Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Social and Educational Sciences
Department of Psychology

Vilde Buhaug Steen

Child Directed Speech in a Kindergarten Setting

A Comparison of Acoustic-Phonetic Characteristics of the Corner Vowels in the Speech of Female Norwegian Pedagogical Employees in Interaction with Toddlers and Adults

Master's thesis in psychology, specialization in learning – brain, behavior, environment
Supervisor: Nunne Englund
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Sammendrag

Lydopptak av barnerettet (BRT) og voksenrettet tale (VRT) fra 33 kvinnelige pedagogisk ansatte i norske barnehager ble innhentet for sammenligning. Opptakene ble gjennomført i en semi-kontrollert leksituasjon med en toddler og seks spesifikke leker, og i samtale med en voksen. Gjennomsnittlig tonehøyde, variasjon i tonehøyde, vokalvarighet, første, andre og tredje formant frekvens for de lange- (/a:/, /i:/ og /u:/) og korte (/a/, /i/ og /u/) hjørnevokalene ble analysert. Vokalområde for hver taletype (BRT og VRT) og vokalkvantitet (lang og kort) ble også kalkulert og analysert. Enveis variansanalyser med gjentatte målinger viste at /a:/, /a/, /i/ og /u:/ i BRT hadde signifikant høyere gjennomsnittlig tonehøyde sammenlignet med de samme vokalene i VRT. Den gjennomsnittlige variasjonen i tonehøyde for alle vokalene som ble undersøkt var signifikant større i BRT sammenlignet med i VRT. Disse funnene viser at kvinnelige pedagogiske ansatte i barnehage forsterker prosodiske karakteristikker ved tale når de interagerer med toddlere. Det ble ikke funnet signifikante forskjeller i vokalvarighet på tvers av taletyper. Sammenligninger av vokalområder på tvers av taletyper viste at vokalområdene for lange vokaler var signifikant mindre i BRT sammenlignet med i VRT. Disse funnene demonstrerer en hypoartikulering av hjørnevokaler i BRT. Oppsummert, indikerer resultatene at kvinnelige pedagogiske ansatte fremhever affektive aspekter ved tale i deres BRT når de samhandler med toddlere i en leksituasjon i barnehagen.

Abstract

Child-directed (CDS) and adult-directed speech (ADS) from 33 female pedagogical employees in Norwegian kindergartens was compared. CDS was elicited from a semi-controlled play-situation with a toddler and six specific toys. A conversation with an adult was used to obtain ADS. Vowel pitch mean, vowel pitch range, vowel duration, first, second and third formant frequency of the long corner vowels /a:/, /i:/ and /u:/ and their short counterparts /a/, /i/ and /u/ were analysed. Vowel spaces for each speech type (CDS and ADS) and vowel quantities (long and short) were also calculated and analysed. Repeated measures analyses showed that /a:/, /a/, /i/ and /u:/ in CDS had a significant higher pitch mean compared to the same vowels in ADS. Pitch range for all investigated vowels was significantly wider in CDS than in ADS. These results show that female Norwegian pedagogical employees in kindergarten enhance prosodic aspects in speech when interacting with toddlers. There were no significant differences in vowel duration across the speech types. Comparisons of the vowel spaces across speech types showed that for long vowels the vowel space was smaller in CDS. These results demonstrate a hypoarticulation of the corner vowels in CDS. Together, the results indicate that female Norwegian pedagogical employees highlight affective aspects of speech in their CDS when interacting with toddlers in a play-situation in kindergarten.

Preface

This thesis marks the end of my time as a master student. It has been an exciting and educational process. A process that would not have been possible without the contribution by the curious and committed participants, and the support and feedback from my supervisor Nunne Englund. I am forever grateful for your confidence in this project.

Recruitment of participants, gathering of data, development of method, research question and hypothesis and statistical analysis, are carried out by the author of this thesis.

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Abbreviations

ADS	Adult directed speech
ANOVA	Analysis of variance
CDS	Child directed speech
DLP	Digital language processor
F0	Fundamental frequency/pitch
F1	First formant frequency
F2	Second formant frequency
F3	Third formant frequency
Hz	Hertz

Child Directed Speech in a Kindergarten Setting: A Comparison of Acoustic-Phonetic Characteristics of the Corner Vowels in the Speech of Female Norwegian Pedagogical Employees in Interaction with Toddlers and Adults

Introduction

To be able to communicate with each other, to express meaning, what we think and what we feel, we are dependent on the use of language (Goldstein, 2010). Acquiring language is therefore of great important in a child's life (Høigård, 2013). To fully acquire a spoken language a child must master both the physical parts and the mental parts it consist of. The mental part is the ability to create meaning based on an understanding of the languages phonetics, morphology, syntax, semantics and pragmatics. The physical part includes movement in the human speech organs to create an acoustic signal (Slethei, Bollingmo, & Husby, 2017). Movement and the position of the different speech organs determine the sound that is produced. In short, vibrations in the vocal cords and changes in the speech apparatus due to movement of the speech organs produce vowels. Narrowing the speech apparatus creates consonants. Up to six months of age infants can distinguish between all the consonants and vowels (phonemes) possible to produce in the languages of the world (Gramann & Torkildsen, 2016). However, this ability is lost during the second half of infants' first year of life. In a perception study of Japanese, it was found that infants could distinguish between /r/ and /l/, which are not phonemes in Japanese, at four months of age, but not at 12 months of age (Goldstein, 2010). The ability to distinguish prototypical phonemes in all languages is gradually exchanged with the capability to differentiate contrasts in their native language that are of importance (Gramann & Torkildsen, 2016). This change in infants' perception illustrates that acquiring language is a laborious process that starts long before a child can utter its first words (Høigård, 2013).

Further, the change in infants' perceptions of phonemes demonstrates that the process of language acquisition involve interactions between innate abilities and experiences. These experiences include contact with adult linguistic models. (Høigård, 2013). More specifically, adults expose children to child directed speech (CDS) (Broesch & Bryant, 2013). Exposure to CDS is believed to support children's acquisition of their native language (Liu, Kuhl, & Tsao, 2003; Thiessen, Hill, & Saffran, 2005) by making them feel safe (Høigård, 2013), tuning them in on the specific features of their native language, guiding discrimination of phonemes and other language sounds (Liu, Tsao, & Kuhl (2003) and ease word learning (Thiessen, Hill & Saffran, 2005). CDS is believed to facilitate language acquisition via adaptations in speech according to the language development of a child (Høigård, 2013). Prosodic adaptations in

CDS compared to adult directed speech (ADS) include higher pitch (Warren-Leubecker & Bohannon, 1984), larger variation in pitch, exaggerated intonation, slower speech (Høigård, 2013), longer pauses and greater focus on specific words. In relation to word selection, CDS is characterised by an extended use of nouns, less use of verbs and greater use of repetitions of words (Andruski & Kuhl, 1996) compared to in ADS. Simple and short sentences (Martin, et al., 2015) are syntactic features that characterises CDS. Pragmatic traits that are typical for CDS are greater use of questions (Andruski & Kuhl, 1996) and expansions of the utterances made by a child (Høigård, 2013). The use of these adaptations of speech by adult interaction partners is assumed to ease children's acquisition of their native languages.

The corner vowels

The use of CDS is believed to realize three tasks: the first is to activate a child's attention, the second is to express emotional cues and last is to convey linguistic/phonological information to a child (Fernald, 1992; Uther, Knoll & Brunham 2007). Investigating the corner vowels /a/, /i/ and /u/ offers the ability to explore these three tasks. Vowel pitch and vowel pitch range are associated with attention (Englund, 2005) and emotional cues (Kitamura, Thanavishuth, Burnham, & Luksaneeyanawin, 2001). Pitch is the lowest vibration in the vocal cords during the creation of the acoustic signal (Englund, 2017). Higher pitch and a wider pitch range in CDS compared to ADS have been found in variety of studies across different languages (Broesch & Bryant, 2013). The exaggerated intonation found in CDS is associated with the emotional value of speech and is believed to be the key characteristic that makes infants prefer to listen to CDS compared to ADS (Fernald & Kuhl, 1987).

Aspects that are directly associated with conveying phonological information about a child's native language (vowel duration and vowel space) can also be explored by studying the corner vowels. In Norwegian ADS, the long vowels /a:/, /i:/ and /u:/ have a longer duration than their short counterparts /a/, i/ and /u/ (Behne, Moxness, & Nyland, 1996). Sundberg (1998) studied Swedish CDS, which is comparable to Norwegian CDS. She found that the differences between long and short vowels in mothers' CDS toward their three-months-old infants were exaggerated by increased vowel duration for long vowels. An increased vowel distinction would likely make differences between vowel quantities (long and short) with the same corner vowel quality (/a:/-/a/, /i:/-/i/ and /u:/-/u/) more auditory salient to a child and thereby guide learning of the differences.

Vowel space is also associated with making vowel distinctions auditory clearer, but the findings are contradictory (for a summary, see Cristia, 2013). According to the hyperarticulation hypothesis, vowel space in CDS is expanded in size compared to in ADS.

Kuhl et al. (1997) argues that the expansion is a result of enhaced acoustic-phonetic diffrences between the corner vowel qualities to promote language aquicition. The findings of Liu, Tsao, & Kuhl (2003) supports this argument. They found a correlation between maternal speech clarity (the size of the mothers' vowel spaces) of Mandarin-speaking mothers and their infants' ability to distinguish phonemes and other language sounds in their native language. Contradictory, in a production study investigating Norwegian mothers' CDS (Englund & Behne, 2006), it was found that the vowel space was smaller in size in CDS compared to in ADS. Vowel space is calculated based on the first and second formant frequencies (F1-F2) in the vocal spectre of the corner vowels (Liu, Kuhl, & Tsao, 2003). F1 is associated with the degree of openness of the mouth, more specific the positioning of the highest point of the tongue in the mouth (Slethei, Bollingmo & Husby, 2017). F2 is related to the degree of backness: how far back the tongue is in the vocal cavity during articulation. In general; the more open the vowel, the higher the F1 frequency; and the more front the vowel, the higher the F2. The vowel quality /i:/-/i/ is a front vowel quality with relatively low F1 and high F2 in Norwegian (Behne, Moxness & Nyland, 1996). /a:/-/a/ and /u:/-/u/ are back vowel qualities, which means that the tongue is further back in the vocal cavity during articulation compared to when articulating /i:/-/i/, leading to lower F2 frequencies. The vowel quality /a:/-/a/ is articulated with the greatest openness of the three corner vowel qualities, resulting in a relatively high F1 frequency. The vowel quality /u:/-/u/ is articulated with lip-rounding, leading to relatively low F1 frequency. The findings from Englund and Behne (2005; 2006) show that a smaller vowel space size in Norwegian mothers CDS was due to less difference in the F1 frequencies between the vowel qualities /a:/-/a/ and /u:/-/u/ than in ADS, higher F2 frequencies for the vowel qualities /a:/-/a/ and /u:/-/u/, and no changes in the F1 and F2 frequencies for the vowel quality /i:/-/i/ in CDS compared to in ADS. The inconsistent findings regarding vowel space in CDS indicate that an expanded vowel space size might not be universal trait of CDS.

When examining the corner vowels in CDS, the third formant frequency (F3) in the vocal spectra can be relevant. F3 has not been an object of investigation to the same degree as F1 and F2 frequencies in this context. However, F3 frequencies can provide information about the length of the vocal tract (Bender, 2013) during vowel production. Increased F3 corresponds with a shortened vocal tract. Englund and Behne (2005) found that mothers raised their F3 for all the three corner vowel qualities when interacted with their infants face-to-face, which may imply that mothers smile more whilst speaking to their infants face-to-

face compared to when speaking to adults, since speakers shorten their vocal tract by retracting their lips and opening their mouth when smiling (Bender, 2013).

The corner vowels /a/, /i/ and /u/ occur in a high proportion of the world's languages and represent articulatory extremes (Liljencrants & Lindblom, 1972; Kristoffersen, 2000). Thus, they have been of special interest when studying CDS. This has led to a great empirical foundation that can be used when investigating the three tasks CDS is believed to realize: to trigger a child's attention, to express emotional cues and to convey linguistic/phonological information (Fernald, 1992; Uther, Knoll & Brunham 2007). The empirical foundation gives the opportunity for further exploring which aspects of CDS that are universal and which characteristics that varies across languages/cultures, types of speakers and age of children.

CDS in kindergarten

Traditionally mothers have been the prime caregivers for young children and thereby the adult linguistic models and interaction partners young children spend most time with. Naturally, the majority of earlier studies exploring the characteristics of CDS and the effect the usage has on young children's language acquisition include mothers (e.g. Andruski & Kuhl, 1996; Bender, 2013; Englund & Behne, 2005; Ratner, 1984). In Norway 91 % of one- to two-year-olds are enrolled in kindergarten (Statistisk sentralbyrå, 2017), and spend 41 hours or more in kindergarten during a working week. Based on these statistics, during a working week an average Norwegian one- to two-year-old spend most of the time it is awake together with pedagogical employees in kindergarten. Grounded on the probable effect the mother-child interactions can have on a young child's language development, it is likely that pedagogical employees in kindergarten can influence a young child's language acquisition.

According to the Norwegian Framework Plan for Kindergarten (2017), "which sets out supplementary provisions on the content and tasks of kindergartens": "all children shall receive appropriate language stimulation in kindergarten, and all children shall be able to participate in activities that promote communication and comprehensive language development" and pedagogical employees in kindergarten must "be conscious of their role as linguistic role models and be attentive in their communication with all children." Studying CDS in a kindergarten setting can make pedagogical employees in kindergarten more aware of how they contribute to young children's linguistic leaning environment. It has been found that mothers' adaptations of speech according to children's language development can confirm a child's contribution to the interaction and make it feel safe (Høigård, 2013), and by that aid the acquisition of language. Focus on CDS in kindergarten can emphasize the

importance of pedagogical employees speaking to children during everyday interactions to accomplish the same.

Literature on the usage of CDS by pedagogical employees in kindergarten is scarce. Fernald (1992) argues that mothers CDS is biological relevant signals shaped by natural selection, and Cristia (2013) states that speakers normally adapt their speech depending on their conversational partner. It is therefore likely that female Norwegian pedagogical employees adapt their speech unconsciously in the same way Norwegian mothers do when interacting with young children. Studying how pedagogical staff uses known aspects of CDS, when interacting with young children in kindergarten, can be an important contribution to understanding what language input these interaction partners and language models provide young Norwegian children in kindergarten with.

The present study

Research question. In Norwegian kindergartens, children under the age of three are often together in a toddler group cared for by the same employees. A toddler can be defined as "a young child, especially one who is learning or has recently learned to walk" (Cambridge University Press, 2019) and the term is often used when referring to one- and two-year-olds (Løkken, 2004). In the present study, the children the participants interact with will be referred to as toddlers. According to Høigård (2013), toddlers are in a system-learning phase. In this phase the toddlers gradually discover and learn the fundamental subsystems of their native language in interaction with language models. Investigating the language environment of toddlers is therefore of special interest to understand what aspects that might play a part in their language acquisition process.

The majority of pedagogical employees in Norwegian kindergartens are female and ethnic Norwegian (Statistisk sentralbyrå, 2017). Including only female participants with Norwegian as their native language in the present study is most appropriate since there can be differences between male and female CDS (Broesch & Bryant, 2018; Warren-Leubecker & Bohannon, 1984) and some acoustic-phonetic characteristics of CDS vary depending on the language of the speaker (Farran, Lee, Yoo & Oller, 2016; Kitamura, Thanavishuth, Burnham & Luksaneeyanawin, 2001).

CDS produced by other speakers than mothers and directed towards toddlers are scarcely explored research fields. To establish if female Norwegian kindergarten employees use similar adaptations when speaking to a toddler as in mothers' CDS, a broad approach is therefore necessary. Examining different acoustic-phonetic characteristics of the corner vowels, gives the opportunity to see how female Norwegian kindergarten employees use

known aspects of CDS linked to activating a young child's attention, expressing emotional cues and conveying linguistic/phonological information. Based on the argumentation above, the present study's research question is: are there adaptations, resembling those in mothers' CDS, in the characteristic of the vowels /a:/, /a/, /i:/, /i/, /u:/ and /u/ in the speech of female Norwegian pedagogical employees in kindergarten in interaction with a toddler compared to in interacting with an adult?

Eliciting CDS. Different methods have been used when eliciting both CDS and ADS for comparison in earlier studies. When it comes to CDS, one can argue that some settings and situations allow for a more natural interaction between a child and an adult, e.g. Englund & Behne (2005) where the mothers are asked to interact with their infants as they would normally do when changing the infants' diapers at home. Further, one can argue that this type of situation generates data that has high ecological validity and thereby gives a more realistic picture of the use of CDS compared to studies where the CDS condition takes place in a laboratory and/or with a high degree of control (e.g. Andruski & Kuhl, 1996; Ratner, 1984). On the other hand, a completely natural situation would most likely not be optimal for obtaining segments from the same phonetic surroundings in CDS and in ADS. For the present study, it is desirable to use a situation that will feel natural and safe for both the participants and the children, but at the same time provide the opportunity to compare segment from the same phonetic surroundings from CDS and ADS to be able to answer the research question. A semi-controlled play situation with specific toys with names including the vowels of interest is a situation that satisfies these requirements.

Aims. The aims of the present study are threefold. The first is to investigate how female Norwegian pedagogical employees in kindergarten use CDS in interaction with toddlers they care for. The second aim is to contribute to the knowledge concerning acoustic-phonetic characteristics of Norwegian CDS by expanding the research field; children old enough to be enrolled in kindergarten have not been included in earlier research on the topic. The third aim is to make pedagogical employees more aware of how they can affect the language development of the toddlers they care for and interact with by shedding light on the usage of CDS in Norwegian kindergartens.

Hypotheses. The main hypothesis is that there are adaptations, resembling those in mothers' CDS, in the characteristic of the vowels /a:/, /a/, /i:/, /i/, /u:/ and /u/ in the speech of female Norwegian pedagogical employees in kindergarten in interaction with a toddler compared to in interacting with an adult. Following are specific hypotheses in regards to

vowel pitch/fundamental frequency (F0), vowel F0 range, vowel duration, vowel space and first, second and third format frequency (F1-F3):

- Vowel pitch: The F0 mean for each of the six vowels under investigation is higher in CDS compared to ADS.
- Vowel pitch range: The F0 range for each of the six vowels under investigation is wider in CDS compared to ADS.
- Vowel duration: The vowel quantity distinction (difference between long and short vowels) is extended in CDS compared to ADS by an increase in the duration for long vowels.
- Vowel space: As a result of higher F1 frequencies for /u:/ and /u/ in CDS leading to a smaller difference between /a:/ and /u:/ and /a/ and /u/ in CDS compared to in ADS, higher F1 frequencies for /a:/, /a/, /u:/ and /u/ in CDS compared to ADS, and no differences across speech types in F1 and F2 frequencies for /i:/ and /i/, the vowel space for both long and short vowels will be smaller in size in CDS compared to in ADS.
- Third format frequency: F3 frequencies for each of the six vowels under investigation is higher in CDS compared to in ADS.

Method

Participants and recruitment

The participants consisted of 33 female native Norwegian-speaking pedagogical employees in seven different kindergartens, with a mean age of 38.7 years, ranging from 23 years to 65 years. The participants had worked an average of 13.4 years in kindergarten, ranging from one year to 39 years. In Norwegian kindergartens 40% of the pedagogical employees are preschool/kindergarten teachers and 60% are childcare- and youth workers and kindergarten assistants (Barnehagefakta, 2019). In the present study 20 of the participants are preschool/kindergarten teachers and the remaining 13 are childcare- and youth workers and kindergarten assistants (see table 1 for the participants' educational background), illustrating that it is a higher distribution of preschool/kindergarten teachers in the present study than in the composition of pedagogical staff in an average Norwegian kindergarten. All of the participants had experience taking care of children in addition to working in kindergarten; 27 of the participants had children of their own, with an average of 1.83 children. All the participants without children had other experience with caring for children. The majority of the participants spoke a Central Norwegian dialect. Only six participants spoke another

dialect; three spoke Western Norwegian, two spoke Northern Norwegian and one spoke Eastern Norwegian. The participants did not receive compensation for their participation, but by participating in the study the kindergartens were offered a lecture on the topic "child directed speech" and a presentation of results from the study when available.

Table 1

The participants' educational background

Education	N
No higher education related to child-care/pedagogy	7
Certificate of completed apprenticeship in childcare and youth work	4
Currently studying kindergarten teaching part-time	2
Bachelor degree in preschool/kindergarten teaching	10
Bachelor degree in preschool/kindergarten teaching and additional education in pedagogical subjects	10

The recruitment of the participants was initiated by contacting the head teachers or other administrative staff of municipal and non-municipal kindergartens located in Trøndelag, Norway via email. They were given information about the theoretical background (see Appendix A) and procedure of the study, and were invited to the study. A total of four municipal and three non-municipal kindergartens accepted the invitation. After getting the approval, a meeting to inform the pedagogical employees about the nature of the study and how they could participate was set up with the head teachers or administrative staff. In some cases the head teachers/administrative staff provided contact information to employees that wanted to take part in the study. All the employees that wanted to take part in the study and fitted the selection criteria were included as participants. The selection criteria were that you had to be a female, a part of the pedagogical staff, working with children less than three years of age and have Norwegian as a native language. A time for conducting the audio recordings was settled with each participant orally or via email. The participants were provided with an information paper when they expressed interest in taking part in the study and again at the day of the recording. The paper explained the procedure of the study, what was expected of the participants and that the participants could withdraw from the study at any time without any specific reason (see Appendix B). Based on the information from the information paper the participants gave free, informed and voluntary written consents to participate in the study before the recordings took place.

The toddlers

The participants interacted with toddlers they cared for on a daily basis, 19 girls (two of the girls interacted with two participants each) and 12 boys in total. The mean age of the toddlers was 24.3 months, ranging from 10-34 months. The age of the girls range from 10-31 months, with a mean age of 24.2 months. The boys mean age was 24.4 months, with a range from 13-34 months. The majority, 29, of the toddlers had Norwegian as their only native language or as one of two native languages. The bilingual toddlers consisted of three girls with one parent with Norwegian as their native language and one parent with another native language: one with an Arabic father, one with an Arabic mother and one with a Russian mother. The toddlers who did not have Norwegian as a native language consisted of two boys with Arabic speaking parents.

Members of staff in the kindergartens were asked to distribute written information about the nature of the study (see Appendix C) to parents at least one week before the recordings were going to take place. In the information leaflet the parents were made aware of their opportunity to not allow for their toddler to take part in the study by notifying a member of staff. Additionally, to make sure the parents agreed on their toddlers taking part in the study the participants were asked to inform the parents orally.

Sound recordings and equipment

To conduct the audio recordings of CDS and ADS the sound recorder LENA digital language processor (DLP) was used (LENA, 2018a) (see figure 1). During both recordings the participants wore a t-shirt with a pocket on the chest containing the DLP (see figure 2). This ensured that the distance between the DLP and the mouth of the participants was ideal. Table 2 lists the six toys the participants were asked to use when playing with the toddlers (CDS condition) and the vowels of interest their names include (see Appendix D for pictures of the toys). In some cases, the participant used toys already present in the room where the recordings of the CDS condition took place. A paper displaying pictures and the names of the six toys (Appendix D) were shown to the participants before playing with the toddlers and during the conversation between participant and experimenter (ADS condition).

Figure 1. Picture of DLP

Figure 2. Picture of t-shirt with pocket

Table 2

Specific toys used to elicit the vowels /a:/, /a/, /i:/, /i/, /u:/ and /u/

Vowel of interest	Toy	Name in Norwegain
/a:/	Plush cake	"Kake"
/a/	Plush cat	"Katt"
/i:/	Plush tiger	"Tiger"
/i/	Plush Pippi Longstocking doll	"Pippi"
/u:/	Children's touch and feel book about animals	"Bok"
/u/	Wood billygoat	"Bukk"

Procedure

The audio recordings were made in two sessions for each participant; recording of the participant playing with the toddler (CDS condition) and recording of a conversation between the participant and the experimenter (ADS condition). Before the CDS condition the participant was given the information paper and had the possibility to ask the experimenter questions if anything was unclear. Written consent was obtained in this situation.

CDS condition. In the CDS condition the participant was asked to use and mention the six toys she would be provided with by the experimenter and to otherwise interact with the toddler as she normally would do. The participant put on the t-shirt with the DLP and was given a cloth bag with the six toys right before the CDS condition. Simultaneously, she was presented with pictures and names of the toys. The recording of CDS took place in a room within the kindergarten with only the participant and the toddler present. The participant decided which room to use based on availability and what she felt was suitable. The experimenter inspected the room before the recordings and removed items that could make a lot of sound, e.g. instruments, and make part of the audio recordings unsuitable for further analyses. Windows and doors were closed for the same purpose.

ADS condition. During the ADS condition, the participant was encouraged to talk about what she and the toddler had done during the CDS condition. The experimenter asked follow-up questions with the intent to get the participant to mention the names of the toys in a natural manner. For example; "You mentioned that the child showed a lot of interested in the toys, what toy was the child most interested in?", "You said that the child recognized some of the toys, did the child know the name of any of the toys?" and so on. Additionally, the experimenter asked the participant about her age, her education, her experience with working with children, if she had any children of her own, what dialect she spoke, the age of the toddler she had played with, the gender of the toddler and if the parents of the toddler had Norwegian as their native language. After the conversation, the participant was debriefed by being informed about the purpose of the study, how the sound recordings where going to be analysed and how the results would be presented.

Based on previous studies using a similar paradigm (e.g. Bender, 2013), it was estimated that the two conditions would last for approximately 10 minutes each. The participant was informed that this time estimation was just a guideline in relation to the CDS condition, and that she had to decide how long she wanted to interact with the toddler based on the toddler's attention and temper, what she felt was natural and how much time she had at her disposal. The participants kept track of the time themselves during the CDS condition. The experimenter notified them if the interaction with the toddler exceeded 15 minutes. The CDS condition ranged from ten to 29 minutes, with an average of 18.1 minutes. The average time for the ADS condition was 8.59 minutes, ranging from four to 15 minutes.

Acoustic analyses

LENA pro (LENA, 2018b) was used to transfer the audio recordings to a computer and to convert them into audio files in wav-format. The sound-editing program PRAAT

(Boersma & Weenink, 2016) was used to edit the audio files according to the participants and conditions. File names explaining the content of the audio files were used to organize them. Further, the audio files were organized in numbered folders representing the participants. The audio files for each participant and each setting were cut into sentences expressed by the participants. These new audio files were saved in the same folders as the original audio files to ensure an overview of which participant they originated from. Based on the sentences the words “katt” (cat), “Pippi” (a doll), “bukk” (billygoat), “kake” (cake), “tiger” (tiger), and “bok” (book) were extracted.

Finally, PRAAT was used to conduct acoustic analysis of the vowels of interest: /a:/, /a/, /i:/, /i/, /u:/ and -u/. To ensure the same phonetic environment, only vowels from the six toy words for each of the participants and conditions were analysed. The beginning and the end of a target vowel were identified based on visual examination of the spectrogram and auditory interpretation of the sound clip. For each vowel pitch/fundamental frequency (F0), first, second and third formant frequency (F1-F3) and duration were calculated by PRAAT. F0 and F1-F3 were calculated in Hertz (Hz) bases on the mean of the selected area between the beginning and the end of a target vowel. Duration of each vowel was calculated in seconds based on the total selected area. All detectable examples of vowels of interest were analysed, resulting in an uneven number of exemplars from the different participants and conditions. There were more examples of the vowels of interest elicited in the CDS condition than in the ADS conditions. Vowels were excluded if they were not possible to distinguish visually or auditory due to other sounds, if two people spoke simultaneously or if their formant frequencies were not visible in the spectrogram.

Results

The SPSS (version 25) statistical package was used to preform multiple imputations for missing values, aggregation, reconstruction and statistical analysis. For a minority of the participants data was missing for one or more vowels: eight participants had missing data for one vowel in both CDS and ADS, two participants had missing data for two vowels in CDS, one participant had missing data for two vowels in ADS and one participant had missing data for three vowels in ADS. The missing data was due to some participants not mentioning all of the toys in one or more conditions. In other cases the exemplars could not be analysed. To preform appropriate statistical analysis on the data the original data had to be aggregated. It was not possible to conduct an aggregation with missing values in the dataset. Missing values were therefore replaced with the pooled values after five imputations. Following the imputation, the data was aggregated to create means of two independent variables: speech

type (CDS and ADS) and vowels (/a:/, /a/, /i:/, /i/, /u:/ and /u/). After aggregation the dataset was reconstructed before preforming one-way repeated-measures ANOVAs with speech type and vowels as independent variables and pitch (F0) means, F0 range means, duration, vowel space and the three first formant frequencies (F1-F3) as dependent variables. In the present study the same participants contributed with data in both conditions (CDS and ADS), mean values are therefore likely to be correlated (Field, 2013). Conventional *F*-tests depends on the assumption that values in different conditions are independent, and would therefore lack accuracy. One-way repeated-measures ANOVAs do not depend on this assumption and was consequently used to compare the means from the different conditions. To decrease the likelihood of committing a type I error a 5% significance level was used throughout the analyses. Bonferroni correction was used for the post hoc tests for the same reason.

Table 3

Range, minimum, maximum, mean and standard deviation of F0 measured in Hz organized by speech type (based on original data before multiple imputation and aggregation)

Speech type	Vowel	N	Range	Min.	Max.	Mean	SD
CDS	/a:/	398	534**	82	616	261*	97.3
	/a/	286	559**	84	643	294*	106
	/i:/	269	605**	81	686	248*	105
	/i/	209	494**	89	583	293*	89.3
	/u:/	193	468**	86	554	259*	96
	/u/	221	499**	78	577	271*	98.7
ADS	/a:/	104	369	122	491	224	55.8
	/a/	100	289	94	383	236	61.2
	/i:/	81	328	116	444	213	52.8
	/i/	97	270	89	359	245	53.5
	/u:/	110	264	79	343	204	47.7
	/u/	105	302	85	387	227	55

* Highest mean F0 for each vowel independent of speech type

* *Largest range value for each vowels independent of speech type

Pitch means

Table 3 shows that the F0 means for all vowels are larger in CDS compared to in ADS. The main analysis showed a statistically significant difference in the F0 means, $F(6.29, 201) = 15.6$, $p < .001$, partial $\eta^2 = .328$. Mauchly's test indicates that the assumption of sphericity had been violated, $x^2(11) = 124$, $p < .001$, therefore Greenhouse-Geisser correction was used ($\varepsilon = .572$). Post hoc test revealed that F0 means were significantly higher for /a:/, /a/, /i/ and /u:/ in CDS compared to the F0 means of the same vowels in ADS (see table 4 for mean differences, standard error and *p*-values). No significant differences in the F0 means for /i:/ and /u/ were found across speech types.

Table 4

Pairwise comparison of mean F0 for /a:/, /a/, /i:/, /i/, /u:/ and /u/ in CDS and ADS

CDS	ADS	Mean difference	Sig.	SE
/a:/	/a:/	39.8	.001	7.52
/a/	/a/	54.5	.007	12.4
/i:/	/i:/	35.7	.138	10.7
/i/	/i/	51.3	.003	11
/u:/	/u:/	48.4	.007	11
/u/	/u/	41.8	.069	11

Pitch range

Table 3 shows that the mean F0 ranges for all vowels are wider in CDS than in ADS. The main analysis showed a statistically significant difference in F0 range means, $F(6.54, 209) = 17.9$, $p < .001$, partial $\eta^2 = .36$. Mauchly's test indicates that the assumption of sphericity had been violated, $x^2(11) = 123$, $p < .001$, therefore Greenhouse-Geisser correction was used ($\varepsilon = .595$). Post hoc test revealed that for all the vowels the range was significantly wider in CDS compared to in ADS (see table 5 for mean differences, standard error and *p*-values)

Table 5

Pairwise comparison of mean F0 range for /a:/, /a/, /i:/, /i/, /u:/ and /u /in CDS and ADS

CDS	ADS	Mean difference	Sig.	SE
/a:/	/a:/	168	.001	25.4
/a/	/a/	159	.001	22.8
/i:/	/i:/	149	.001	50.9
/i/	/i/	97.7	.001	25.6
/u:/	/u:/	115	.001	19.8
/u/	/u/	99.3	.01	23.1

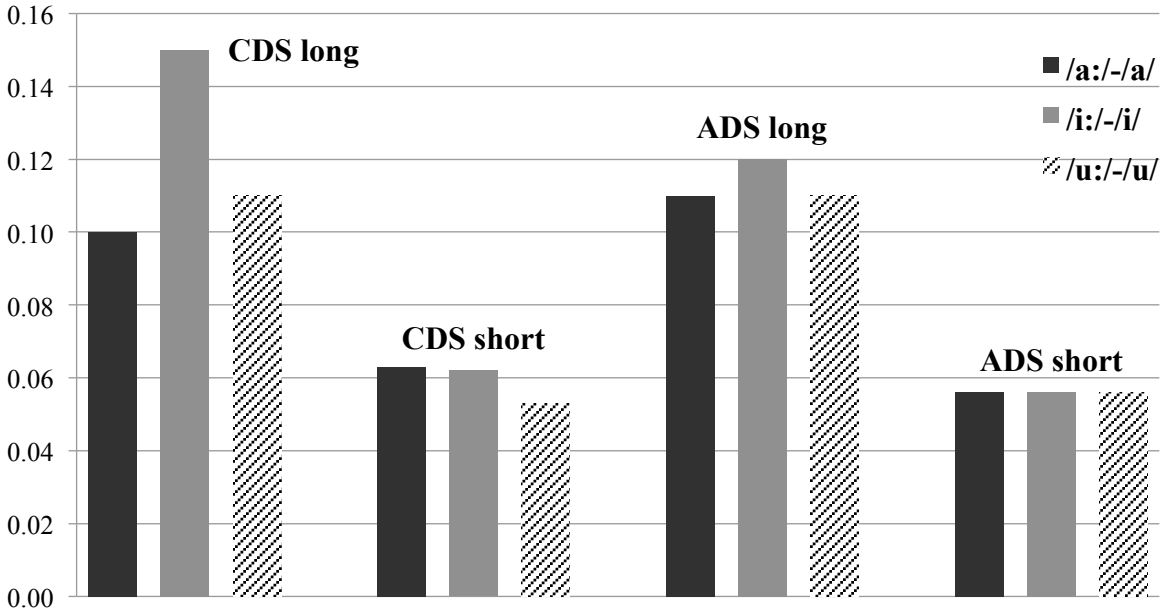

Figure 3. Mean duration for /a:/-/a/, /i:/-/i/ and /u:/-/u/ measured in seconds, organized according to speech type and vowel quantity (based on original data before multiple imputations and aggregation)

Duration

The main analysis showed a statistically significant difference in the vowel duration means, $F(3.99, 128) = 50.9$, $p < .001$, partial $\eta^2 = .614$. Mauchly's test indicates that the assumption of sphericity had been violated, $x^2(11) = 214$, $p < .001$, therefore Greenhouse-Geisser correction was used ($\varepsilon = .363$).

Long vowels in ADS had a significantly longer duration compare to their short counterparts: /a:/ ($M = .11$, $SD = .027$) had a longer duration than /a/ ($M = .058$, $SD = .016$, $p < .001$), /i:/ ($M = .11$, $SD = .026$) had a longer duration than /i/ ($M = .059$, $SD = .014$, $p < .001$) and /u:/ ($M = .11$, $SD = .036$) had a longer duration than /u/ ($M = .06$, $SD = .016$, $p < .001$). This statistically significant vowel quantity distinction was maintained in CDS: /a:/ ($M = .11$, $SD = .025$) had a longer duration than /a/ ($M = .064$, $SD = .015$, $p < .001$), /i:/ ($M = .16$, $SD = .059$) had a longer duration than /i/ ($M = .066$, $SD = .015$, $p < .001$) and /u:/ ($M = .12$, $SD = .032$) had a longer duration than /u/ ($M = .058$, $SD = .014$, $p < .001$).

Figure 3 indicates that there is only /i:/ in CDS that has an increased duration compared to its counterpart in ADS. Post hoc tests revealed that there was no significant difference between /i:/ in CDS ($M = .16$, $SD = .059$) compared to /i:/ in ADS ($M = .11$, $SD = .026$, $p = .084$). As indicated by figure 3, no other significant differences across the speech types where found. For vowels in CDS, /i:/ ($M = .16$, $SD = .059$) had a significantly longer duration than /a:/ ($M = .11$, $SD = .025$, $p = .021$), /i:/ in ADS ($M = .11$, $SD = .026$) did not have a longer duration than /a:/ in ADS ($M = .11$, $SD = .027$, $p = 1$).

Vowel space

Vowel spaces were calculated separately for long (a:/, /i:/ and /u:/) and short (/a/, /i/ and /u/) vowels for each level of the independent variable speech type. Vowel space refers to the size of the area within the lines drawn between the vowels /a:/, /i:/ and /u:/ and /a/, /i/ and /u/ (see figure 4 and 5). The vowel spaces were calculated in SPSS using the following formula, described in Liu, Kuhl and Tsao (2003):

Vowel space = {[F1i*(F2a - F2u) + F1a*(F2u - F2i) + F1u*(F2i - F2a)]/2}, where F1i is the first format frequency for the vowel :/i/ or /i/, etc.

The figure 4 and 5 indicate that the mean vowel spaces for both vowel quantities are larger for ADS compared to CDS. The main analysis showed a statistically significant difference in the size of the vowel spaces, $F(3, 96) = 26.9$, $p < .001$, $\eta^2 = .161$. Mauchly's test indicates that the assumption of sphericity had been met, $x^2(11) = 7.3$, $p = .195$. Post hoc tests revealed that for long vowels, the vowel space for ADS ($\mu = 169780$, $SD = 70923$) was significantly larger than the vowel space for CDS ($\mu = 105258$, $SD = 83835$, $p = .004$). The

vowel space for short vowels in ADS (μ = 142196, *SD* = 101498) were larger than the vowel space for short vowel in CDS (μ = 100211, *SD* = 77294, *p* = .227), but not significantly.

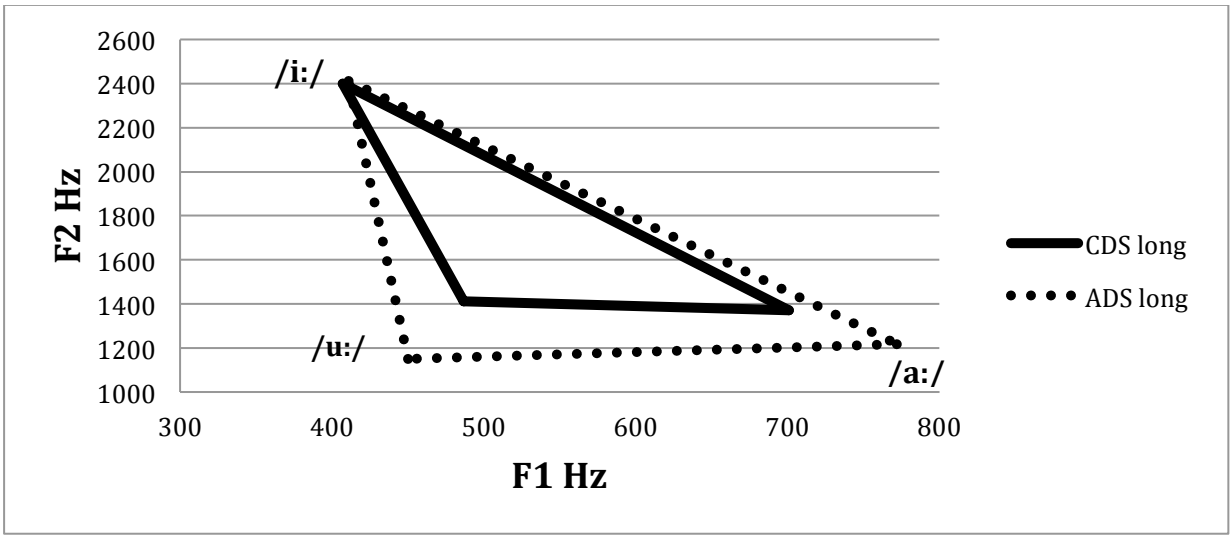

Figure 4. Vowel space for long vowels

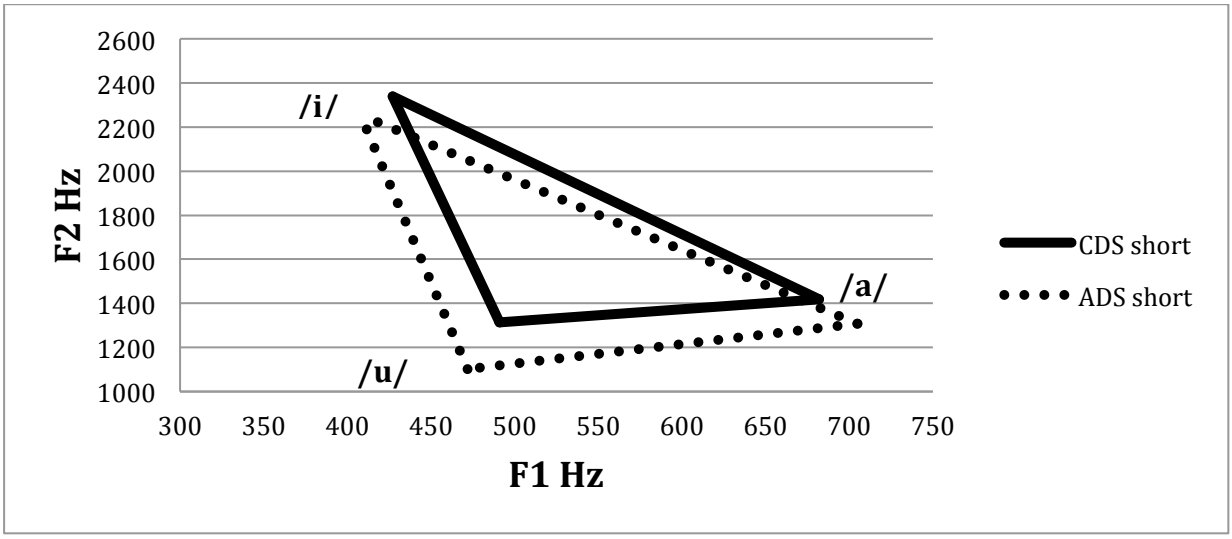

Figure 5. Vowel space for short vowels

First format frequencies

Figure 4 indicates that F1 mean for /u:/ is higher in CDS than in ADS and that F1 mean for /a:/ is lower in CDS compared to in ADS. It seems to be no difference in F1 mean for /i:/ across speech types. Figure 5 shows a small shift along the x-axis for the vowel space of CDS due to higher F1 means for /u/ and /i/.

The main analysis shows a statistically significant difference in the F1 means, $F(6.19, 198) = 174$, $p < .001$, partial $\eta^2 = .844$. Mauchly's test indicated that the assumption of

sphericity had been violated, $x^2(11) = 135$, $p < .001$, therefore Greenhouse-Geisser correction was used ($\varepsilon = .563$). Post hoc tests revealed that there were no significant differences in the F1 means for the same vowels across speech types (see table 6 for mean differences, standard error and *p*-values).

Table 6

Pairwise comparison of mean F1 for /a:/, /a/, /i:/, /i/, /u:/ and /u /in CDS and ADS

CDS	ADS	Mean difference	Sig.	SE
/a:/	/a:/	-21.3	1	12.1
/a/	/a/	-23.2	1	16.8
/i:/	/i:/	-4.23	1	5.7
/i/	/i/	19.2	1	9.13
/u:/	/u:/	36.7	.335	12.2
/u/	/u/	18	1	14.1

The only significant differences in F1 means were found between vowel qualities. For long vowels in CDS, /a:/ ($M = 701$, $SD = 79.4$) had a significantly higher F1 mean than /i:/ ($M = 407$, $SD = 40.2$, $p < .001$) and /u:/ ($M = 487$, $SD = 54.4$, $p < .001$), and /u:/ had a significantly higher F1 mean than /i:/ ($M = 407$, $SD = 40.2$, $p < .001$). This is the same pattern as in ADS: /a:/ ($M = 722$, $SD = 70.7$) had a significantly higher F1 mean than /i:/ ($M = 411$, $SD = 36.8$, $p < .001$) and /u:/ ($M = 450$, $SD = 41.5$, $p < .001$), and /u:/ had a significantly higher F1 mean than /i:/ ($M = 411$, $SD = 36.8$, $p = .009$).

Short vowels follow the same pattern as the long vowels; in CDS, /a/ ($M = 682$, $SD = 83.9$,) had a significantly higher F1 mean than /i/ ($M = 427$, $SD = 49.8$, $p < .001$) and /u/ ($M = 491$, $SD = 64.2$, $p < .001$), and /u/ had a significantly higher F1 mean than /i/ ($M = 427$, $SD = 49.8$, $p < .001$); in ADS, /a/ ($M = 705$, $SD = 100$) had a significant higher F1 mean than /i/ ($M = 408$, $SD = 41.5$, $p < .001$) and /u/ ($M = 473$, $SD = 65$, $p < .001$), and /u/ had a significant higher F1 mean than /i/ *(*$M = 408$, $SD = 41.5$, $p = .003$)

Second formant frequencies

Figure 4 indicates that F2 means for /a:/ and /u:/ are higher in CDS than in ADS, and that there is no differences in F2 mean for /i:/ across speech types. Figure 5 shows that for short vowels all F2 means are higher in CDS than in ADS.

The main analysis showed a statistically significant difference in the F2 means, $F(6.51, 208) = 155$, $p < .001$, partial $\eta^2 = .829$. Mauchly's test indicated that the assumption of sphericity had been violated, $x^2(11) = 157$, $p < .001$, therefore Greenhouse-Geisser correction was used ($\varepsilon = .592$). Post hoc tests revealed that the F2 mean for /a:/ in CDS ($M = 1370$, $SD = 153$) was significantly higher than the F2 mean for /a:/ in ADS ($M = 1218$, $SD = 137$, $p < .001$). There were no other significant differences in the F2 means for the same vowels across the speech types (see table 7 for mean differences, standard error and *p*-values).

Table 7

Pairwise comparison of mean F2 for /a:/, /a/, /i:/, /i/, /u:/ and /u/ in CDS and in ADS

CDS	ADS	Mean difference	Sig.	SE
/a:/	/a:/	152	.001	25.8
/a/	/a/	111	1	65.2
/i:/	/i:/	-11.7	1	47.5
/i/	/i/	85.2	1	43.5
/u:/	/u:/	262	.068	72.6
/u/	/u/	212	.837	80.4

Post hoc tests also showed significant differences between the F2 means for the different vowel qualities. For long vowels in CDS /i:/ ($M = 2401$, $SD = 177$) had a significantly higher F2 mean than /a:/ ($M = 1370$, $SD = 153$, $p < .001$) and /u:/ ($M = 1411$, $SD = 339$, $p < .001$). This is the same pattern as in ADS: /i:/ ($M = 2412$, $SD = 199$) had a significantly higher F2 mean than /a:/ ($M = 1218$, $SD = 137$, $p < .001$) and /u:/ ($M = 1149$, $SD = 300$, $p < .001$). No significant differences were found between the F2 means for /a:/ and /u:/; in CDS, /a:/ ($M = 1370$, $SD = 153$) had a lower F2 mean than /u:/ ($M = 1411$, $SD = 339$, $p = 1$); in ADS, /a:/ ($M = 1218$, $SD = 137$) had a higher F2 than /u:/ ($M = 1149$, $SD = 300$, $p = 1$).

Short vowels follow the same pattern as the long vowels; in CDS, /i/ ($M = 2339$, $SD = 153$) had a significantly higher F2 mean than /a/ ($M = 1307$, $SD = 341$, $p < .001$) and /u/ ($M = 1314$, $SD = 362$, $p < .001$); in ADS, /i/ ($M = 2254$, $SD = 237$) had a significantly higher F2 mean than /a/ ($M = 1307$, $SD = 341$, $p < .001$) and /u/ ($M = 1102$, $SD = 286$, $p < .001$). As with long vowels, no significant differences were found between the F2 means for /a/ and /u/:

in CDS /a/ (*M* = 1419, *SD* = 155) had a higher F2 mean than /u/ (*M* = 1314, *SD* = 362, *p* = 1) and in ADS /a/ (*M* = 1307, *SD* = 341) had a higher F2 mean than /u/ *(M* = 1102, *SD* = 286, *p* = .703).

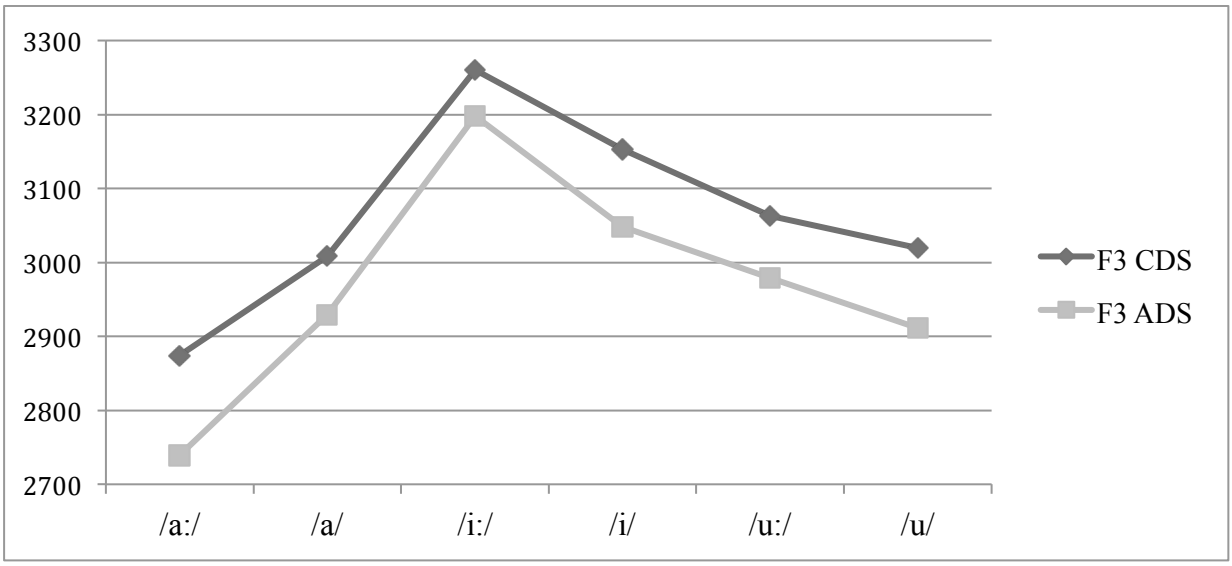

Figure 6. F3 means measured in Hz for /a:/, /a/, /i:/, /i/, /u:/ and /u/ organised by speech type

Third formant frequencies

Figure 6 shows that the F3 means for all vowels follows the same pattern in both speech types and that F3 means are generally higher in CDS than in ADS. The main analysis showed a significant difference in the F3 means, $F(6.2, 198) = 25.9$, $p < .001$, partial $\eta^2 = .477$. Mauchly's test of sphericity indicated that the assumption of sphericity had been violated, $x^2(11) = 118$, $p < .001$, therefore Greenhouse-Geisser correction was used ($\varepsilon = .563$). Post hoc tests revealed that the F3 mean for /a:/ in CDS (*M* = 2874, *SD* = 126) was significantly higher than the F3 mean for /a:/ in ADS (*M* = 2739, *SD* = 136, *p* = .003). There were no other significant differences in the F3 means for the same vowels across speech types (see table 8 for mean differences, standard error and *p*-values).

Table 8

Pairwise comparison of mean F3 for /a:/, /a/, /i:/, /i/, /u:/ and /u /in CDS and ADS

CDS	ADS	Mean difference	Sig.	SE
/a:/	/a:/	135	.003	28.5
/a/	/a/	77.8	1	46.4
/i:/	/i:/	62.5	1	31.9
/i/	/i/	105	1	43.8
/u:/	/u:/	84	1	34.7
/u/	/u/	109	1	46.8

Post hoc tests also exposed that there were significant differences in F3 means between vowel qualities. For long vowels in CDS, /a:/ (M = 2874, SD = 126) had a significantly lower F3 mean than /i:/ (M = 3260, SD = 121, $p < .001$) and /u:/ (M = 3063, SD = 161, $p < .001$), and /u:/ had significantly lower F3 mean than /i:/ (M = 3260, SD = 121, $p < .001$). This is the same pattern as in ADS: /a:/ (M = 2739, SD = 136) had significantly lower F3 mean than /i:/ (M = 3198, SD = 199, p = .003) and /u:/ (M = 2979, SD = 142, p = .003), and /u:/ had a significant lower F3 mean than /i:/ (M = 3198, SD = 199, p = .003).

For short vowels in CDS, /a/ (M = 3008, SD = 120) had a significant lower F3 mean than /i/ (M = 3153, SD = 131, p = .003), /i/ had a significant higher F3 mean than /u/ (M = 3020, SD = 199, p = .003). No significant difference was found between the F3 means for /a/ (M = 3008, SD = 120) and /u/ (M = 3020, SD = 199, p = 1). In ADS no significant differences were found in the F3 means between any of the vowel qualities: /i/ (3048, SD = 299) had a larger F3 mean than /a/ (M = 2930, SD = 269) and /u/ (M = 2911, SD = 153, p =.886), and /u/ had a smaller F3 mean than /a/ (M = 2930, SD = 269, p = 1).

Summary of results

Together, the results show that there are adaptations, which resembles those in mothers' CDS, in the characteristics of the vowels /a:/, /a/, /i:/, /i/, /u:/ and /u/ in the speech of female Norwegian pedagogical employees in kindergarten in interaction with a toddler compared to in interacting with an adult. More specifically the vowel pitch mean is higher for all vowels in CDS compared to in ADS, significantly higher for /a:/, /a/, /i/ and /u:/. The mean pitch range was significantly wider for all vowels in CDS compared to in ADS. The specific hypothesis regarding vowel space was that the vowel space for both long and short vowels

would be smaller in size in CDS compared to in ADS. It was hypothesised that the reason for a significantly smaller vowel space size would be due to higher F1 frequencies for /u:/-/u/ in CDS than in ADS, higher F2 frequencies for /a:/-/a/ and /u:/-/u/, and no changes in the F1 frequencies for /i:/-/i/ across speech types. For long vowels, the F1 frequency for /u:/ is not significantly higher in CDS compared to in ADS, but it is increased. Together with a decrease in the F1 frequency for /a:/, this lead to /a:/ and /u:/ in CDS being closer to each other in the vowel space compared to in ADS (see figure 4). Additional increased F2 frequencies for /a:/ and /u:/, and no change in the F1 or F2 frequencies for /i:/, makes the vowel space for long vowels in CDS significantly smaller in size compared to in ADS. The vowel space for short vowels is not significantly smaller in CDS compared to in ADS, but it is shifted along the x- and y-axis due to increased F1 and F2 frequencies for all vowels in CDS (see figure 5). In regards to F3, the hypothesis was that F3 frequencies for all vowels in CDS would be higher than the same vowels in ADS. The results show that the F3 frequencies for all vowels are higher in CDS than in ADS, but only significantly for /a:/. The only results that contradict the specific hypothesis are the results regarding vowel duration. Vowel quantity distinction was not extended in CDS by an increase in the duration for long vowels in CDS compared to in ADS.

Discussion

As mentioned in the introduction, the use of CDS is believed to realize three important tasks: to trigger a child's attention, to express emotional cues and to convey linguistic/phonological information (Fernald, 1992; Uther, Knoll & Brunham 2007). Following, the adaptations in the characteristics of the corner vowels in the CDS of female Norwegian pedagogical employees in kindergarten will be discussed in light of the three listed tasks. Further, the possible implications of the usage of these adaptations for toddlers' language acquisition will be proposed.

Attention

The use of a heightened pitch and larger variation in pitch in CDS compared to in ADS have been found in numerous studies across different cultures and languages (Broesch & Bryant, 2013; Kitamura, Thanavishuth, Burnham, & Luksaneeyanawin, 2001). Fernald and Kuhl (1987) argue that these are these prosodic features that make infants prefer to listen to and pay more attention to CDS compared to ADS (Fernald, 1985; Golinkoff, Can, Soderstrom & Hirsh-Pasek, 2015). Estes and Hurley (2013) looked at 17-months-old children's ability to learn labels produced in ADS and in CDS. They found that the children succeeded in learning labels produced in CDS, but failed to learn the same labels produced in ADS. Further, they

found that the variability in the prosody in CDS could explain these findings. Indicating that the attention caused by the variability in prosody that characterises CDS may play an important role in learning new words. The results of the present study showed a significant higher mean pitch for the vowels /a:/, /a/, /i/ and /u:/ and wider pitch range means for all vowels in CDS compared to in ADS. This study did not look at the implications these adaptations had for the toddlers, but based on findings from previous studies, one can assume that a more extreme use of prosodic features by the pedagogical employees might make it possible to direct and hold a toddlers attention over longer periods of time, and by that facilitate language acquisition.

Emotional cues

Bender (2013) describes pitch in CDS as the "main acoustic vehicle of positive affect". Similar affective pitch changes to those found in CDS are found in pet directed speech, but not in speech directed towards second language learners (Bender, 2013). Indicating that the use of positive intonation, characterized by higher pitch and a large variation in pitch, is a way of expressing intimacy and love towards a child (Kitamura, Thanavishuth, Burnham and Luksaneeyanawin, 2001). The use of positive intonation by the female pedagogical employees in the present study could be an unconscious means for making the toddler they interact with feel confortable in the play-situation. Or, the positive intonation could be due to an existing good connection between the toddler and the participant, as the participants were asked to interact with a toddler they cared for on a daily basis and that they though would feel secure playing in a room alone with them.

Attachment. Safe attachment is especially important for the youngest children in kindergarten and fundamental for cognitive development, which language acquisition is a part of (Høigård, 2013). According to Drugli (2010), a long-standing researcher in the kindergarten field:

> For a young child, the quality of the kindergarten is no better than the quality of the relations between the employees and the child. The everyday situations and the interpersonal interactions are the most central for the youngest children.

The bond between a child and a pedagogical employee in kindergarten can possibly be strengthened by the use of positive intonation. Schancher and Hannon (2011) looked at five-months-olds visual preferences of different speakers. They found that the infants showed positive associations towards individuals who addressed them in CDS, and negative association towards those who addressed them in ADS. The preference for speakers addressing them in CDS continued after the speaking behaviour had ended. The use of CDS

characterised by positive intonation by pedagogical employees in kindergarten can thus function as an affective cue for toddlers; they can choose to pay more attention to interaction partners they believe that can provide care.

Affective messages. According to Trainor, Austin and Desjardins (2000) expression of emotions is more inhibited in ADS compared to in CDS. They argue at that it is the widespread expression of emotions that make young children prefer to listen to CDS compared to ADS, and that CDS modifications in pitch resemble those in emotional ADS and might be used to empathize affective messages. Young children might not understand the lexical content of what is being said to them (Høigård, 2013), but they can understand the emotional content. By the use of a positive intonation an adult interaction partner can convey that "what I'm talking about now is something I like and I want you to like it as well." This assumption is supported by the findings of Fernald (1989), investigated adult listeners' accuracy identifying communicative intent based on prosodic cues from CDS and ADS. She found that the accuracy in identifying the communicative intent of the speakers was significantly higher when the listeners were exposed to CDS compared to ADS. Thus, the extended use of variation in pitch in CDS by the pedagogical employees might make it easier for the toddlers to understand the affective content of what is being said to them.

Feedback. In regards to language acquisition, being understood by their interaction partners is equally important for children as understanding what is being said to them (Høigård, 2013). Tamis-LeMonda, Bornstein and Baumwell (2001) observed mothers playing with their children at nine months of age and again at 13 months of age. They found that children who received a lot of response on their utterances reached linguistic milestones earlier than children that received little response to what they tried to say. The use of a higher pitch compared to in ADS, is a characteristic of CDS that is associated with acknowledging a child's contributions to the verbal interaction (Høigård, 2013). Children start to produce their first words around one year of age, and the understanding and production of words increase rapidly in the second and third year of life (Gramann & Torkildsen, 2016). It is natural for caregivers to try to encourage children to utter the words they know and new words when interacting with children in this age span (Høigård, 2013). The age of the toddlers in the present study range from 10-34 months. In the situation that was used for eliciting CDS, female pedagogical employees likely tried to motivate the toddlers to express the names of the toys, and probably used a positive intonation when acknowledging the toddlers' effort.

The encouragement and the word knowledge of the toddlers might also explain why it was not found that all the vowels had a significant higher pitch mean in CDS compared to in

ADS. Smith and Trainor (2008) observed mothers' adaptations of pitch in CDS based on their children's response. They found that mothers raised their pitch significantly when their children responded positively to their utterances compared to when they did not. The reason that it was not found that /i:/ and /u/ had a significant higher pitch mean in CDS compared to in ADS in the present study, might be that there was a larger variation in the affect the toddlers displayed towards the toys containing the vowels /i:/ and /u/ in their names (the plush tiger and the wood billy goat) compared to the other four specific toys. This could have had an effect on the vowel pitch of the female pedagogical employees and thus the variation in variables leading to insignificant differences in the vowel pitch mean for /i:/ and /u/ across speech types.

Affective vs didactic speech. The results of the present study display that the pedagogical employees use aspects of affective speech in interaction with the toddlers. It has been argued that affective speech, characterised by exaggerated pitch and a wider pitch range, is a characteristic of CDS directed toward pre-verbal children and to a lesser extent children that have started producing language (Bender, 2013). The findings of Kitamura, Thanavishuth, Burnham and Luksaneeyanawin (2001) indicate that mothers shift from using affective speech to didactic speech, characterised by enhanced speech sound constrasts (Bender, 2013), when their children enter their second year of life. Based on the results for the present study, this does not seem to be the case for the CDS of female Norwegian pedagocial employees.

Cultural differences may be a part of the reasons for the conflicting findings. Affective pitch modifications are particularly large in American-English CDS (Bender, 2013). On the other hand Japanese mothers have been found to have a restricted F0 range in CDS directed towards their 13-months-old children (Bornstein, et al., 1992), and use nonsense words to communicate emotions. These contradictory findings illustrate that speakers from different cultures might use various methods for conveying positive affect to young children, and that the extent of use of higher and more varied pitch in CDS might be cultural/language dependent.

Warren-Leubecker and Bohannon (1984) analysed American mothers' and fathers' pitch adaptations in CDS in interactions with their two- and five-year-olds. They found that mothers' pitch was higher for both age groups compared to in ADS, and that pitch range was exaggerated the most in interaction with the two-year-olds. The fathers' pitch height and pitch range was even larger than the mothers' in interaction with the two-year-olds compared to in ADS. These findings underpin the results of the present study, indicating that affective pitch modifications can be a characteristic of CDS directed towards children after they have entered

their second year of life. Thus, one can argue that a clear shift from affective to didactic speech in a child's second year of life is not necessary a universal trait. The results of the present study shows that female Norwegian pedagogical employees in kindergarten use affective speech characterised by positive and varied intonation in interaction with children up to their third year of life. To establish if this is a general trait for the Norwegian culture, studies looking at CDS produced by other speakers and elicited form different settings than in the present study must be conducted.

Previous studies looking at the relationship between adaptations in pitch in CDS and emotions, illustrates the importance of linguistic models and interaction partners that both provide linguistic input and are observant and respond to the children's contribution. In light of these earlier findings, the use of positive and varied intonation by female pedagogical employees in kindergarten can possibly convey emotional cues that can have a positive effect on the relationship between a toddler and a female pedagogical employee (Schachner & Hannon, 2011). The pitch adaptations can help a toddler interpret emotional intent, as well as encourage him or her to contribute verbally in an interaction (Høigård, 2013). A toddlers contribution to the interaction could affect the acoustic adaptations in the speech produced (Smith & Trainor, 2008), as implied by the results regarding vowel pitch mean. The significant differences in mean vowel pitch and mean vowel range across speech types in the present study, indicates that such affective speech might be a trait for female Norwegian CDS directed towards children in the age span of 10-34 months.

Linguistic/phonological information

Hypoarticulation in female Norwegian CDS. According to the hyperarticulation hypothesis, a means of conveying linguistic/phonological information is to exaggerate the contrast between the corner vowels (Kuhl et al., 1997), creating a larger vowel space size in CDS than in ADS. Kuhl et al. (1997) found evidence for a larger vowel space size in the CDS produced by American, Russian and Swedish mothers speaking to their two- to five-months-old infants, indicating that an enlarged vowel space might be a universal trait of mothers' CDS. An increased vowel space size in CDS would make the differences between the corner vowels more auditory salient and thereby vowel categories easier to learn. Liu, Kuhl and Tsao (2003) examined the correlation between the maternal speech clarity, measured as the degree of expansion of the vowel space, and infant speech perception performance, measured with a head turn-task. The results showed that Mandarin mothers' vowel space size in CDS was positively correlated with their six- to 12-months-old infants ability to discriminate vowels. In the present study the vowel space is significant smaller in size for long vowels in CDS

compared to in ADS. The vowels are thus hypoarticulated; the contrasts between the corner vowels in CDS are less clear than in ADS. For short vowels the contrasts between the corner vowels are kept comparable across speech types, thus their differences are probably not auditory clearer in CDS. In the present study, the participants interacted with older children than have previously been included in studies investigating vowel space size. Indicating that an enlarged vowel space size in CDS may be a characteristics of CDS directed towards preverbal children and not children between one and three years of age.

Caregivers adapting their language input according to the developmental stage of the children they interact with might explain the absence of a larger vowel space in CDS in the present study. Bender (2013) investigated the characteristic of Dutch mothers' CDS when playing with their 11- and 15-months-old children, compared to when speaking to an adult. The findings were similar to those of the present study: the mothers' vowel space size was smaller in CDS compared to in ADS. It has been found evidence for children's ability to distinguish language-specific vowel differences at six months of age (Kuhl, Williams, Lacerda, Stevens & Lindblom, 1992). One could argue that interaction partners, like the female pedagogical employees in the present study, do not need to enhance their vowel space size for children around one year of age and above, since they are likely already familiar with the vowel differences that are specific of their native language.

On the other hand, the method used for eliciting CDS in Bender (2013) and the present study might have affected the size of the vowel space of the adult interaction partners. CDS is multimodal (Englund, 2005). Meaning that both auditory and visual cues are used in an interaction with a child. The hyperarticulation associated with an enlarged vowel space size in CDS can thus be due to making vowel distinctions visually more salient. In a play-situation with highly mobile toddlers it would likely be less face-to-face interaction between an adult interaction partner and a child compared to in an interaction with two- to five-months-olds as in Kuhl et al. (1997). In a situation with little face-to-face interaction, hyperarticulation would be unnecessary if it is a means of making vowel differences visually more salient, and can explain why evidence for a larger vowel space size in CDS compared to in ADS was not found in the present study.

However, similar to female Norwegian pedagogical employees in kindergarten, it was not found that Norwegian mothers displayed enlarged vowel spaces in CDS in face-to-face interactions with their infants through their infant's first six months of life (Englund & Behne, 2006). Indicating that the lack of a larger vowel space size in the present study might not be due to the language development of the toddlers the pedagogical staff interacts with, or the

situation CDS was elicited from, but rather that hyperarticulation of corner vowels is not a characteristic of female Norwegian CDS. This illustrates that enhancement of vowel space size is not a universal characteristic of CDS.

The findings of the present study and by Englund and Behne (2006) indicate that hypoarticulation is a trait of female Norwegian CDS directed toward children from birth and throughout their third year of life. The happy speaking style used by the female pedagogical employees in the present study, characterised by a higher mean pitch and larger variation in pitch, can explain the hyporarticulation found in female Norwegian CDS. Behne, Moxness and Nyland (1996) investigated the acoustic-phonetic characteristics of vowel quantity and quality in Norwegian. They found that the articulation of /i:/ and /i/ with the tongue in the front part of the vocal cavity results in a relatively low F1 and high F2; /a:/ and /a:/ are back vowels (the tongue is in the rear part of the vocal cavity during articulation) articulated with the tongue pressed against the throat, leading to relatively high mean F1 and low mean F2; and due to lip-rounding and back articulation /u:/ and /u/ had relatively intermediate F1 and low F2. The pattern is the same for ADS in the present study. In CDS an increase in F1 is observed in the vowels /i/, /u:/ and /u/. An open mouth would lead to an increase in these vowels and could thus explain the findings (Bender, 2013). A joyful smile, often with a slightly open mouth, and an open "surprised" mouth are facial expressions that are related to the affective part of CDS. Bender (2013) argues that /a:/ and /a/ is already produced with an open mouth, which would make it difficult increase F1 of these vowels even more. Consequently, the vowel space decreases along the F1 dimension in CDS compared to ADS. However, this does not explain the decrease in F1 for /a:/ and /a/ that is found in CDS compares to in ADS in the present study.

Englund and Behne (2005) found that /a:/, /a/, /u:/ and /u/ in CDS was articulated more front in the vocal cavity, indicated by higher F2 for the vowels compared to in ADS. In the present study, /a:/ is articulated more front in CDS, displayed by a significant higher F2 in CDS than in ADS. /a:/ also had a significant higher F3 in CDS compared to in ADS. Englund and Behne (2005) proposes that the increase in F2 and F3 frequencies in CDS might be due to mothers smiling while speaking to their infants. Further supporting the argument that smiling whilst interacting with a young child may be the reason for hypoarticulation in female Norwegian CDS. In the present study there is only a significant difference in the F2 and F3 means across speech types for /a:/, but as indicated by figure 4, figure 5 and figure 6, F2 and F3 seems to be increased for all vowel qualities in CDS. As pointed to by Englund and Behne (2005), human auditory perception of formant frequency changes are nonlinear, meaning that

at frequencies over 1000 Hz, higher frequency differences are necessary for the human auditory system to detect a change compared to frequency changes at frequencies lower than 1000 Hz. In the present study, the toddler would likely not be able to hear the insignificant differences in F2 and F3, further supporting the assumption that F2 and F3 frequencies are raised in female Norwegian CDS as a possible result of smiling rather than as a mean of unconsciously transferring language specific differences in vowel qualities.

Vowel duration. Vowel duration has been linked to the transfer of important language specific differences from language models to learners (Lindblom, 1967). The prolonged vowel duration found in CDS (Cristia, 2013) could be the result of a slower speaking rate, which has been shown to be attractive to infants (Englund & Behne, 2006). In the present study it was found that the vowel quantity distinction was the same across the speech types. The vowels did not have a general longer duration in CDS compared to in ADS, indicating that the speaking rate was the same across speech types. These findings diverge from the findings of Englund and Behne (2006). They found that Norwegian mothers exhibited longer vowel duration in CDS than in ADS thought their infant's first six months of life. They also found that the age of the infant had a significant effect on the differences in vowel duration across speech types. The absence of vowel duration differences across speech types in the present study might be due to the toddlers being older than the children in Englund and Behne (2006), and that they already can distinguish language-specific vowel differences in Norwegian (Kuhl, Williams, Lacerda, Stevens & Lindblom, 1992). The use of longer vowel duration would likely be beneficial for children in the process of acquiring language-specific vowel differences, but not necessary to use towards children already familiar with these differences. Indicating that the toddlers in the present study as a group master the Norwegian vowel quantity distinctions.

Word learning in kindergarten. When in interaction with a toddler, the female pedagogical employees in the present study adapted aspects of their speech that can be viewed as beneficial for learning and distinguishing between words. Thiessen, Hill and Saffran (2005) investigated infants' ability to distinguish word boundaries in nonsense sentences spoken with ADS intonation and CDS intonation. They found that the infants were able to differentiate the words produced in CDS, but not produced in ADS. Indicating that the intonation, which is the variation in pitch, of CDS facilitates word segmentation. Zachrisson, Moser, Nærde and Dearing (2014) point out that Norwegian children who had gone to high-quality kindergartens, characterised by stimulating and caring relationship between adults and children, had larger vocabularies and lower risk at delayed language development at three-

four years of age, compared to children that had not gone to kindergarten or gone to low-quality kindergartens. Zachrisson et al. (2014) states that in order to understand why this is the case, there is a need for more research that focuses on kindergartens' role in children's language acquisition. The results of the present study, regarding vowel pitch and vowel pitch range, might be one of the explanations for why spending time in high-quality kindergartens have a positive effect on children's vocabularies. In a high-quality kindergarten, a child is probably exposed to a larger amount of CDS than at home, due to exposure to CDS directed towards oneself and towards other children. If this CDS is characterised by greater variation in intonation, as found in the present study, the children could possibly learn more words.

Further, depressed mothers have been found to use less of the exaggerated prosody that characterizes CDS compared to non-depressed mothers. Kaplan, Bachorowski, Smoski and Hudenko (2002) examined the consequences of this trend for four-months-old infants learning ability. The children of the depressed mother could not learn that their mother's speech signalled a face, but were able to learn that a speech cues from non-depressed mother signalled certain faces. Displaying that children of the depressed mothers were capable learners equal to children of non-depressed mothers. The findings indicate that children to a lesser extent can learn from CDS that is not characterised by the use of exaggerated prosody. If this is the case, exposure to CDS typified by higher pitch and wider pitch range in kindergarten can be especially beneficial for children with primary caregivers that do not exhibit exaggerated prosody in their CDS.

An average Norwegian toddler spends most of its time it is awake during a working week together with pedagogical employees in kindergarten (Statistisk sentralbyrå, 2017). It is therefore likely that the characteristics of female pedagogical employees' CDS would play a part in the language acquisition process of a toddler, and can thus be a part of the explanation why children enrolled in high-quality kindergartens have greater vocabularies compared to children how have not been enrolled in kindergarten (Zachrisson et al., 2014), since CDS characterized by higher vowel pitch and wider vowel range, as used by the female pedagogical employees, has been associated with children's word learning (Thiessen, Hill & Saffran, 2005). Underpinning that exposure to CDS in kindergarten can be especially important for children with primary caregivers that do not display higher vowel pitch and amplified intonation in their CDS (Kaplan, Bachorowski, Smoski, & Hudenko, 2002). The results regarding vowel space size and duration indicate that female pedagogical employees in kindergarten do not use these know aspects of CDS that have been directly linked to conveying linguistic/phonological information about a child's native language (Kuhl, et al.,

1997; Sundberg, 1998) in interaction with a toddler. The hypoarticulation of vowels in CDS might be due to the pedagogical employees smiling, together with higher vowel pitch in CDS, this supports the assumption that female pedagogical employees use an affective speaking style during play with toddlers in kindergarten.

Methodological considerations and further studies

Ethics

Written informed consent was obtained from all participants and the study was registered in Norwegian center for research data (see Appendix E). Personal information was treated confidentially. Each participant was debriefed after the sound recordings of the ADS condition was obtained. The sound recordings were saved on a password-protected laptop and only the experimenter and the supervisor had access to the data. The sound recordings were deleted after the acoustic analyses were completed.

Information about a third person, the toddlers the participants interacted with, was obtained. Since this information was not of a sensitive kind and speech from the toddlers was not analysed, it was decided that it would be sufficient to provide the parents with written and oral information and the possibility to reserve their toddlers from inclusion in the project. Children taking part in research are especially entitled to protection (The Norwegian National Committees for Research Ethics, 2016). It was therefore specified in the communication with the participants that the toddler they chose to interact with should be a child they cared for on a daily basis and had a good connection with. This was to ensure that the toddlers would feel safe being alone in a room with the participants. Before the participant and the toddler entered the room, the experimenter repeated that ten minutes was just a guideline for the duration of the interaction and that they should stop earlier if the toddler was uncomfortable in the situation.

Data collection

CDS condition. The method that was used in the present study was chosen based on a pilot study where two different conditions for eliciting CDS were tested in one kindergarten with one participant. In short, the first condition was a natural everyday-situation where the participant helped a toddler to get ready to go outside. The second condition was a play-situation with the same six toys used in the present study. In the pilot study the natural everyday-situation did not provide usable segments from the same phonetic surroundings for comparison with ADS. It was therefore concluded that a semi-structured play-situation would provide the most pragmatic and natural situation for mapping the possible differences in

acoustic-phonetic characteristic of the corner vowels in CDS and in ADS in a kindergarten setting.

In contrast to the implications of the original data in the present study, Englund and Behne (2005) found that the duration of the vowel /i:/ appeared to be very similar in Norwegian mothers' CDS and ADS compared to the other vowels. In the present study /i:/ is the only vowel that appears to have considerably longer duration in CDS than in ADS. The differences might be due to the exemplars of /i:/ in the two studies being drawn from words with different phonetic environments. The phonetic environment of a targeted vowel refers to the sounds that are articulated before and after the targeted vowel, and thus affects the auditory and phonetic traits of the targeted vowel. The difference in duration across the studies regarding the vowel /i:/, displays why it could be beneficial to elicit target vowels from the same words. If target vowels were elicited from different words, the possible acoustic-phonetic differences found across speech types could be due to the phonetic environment rather than adaptation according to conversational partners. By ensuring a consistent phonetic environment with the use of the specific toys with names including the corner vowels, it was possible to compare CDS and ADS, and thus answer the research question and test the hypotheses.

The ambition of the method for eliciting CDS was to make both the toddlers and the participants feel like it was a natural situation, with the intent to provoke the use of natural speech. A means of achieving this was to encourage the participants to select a toddler they cared for on a daily basis and felt they had a good chemistry with to take part in the interaction. During the conversations with the participants, the participants were asked how they felt about the play-situation. The majority pointed out that they did not feel that it was unnatural. None of the participants stopped the play-situation before ten minutes had past, indicating that they felt that the toddlers were confortable. Together, this illustrates that the ambition to create a CDS-condition that felt natural for both the participant and the toddlers was likely fulfilled. Further, the participants pointed out that they were aware that they were wearing an audio recorder, especially in the beginning of the session. This exemplifies that even though the participants did not feel that the situation was unnatural, their speech might have been affected by the fact that they were aware that they were taking part in a study.

Experimental control. By using one room separate from the other children it was possible to limit the degree of noise. The participants chose the room that they felt was suitable and that was available for the time period. In some cases, these were rooms containing objects that could be played with. Objects that could make analysis difficult, such

as instruments, were removed. A minority of the participants pointed out that the rooms they had used when playing was not well know for the toddlers. In these cases, participants found it difficult to get the children interested in the specific toys. In further studies it might be of importance to specify that the room where the CDS-condition is going to take place must be a room that the children are familiar with. Both to arrange for a setting that is ideal for playing with the specific toys, and to make sure that the children do not feel any discomfort in the situation.

Statistical analysis

Missing data. There are many ways of treating missing data (Papageorgiou, Grant, Takkenberg, & Mokhles, 2018). The optimal approach is to ensure that strategies are developed to ensure that the amount of missing data is as small as possible. In the present study the participants were presented with the names of six specific toys and encouraged to mention and play with all of the toys during the interaction with the toddler. At the same time, to create a natural situation, they were asked to play with the toddler as they normally would do. This may have led the participants to focus more on the toddlers initiative, than to make sure that they included and mentioned all of the toys in the interaction. To ensure that the desirable names of the toys were mentioned in the conversation with an adult, a paper with pictures and the names of the toys was used as guidance when talking about the play-situation. The use of the paper led some of the participants to point at the paper instead of uttering the names of the toys. In these cases, the experimenter chose not to directly ask the participants to utter the toys as well, as this might have made the conversations feel less natural. It was viewed as more important to obtain natural speech than to stress the participants to utter the desirable names of the toys.

In the case of missing data, an option is to exclude participants with missing values. In the present study this would have led to excluding approximately 1/3 of the participants, which again would have had consequences for the power of the statistical analyses. Since the missing data are missing at random (e.g. using a lot of time one toy would lead to using less or no time one another toy) (Papageorgiou, Grant, Takkenberg, & Mokhles, 2018) and the data include several variables, multiple imputations was viewed as a suitable method for treating missing values. Multiple imputations allows for generating approximately unbiased and valid estimates for missing values, by taking both the variability in the observed data and the generated values into account. It is not a consensus of how many imputations one should conduct before creating a pooled value. The original numbers of imputations that are viewed

as sufficient are five imputations (Rubin, 1987). In the presents study five imputations were therefore conducted.

Aggregation. Aggregation leads to reduction of the amount of information that can be drawn from the initial data. Making conclusions about single observations based on aggregated data may cause what is referred to as ecological fallacy (Steel & Holt, 1996). In the present study, data is analysed on a group level. Aggregation was therefore both regarded as necessary and appropriate due to uneven numbers of exemplar of the vowels from the original data (see table 3 for total number of each vowel for the different speech types). To show some of the variation in the original data, table 3 displays the range, minimum, maximum, mean and standard deviation for all vowels' F0 and figure 3 displays the mean duration for /a:/-/a/, /i:/-/i/ and /u:/-/u/ based on original data before multiple imputation and aggregation.

Violation of the assumption of sphericity. In the majority of the one-way repeated-measures ANOVAs conducted in the present study, the assumptions of spehericity were violated. Sphericity "assumes that the variance of the difference between data taken from the same participant are equal" (Field, 2013). Violation of sphericity would lead to an increase in the type I error rate. If violations do occur, as in the present study, corrections can be made to reduce the type I error rate by producing a more valid critical *F*-value. Greenhouse-Geisser correction is viewed as most suitable to use as long as the Greenhouse-Geisser estimate is less than .75, which is the case in the one-way repeated-measures ANOVAs conducted in the present study.

Bonferonni correction. To determine which means that are significant different from each other when a one-way repeated-measures ANOVA has a significant main effect, post hoc tests must be conducted. When multiple significant tests are carried out at the same time the type I error rate increases, Bonferonni correction was used to control for this increase. A consequence of ensuring that the type I error does not increase, is that the type II error rate increases. It is therefore a possibility that some adaptations in CDS compared to in ADS is not detected in the present study, such as the differences in the pitch mean of /i:/ and /u/.

Further studies

The present study is the first of its kind. Thus, there are additional aspects of CDS in a kindergarten setting that can be explored to get a better picture of the language environment pedagogical employees provide. The same design could be used to establish how male pedagogical employees use aspects of CDS when interacting with toddlers. This could both give insight into the language environment in kindergarten and the possible differences

between female and male Norwegian CDS. It has been found evidence for gender differences in language development in Norwegian children from eight- to 36-months-of-age (Høigård, 2013); females develop earlier than males and have greater vocabularies. Zachrisson et al., (2014) have found that the number of years a male child spends in kindergarten is positively correlated with his vocabulary. This correlation was not found for female children. Investigating if there are differences in the characteristics of CDS directed toward female and male toddlers might give an insight to why differences in language development are present at an early age and why males benefit linguistically from spending more time in kindergarten. Both the quality and the quantity of linguistic input are important in children's language development (Gramann & Torkildsen, 2016), further exploring characteristics of CDS can give more insight into the quality of toddlers linguistic environment in kindergarten.

The present study only includes corner vowels. The exploration of the acoustic-phonetic characteristics of these vowels indicates that female Norwegian pedagogical employees in kindergarten do not highlight aspects that are associated with didactic speech when interacting with the toddlers. It is assumed that Norwegian children use both information from vowels and consonants to recognize and distinguish between similar words, like "hat" (hatred) and "hatt" (hat) (Gramann & Torkildsen, 2016). Investigating consonants would give further insight in to what aspects of speech that are highlighted in CDS by pedagogical employees in kindergarten, and the possibility to strengthen or challenge the assumption that their CDS is mostly characterized by affective adaptations.

Cameron-Faulkner, Lieven & Tomasello (2003) looked at the interaction between English-speaking mothers and their children, and found that a child around three years of age is exposed to approximately 700 utterances each hour. In a longitudinal study by van de Weijer (2002), it was found that only 15% of the utterances Dutch infants were exposed to in a day were utterances produced by adults directed towards them. After gaining insight into the characteristics of CDS produced by pedagogical employees in kindergarten, it could be possible to explore how large portion of the utterances a child in kindergarten is exposed to that is CDS. This could provide data with higher ecological validity and give a more accurate picture of the language environment the youngest children in kindergarten are a part of, compared to the present study witch focus more on the characteristics rather than the amount of usage of CDS in a kindergarten setting. Investigating this aspect might give a foundation for comparison with the amount of CDS children in the same age group are exposed to at home. Further, this comparison could give more insight into why children enrolled in high-quality kindergartens have greater vocabularies than children that have not gone to

kindergarten at the age of three- to four-years (Zachrisson et al., 2014) and why boys to a larger degree than girls benefit lingustically from spending time in kindergarten.

Conclusion

This study tested if female Norwegian pedagogical employees adapted, in similarity to in mothers' CDS, the characteristic of the vowels /a:/, /a/, /i:/, /i/, /u:/ and /u/ in their speech in interaction with a toddler compared to in interacting with an adult. The results showed that the pedagogical staff enhanced affective aspects in their speech when interacting with toddlers during play. These aspects include higher vowel pitch and greater vowel pitch range in CDS compared to ADS, which are characteristics similar to those found in the CDS of mothers across different languages, cultures and settings. The hypoarticulation of long vowels in CDS displayed in the present study are comparable to earlier research on Norwegian mothers' CDS, and is perhaps not beneficial for toddlers' auditory language learning. Further supporting that female Norwegian pedagogical employees highlight affective aspects of speech in interaction with toddlers in kindergarten, which can facilitate perception of emotional aspects in communication and provoke attention rather than highlighting specific vowel differences in the Norwegian language.

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Appendix A

Bakgrunn for prosjektet

Tidligere forskning viser at voksne benytter seg av barnerettet tale når de snakker til barn. Denne talen inneholder aspekter som voksenrettet tale ikke gjør. Disse aspektene er med på å styrke den emosjonelle tilknytningen mellom barnet og den voksne og dermed gjøre at barnet føler seg trygt. I tillegg er denne typen tale tilpasset barnets utviklingsnivå slik at den fasiliteter videre språkutvikling hos barnet.

Det er hittil ikke gjort noen studier på bruk av barnettet tale i barnehager. Men det er en enighet i fagfeltet om at barnerett tale er svært viktig for barns kognitive utvikling. Med tanke på at norske barn i dag tilbringer mye tid i barnehage fra de er 1 år og debatten rundt hvordan dette påvirker barna, ønsker jeg å belyse hvordan ansatte i barnehage kan ha en positiv effekt på barns utvikling ved å kartlegge bruken av barnerettet tale. Videre håper jeg at disse funnene skal gjøre barnehageansatte mer bevisst på hvordan de interagerer med barna og at selv små overgangssituasjoner er viktige når det kommer til barns utvikling. Jeg ønsker også å få fram at det er behov for mange nok voksne som har kunnskap om hva som påvirker barns utvikling. Dette for å kunne støtte den språklige og emosjonelle utviklingen til barn som går i barnehage like godt som en omsorgsperson kunne gjort hjemme. Jeg stiller gjerne opp for å dele den kunnskapen jeg har på dette temaet, både før og etter gjennomføring av masteren, hvis det er ønskelig.

Appendix B

Forespørsel om deltakelse i forskningsprosjekt

"Språkmiljø i barnehagen"

Bakgrunn og formål

Dette er et mastergradsprosjekt i psykologi ved NTNU. Formålet med denne undersøkelsen er å få større innsikt i det språklige læringsmiljøet til barnehagebarn, ved å analysere hvordan barnehageansatte snakker til de minste barna i barnehagen. Du er forespurt om å delta i dette prosjektet med bakgrunn i at du er kvinnelig pedagogisk personale i barnehage med norsk som morsmål og arbeider med barn i aldersgruppen 0-3 år.

Hva innebærer deltakelse i studien?

Deltakelse i denne studien innebærer lydopptak av deg som leker med et barn i alderen 0-3 år. Denne interaksjonen vil finne sted i et rom ved barnehagen du er ansatte ved. Du vil få utdelt en t-skjorte med en lomme som er tilpasset lydopptakeren som blir benyttet. Du vil også få utdelt seks leker som du skal benytte og benevne når du leker med barnet. Det er ønskelig at du leker med barnet i minimum 10 minutter. Men du må selv avgjøre hvor lenge du vil leke med barnet basert på barnets oppmerksomhet og hva som føles naturlig. Etter at du har lek med barnet ønsker jeg å ha en samtale med deg på ca. 10 minutter. Det vil bli tatt lydopptak av denne samtalen. Samtalen er uformell, men vil jeg stille deg spørsmål om leksituasjonen med barnet og generelle spørsmål som omhandler det å arbeide i barnehage. Du vil også bli spurt om hvor gammel du er, hvor lenge du har arbeidet med barn, hvilken utdanning du har, hvor gammel barnet du lekte med er, om barnets kjønn og om barnet du lekte med har norsk som morsmål eller ikke. Gjennomføring av lydopptak vil skje når det passer for deg og dine medarbeidere i tidsrommet september-desember 2018.

Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt. Lydopptakene vil bli oppbevart på en passord-beskyttet datamaskin og ingen andre enn masterstudenten og veileder vil ha tilgang til datamaterialet. Det vil gjøres akustisk-fonetiske lydanalyser av datamaterialet. Etter prosjektet er gjennomført vil filene bli slettet. Prosjektet skal etter planen avsluttes mai 2019. Øvrig informasjon vil lagres adskilt fra lydfilene, og vil bli slettet etter prosjektet er gjennomført. Deltakere vil ikke kunne gjenkjennes i publikasjonen.

Frivillig deltakelse

Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert.
Dersom du ønsker å delta eller har spørsmål til studien, ta kontakt med Vilde Buhaug Steen, 94869132 eller e-mail vildebst@stud.ntnu.no. Veileder for masterprosjektet er Kjellrun Thora Englund, 73590569 eller e-mail kjellrun.englund@ntnu.no.

Studien er godkjent av Personvernombudet for forskning, NSD - Norsk senter for forskningsdata AS.

Samtykke til deltakelse i studien

Jeg har mottatt informasjon om studien, og er villig til å delta

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(Signert av prosjektdeltaker, dato)

Appendix C

Informasjon til foreldre ang. forskingsprosjekt

I tidsperioden oktober-desember 2018 vil det gjennomføres et mastergradsprosjekt i psykologi tilknyttet NTNU ved ditt barns barnehage. Formålet med denne undersøkelsen er å få større innsikt i det språklige læringsmiljøet til barnehagebarn, ved å analysere hvordan barnehageansatte snakker til de minste barna i barnehagen. Du blir gitt informasjon om dette prosjektet med bakgrunn i at du er foresatt til et barn i aldersgruppen 0-3 år.

Datamateriale til dette prosjektet er lydopptak av en ansatte i lek med barn i aldersgruppen 0-3 år. Det er de ansatte som er fokuset for prosjektet. Men det er ønskelig å registrere alderen, kjønn og om barna de ansatte leker med har norsk som morsmål eller ikke.

Hva skjer med informasjonen?

Alle personopplysninger vil bli behandlet konfidensielt. Datamaterialet vil bli oppbevart på en passord-beskyttet datamaskin og ingen andre enn masterstudenten og veileder vil ha tilgang til datamaterialet. Prosjektet skal etter planen avsluttes mai 2019. Datamaterialet vil bli slettet etter prosjektet er gjennomført. Verken den ansatte, barnehagen eller ditt barn vil ikke kunne gjenkjennes i publikasjonen.

Hvis du ikke ønsker at barnet ditt skal inkluderes i dette prosjektet vennligst gi beskjed om dette til personalet snarest.

Dersom du har spørsmål til studien, ta kontakt med Vilde Buhaug Steen, 94869132 eller e-mail vildebst@stud.ntnu.no. Veileder for masterprosjektet er Kjellrun Thora Englund, 73590569 eller e-mail kjellrun.englund@ntnu.no.

Studien er godkjent av Personvernombudet for forskning, NSD - Norsk senter for forskningsdata AS.

Information for parents regarding research project (English)

During the period October-December 2018, a Master's Degree Project in Psychology will be conducted at your child's kindergarten. The aim of this project is to gain more insight into the linguistic learning environment of kindergarten children, by analyzing how kindergarten employees speak to the smallest children in kindergarten. You are given information about this project as the parent of a child the age group 0-3 years.

Data material for this project is sound recordings of employees playing with children in the age group 0-3 years. The employees are the focus of this project. However, it is desirable to register the age, gender and whether the children the employees play with have Norwegian as their native language or not.

What happens to the information?
All personal information will be treated confidentially. The data will be stored on a password-protected computer and no one other than the master student and supervisor will have access to the data material. The project is scheduled to end in May 2019. The data will be deleted after the project has been completed. The employees, the kindergarten, nor your child will be recognized in the publication.

If you do not want your child to be included in this project, please notifying an employee as soon as possible.

If you have questions about the study, please contact Vilde Buhaug Steen, 94869132 or email vildebst@stud.ntnu.no. The supervisor for the master project is Kjellrun Thora Englund, 73590569 or e-mail kjellrun.englund@ntnu.no.

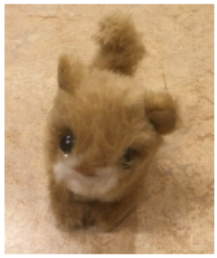
The study has been approved by the Norwegian Data Protection Official for Research, NSD.

Appendix D

Du vil få utdelt følgende seks leker som du skal benytte og benevne når du leker med barnet. Utover dette er det ingen føringer for hvordan du skal interagere med barnet. Du velger selv hvor lenge du vil leke med barnet basert på barnets oppmerksomhet og hva som føles naturlig. Men det er ønskelig at du leker med barnet i minimum 10 minutter.

TIGER

BUKK



KATT

BOK

KAKE

PIPPI

Appendix E

Kjellrun Thora Englund

7048 TRONDHEIM

Vår dato: 25.06.2018 Vår ref: 60950 / 3 / TAL Deres dato: Deres ref:

Vurdering fra NSD Personvernombudet for forskning § 31

Personvernombudet for forskning viser til meldeskjema mottatt 30.05.2018 for prosjektet:

60950	*Barnerettet tale i barnehagen*
Behandlingsansvarlig	*NTNU, ved institusjonens øverste leder*
Daglig ansvarlig	*Kjellrun Thora Englund*
Student	*Vilde Buhaug Steen*

Vurdering

Etter gjennomgang av opplysningene i meldeskjemaet og øvrig dokumentasjon finner vi at prosjektet er meldepliktig og at personopplysningene som blir samlet inn i dette prosjektet er regulert av personopplysningsloven § 31. På den neste siden er vår vurdering av prosjektopplegget slik det er meldt til oss. Du kan nå gå i gang med å behandle personopplysninger.

Vilkår for vår anbefaling

Vår anbefaling forutsetter at du gjennomfører prosjektet i tråd med:

- opplysningene gitt i meldeskjemaet og øvrig dokumentasjon
- vår prosjektvurdering, se side 2
- eventuell korrespondanse med oss

Vi forutsetter at du ikke innhenter sensitive personopplysninger.

Meld fra hvis du gjør vesentlige endringer i prosjektet

Dersom prosjektet endrer seg, kan det være nødvendig å sende inn endringsmelding. På våre nettsider finner du svar på hvilke endringer du må melde, samt endringsskjema.

Opplysninger om prosjektet blir lagt ut på våre nettsider og i Meldingsarkivet

Vi har lagt ut opplysninger om prosjektet på nettsidene våre. Alle våre institusjoner har også tilgang til egne prosjekter i Meldingsarkivet.

Vi tar kontakt om status for behandling av personopplysninger ved prosjektslutt

Ved prosjektslutt 01.05.2019 vil vi ta kontakt for å avklare status for behandlingen av

personopplysninger.

Se våre nettsider eller ta kontakt dersom du har spørsmål. Vi ønsker lykke til med prosjektet!

Marianne Høgetveit Myhren

Trine Anikken Larsen

Kontaktperson: Trine Anikken Larsen tlf: 55 58 83 97 / Trine.Larsen@nsd.no

Vedlegg: Prosjektvurdering
Kopi: Vilde Buhaug Steen, vildebst@stud.ntnu.no

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 60950

INFORMASJON OG SAMTYKKE

Du har opplyst i meldeskjema at utvalget vil motta skriftlig og muntlig informasjon om prosjektet, og samtykke skriftlig til å delta. Vår vurdering er at informasjonsskrivet til utvalget er godt utformet.

OPPLYSNINGER OM TREDJEPERSON

Det fremgår av meldeskjema at du skal samle inn og registrere opplysninger om tredjepersoner. Det er i hovedsak de kvinnelige ansatte i barnehagen som er informantene i prosjektet, men det vil gjøres lydopptak med informanten og barnehagebarn i interaksjon med hverandre. I tillegg skal barnets alder og kjønn registreres. Studenten legger opp til å informere foreldrene om prosjektet med mulighet til å reservere deres barn fra inklusjon i prosjektet. Personvernombudet legger til grunn at informasjonsplikten er tilstrekkelig ivaretatt.

INFORMASJONSSIKKERHET

Personvernombudet forutsetter at du behandler alle data i tråd med NTNU sine retningslinjer for datahåndtering og informasjonssikkerhet. Vi legger til grunn at bruk av privat pc/mobil lagringsenhet er i samsvar med institusjonens retningslinjer.

PROSJEKTSLUTT

Prosjektslutt er oppgitt til 01.05.2019. Det fremgår av meldeskjema at du vil anonymisere datamaterialet ved prosjektslutt. Anonymisering innebærer vanligvis å:

- slette direkte identifiserbare opplysninger som navn, fødselsnummer, koblingsnøkkel
- slette eller omskrive/gruppere indirekte identifiserbare opplysninger som bosted/arbeidssted, alder, kjønn
- slette lydopptak

For en utdypende beskrivelse av anonymisering av personopplysninger, se Datatilsynets veileder:
https://www.datatilsynet.no/globalassets/global/regelverk-skjema/veiledere/anonymisering-veileder-041115.pdf

NTNU
Norwegian University of
Science and Technology