information, and at the same time withholding attention focused on the to-be-recalled task-relevant items (Carretti et al., 2007). It could be that the immediate suppression mechanism is crucial for the inhibition of a speech distraction. Individuals that get distracted by the background speech in the reading comprehension task may also be the ones who make immediate suppression errors in the updating task. In both cases task-irrelevant information has to be prevented from interfering with the ongoing cognitive task. If that’s true then the immediate suppression mechanism would function as a moderator on the effects of speech on reading comprehension.

While reading a text the role of working memory is to maintain relevant information at the same time as the information is being continuously evaluated and updated (Gernsbacher, 1993; Palladino et al., 2001). Studies have shown that there is a relationship between performance on an updating task and performance of a reading comprehension task. Those who perform well on the reading comprehension task (i.e. participant that scored 1 SD above average) also performed significantly better on the updating task and made fewer intrusion errors than those who didn’t perform well on the reading comprehension task (i.e. participants that scored 1 SD below average) (Carretti et al., 2007; De Beni, Palladino, Pazzaglia, & Cornoldi, 1998; Palladino et al., 2001). It has been shown that the best predictor for reading comprehension performance is the measure of delayed intrusions (Carretti, Cornoldi, De Beni and Romanò, 2005), which suggest that a participant with poor reading comprehension ability have a problem to inhibit no-longer relevant information. This observation is in line with Oswald et al.’s (2000) findings that give a hint that the same mechanism is involved when
performing on an updating task and a reading comprehension task. In Oswald et al.’s study participants had problems to sort out the information that was task-relevant from their stored information when it was attained under the presence of meaningful background speech. The delayed suppression mechanism is involved in the process of sorting out information that is task-relevant and it’s possible that the speech distraction will affect the mechanism’s ability to sort out the task-relevant information. If so, then the effect on speech of reading comprehension is mediated by the effects of speech on the delayed suppression mechanism.

In present study, participants did the number updating task and a reading comprehension task (both in silence vs. speech) to investigate following hypotheses:

Hypothesis 1.
The effect of speech on reading comprehension is mediated by the effect of speech on delayed suppression (Judd, Kenny & McClelland, 2001).

Hypothesis 2.
Immediate suppressions moderates the effect of speech on reading comprehension.

Hypothesis 3.
The total score on the updating task also moderates the effect of speech on reading comprehension, but this relationship is mediated (fully explained) by immediate suppressions.
Method

Participants
Forty participants (25 females and 15 males) aged between 19 and 36 ($M = 23.70$, $SD = 4.39$) were recruited at the University of Gävle. All participants reported having normal hearing ability, normal or corrected-to-normal vision and normal reading ability. For their participation they received a movie ticket.

Materials
Two tests were used in this experiment: the number updating task and a reading comprehension task. Both tests were constructed in two sets of similar blocks that were presented with a background of either silence or speech. Block and presentation order were balanced with a Latin square.

Number updating task
This test was used to measure participants’ ability to exchange information in working memory. The to-be-remembered materials were sequences of 10 two-digit numbers (15-99), which were presented in the centre of the computer screen with a 72-point font size. Presentation time for every number was 2 sec. and the inter-stimulus interval was 1 sec. The participant’s task was to remember the three lowest numbers in each list (called target numbers) and their order of presentation. For example in the sequence 42, 30, 37, 51, 62, 34, 89, 25, 46, 72 – the correct answer was 30, 34, 25.

Two types of sequences were constructed requiring two and five updates, respectively. In sequences with two updates participants had to exchange information twice to be able to recall the correct target numbers (like in the example above) and their order of presentation. In sequences with five updates you had to exchange information five times. Some further restrictions were made on the design of the sequences. No more than two target numbers were in the same ten (like in the example above) and for every experimental block a number could only be a target number once. Moreover, all numbers in a sequence were randomized with some restrictions. The difference between the highest and the lowest number within a sequence was always in the range of 31 to 36. Finally, if a sequence was organised in arithmetic order the distance between two numbers that followed after each other would always be in-between 2 to 6.
The updating task consisted of 28 sequences that were divided into two blocks (i.e. silence and speech) with 14 sequences each. The first two sequences in each block were considered to be training rounds. In every sequence, before the first number was presented a “##” turned up on the screen indicating to the participants were to look. When all ten numbers had been presented an answer box appeared on the screen and participants had to fill in the three numbers they believed were the target numbers. If they had forgotten a target number they were encouraged to guess so that they always typed three numbers. The participants got one point for every number that they placed in its correct position. Therefore, they could get three points for every sequence and maximum for an experimental block was 36 points. Also, participant’s wrong answers were monitored and divided into four different categories: delayed suppressions (i.e. numbers that once was task-relevant but no longer is), immediate suppressions (i.e. numbers that should be excluded immediate), order errors (i.e. error due to placing a target number in a wrong position) and inventions (i.e. other errors than those already mentioned).

Reading comprehension task

In previous studies on the effects of irrelevant speech on reading comprehension participants had to complete a text before they got the questions about it (Martin et al., 1988; Oswald et al., 2000). This procedure gives a long retention interval and it’s possible that speech disrupts the long-term memory of the text instead of the comprehension of it. In the present study, to minimise a long retention interval, a text and a question about the text were presented at the same time. The two reading comprehension tasks (i.e. silence and speech) consisted of 20 shorter texts. The first five texts in both the tasks were on different subjects that in the end had a question about the content of the text with four alternative answers (one of them was correct). In the remaining fifteen texts a word was removed from the text and the task was to fill in the missing word choosing among four possible alternatives. All alternatives were grammatically correct, but only one of them was also in line with the meaning of the text. Participants answered every question by clicking A, B, C or D on the keyboard. For every question time was limited to 1.5 minutes. If the time limit was reached, or when participants answered a question, the next question was automatically presented.

The reading comprehension task started with an introduction to the test with two examples of the different question types (text question and fill-in-blanks question). After the brief introduction the experimental session started. Participants got one point for every correct answer and maximum for an experimental block was 20 points.
**Background speech**

During the whole experiment the participants were wearing headphones. In the sound condition subjects heard a recorded story about the fictitious culture *Ansarierna*, which was told by a male actor. The sound level was between 65 to 75 dB(A).

For the updating task the story was divided into fourteen smaller segments and these segments were randomly divided amongst the fourteen test sequences. No sound was presented during the self-paced recall period. In the reading comprehension task a uniform sound file were constructed from the same parts of the main story that was used in the sound for the updating task. The sound file was played without intermissions throughout the test.

**Design**

The present study used a within-subject design. The sound condition (silence vs. speech) was the independent variable for both the updating task and the reading comprehension task. The dependent measure for the updating task was the correct number of recalled target numbers and four different types of errors (delayed suppressions, immediate suppressions, order error and innovations) that participants could make. For the reading comprehension task the dependent measure was the correct number of answered questions and the average time it took to complete one question.

**Procedure**

The experiment took place in the psychology laboratory at University of Gävle. Participants sat alone in front of a laptop in an isolated room and were instructed to wear headphones during the whole session. After a brief verbal introduction about the experiment and ethical considerations the experimental session started with the updating task. First, participants read an instruction about the updating task on the computer screen. When they understood the procedure they clicked an optional key and the session began. Half of the participants started the updating test in silence and the other half started with background speech in their headphones. Those who started the updating task in silence also started the reading comprehension task in silence and vice versa. The experiment took approximately one hour to complete.
Statistics

This study used multivariate analysis of variance, chi² and hierarchical regression analysis to analyse data from the experiment. All data were analysed with a significance level of $p < .05$. All calculations were performed using SPSS version 16.0.

Ethical considerations

Participants participated on the basis of free will and their data were confidential.

Results

Essential descriptive and inferential statistics for the number updating task and the reading comprehension task are presented in Table 1. First, the multivariate analysis of variance for the reading comprehension task and the number updating task will be presented, followed by the hierarchical regression analysis testing the hypotheses.

Reading comprehension

As seen in Table 1, the mean score for reading comprehension was higher in the silent condition than in the speech condition. A 2 Sound condition (silence vs. speech) x 2 Condition order (silence first vs. speech first) multivariate analysis of variance with correct answers and time per question as dependent variables revealed a main effect of Sound condition, $F(2,37) = 3.39$, Wilks’ Lambda = .85, $p < .05$, $\eta^2 = .15$, but there was no main effect of Condition order, $F(2,37) = 1.26$, Wilks’ Lambda = .94, $p > .05$, $\eta^2 = .06$, and no interaction

<table>
<thead>
<tr>
<th>Task</th>
<th>Silence Mean</th>
<th>Speech Mean</th>
<th>F</th>
<th>p</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reading Comprehension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct answers</td>
<td>11.55</td>
<td>10.57</td>
<td>6.34</td>
<td>.02</td>
<td>.14</td>
</tr>
<tr>
<td>Time per question (in seconds)</td>
<td>42.66</td>
<td>43.23</td>
<td>.36</td>
<td>.55</td>
<td>.01</td>
</tr>
<tr>
<td><strong>Updating</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct answers</td>
<td>21.43</td>
<td>18.95</td>
<td>10.52</td>
<td>.01</td>
<td>.22</td>
</tr>
<tr>
<td>Delayed Suppression</td>
<td>2.40</td>
<td>2.63</td>
<td>.40</td>
<td>.53</td>
<td>.01</td>
</tr>
<tr>
<td>Order Errors</td>
<td>3.95</td>
<td>4.03</td>
<td>.02</td>
<td>.90</td>
<td>.00</td>
</tr>
<tr>
<td>Inventions</td>
<td>6.80</td>
<td>9.18</td>
<td>14.77</td>
<td>.001</td>
<td>.28</td>
</tr>
<tr>
<td>Immediate Suppression</td>
<td>1.40</td>
<td>1.28</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Participant’s performance on the reading comprehension task and the number updating task in the silent condition and in the speech condition collapsed on condition order.

* No analysis of variance was performed on immediate intrusions.
between Sound condition and Condition order, $F(2,37) = 1.98$, Wilks’ Lambda = .90, $p > .05$, $\eta^2 = .10$. The univariate analysis revealed that speech disrupted reading comprehension, $F(1,38) = 6.34$, $MSE = 3.00$, $p < .02$, $\eta^2 = .14$, but it didn’t affect the time it took to complete a question, $F(1,38) = .36$, $MSE = 17.66$, $p > .05$, $\eta^2 = .01$.

**Number updating**

No analysis of variance was performed on immediate suppressions. The distribution of the immediate suppression errors was that 17 out of 40 participants made no immediate suppression in the silent condition and 13 made none in the speech condition. These variables were therefore dichotomised (i.e. those with no immediate suppression errors vs. those with at least one immediate suppression error) before the analysis. A chi$^2$ test revealed that there was no significant effect of speech, $\chi^2 (1, N = 40) = .86$, $p > .05$.

A 2 Sound condition (silence vs. speech) x 2 Condition order (silence first vs. speech first) multivariate analysis of variance on the dependent variables correct answers, delayed suppressions, inventions and order errors revealed a main effect of Sound condition, $F(4,35) = 6.25$, Wilks’ Lambda = .58, $p < .01$, $\eta^2 = .42$. There was no main effect of Condition order, $F(4,35) = 1.24$, Wilks’ Lambda = .88, $p > .01$, $\eta^2 = .12$, and the interaction between Sound condition and Condition order almost reached significance, $F(1,38) = 2.56$, Wilks’ Lambda, .77, $p = .056$, $\eta^2 = .23$. The univariate analysis revealed a main effect of Sound condition on correct answers, $F(1,38) = 10.52$, $MSE = 11.64$, $p < .01$, $\eta^2 = .22$, which interacted with Condition order, $F(1,38) = 10.52$, $MSE = 11.64$, $p = .01$, $\eta^2 = .22$, and a main effect of Sound condition on invention, $F(1,38) = 14.77$, $MSE = 7.64$, $p < .01$, $\eta^2 = .28$, which also interacted with Condition order, $F(1,38) = 4.26$, $MSE = 7.64$, $p < .05$, $\eta^2 = .10$, no further analysis were significant. The nature of the interaction between Sound condition and Condition order for correct answers and inventions were that those who started the task in silence showed no disruption from speech (i.e. more correct answers and fewer inventions), while those who started the task in speech show a large disruption. This suggests that the training effect was strong.
Individual differences in susceptibility to the effects of speech

To test the hypothesis that the effect of speech on reading comprehension is mediated by the effect of speech on delayed suppression the analysis had to reveal that there was an effect of speech on delayed suppressions. That wasn’t supported and this indicates that there was no support for the hypothesis (Judd et al., 2001).

To test the hypothesis that immediate suppressions moderates the outcome of speech on reading comprehension a hierarchal regression analysis as recommended by Cronbach and Furby (1970) was used.

To find out if immediate suppression moderates the outcome of speech on reading comprehension the first step is to remove the variance from reading comprehension in the speech condition that is explained by reading comprehension in the silent condition. The next step is to see if immediate suppressions explain a significant part of the residual variance that is left. If so, then the outcome of speech interacts with immediate suppressions.

A hierarchical regression analysis with reading comprehension in the speech condition as dependent variable, reading comprehension in the silent condition as independent variable in the first step, and dichotomised immediate suppressions in silence as independent variable in the second step revealed that reading comprehension in the silent condition explained a significant part of the variance, \( \beta = .51, t = 4.27, p < .001 \), and that the dichotomised immediate suppressions in silence explained a significant part of the residuals in the second step of the analysis, \( \beta = -.42, t = -3.53, p = .001 \). This result confirms the hypothesis that immediate suppressions moderates the outcome of speech on reading comprehension.

Participants that are sensitive to meaningful background speech also let task-irrelevant information enter their working memory during the number updating task.

To test the hypothesis that the total score on the updating task also moderates the outcome of speech on reading comprehension, but that this relationship is mediated by immediate suppressions a hierarchical regression analysis with reading comprehension in speech condition as dependent variable, reading comprehension in the silent condition as independent variable in the first step, and the total score on the updating task in silence as independent variable in the second step were computed. This analysis revealed that reading comprehension in the silent condition as well as the total score on the updating task in silence explained a significant part of the variance \( \beta = .49, t = 3.85, p = .001 \) and \( \beta = .34, t = 2.69, p = .01 \), respectively. This confirms the first part of the hypothesis that the total score on the updating task in silence moderates the outcome of speech on reading comprehension. To test if this relationship is mediated by immediate suppressions a statistical approach recommended
by Frazier, Tix and Barron (2004) were used. To answer this question a couple of criteria first have to be fulfilled. The first step is to show that there is a significant relation between the predictor variable (i.e. total score on the updating task in silence) and the outcome variable (i.e. reading comprehension in the speech condition) which is confirmed by a Pearson product-moment correlation, $r(38) = .46, p = .003$. The second step is to show that the predictor is related to the mediator (i.e. dichotomised immediate suppression in the silent condition), which is confirmed by a Pearson product-moment correlation, $r(38) = -.82, p < .001$. The final step is to show that the strength of the relation between the total score on updating task and the effect of speech on reading comprehension is significantly reduced when dichotomised immediate suppression in silence is added to the model. Such analysis revealed that the variance explained by the total score on the updating task in silence no longer is significant after introducing dichotomised immediate suppression, $\beta = -.007, t = -0.32, p = .97$, whereas dichotomised immediate suppression explained a significant part of the variance, $\beta = -.42, t = -2.06, p = .05$. To test the significance of the mediated effect, the mediated effect is divided by its standard error and it yields a $z$ score of the mediated effect. If the $z$ score is greater than 1.96 the effect is significant at .05 level\(^1\). Computation gave a $z$ score of 1.99, $p < .05$, which confirms the hypothesis that immediate suppression acts as a mediator in the relation between the outcome of speech on reading comprehension and the total score on the updating task in silence. It seems that participant’s performance on a reading comprehension task with a meaningful background speech present depends on their WMC as measured by the number updating task and that this interaction is mediated by the immediate suppression mechanism. Again, those who let task-irrelevant information to interfere with an ongoing cognitive operation also showed a greater susceptibility to meaningful background speech.

Discussion

The purpose of the present study was to investigate if individual differences in susceptibility to effects of speech on reading comprehension are moderated by working memory capacity as measured by the number updating task and the two different mechanisms within this construct, namely delayed suppression and immediate suppression. Two of the three investigated hypotheses were confirmed by the analysis. Immediate suppression moderates the effect of speech on reading comprehension. So did also the total score on the

\(^1\) The mathematical formula is $\frac{b^2sa^2 + a^2sb^2 + sa^2ba^2}{sa^2 + sb^2 + ba^2}$, where $a$ and $b$ are the unstandardized regression coefficients for the predictor and the mediator and $sa$ and $sb$ are their standard error (Frazier et al., 2004).
number updating task, but that interaction was mediated by the immediate suppression mechanism.

These results are in line with the findings of Conway et al. (2001) and Beaman (2004). Performances on cognitive tasks, such as reading comprehension, are less disrupted by speech for individuals that are better at focusing their attention on information that is task-relevant. Those individuals whose performance is disrupted by speech are showing a less efficient attentional control, because they let the irrelevant stream of information (e.g. meaningful background speech or immediate intrusions) interfere with an ongoing operation. The involvement of immediate suppression may somewhat explain why Beaman (2004) didn’t find a strong relation between OSPAN and the susceptibility to meaningful speech. The OSPAN task only measures one type of intrusion, namely those based on information that once was task-relevant but no longer is (i.e. delayed intrusion). In the case of OSPAN this considers the to-be-remembered words from previous lists. But also the mathematical elaboration could be a possible intrusion that will not be visible in the OSPAN data because the two tasks use different types of objects (i.e. numbers vs. words). If OSPAN measured immediate suppression then one had to answer with a number instead of a word, but it’s unlikely that someone answers with a “2” instead of “CAT” by mistake. The immediate suppression mechanism isn’t therefore represented in the OSPAN data.

As OSPAN task can’t measure the immediate suppression mechanism, the number updating task can’t clearly sort out which type of error a participant has done. Because the to-be-remember items in the number updating task are within a limited range of numbers (15-99) it is difficult to pinpoint an error’s origin (i.e. a specific number appears more than one time in an experimental block). It is hard to know if a wrong answer was caused by interferences from a previous list, a mix-up between items from a previous list and the task-relevant list or a phonological mishap within the task-relevant list. An experimental list based on objects (e.g. tools) instead of numbers, with control over the comparison bias\(^2\), maybe are a more suitable instrument than the number updating task. An object-based task would almost be the same as the number updating task with the only difference that the participants has to work with different objects (e.g. an experimental list could contain: lawn mower, corkscrew, axe, hammer, wheelbarrow, ladder, nail clippers, saw, needle) instead of numbers. However, the method used in this investigation provided a solid result regarding the significance of the

\(^2\) The judgement of an object can differ depending on individual preferences. One individual might consider a TV bigger than a suitcase and another one thinks it’s the opposite.
immediate suppression mechanism’s involvement in individual’s susceptibility to speech distraction.

The performance on the reading comprehension task, as well as the number updating task, was significantly impaired in the speech condition. This confirms the results of studies such as Martin et al. (1998) and Oswald et al. (2000) that the semantic similarity in the background speech causes an interference with the ongoing comprehension task. Ellermeier and Zimmer (1997) also found a similar disruption regarding errors made on a short-term memory task based on numbers. They used a background speech that wasn’t meaningful to their participants (i.e. Japanese speech). Looking at the errors made by participants in this study, the largest increase in the speech condition is for the so called inventions (i.e. guesses). In the speech condition they tend more often to totally forget the presented numbers with the outcome that they more often just guesses the target numbers (which they were instructed to do). The background speech, regardless semantic meaning, disrupts performance on these two types of tests and that’s probably because it gets harder for the participants to focus all their attention on the task-relevant information when a task-irrelevant speech source are present at the same time. However, the speech distraction didn’t have the same effect on delayed suppression. It was hypothesised that the effect of speech of reading comprehension was mediated by the effect of speech on delayed suppression. That the effect of speech on delayed suppression didn’t reach significance could mean that the delayed suppression mechanism isn’t involved in the suppression of a speech distraction.

For reading comprehension the magnitude of disruption is greater when the background speech has a semantic meaning to the listener (Martin et al. 1998; Oswald et al., 2000). Particularly disruptive is the speech for those individuals with a weaker attentional control (Redick et al., 2008). This means that it’s important to have a quiet atmosphere in environments, like school’s or open office’s, where you often read. Carretti et al. (2005) found a relationship between performance on an updating task and reading comprehension in a study with school children (ages 8-11 years). Data from the present investigation is drawn from an adult population, but it isn’t farfetched to reason that a noisy learning environment also may have a negative effect for younger individuals’ school achievement, particularly for individuals with a poor immediate suppression mechanism. This notion should be addressed in future investigations.
References


