QUALITY OF LANGUAGE IN DISCOURSE DURING TABLET AND TRADITIONAL PLAY

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Abstract

Background: Children with specific language impairment (SLI) form a large part of the caseload of speech and language therapists. Speech and language therapists often use play in their language interventions. Tablet games have entered the therapy room, because they appeal to children and might offer opportunities to stimulate language development at home. Still, little is known about the effect of tablet games on syntax and word use during discourse in children with SLI.

Aim and research question(s): The current study aims to assess whether there is a difference in syntactic complexity and word use in dialogues of children with SLI, during play with tablet games compared to real objects.

Method: In this observational study, with a within subjects experimental design, 16 participants with SLI, aged 4;00-6;11 years old, alternately played with wooden blocks and a tablet game, simulating a block building activity, during four weekly play sessions. Their conversations were recorded, transcribed and analysed afterwards.

Results: No difference was found in mean length of utterance between tablet play and real block play. Participants on average used significantly more different words during real block play. Overall, they used more words during real block play, but this difference was not significant.

Conclusion: This study indicates there seems to be no difference in syntactic complexity in children with specific language impairment, in the age of 4;00-6;11 years, during free play with tablet games and real objects. However, these children do use significantly more different words during play with real objects compared to play with a tablet game.

Recommendations: For clinical practice this implies that, for word learning, it is preferred that teachers and parents offer real objects over tablet games to SLI children during free play with their peers.

Keywords:

Specific language impairment, tablet games, language therapy, language development, pre-school children

Introduction

Background

Over fourteen percent of all children referred to speech and language therapy practices, are children with specific language impairment (SLI).[1] SLI is a disorder that affects 7,4% of all school aged children.[2] SLI is defined as a language disorder that cannot be explained by other developmental deficiencies.[3–5]

Children normally develop a large part of their language during the interaction of play with their peers and adults.[6] Speech and language therapists (SLTs) often use play in their language therapy, because attention and focus are shared during the interaction in play.[6] Play also motivates children to exercise, because it is fun and removes pressure from the interaction.[6] Within play SLTs can manipulate context and communication in a way targets in therapy can be repeated and practiced in a meaningful context. This promotes success of the intervention.[7]

Since the introduction of the iPad in 2010[8] educational tablet games, aiming at (aspects of) language development, are used in speech and language therapy too. Noordzij (2012)[9] reported SLTs in practices used the iPad in 80,9% of their language treatments. Because tablet games are easy to use and attractive to children, they increase children's interest in learning.[10] In therapy children seem to prefer exercises by means of tablet games over real objects.[11]

Tablet games also offer opportunities to stimulate language development at home, because a majority of parents is positive about the effects of tablet games on their children's development[12] and tablets are present in many homes. In 2015 approximately 79% of the Dutch households possessed a tablet computer[12] and 72,9% of the children in the UK, aged three to seven years, had access to a touch screen device in 2013.[13] On average Dutch children in the age of one to eight years old spend over 30 minutes a day playing on tablets.[12] This means tablet games can be a perfect agent to practice language, if they influence language development positively.

However, to date little is known about the effects of tablet games on language learning. Recently there have been two small size randomized-controlled crossover studies addressing the effects of tablet games on vocabulary. Singer and Gerrits[14] compared the effects of vocabulary intervention with real objects and tablet games on word learning in typically developing toddlers. Van Noord[11] compared the effects of real objects and tablet games on word learning in young children with SLI. Both studies found tablet games can be used as effectively in vocabulary intervention as real objects.

Mirtes (2014)[15] found less positive effects of tablet games on children's language. Mirtes[15] performed a study on the quality of discourse between four year old children while playing

with traditional play blocks, compared to play with a comparable tablet game. The results showed that mean length of utterance and number of different words used were significantly higher in traditional block play, compared to tablet play. However, one can question the clinical relevance of the difference in mean length of utterance, which only was 0.5 morpheme. Because of the small sample size (n=8) in this study, the level of evidence is limited.

Yet Mirtes' study is interesting, especially in the light of SLI, because it addresses the influence of tablet games on the quality of syntax and a deficit in syntax is one of the most salient characteristics in SLI.[16] Since SLTs are increasingly using tablet games in their language interventions and advise parents to use tablet games to stimulate language development, it is important to know more about how tablet games influence syntax and word use of children with SLI compared to play with real objects.

To the best of our knowledge, the effect of tablet games on syntax and word use during discourse has not been investigated before in children with SLI compared to the effect of real objects. The current study aims to assess whether there is a difference in syntactic complexity and word use in dialogues of children with SLI, playing with tablet games or real objects. This leads to the following objectives of this investigation.

Objectives

Primary Objective: To compare length and complexity of utterances during discourse between preschool children with SLI (4 - 6;11 years), while playing with traditional building blocks, compared to playing with a comparable construction app on a tablet computer.

Secondary Objectives: To compare the number of different words used during discourse in preschool children with SLI (4 - 6;11 years), when playing with traditional building blocks and a comparable construction app on a tablet computer.

To compare the total number of words used by preschool children with SLI (4 - 6;11 years), when playing with traditional building blocks and a comparable construction app on a tablet computer.

Methods

Study design

The present observational study has a within subjects experimental design.[17] During four weekly play sessions eight couples of children with SLI were observed during play with traditional building blocks and a tablet game, simulating a comparable building activity. In

week one and three half of the couples played with building blocks and in week two and four with a tablet game. The other couples followed this sequence in a reversed order to prevent possible sequence effects between play conditions.[18] (See Figure 1). The play sessions started on the 15th of March 2017. The final session was on the 3rd of May 2017. The 32 play sessions were audio and video recorded and utterances of the children were transcribed and analysed.

Participants

The participants were recruited from two locations of a school for children with speech, language and communication needs in the northern part of the Netherlands. Participants were 16 children with SLI. Because the primary outcome measure is mean length of utterance in words (MLUw), the sample size was calculated by the computer program G*Power 3.1.9.2[19], based on the mean length of utterance in morphemes (MLUm) in Mirtes.[15] This can be justified, because MLUm is almost perfectly related to MLUw.[20] At a power of 0.90 and α=0.05 the calculated sample size was 16. By assuming a power of 0.90, there was a safety margin built in, because a power of 0.80 is normally recommended.[21]
In order to be eligible to participate in this study, a subject had to meet all of the following criteria: Diagnosis of SLI, attending the school for speech, language and communication needs, talk with a minimum length of spontaneous utterances of two words and an age in between 4;00 and 6;11 years old. Potential subjects with a known hearing loss over 20 dB or diagnosed with an autism spectrum disorder were excluded from participation in this study. After studying the files of 39 potentially eligible participants, 18 were confirmed eligible. The parents of 16 possible participants were asked for informed consent. All but one agreed. The parents of another eligible participant were asked and gave informed consent, which made it possible to include the intended 16 participants. After inclusion, children were assigned into eight couples by their teacher on the condition that they could get along with each other well. These couples were randomly assigned to one of the research sequences by computer (see Appendix 1) by an independent researcher outside the research setting.

Ethical issues

This study was conducted according to the Declaration of Helsinki[22] and in accordance with the Medical Research Involving Human Subjects Act (WMO). It was approved by the Internal Ethical Review Committee of the faculty of Health Care of HU University of Applied Sciences Utrecht. Personal data was processed in compliance with the Dutch Personal Data Protection Act (Wet Bescherming Persoonsgegevens). Signed informed consent was obtained from the parents of all participants.

Variables

The primary study parameter was the mean difference of MLUw between play conditions. MLUw is computed by counting all utterances in a language sample and divide them by the number of words of this sample. MLUw has proven to be a reliable and valid indicator of (morpho-)syntactic development, that can effectively and reliably be used for comparisons of language samples in research and across different languages.[20,23] MLUw is a more reliable measure than MLUm, because arbitrary decisions regarding morpheme assignment are avoided.[20] In this study the MLUw of samples, obtained from children playing with building blocks, was compared to the MLUw of samples obtained from the same children playing with a comparable construction tablet game.

The secondary study parameter was the mean difference of number of different words used (NDW) between play conditions. NDW qualifies the variability in word use of the children during play. The higher NDW, the more different words a child uses. It is derived by counting the number of different words in the language samples and is an appropriate measure to evaluate lexical diversity between conditions.[24]

The third study parameter was the mean difference of total words used (TW) between play conditions. In this study it was used as an explorative indicator of how talkative children were under the different play conditions. It measures if children talk more or less in one of the conditions.

Materials

In the play sessions with traditional building blocks a set of 100 coloured wooden building blocks[25] per participant was used, from here referred to as real objects (RO). During the tablet game sessions the couples played with the “Little Builder” app by Coda Multimedia[26] installed on an iPad. In this tablet game (TG) children can pick and move virtual building blocks in a 2-d screen and build with them, similar to traditional blocks. Participants could change the size and colours of the virtual blocks. There were two iPads available, one for each participant. Game sound was turned on at a level it was just audible and would not interfere with the recordings of the participants’ speech. For the audio recording an Olympus VN-3100PC digital voice recorder was used. The video recordings were made by means of Free2X Webcam Recorder v.1.0.0.1[27] video capture software, installed on an Acer Aspire E5-575G-55LU laptop with an external Logitech C270 webcam and a HP 210-4120ed laptop. To prevent data loss and to increase the ease and success of transcribing utterances, the recording devices were used simultaneously.

Procedure

Participants were pulled out from their classroom in fixed couples four times in four weeks for a play session in the speech- and language therapy room in school. Depending on their

allocation participants followed a RO-TG-RO-TG or TG-RO-TG-RO sequence of sessions. During all play sessions participants played 10 minutes at a table, sitting next to each other. The instructions the children received were standardised (see Appendix 2). During the instruction, in both TG and RO sessions, children were invited to build anything they'd like with the virtual blocks or wooden building blocks. They were told that they could play alone or together. During all play sessions a time timer was visible to the children, which indicated the remaining play time. The researcher made field notes about play behaviour, child participation, utterances and other possible informative observations to the study. At the end of each session the investigator showed the children what they would do the next time by means of a strip with four pictures representing the TG and RO sessions (Appendix 3). Next the children were guided back to their classrooms.

Data analysis

All utterances in the 10 minute lasting recordings were transcribed and analysed by the researcher, using the CHILDES programs CHAT and CLAN V 20-Feb-2017[28].
The language samples were transcribed according to the guidelines in the CHILDES manual[29] and the principles to analyse children's language according to the 'Taal Analyse Remediëring en Screening Procedure' (TARSP)[29]. This implicated that social and stereotype expressions like "look", "yes" and "no" and sound-simulations were excluded from analysis. Because the collected data consisted of video recordings and viewing was essential for the accuracy of the transcription, blinding was not possible during transcription and analysis. Once the transcriptions were completed the outcome measures MLUw, NDW and TW were computed by CLAN and registered in an Excel-data-collection file.

The statistical analysis was computed by IBM SPSS Statistics version 22.[30] Data were imported from the Excel-data-collection file.
Because every participant was recorded and analysed in CHILDES twice under the same condition, the mean MLUw (µMLUw) per condition was calculated. Next for every participant the difference of mean MLUw between conditions was calculated. Subsequently, based on the descriptives, it was tested whether there was a difference in mean MLUw between study conditions in the participants as a group. Because of the small sample size, the data cannot be assumed to be normally distributed.[21] Since this study has a within subjects design the non-parametric Wilcoxon Signed Ranks test (WSRt) was appropriate.[31] The p-value was set at 0.05 (two-tailed). In case of significant differences the effect size (r) was calculated manually by the formula[21]

$$r = \frac{Z}{\sqrt{N}}$$

where Z is the calculated Z-value by SPSS and N is the number of observations made. Effect sizes of 0.10, 0.30 and 0.50 are respectively considered small, medium and large.[32] The statistical analysis of NDW and TW was identical to the procedure in MLUw.

Results

Participants

All 16 participants started and finished the complete trial. The descriptives of the participants are presented in Table 1. They are based on the most recent available test scores at the start of the trail. In some cases, like in 'participant 4', other aspects not listed also contributed to the diagnosis of SLI, e.g. communicative ability and phonological development. A mean non-verbal IQ was not calculated, because intelligence was assessed by means of different non-verbal IQ-tests. The characteristics show there is a much variation in scores between participants, but also within individual participants.

Main results

Difference in MLUw between play with RO and TG. No significant difference between play conditions was found in mean MLUw. The Wilcoxon Signed Ranks test statistic resulted in a Z-value of -1.413 at a p-value of 0.158. Figure 2 gives a visual representation of the individual values. Table 2 shows the exact values of the mean MLUw and differences in mean MLUw per participant under the different play conditions, as well as the descriptive statistics.

Difference in NDW between play with RO and TG. A significant difference was found between NDW between play conditions in favour of the RO condition at a Z-value of -1,978 and a p-value of .048. The calculated effect size is -0.35, which is a medium effect size. The mean NDWs are presented in Figure 3. See Table 2 for the exact values and differences in mean NDW (µNDW) under both conditions per participant, as well as the descriptive statistics.

Difference in TW between play with RO and TG. Although a difference of 44.3 total words used was found in favour of the RO condition, this difference was not significant. The calculated Z-value was -1,915 at a p-value of .056. See Figure 4 for the visual representation. The representation of the TW-values in Table 2 reveals a large standard deviation of the mean difference in TW and indicates a large variance between participants.

To summarize, the only significant difference found was that participants used more different words during the RO condition compared to the TG condition.

Discussion

The purpose of this study was to assess whether the length and complexity of utterances, in terms of mean length of utterance (in words), number of different words and total words used, differ in children with SLI during TG and RO play. To make this comparison, 16 participants were observed under the two play conditions. The results indicate that at a group level no significant difference in MLU can be found between play conditions. Still 11 out of 16 participants show a (slightly) higher MLU under the RO condition. The MLU of only three participants was higher under the TG condition, namely of participants “3”, “4” and “16”. The differences respectively were 1.1, 3.5 and 0.25 words. Participant “4” also showed the biggest difference, but one has to consider that she only had two analysable utterances under the TG condition and no analysable utterances under the RO condition.
The findings in this study are not in line with the results of the study of Mirtes (2014)[15], who found a significant, however small difference in MLU of nearly 0.5 morphemes in favour of the RO condition in typically developing children. Mirtes[15] measured MLU in morphemes and her participants were English-speaking. Therefor the outcomes of the study of Mirtes[15] cannot be compared one on one with the current study, in spite of the strong correlation that exists between MLU in morphemes and MLU in words[20], due to inflection differences between languages, which influence MLU in morphemes.[20] The results of the present study are based on a larger sample size. Therefor the conclusion that MLU in words of children with SLI during play with TG doesn’t differ from play with RO, seems legitimate.

In relation to the secondary objectives, examination of the mean number of different words shows participants on average use 10 more different words in the RO condition compared to the TG condition. This difference is significant and it also seems clinically relevant considering it is derived from 10 minute samples. Calculations indicate a medium effect. These results are in accordance with the significant difference in NDW Mirtes[15] found. Since the participants in the current study are children with impaired language, it is no surprise the found mean NDW during 10 minutes play is remarkably lower in both conditions compared to the participants (mean age 4.6 years) in Mirtes’ study, namely 41 versus 71 under the TG condition and 51 versus 90 under the RO condition. But the effect size is also smaller than Mirtes’ (-0.35 versus 0.89). Apparently the difference of the effect between TG compared to RO is smaller in children with SLI than it is in typically developing children.

Finally in the current study the range of mean total words used is large under the TG condition (0-219 words) and almost 2.6 times as large under the RO condition (0-564 words) compared to the TG condition. Under both conditions the variance of total words used is large between participants. Although participants on average use 44 words more under the

RO condition compared to the TG condition and thus seem to be more talkative while playing with RO, this difference is not significant, yet seems clinically relevant.

Block play showed to stimulate creativity and fantasy play in most participants and gave rise to verbal interaction. Participants built objects like houses and castles, zoo's, cars and even imaginary planes and helicopters. Participants showed similar play behaviour during TG and RO play. For instance participants who built constructions with RO tended to do so too whilst playing with the TG. Those who focused on collapsing constructions tended to do that under both conditions. The children who interacted with each other during play in general did under both conditions. There seemed to be a relationship between interaction and talkativeness. The less participants spoke, the more they played without interacting with each other during play. Participants 11 and 12 in couple 6 did not speak during any of the play sessions, although they did speak before and after the play sessions. The reason remains unclear.
The TG offered the possibility to change size and colour of blocks and even had the possibility to make the blocks look like fruit and vegetables. Therefor one might expect it would elicit more different words than it did compared to RO. However, this wasn't the case, although children did use words that described the virtual blocks appearance. The difference in NDW might be explained by the fact a TG limits interactions like pushing your playmates' building or exchanging blocks. This might cause a difference in word use that is related to interaction and word use that is not. Because the TG didn't influence the MLU differently from RO, it would be interesting to analyse the NDW split by lexical category to see whether there are certain word categories that account for the difference in NDW between play conditions. This wasn't within the scope of this study, but could be subject of future study. The current transcriptions could be used for that, but would have to be recoded to perform this analysis in CLAN.
The results found apply to a block building TG compared to traditional building blocks and can be different in other educational TGs and comparable RO. Replication of this study in different types of TGs will give a more detailed understanding of the effect of TGs on MLU and NDW compared to their real equivalents.
One also has to consider this study was performed during children's free play. Apparently this doesn't say anything about the use of TGs in language interventions, given the fact van Noord[11] found TGs to be equally effective as RO in word learning intervention in SLI children. Since no difference was shown in MLU in words in the current study, one might expect the use of TGs to be at least equally effective as the use of traditional therapy materials in syntax interventions in children with SLI. Future research is necessary to test this assumption. To make a fair comparison it is recommended to use a TG that is designed for syntax learning.

Using tablet games that originally were not designed for syntax intervention would possibly bias the comparison.

Strengths and limitations

This study has some limitations that should be considered. The transcription and analyses were not checked by a second researcher. This implies no inter-rater reliability could be computed which limits the appraisal of the overall reliability of this study.
The fact that data collection and analysis were performed by the same researcher and without blinding is normally seen as a limitation. However, in this study it is a strength, because the presence of the researcher during data collection, in combination with the notes made during this phase, made it possible to transcribe utterances that otherwise could not be transcribed due to their often poor intelligibility. The use of multiple recording devices also contributed to this.
Eventual bias caused by interaction between play conditions was accounted for by the reversed play cycle for half of the participants.

Conclusion

This study indicates there seems to be no difference in syntactic complexity in children with specific language impairment, in the age of 4;00-6;11 years, during free play with tablet games and real objects. However, these children do use significantly more different words during play with real objects compared to play with a tablet game. For clinical practice this implies that, for word learning, it is preferred that teachers and parents offer real objects over tablet games to SLI children during free play with their peers.

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Tables and figures.

Table 1 Participant Characteristics

Participant	Gender[a]	Age in months[b]	IQ[c]	TBQ[d]	ZQ[e]	WQ[f]	Mother tongue
1	F	62	108	93	64	56	Dutch
2	M	72	85	68	67	66	Dutch
3	M	80	81*	64	69	55	Turkish
4	F	70	95*	101	82	101	Dutch
5	M	70	119*	77	69	60	Dutch
6	M	68	105	104	77	85	Dutch
7	M	53	122	97	77	84	Dutch
8	M	55	95	70	69	74	Turkish
9	M	53	111	79	79	66	Tsjech/Albanese
10	M	54	101	55	65	55	Turkish
11	M	53	91	75	75	91	Dutch
12	M	68	85	96	55	96	Dutch
13	M	64	91	66	68	74	Dutch
14	M	65	95	[g]	[g]	[g]	Dutch
15	M	77	100	63	72	55	Polish
16	M	69	87*	79	69	91	Dutch

Summary	***n (%)***	***mean (sd)***	***mean(sd)***	***mean(sd)***	***mean(sd)***	***n (%)***	
n = 16	M 14(88)	65.25 (8.25)	79.1 (15.5)	70.5 (6.8)	73.9 (16.4)	Dutch	11 (69)
	F 2 (12)					Polish	1 (6)
						Tsjech/	
		Range	***Range***	***Range***	***range***	Albanese	1 (6)
		53-80	55-104	55-82	55-101	Turkish	3 (19)

*[a]Male or Female. [b]Age at start of trial. [c-f]Quotient scores M=100 ±15. [c]Non verbal Intelligence Quotient measured by SON-R 2,5-7[33] or *WNV.[34] [d]Language comprehension measured with SchlichtingTest for Language Comprehension.[35] [e]Sentence production measured with Schlichting test for Language Production II.[36] [f]Active vocabulary measured with Schlichting test for Language Production II. [36] [g]No recent TBQ, ZQ and WQ, instead values of CELF-4-NL: Core Language score 65, Receptive Language index 72, Expressive Language index 63, Language Content index 65, Language Structure index 65, M = 100 ±15.*

Table 2. Mean MLU, mean NDW and mean TW data and descriptive statistics.

	μMLU			μNDW			μTW		
Participant	**TG**	**RO**	**diff**	**TG**	**RO**	**diff**	**TG**	**RO**	**diff**
1	1.74	2.18	-0.45	41	40	0.5	54	67	-12.5
2	2.21	2.55	-0.33	23	61	-38.0	27	94	-67.5
3	4.10	3.00	1.10	12	10	2.0	15	13	1.5
4	3.50	0.00	3.50	4	0	3.5	4	0	3.5
5	3.48	4.05	-0.57	94	108	-14.0	214	353	-139.5
6	3.67	4.02	-0.34	88	95	-6.5	218	258	-40.0
7	2.00	2.55	-0.55	2	13	-11.0	2	17	-15.0
8	3.07	3.15	-0.08	73	49	23.5	163	124	39.0
9	2.03	2.18	-0.15	13	22	-9.0	17	31	-14.0
10	0.71	1.75	-1.04	8	14	-6.5	9	21	-12.0
11	0.00	0.00	0.00	0	0	0.0	0	0	0.0
12	0.00	0.00	0.00	0	0	0.0	0	0	0.0
13	3.63	4.63	-1.01	95	163	-68.0	219	564	-345.0
14	2.92	3.49	-0.57	72	77	-4.5	162	162	-0.5
15	2.80	3.08	-0.28	73	109	-36.0	175	317	-141.5
16	4.25	4.00	0.25	63	62	0.5	132	97	34.5
Mean	*2.51*	*2.54*	*-0.03*	*41.1*	*51.3*	*-10.2*	*87.9*	*132.2*	*-44.3*
SD	*1.36*	*1.48*	*1.07*	*37.2*	*48.4*	*21.2*	*90.2*	*162.4*	*95.5*
Minimum	*0.00*	*0.00*	*-1.04*	*0.0*	*0.0*	*-68.0*	*0.0*	*0.0*	*-345.0*
Maximum	*4.25*	*4.63*	*3.50*	*95.0*	*163.0*	*23.5*	*219.0*	*564.0*	*39.0*

Italic: descriptives computed during Wilcoxon Signed Ranks test statistic.

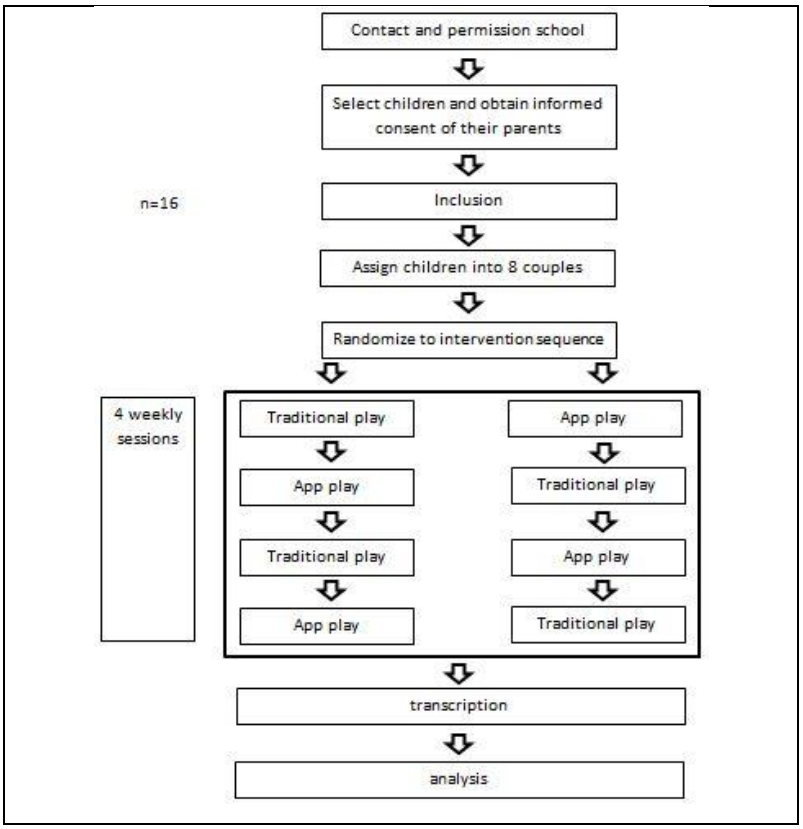


***Figure 1*. Research design.**

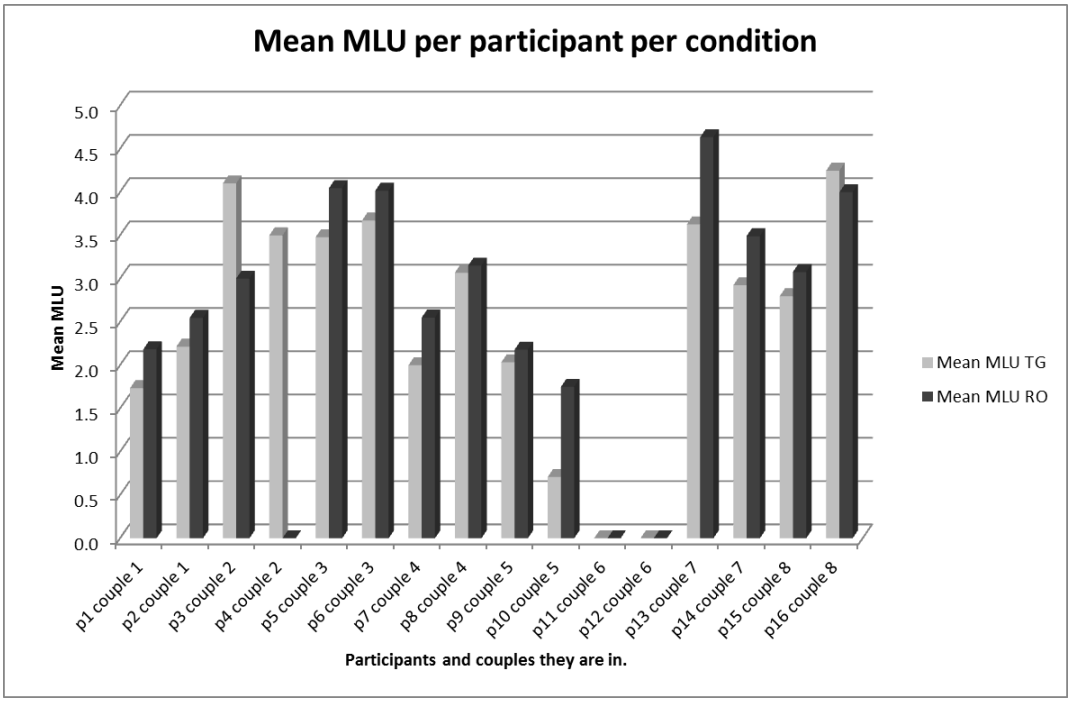


Figure 2. Mean MLU per participant per condition.

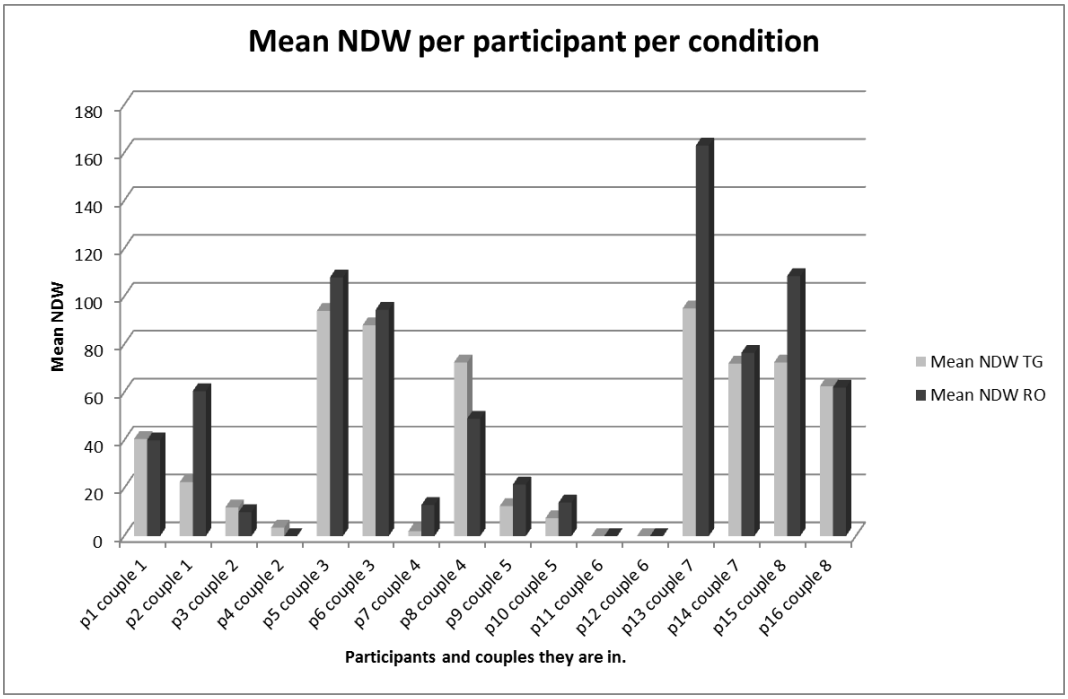


Figure 3. Mean NDW per participant per condition.

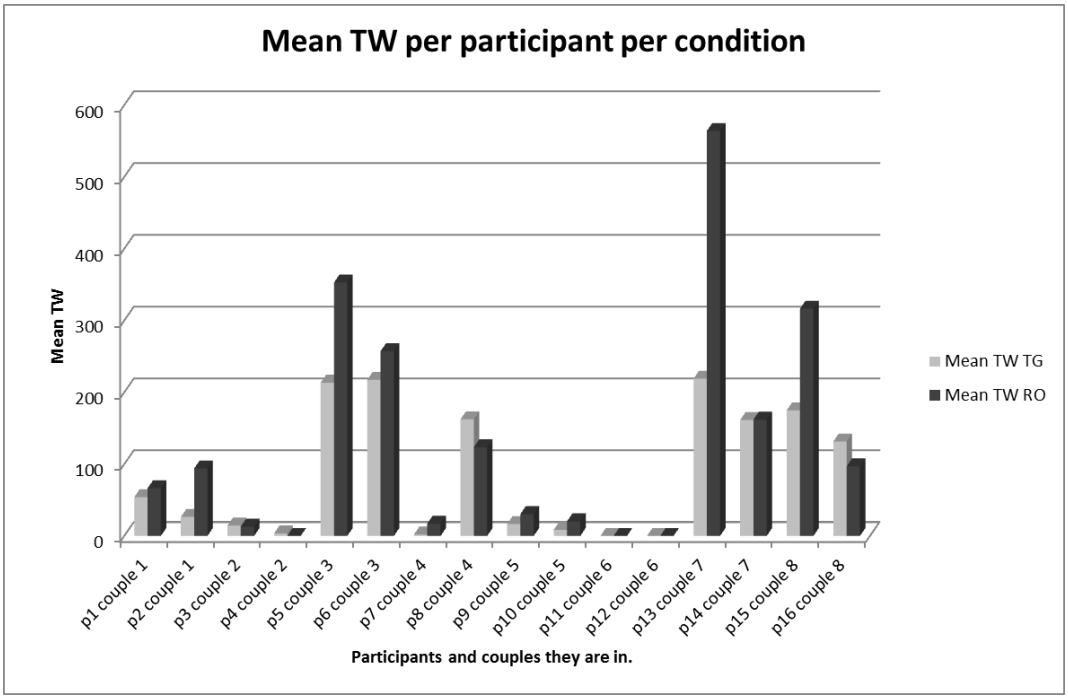


Figure 4. Mean TW per participant per condition.

Dutch summary (298 woorden)

Achtergrond: Een groot deel van de case-load van logopedisten bestaat uit kinderen met een taalontwikkelingsstoornis (TOS). Logopedisten gebruiken vaak spel tijdens hun taalbehandelingen. Tablet games zijn inmiddels doorgedrongen tot de logopediekamer, omdat ze aantrekkelijk zijn voor kinderen en mogelijkheden zouden kunnen bieden voor stimulering van de taalontwikkeling thuis. Er is echter nog weinig bekend over het effect van tablet games op zinsbouw en woordgebruik tijdens conversatie van kinderen met een TOS.

Doel en onderzoeksvraag: De huidige studie onderzoekt of er een verschil is in syntactische complexiteit en woordgebruik in dialogen van kinderen met een TOS, tijdens vrij spel met tablet games vergeleken met concreet spelmateriaal.

Methode: In deze studie met een “within subjects experimental design” speelden 16 proefpersonen met een TOS, tussen de 4;00 en 6;11 jaar oud, gedurende 4 wekelijkse spelsessies afwisselend met houten blokken en een tablet game, die een bouwactiviteit met blokken nabootst. Hun dialogen werden opgenomen, getranscribeerd en achteraf geanalyseerd.

Resultaten: Er werd geen verschil gevonden in gemiddelde uitingslengte tijdens tabletspel en spel met echte blokken. Participanten gebruikten gemiddeld significant meer verschillende woorden tijdens echt blokkenspel. In zijn totaliteit gebruikten ze meer woorden tijdens echt blokkenspel, maar dit verschil was niet significant.

Conclusie: Volgens deze studie lijkt er geen verschil te zijn in syntactische complexiteit bij kinderen met een TOS, tussen de 4;00 en 6;11 jaar, tijdens vrij spel met een tablet en spel met concreet spelmateriaal. Deze kinderen gebruiken echter significant meer verschillende woorden tijdens spel met concreet spelmateriaal ten opzichte van spel met een tablet game.

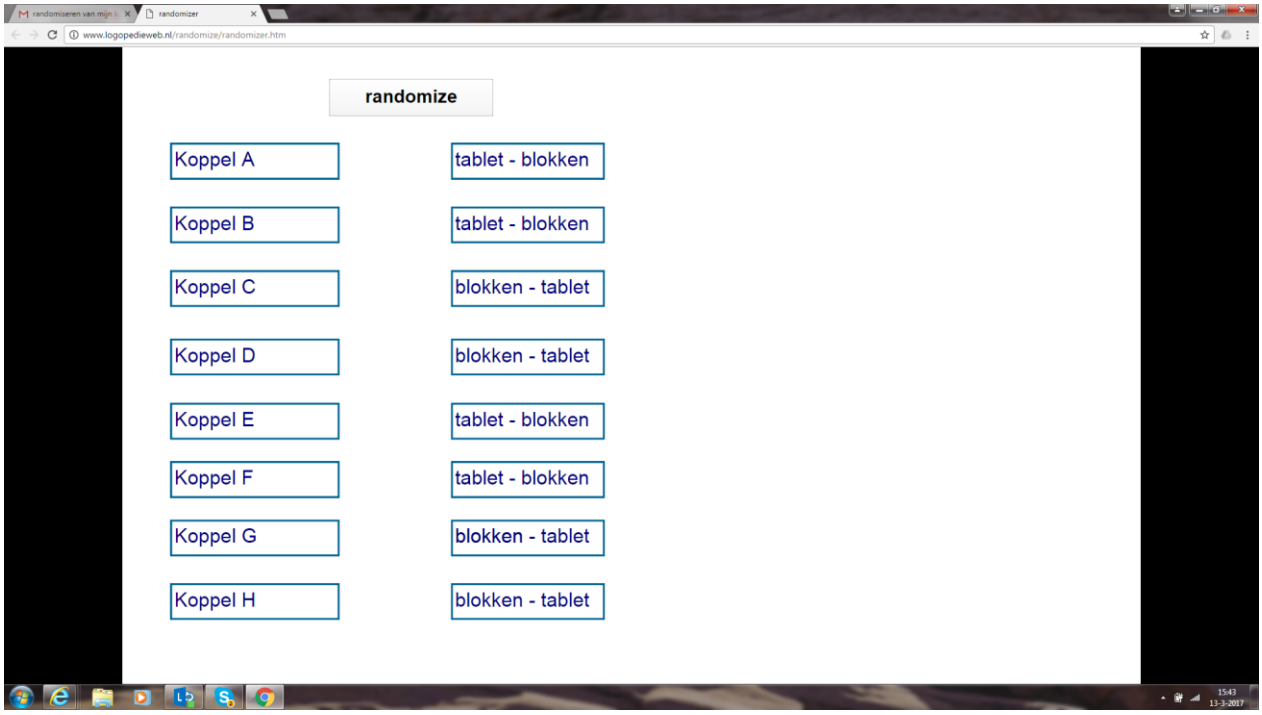
Aanbevelingen: Voor de klinische praktijk impliceert dit dat het, met het oog op woord-leren, de voorkeur heeft dat leerkrachten en ouders kinderen met een TOS tijdens vrij spel met leeftijdgenoten concreet spelmateriaal aanbieden in plaats van tablet games.

Trefwoorden:

Taalontwikkelingsstoornis, tablet games, logopedie, kleuters.

APPENDIX 1

Computerized allocation randomisation application.



A web based application to randomise the couples into the trial sequences.

Available at http://www.logopedieweb.nl/randomize

APPENDIX 2

Instruction Protocols

Blocks (RO):

Welkom heten.

Instructie:

Jullie mogen zo meteen met de blokken spelen. Als jullie beginnen met spelen zet ik de time-timer op 10 minuten. Als de timer afloopt gaan we stoppen met spelen en opruimen. Je mag zelf bedenken wat je gaat bouwen. Je mag alleen of samen spelen. Ik ben benieuwd wat jullie allemaal kunnen bouwen. Laat maar zien. Veel plezier jullie mogen nu beginnen. Timer zetten.

Na afloop:

De volgende keer gaan jullie bouwen met blokken op de Ipad. Laten zien op ritmekaart.

Tablet Game (TG)

Welkom heten.

Instructie:

Jullie mogen zo meteen met blokken op de Ipad spelen. Ik laat even zien hoe je dat kan doen. (uitleggen). Als jullie beginnen met spelen zet ik de time-timer op 10 minuten. Als de timer afloopt gaan we stoppen met spelen en mogen jullie naar de klas terug.

Nu mogen jullie zelf met de blokken op de Ipad spelen. Je mag zelf bedenken wat je gaat bouwen. Je mag alleen of samen spelen. Ik ben benieuwd wat jullie allemaal kunnen bouwen. Laat maar zien. Veel plezier! Begin maar. Timer zetten.

Na afloop:

De volgende keer gaan jullie met echte blokken spelen.

APPENDIX 3

Sequence strips.

Sequence strips the researcher used to show participants what the next game in the sequence would be. (sequence TG-RO-TG-RO or RO-TG-RO-TG).