Influence of the Dutch Word 'er' in Prepositional Form on Reading Speed

Bachelor's Project Thesis

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Abstract: The Dutch word 'er' is a linguistically intricate yet highly prevalent word that serves in various functions. This investigation centers around its prepositional property (er_p). Previous research suggested that the er_p can create Long-Distance Dependencies (LDD) with the pronoun they are dependent on, resulting in decreased reading speed. Through utilizing a similar eye-tracking experiment setup with self-paced reading, the present study collected participants' eye movement data. The findings contradict existing understanding, and showed no significant effect of er_p on the reading speed. The observed variation might have been caused by the methodological issues and but also can provide more understanding for future research.

1 Introduction

The Dutch word 'er' is not only highly frequent, but also linguistically very complex, which has attracted the interest of researchers. This word, when used as a pronoun, can convey multiple meanings.

The most common translation of 'er' is 'there'. However, this word can be used in different functions, and there are many notable descriptions of it done on different papers such as Bech (1968), Grondelaers, Speelman, Drieghe, Brysbaert, and Geeraerts (2009) and Voortman (2005). This paper will consider four main functions, as outlined by Odijk (1993): expletive (er_X), locative (er_L), quantitative (er_Q), and prepositional (er_P).

Only the prepositional er_P among the four named functions will be focused on. However, gaining an understanding of each function is essential to recognize the unique features of the er_P. Therefore, in the following subsections, we will introduce the fundamentals of the remaining three functions before going into the detailed explanation of er_P.

1.1 Expletive er_X

The expletive er_X, also referred to as the existential or presentative er in other literature, is used in sentences with indefinite subjects or is the subject in passive sentences. This means that the er_X isn't the real subject of the sentence in any of the cases, but has a special position. One way of using it is in (1), where the er_X is used as an impersonal passive. Another usage is in sentences where the subject is apparent but still in the passive use, as in (2). The last example (3) illustrates a sentence where there is no explicit subject, but the start of the sentence is occupied by another word.

(1) Er werd gezongen.
There was singing.

(2) Er zong iemand.
Someone was singing.

(3) Waar werd er geëxperimenteerd?
Where was experimenting done?

1.2 Locative er_L

The locative function serves as an adjunct or an argument of location. It is considered as an abbreviation of 'daar/hier' translating to 'there/here'. This unique phrase is used as an adverbial pronoun to describe a location, usually located after the verb in the sentence and cannot be the first word of the

sentence. In (4), we can see an example of how er_L is used in a sentence.

(4) Ik heb er gewerkt.
I have worked there.

1.3 Quantitative er_Q

The er_Q is used before a numeral in sentences informing about quantity, always used alongside a numeral or an adverb. This function essentially carries no meaning on its own, and solely serves a semantic purpose. Adding a noun after the er_Q would define it and transform it to an er_L, indicating how similar yet different the functions of 'er' are. We can see the use of this function in (5) where the word occurs in the middle of the sentence, similar to the er_L.

(5) Ik heb er twee gekocht.
I bought two of them.

1.4 Prepositional er_P

Lastly the prepositional function serves as a combination of a personal pronoun and a preposition, and performs in a linguistically complex way on its own. The er_P is used in combination with a preposition. In some cases, such as in (6), the er_P and the preposition are written as one word. On the other hand, the er_P can have the 'er' separated from the preposition it relates to in longer sentences. For example, in (7) the er_P is not attached to the preposition 'mee' due to the adverb in between.

(6) Loes brengt Karin **erheen**.
Loes takes Karin there.

(7) Nadia wil **er** niet **mee** vliegen.
Nadia doesn't want to fly with it.

As the two bold words in (7) are related to each other, they require one another to decipher their meanings. This suggests that there is some form of non-linear dependency in such sentences.

1.5 Long-Distance Dependencies

When two words that are dependent on each other are located far apart in a sentence, it creates a unique linguistic phenomena. This concept aligns well with the principles of Lexical-Functional Grammar, which suggests that dependencies in sentences do not have to follow a linear order (Dalrymple, Kaplan, Maxwell III, Zaenen, et al., 1995). Such dependencies are called Long Distance Dependencies (LDD), relation between words or morphemes in a sentence that are not adjacent (Kaplan & Zaenen, 1989). LDDs can be separated from each other by a singular word or by a phrase.

Given that two words in an LDD are interdependent, knowledge on the latter one is required to comprehend the former one. The first word encountered creates an ambiguity, and for the rest of the sentence, the reader tries to solve this ambiguity. Until the word that solves the uncertainty appears, the previous word, and the whole sentence will be lacking in meaning. This makes LDDs syntactically complex and impose a high processing load. This phenomenon has been extensively studied in reading experiments that manipulate the linear distance between words exhibiting such dependencies.

To improve the understanding of it, an example of the LDD construction is wh-phrase questions in English (Slavkov, 2015). In (8), we can see a sentence starting with "where". The corresponding declarative sentence to this would be (9), where no object is expected by the reader. Research found that the reading comprehension was much faster in sentences without the LDD.

(8) Where is the car?

(9) The car is there.

1.6 Eye-tracking

Existence of LDDs impose high demand in cognition, and this paper tries to measure this demand. A sentence with only linear dependencies is expected to have a gradual and consistent increase in the total reading speed. In contrast, sentences with LDDs have a region that will impose a longer reading time. The cognitively high demand section of the sentence is expected to create a disturbance on the reading speed of the sentence. Thus, when interrupted with an LDD, we expect to see a slow-down in reading speed around the location of the latter word.

To perform further calculations, eye-tracking was chosen as the measurement instrument. Eye-tracking is a widely used method in psycholinguistics, as it provides real-time data on intricate eye saccades. Stowe (1986)'s pioneering early work essentially laid the foundation for many such LDD based eye tracking studies.

Eye movements can offer understanding to the demand of the processes happening in the mind. This was illustrated in reading experiments, where greater loads of processing resulted in longer stops (Just & Carpenter, 1980). Through controlling variables, researchers can explore effects of many other linguistic factors and phenomena. Self-paced reading (SPR) using eye-tracking is a non-intrusive, natural method that assures that the reading speed is controlled only by the participant and requires no other interference. This can provide insight into attention and reading with the help of high temporal resolution cameras. Therefore eye-tracking is a valid measurement for the present study.

1.7 Context clues

As discussed so far, a sentence with er$_P$ is expected to have some ambiguity. This ambiguity might make it hard for the readers to decipher even when they get to the goal word er$_P$. Thus, it becomes unclear whether an observed slow-down in the reading speed is caused by the LDD, or solely from the overall ambiguity of the sentence. To cancel this ambiguity, some context can be provided before the sentence with the er$_P$.

Previous works suggested a potential improvement using this approach, and the idea aligns well with prior work on reading speed and comprehension (Kaasjager, 2023). Presenting a word within a sentence makes it easier to comprehend the word compared to presenting it in isolation (Stanovich & West, 1983). It is assumed that the same phenomenon might be occurring with the word 'er' in a context. Even though the general meaning of 'er' is known to all Dutch native speakers, in the given context it can carry any of the 4 functions meanings. Thus, presenting an extra sentence before the recorded sentence that includes what the er$_P$ will act as a priming context clue sentence. Consequently, a sentence pair of a context clue sentence followed by a sentence with er$_P$ will look like (10). The phrase 'een dessert' in the first sentence is what the er$_P$ is referring to in the second sentence.

(10) We wilden samen een dessert bakken. Ik nam er het grootste stuk van na het eten.
We wanted to bake a dessert together. I took the largest piece of it after dinner.

1.8 Research Aim

As LDDs are claimed to affect the reading speed and er$_P$ can have an LDD with its preposition, an eye-tracking reading experiment can provide insight into both topics. Hence, in this paper will be aiming to see a possible change with the research question:

"How does the prepositional er$_P$ and its distance to the preposition it refers to impact the reading speed in the Dutch language?"

This study hypothesizes that the presence of er$_P$ in Dutch with a LDD will cause a decrease in the reading speed. The testing sentences where the er$_P$ is located further away from the preposition should cause the participants a time delay. This is due to the fact that the participants will keep searching for the location where the er$_P$ connects to, and when they find a possible connection, they will need to go back and reread from the er$_P$ again in order to fully comprehend the meaning.

The present study uses an SPR eye-tracker setup, similar to Weit (2022)'s paper, calculating the saccade, fixation, and regression intervals to see a possible slow-down. However, this is an extension of the previous study as a modified stimuli format and other details are implemented. The original experiment found a significant difference, thus the hypothesis is in line with Weit (2022)'s paper. The hypothesis is also likewise supported by the theoretical background provided.

2 Methods

To test the hypothesis, an eye-tracking experiment was conducted. Through an SPR setup, collected data points containing gaze coordinates and timestamps wer collected. The following section provides an elaborate explanation of this experimental process.

2.1 Experiment Participants

The participants for the study were recruited via an online form and posters distributed around through various University of Groningen buildings. The poster specifically mentioned the criteria for the participants, along with the compensation they will receive for their contribution. Eventually there were 10 participants, 3 of whom were female, that are all native Dutch speakers with no history of dyslexia.

2.2 Experiment Setting

The experiment took place at the University of Groningen, specifically in the Bernoulliborg building in the Zernike Campus. The laboratory space is partitioned into two sections, dividing the participant and the experimenter areas.

The eye-tracking equipment used in the study was Eye-Link Portable Duo Eye Tracker set. The participant side was equipped with the eye-tracker sets' camera and a monitor with a resolution of 1080 by 1920, which were connected to another laptop located on the experimenter side to enable remote control. The experimenter side only featured the remote control display, where the sampling rate of 500Hz and right-eye tracking options are selected.

On the participant side, the display screen and the camera are placed as instructed in the eye-tracker manual, as shown in figure 2.1. The brightness of the display screen is set at 75 percent, and a head stabilizer was securely attached to the edge of the table to ensure stability of the participant's head during the experiment.

Figure 2.1: Participant setting

2.3 Experiment Setup

Upon the participant's arrival in the meeting room, the head stand and the chair is adjusted to their height of comfort. This is followed by the calibration process according to the eye-trackers instructions to locate the gaze on the screen.

After calibration is completed, the participant is presented a screen that tells them to press the space bar to proceed whenever they have finished reading the last presented sentence. The experiment typically takes around 10 minutes to complete and only the experimenter and participant are present in the room during the process.

2.4 Experiment Procedure

The experiment was designed using OpenSesame, an open-source experiment building program for social sciences (Mathôt, Schreij, & Theeuwes, 2012). This program was utilized to set the entire flow of the experiment, and collect the data from the participants.

The stimuli were presented in black on white background. The font was kept at the default font 'mono' and the size is increased to 20px for optimal legibility. Each participant had their unique input data, so the correct CSV file had to be input into the experimental loop before each participant.

The OpenSesame code you can find here was designed so that the participants see the first sentence of a stimulus. When they hit the space bar, the second sentence of the stimulus was shown under the first sentence. This completes one pair, and pressing the space bar once more removes the previous sentences and repeats the procedure for the next stimulus pair. An example of two consecutive screens that some participant saw is as shown in Figure 2.2.

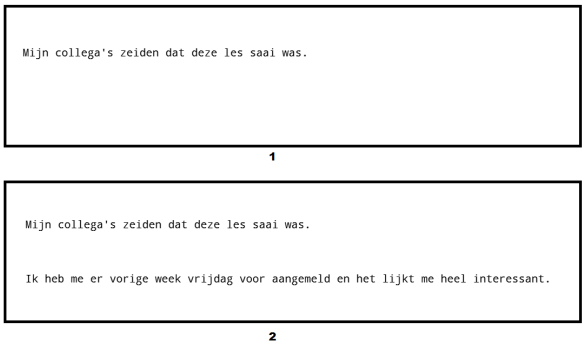

Figure 2.2: Procedure example screenshot

Following each trial there was a fixation dot presented to redirect participants' gaze back to the starting axis and ensure its stability.

2.5 Experiment Stimuli

The input CSV files were created using a python script available here. There are a total of 64 items added to the script initially. All the items were checked with Dutch native speakers for fluency and natural-sounding language.

Each item consists of 2 sentences as mentioned above, with the first one being the context clue sentence. The second part of the item is the sentence that pertains to the experiment's conditions. Amongst the 64 items in the pool, 16 are target sentences, 16 are baseline sentences and 32 are filler sentences. The criteria for these 3 categories of sentences are explained further below, and the full list of sentences is in the Appendix.

2.5.1 Target Sentences

The main focus of this study is found in this sentence category, where all the sentences follow the same order. The first 2-3 words of the sentences are the subject, allowing the eye to focus on the y-axis the sentence is on. The word er_p as explained in the introduction comes right after the subject. Following the er_p are 2-5 filler words, to create the LDD effect and manipulate the distance. Adding the preposition that er_p connects to now is far enough to observe the effect, while keeping the distance rather consistent amongst the sentences. This word also marks the start of the region of interest in this sentence (explained further in 2.7). Lastly there are 2-5 words after the preposition. This bit is necessary to record the spillover effect, which accounts for the speed difference between reading and processing the meaning of a word (Vasishth, 2006). Thus, if there is a slow-down caused by the complexity of a section, the processing of that section might spill over to the following section.

Again to assure consistency, the sentences were all about a similar length. To prevent repetition in the experiment, there were various prepositions used across the sentences. Additionally, present, present perfect and past tenses were used.

2.5.2 Baseline Sentences

The baseline sentences is the other key point of this research, and have a corresponding target sentence each. The baseline sentences are almost the same as the target sentences, but don't have the er_p in them. Correspondingly to make the sentence make sense, the phrase that the er_p refers to is added after the preposition. An example of paired target and baseline sentences is (11) and (12).

(11) Hij betaalde er een zeer hoog bedrag voor maar droeg het nauwelijks.
He paid a very high amount for it, but hardly wore it.

(12) Hij betaalde een zeer hoog bedrag voor de kleding maar droeg het nauwelijks.
He paid a very high amount for the clothing, but hardly wore it.

With this setup, the two sentences are about the same length and carry the same meaning. Between the only 2 parts the target sentences and baseline sentences differ from each other is the area of interested.

The similarity between these two sentences also made it possible to create a paired participant setup. The two versions of the same sentence are too alike to be presented to the same participant, but they are ideal to compare reading speed in between-participants.

2.5.3 Filler Sentences

The rest of the sentences are filler sentences, extra stimuli presented that make the tested condition less obvious. The 2 main criteria for this category of sentences is having similar length to experimental stimuli, and not using er. Along with the recorded filler sentences, there are preceding context clue sentences for each. To generate a sufficient amount of such pairs of sentences, the AI chatbox chatGPT was used (OpenAI, 2021). Subsequently, the sentences were then again verified to fit all the criteria with native Dutch speakers.

2.6 Stimuli Pairing

A Latin Square design was utilized to create pairs of stimulus sets for each participants. This ensures that all the created CSV files will have controlled order effects. Similar to the participants, the stimuli are also paired in a way. Each target sentence has a corresponding baseline sentence, as explained, and all sentences are initially enumerated accordingly.

To create the data input for two paired participants, for each odd-numbered participant, a random selection of 8 baseline sentences are picked from the pool of 16. According to the number of sentences they receive, the following even-numbered participant will see the corresponding target sentences. An example of the chosen sentence numbers for two paired participants are as shown in 2.3.

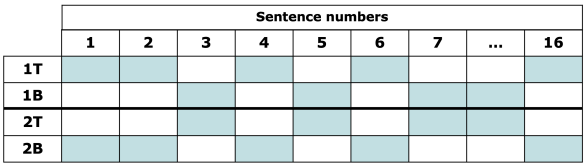

Figure 2.3: Stimuli division diagram for two paired participants, where T stands for target and B for baseline

As seen in the example pairing in 2.3, if the sentence marked *baseline 1* is shown to participant 1, participant 2 will see sentence marked *target 1*. The same switch between baseline and target sentence indexes are applied to the rest of the sentences. Repeating this process and shuffling those first 8 baseline sentences for every new odd participant creates a linked data set.

Besides the target and the baseline sentences, there were also 16 random filler sentences added in for each file. Shuffling these 3 categories of sentences creates 32 pairs of sentences that will be shown to each participant. Lastly, 2 unused filler sentences are added before the entire list.

2.7 Data Collection

The data collection was done through the OpenSesame interface. The software creates an eye-link data file (EDF) for each participant after the experiment is completed. The EDF includes information about the current participant and sentence numbers, and the time stamps with the position of the eye in the x-axis and y-axis on the screen.

2.7.1 Region of Interest

The recorded x and y coordinates of gaze enable the calculation of Regions of Interest (ROI). In a reading experiment, ROIs are specific areas of a text, such as sentences, that are analyzed to explore potential effects on reading.

This experiment is looking to see if the Dutch word 'er' has an LDD with the preposition it relates to, resulting in a slow-down in reading speed. Therefore, the ROI for this experiment is centered

around the preposition where the slow-down effect is expected per the hypothesis.

Along with the preposition, the 2 subsequent words are also recorded for the spillover effect, as mentioned earlier. The width of these following words is measured in pixels, along with the space that comes after them. The ROI is then padded by the total width of these elements in the back. Moreover, the recording started from the preceding word, considering that most of the prepositions used are shorter words. Very short and common words can often be noticed through the peripheral view while still focusing on the preceding word. Likewise, sentence comprehension is determined both by the word that is primarily focused on, and the words that the peripheral vision can detect (Conklin & Pellicer-Sánchez, 2016). To account for this possible preview effect on the preposition and any eye-tracking inaccuracies, the ROI was padded in the front by 20 pixels as well.

2.8 Data Conversion & Processing

The EDF type contains a vast pool of raw and convoluted data that isn't easily readable by the human eye or most data analysis software. Therefore, the EDF files were converted into ASCII files, using the software provided on the SR Research forum. Later the ASCII files were ran through the provided code here, to create CSV files for the recorded right eye with the essential information.

The participant number, the order of when a sentence is shown, as well as where that shown sentence was located in the initial stimuli input to the script, are all put in the CSV file. The category of the sentence presented on each iteration, and the current timestamp and the duration of the recording are also measured. Lastly included are the average x and y coordinate values, which shows approximately where the participant was focusing on the screen in the given timestamp. Using this file format and the listed data, the variables are investigated to perform a statistical analysis.

3 Results

The current study aimed to find any possible effects of er_p on reading speed. There were 10 participants included in the study, following a between-subjects design. Each participant read 34 sentence pairs each, where 18 were excluded filler stimuli. Amongst the remainders half were target, and half were baseline sentences, that all have a specific ROI that we will be our focus of analysis.

The eye-tracker created an EDF type file for each participant, where each line is for a new timestamp. In this linear order, the first time the x and y coordinates of the fixation was within the x and y boundaries of the current sentences ROI threshold was found. Similarly, the following timestamp where the gaze coordinate values exceed the ROI boundaries, and the difference between the two will resulted in the reading speed were found. All of these calculations were done through a script, and were compiled into one large file consisting of all participants data.

After running the code and compiling all participants files, some of the data was lost due to eye-tracker problems, and the leftover data was highly skewed. To normalize this data and to eliminate any possible outliers, there was data cleaning up done. Firstly, the cut-off point was chosen to be 1.5 times the interquartile range. Then the natural logarithm of leftover data were taken of all values to normalize them.

Prior to a formal analysis, to visualize the effects of these classes on the fixation durations, a violin plot was created. The plot also includes a box plot that shows the median, upper quartile and lower quartile. In the created graph 3.1, it is observed that the values for the target group are slightly higher.

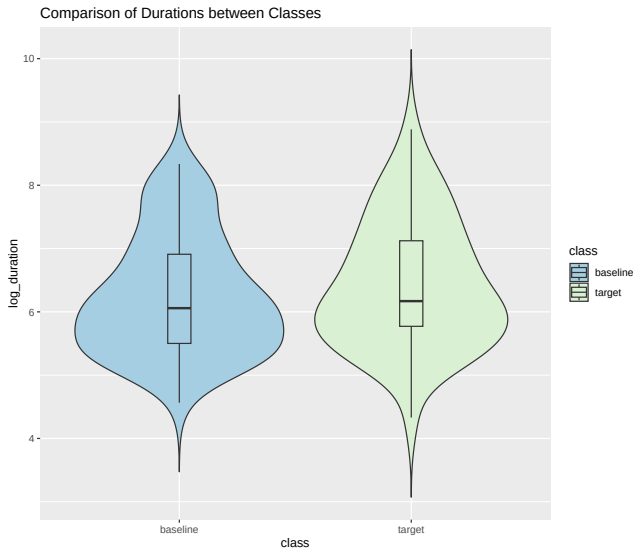

Figure 3.1: Baseline and Target groups reading speed violin plots.

To see if the sentence type had a significant effect on the reading speed, an ANOVA test was conducted. The only independent variable here was the class of the sentence, and the rest of the recorded variables were kept in account as control variables. The classes reported effect on the duration was not significant with p=0.32. Therefore, the null hypothesis is failed to be rejected. The reading speed does not appear to be significantly affected by er_p in the Dutch language. The summary of the ANOVA test is an shown in 3.2.

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
class	1	0.93	0.9257	0.999	0.32
Residuals	110	101.97	0.9270		

Figure 3.2: ANOVA comparing the mixed model and the NULL version of the model

Furthermore, the models residuals were assessed for normality. The created QQ-plot in 3.3 visualizes how the model values differ from the expected values in both classes.

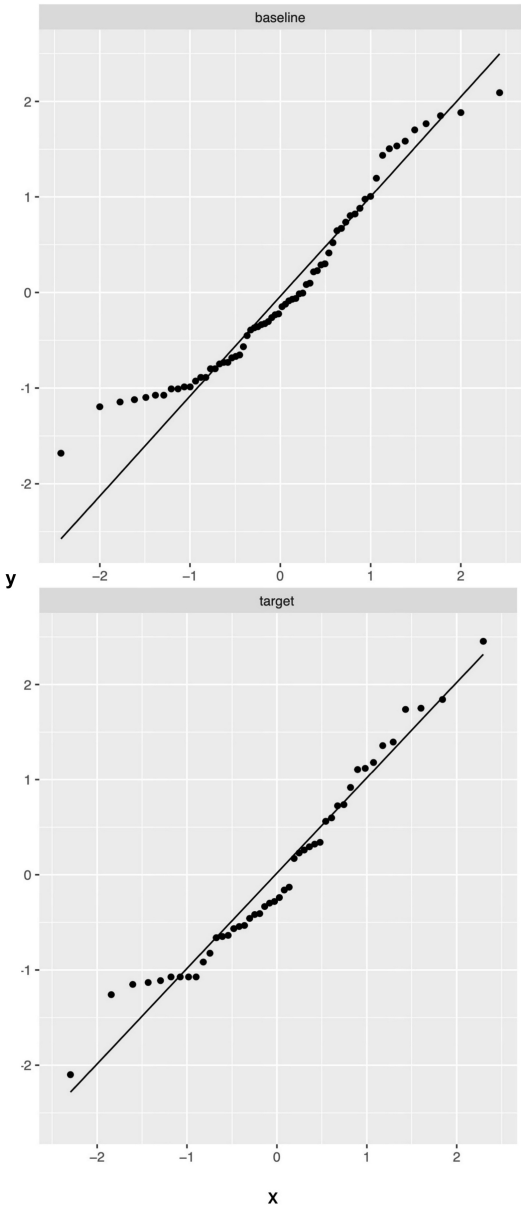

Figure 3.3: QQ-plots

The QQ-plots don't fit the line perfectly, suggesting the distribution isn't normal. Both plots show a fat-tailed data, suggesting that there extreme values in the data set. These extreme high or low values deviate from what is expected from a normal distribution. The baseline QQ-plot also peaks in the middle just as it did in 3.1.

The reading durations were compared in terms of the other variables as well. The observed values were plotted as in 3.4, where the duration is compared with the order of sentence presentation. The scattered dots show all the data points collected, and the red line is the average value for that order.

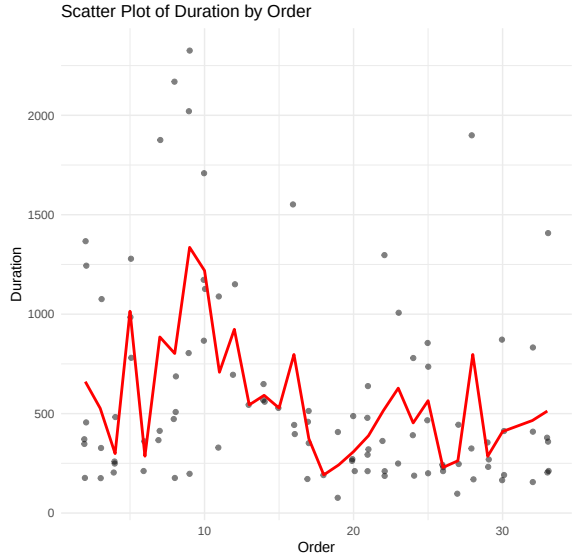

Figure 3.4: Scatter plot with averaged line showing the reading times for each presentation order

The reading durations for the first half of the experimental procedure seem to be higher than the second half in this graph. So lastly, due to these suspicions from the visual observations, a second ANOVA was conducted. In 3.5, all the variables collected from OpenSesame were added as independent variables to see any other possible significant effects that might have effected the data. With p=0.0442, the order of the sentences presented appear to have a significant effect on the reading speed, which will be discussed further.

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
class	1	0.93	0.926	1.046	0.3087	
subject	1	3.46	3.459	3.910	0.0506	.
sentence	1	0.18	0.177	0.200	0.6554	
order	1	3.67	3.667	4.145	0.0442	*
Residuals	107	94.67	0.885			

Figure 3.5: ANOVA with all variables as independent factors.

4 Discussion

The experiment eventually had data from 10 participants, and the demo version was run with 4 participants. The demo participants gave feedback on the language, the experiment setup, and any other details they thought were important.

Eventually two of the target and baseline pairs were modified due to fluency errors. Most of the participants also mentioned the long duration of the experiment. This caused distractions towards the end of the experiment, which was visible during the data visualizations of the demo runs. The sentence list shown to the participants were modified and decreased accordingly, while still keeping an appropriate number of stimuli to formulate a scientific statement (Lakens, 2022).

Lastly, the data visualization and analysis also showed that the first few trials were not inline with the rest of the results for most of the participants. To eliminate the impact on the data set for this study, two extra filler sentence pairs were added for practice to all data sets. Any other underlying cause of this discrepancy can be studied further.

4.1 Limitations

The modifications after the demo still weren't enough to accept the hypothesis. The findings of the experiment not aligning with the hypothesis could have been caused by a flaw in one of these five categories;

1. The er_p doesn't have an LDD relationship with its preposition.
2. Eye-tracking with SPR isn't a sufficient or valid instrument of measurement for such experiments.
3. LDDs don't necessarily cause a slow down in reading speed.
4. There wasn't enough data or the achieved data was flawed.
5. Any other step in the experimental procedure or an unknown variable that has a stronger affect on the data.

The first three options can be safely dismissed for this paper, as all methods were extensively studied and are generally accepted to be reliable by researchers. All of the methods applied followed the background work explained in the introduction section directly.

As for the fourth point, the experiment eventually ended up having only 10 participants. Even though there were lots of data extracted from each, arguably it might have been insufficient. On the other hand, the credibility of the data the eye-tracker collected is uncertain. The eye-tracker is prone to errors and no matter how much you try to perfect the environmental conditions, a small distraction of the participant can end up with the pupil getting out of the camera frame. Finding the pupil again in such situations is problematic for the eye-tracker, and occasionally require experimenter intervention. A different eye-tracker or a different sampling rate even could have given different results, as the saccades of the pupil are very rapid.

Participants were instructed to wear contact lenses if they have blue-lens filters on their glasses per instructed on the eye-tracker manual, however participants wearing glasses still ended up having trouble. When the pupil is lost due to a reflection of light, or a head movement, it can be fixed from the experimenter side easily as said. Yet, especially 2 participants wearing glasses had too many problems and eventually got too distracted, which concluded in their data set having lots of missing values. Like all participants, their reading times increased overall towards the end of the experiment, but rather more promptly.

Lastly for the fifth point, an unaccounted variable having more significant impact on the data is a possibility. The second ANOVA test supported this suspicion by indicating that the presentation order of the sentences had somewhat of an effect on the reading speed. However, the p-value for the order variable was p=0.0442, just below the threshold of 0.05. Comparing this value to the p-value obtained for the subject variable (p=0.0506), it is apparent that the difference is rather very small. Although the difference is quiet small, one of them is reported to be insignificant, while the other is significant. As both values sit around the generally accepted threshold, we could classify them both to be "marginally significant" to avoid vagueness. Yet, this term is viewed skeptically, as it doesn't adhere to the statistical implications directly (Pritschet, Powell, & Horne, 2016). The p-value threshold of 0.05 is a conventional measure, and its significance can be debated on considering the power of the test done (Lakens, 2015). Overall for the implications in this study, the p-value for either of the mentioned variables is insufficient to claim that they had a significant effect on the reading speed.

4.2 Further Research

Especially as the present work contradicts prior findings, further thorough research should be done on the topic. One potential area for future improvements is replicating the same experiment with new participants, to see if increasing the sample size alone will yield in different results. However, it is important to note that the p-values obtained are not even marginally significant. Thus, to observe a significant change, number of additional participants would need to be substantially higher to remove the variance.

As similar setups were found to be working in the past, a similar experiment can be conducted with improved methodology. Given how eye-trackers can be inaccurate, a different eye-tracker or even a different sampling rate can affect the results. Besides this, a whole different approach can be taken to avoid the issue that some of the participants voiced regarding the length of the study. The study can be turned into a longitudinal study, or have breaks in between, to assure that participants read every sentence with the same level of focus.

Controlling more variables and doing more in depth linguistic search is another possible improvement. Meanwhile all the prepositions in the sentence were taken into account, another linguistic phenomena might be interacting or contracting with LDDs. This could explain why the effect of LDDs are not significant overall in the sentences. For this after each sentence is created, they should be all checked for any other kind of dependency and influence, inter and across the sentences, to remove all the unwanted impacts.

5 Conclusion

In this paper, it was hypothesized that the Dutch er_p can create an LDD with the preposition that it relates to. A slowdown in the reading speed around the concerned preposition was expected. Our assumptions were based on the ground work done by Stowe (1986), and the implications of the partially replicated study by Weit (2022). An SPR eye-tracking experiment was constructed to measure the reading speed difference between sentences with and without er_p.

The collected data were statistically investigated using an ANOVA. The comparison of the mix models didn't give a significant p-value (p=0.32). Thus it was failed to reject the null hypothesis that the sentences with er_p didn't have a significantly larger reading times compared to sentences without the er_p. This failing doesn't indicate that the er_p for sure doesn't effect the reading speed, but adds more on to our existing knowledge of the function, and can provide insight for future work.

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Appendix

1. Target Sentence Pairs

1. Mijn favoriete actrice heeft een nieuwe film uit.
   Ik verwacht er met mijn nieuwe vrienden naar te kijken in de bioscoop.

2. We wilden samen een dessert bakken.
   Ik nam er het grootste stuk van na het eten.

3. Breng alsjeblieft de botercontainer uit de koelkast.
   Dennis wil er wat plakjes van om brood te smeren.

4. Joris ging winkelen in een luxe winkelcentrum en kocht een nieuwe jasje.
   Hij betaalde er een zeer hoog bedrag voor maar droeg het nauwelijks.

5. We kregen een heel goede deal voor die auto en konden het niet laten om het te kopen.
   We betaalden er de helft van de prijs voor tijdens de zomervakantie.

6. Wanneer ze praten over verlies komt het onderwerp van zijn grootouders ter sprake.
   Hij denkt er tamelijk vaak en raakt van streek.

7. De piloot had al eerder een ongeval gehad met een oude helikopter en was sindsdien voorzichtiger.
   Hij vermeed er te allen tijde mee te vliegen en slaagde erin.

8. Het was een grote koek en de man wilde wat delen met zijn vrienden.
   Hij brak er enkele even stukken van af om te delen.

9. Er is een wekelijkse vergadering van het bestuur.
   Ik ben er langere tijd niet meer bij sinds het begin van mijn studie.

10. Mijn vrouw raakt de autosleutels altijd kwijt.
    We moeten er meestal samen naar zoeken elke ochtend.

11. Nadat ze de salade had klaargemaakt pakte ze altijd dezelfde kom.
    Ze mengde er elke dag haar salade in om minder vaatwerk te gebruiken.

12. Luuk vond een leuke hardloop playlist.
    Hij luistert er elke keer dat hij rende naar om het tempo bij te houden.

13. Emma kookte een grote paella.
    Haar vriend at er maar de kleinste hap van nadat hij erop had geblazen.

14. Ze werd uiteindelijk bij het politiebureau betrapt terwijl ze's nachts aan het fietsen was.
    Ze racete er elk weekend langs zonder haar fietsverlichting.

15. Dienke is echt geobsedeerd door gamen.
    Zij stopt er vandaag absoluut nog niet mee maar misschien volgende week.

16. Mijn collega's zeiden dat deze les saai was.
    Ik heb me er vorige week vrijdag voor aangemeld en het lijkt me heel interessant.

2. Baseline Sentence Pairs

1. Mijn favoriete actrice heeft een nieuwe film uit.
   Ik verwacht met mijn nieuwe vrienden naar de film te kijken in de bioscoop.

2. We wilden samen een dessert bakken.
   Ik nam het grootste stuk van de taart na het eten.

3. Breng alsjeblieft de container uit de koelkast.
   Dennis wil wat plakjes van de boter om brood te smeren.

4. Joris ging winkelen in een luxe winkelcentrum en kocht nieuwe spullen.
   Hij betaalde een zeer hoog bedrag voor de kleding maar droeg het nauwelijks.

5. We kregen een heel goede deal en konden het niet laten om het te kopen.
   We betaalden de helft van de prijs voor die auto tijdens de zomervakantie.

6. Wanneer ze praten over verlies komt het onderwerp van zijn grootouders ter sprake.
   Hij denkt tamelijk vaak aan de dood van zijn grootouders en raakt van streek.

7. De piloot had al eerder een ongeval gehad en was sindsdien voorzichtiger.
   Hij vermeed te allen tijde met die oude helikopter te vliegen en slaagde erin.

8. Het was groot en de man wilde wat delen met zijn vriend.
   Hij brak enkele even stukjes van het koekje af om te delen.

9. Het bestuur heeft elke week een overleg.
   Ik ben langere tijd niet meer bij de vergaderingen sinds het begin van mijn studie.

10. Mijn vrouw raakt de autosleutels altijd kwijt.
    We moeten meestal samen naar de sleutels zoeken elke ochtend.

11. Nadat ze de salade had klaargemaakt pakte ze altijd hetzelfde bestek.
    Ze mengde elke dag haar salade in dezelfde kom om minder vaatwerk te gebruiken.

12. Luuk luistert graag naar muziek als hij hardloopt.
    Hij luistert elke keer dat hij rende naar een playlist om het tempo bij te houden.

13. Emma kookte Spaans eten.
    Haar vriend at maar de kleinste hap van de paella nadat hij erop had geblazen.

14. Ze werd uiteindelijk betrapt terwijl ze's nachts aan het fietsen was.
    Ze racete elk weekend langs het politiebureau zonder haar fietsverlichting.

15. Dienke is echt geobsedeerd door gamen.
    Zij stopt vandaag absoluut nog niet mee gamen maar misschien volgende week.

16. Mijn collega's zeiden dat de curcus saai was.
    Ik heb me vorige week vrijdag voor de curcus aangemeld en het lijkt me heel interessant.

3. Filler Sentence Pairs

1. Ik heb gisteren een film gekeken.
   Nu ben ik te moe om iets anders te doen.

2. We zijn gisteren naar het museum geweest.
   Er waren veel interessante tentoonstellingen.

3. De zomer komt eraan dus ik ben begonnen met trainen.
   Ik wil graag fit zijn voor het strandseizoen.

4. Ik heb een nieuwe auto gekocht maar hij heeft wel wat mankementen.
   Morgen gaat hij naar de garage voor reparatie.

5. Ik ben net begonnen aan mijn afstudeerproject.
   Het is een interessant onderwerp maar ook erg uitdagend.

6. Ik ben gaan wandelen in het bos en kwam een mooie waterval tegen.
   Daar heb ik even gepauzeerd om van het uitzicht te genieten.

7. Ik heb eindelijk mijn eigen huis gekocht.—Het is een oude woning die wel wat renovatie nodig heeft maar ik ben er ontzettend blij mee.

8. Ik wilde een nieuwe taal leren en heb me ingeschreven voor een cursus.
   Het is moeilijker dan ik dacht maar ook erg leuk om te doen.

9. Ik ben begonnen met hardlopen om meer aan mijn conditie te werken.
   Vandaag heb ik mijn eerste 5 kilometer gelopen zonder te stoppen.

10. Ik heb mijn baan opgezegd en ben voor mezelf begonnen.
    Het is spannend maar ook een grote uitdaging.

11. Mijn vriend en ik hebben besloten om samen te gaan wonen.
    We hebben een mooi appartement gevonden en zijn druk bezig met het inrichten ervan.

12. Het is al laat en ik moet nog boodschappen doen.
    Gelukkig is de supermarkt 24 uur open.

13. De hele dag was het al druk op het werk en het begon te regenen toen ik naar huis reed.
    Ik was doorweekt tegen de tijd dat ik thuiskwam.

14. Nadat ik mijn spullen in mijn kamer had gezet besloot ik te gaan sporten.
    Het was een zware training maar ik voel me nu goed.

15. Ik had afgesproken met een vriendin om samen te lunchen.
    Zij had een nieuw restaurant ontdekt en het eten was heerlijk.

16. Vanochtend ben ik begonnen met mijn sollicitatiegesprek.
    De interviewer was vriendelijk maar de vragen waren moeilijk.

17. Na het boodschappen doen besloot ik een wandeling te maken in het park.
    Het was een mooie dag en het park was rustig.

18. Ik had een belangrijke presentatie op het werk.
    Ik was zenuwachtig maar het ging goed en ik kreeg positieve feedback.

19. Vandaag had ik afgesproken met mijn ouders.
    We hebben samen geluncht en daarna hebben we foto's bekeken van mijn kindertijd.

20. Na het werken besloot ik om te gaan winkelen.
    Ik heb een paar leuke kleren gevonden en ik ben blij met mijn aankopen.

21. Ik had afgesproken met een vriendin om naar de film te gaan.
    Het was een goede film maar de popcorn was te zout.

22. Nadat ik mijn huiswerk had afgerond besloot ik om te gaan joggen.
    Het was een mooie dag en de omgeving was prachtig.

23. Mijn moeder belde me net op om te vragen of ik komend weekend langs wil komen voor het familiefeest.
    Ik had eigenlijk andere plannen maar ik kan haar niet teleurstellen.

24. Tijdens mijn vakantie in Thailand heb ik geleerd hoe ik zelf Pad Thai kan maken.
    Ik ben van plan om het vanavond te proberen voor mijn vrienden.

25. Na een lange dag op het werk kwam ik thuis en zag ik dat mijn kat overal had geplast.
    Ik was zo gefrustreerd maar uiteindelijk kon ik er toch om lachen.

26. Vorige week ben ik begonnen aan een nieuwe hobby: schilderen.
    Het is zo ontspannend en ik kan niet wachten om mijn eerste schilderij aan de muur te hangen.

27. Vandaag heb ik een sollicitatiegesprek voor mijn droombaan.
    Ik ben ontzettend zenuwachtig maar ik heb me goed voorbereid en ik hoop dat het goed gaat.

28. Mijn vriend belde me net op om te vertellen dat hij een verrassing voor me heeft.
    Ik ben heel benieuwd wat het is maar ik moet nog even geduld hebben tot vanavond.

29. De zon gaat langzaam onder en de lucht kleurt rood.
    Straks is het helemaal donker en gaan de straatlantaarns aan.

30. De treinreis duurt uren en ik verveel me.
    Gelukkig heb ik een goed boek bij me om de tijd te doden.

31. De lucht is grijs en het begint te regenen.
    Ik denk dat we vandaag beter binnen kunnen blijven.

32. De kinderen spelen vrolijk in de speeltuin en maken nieuwe vriendjes.
    Ondertussen genieten de ouders van een kopje koffie op het terras.