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Impact of communication partner familiarity and speech accuracy on parents' ratings of their child for the Intelligibility in Context Scale: Dutch

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Abstract

Purpose: The aim of this study was to examine the role of familiarity of a communication partner on Dutch parents' perception of their child's intelligibility, for children with typically-developing speech (TD) or speech sound disorder (SSD).
Method: Participants were 67 Dutch-speaking children (48–84 months), 48 with TD and 19 with SSD. Item scores on the parent-rated Intelligibility in Context Scale: Dutch (ICS-NL) were compared between groups and related to naive listeners' ratings of children's intelligibility (IR), and a measure of speech accuracy (i.e. percentage of consonants correct-adjusted, PCC-A).
Result: Statistical analysis yielded a significant Group by Familiarity interaction on the ICS-NL. Parents rated the intelligibility of their child with SSD as higher with more familiar communication partners than less familiar, more so than parents of children with TD. In the SSD group, IR was more strongly correlated with ICS-NL item scores for less familiar partners. PCC-A was only correlated with ICS-NL item 7 (strangers).
Conclusion: Parents perceive their children as more intelligible with people in close relationships, likely due to their higher familiarity with the child's speech. Children's relationships should be considered with respect to communicative participation. PCC-A may be a less reliable predictor of participation in family and community life.

Keywords: *intelligibility*; *speech sound disorders*; *familiarity*; *Intelligibility in Context Scale*; *parents*; *rating*

Introduction

Intelligibility of speech has a large impact on children's ability to participate in valued activities or situations such as talking with family members or playing with friends. Being understood by parents, teachers, friends and also strangers is essential for effective communication. Moreover, intelligibility is a contributing factor to quality of life in children (Markham, van Laar, Gibbard, & Dean, 2009). Unintelligible speech often leads to communication breakdown with frustration as a consequence. Frustration due to communication breakdown may trigger detrimental behaviour such as the child avoiding speaking or becoming angry (McCormack, Baker, & Crowe, 2018; McCormack, McLeod, McAllister, & Harrison, 2010; McLeod, Daniel, & Barr, 2013). Children with speech sound disorders (SSD) are less intelligible than children with typical speech development and therefore potentially more exposed to communication breakdown and frustration in daily life. SSD are defined as "any combination of difficulties with perception, articulation/motor production and/or phonological representation of speech segments (consonants and vowels), phonotactics (syllable and word shapes) and prosody (lexical and grammatical tones, rhythm, stress and intonation) that may impact speech intelligibility and acceptability … of both known … and presently unknown origin" (International Expert Panel on Multilingual Children's Speech, IEPMCS, 2012).

Speech intelligibility is defined as "a relative measure of the degree to which a speaker's speech signal is understood, the relativity depending at a minimum on the identities of speaker and listener, what is spoken and where it is spoken" (Weismer, 2008, p. 569). There are a number of contributing factors to intelligibility, including "…whether he [the listener] is familiar with the speaker's voice, or his accent or dialect" (Connolly, 1986, p. 372).

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Flipsen (1995) found that mothers were significantly better at recognising their child's words than all other listeners including fathers, teachers and other people who were potentially less familiar with the child. These findings were confirmed by Baudonck, Buekers, Gillebert, and Van Lierde (2009) who compared the transcription of words, sentences and stories by mothers, fathers and unfamiliar listeners. They concluded that mothers were the best at understanding children's words compared with the other groups. Other research on the differences between the listening skills of experienced listeners such as speech–language pathologists (SLPs) and untrained listeners showed that experienced listeners have better perception of phonetic detail in children's speech (Brunnegård et al., 2009; Klein, Grigos, McAllister Byun, & Davidson, 2012; Munson, Johnson, & Edwards, 2012). Familiarity, thus, is supposed to be an important factor in recognising the child's speech and influences intelligibility.

Recently, Sprunt and Marella (2018) explored the influence of listener familiarity on children's speech and participation in situations inside and outside the home and school, using a new interviewer-administered tool for parents and teachers: the UNICEF/Washington Group Child Functioning Module (CFM). In this study, typically developing children as well as those with SSD were included. Listeners inside the household or inside the main classroom were judged to be more familiar to the child than listeners outside the household or outside the main classroom. Children's highest level of difficulty was found on the questions relating to situations outside the household and outside the main classroom. Therefore, the researchers concluded that questions regarding situations outside the main classroom and outside the home were the most sensitive for recognising children's communicative difficulties. These findings correspond with the study of McLeod, Daniel, and Barr (2013) who found that SSD had limited impact on daily functioning when children interacted with close family members. However, in situations outside the family, children were disempowered because of frequent communication breakdowns.

Intelligibility can be measured at different levels of the International Classification of Functioning, Disability and Health (ICF) (World Health Organization, WHO, 2001), that can be used to describe the functioning of children in daily life. The ICF covers five components: Body Functions, Body Structures, Activities and Participation, Personal Factors and Environmental Factors. Different aspects of SSD are present at the different levels of the ICF, for example, Body Functions include speech characteristics and intelligibility at the word level, Activities include speaking and listening skills, and Participation is associated with intelligibility in different contexts. Personal and Environmental Factors contribute as barriers or facilitators to daily functioning of children with SSD. Intelligibility, thus, can be measured at the level of Body Functions (impairment) and Participation.

The current study used two intelligibility scales for continuous speech completed by listeners who are familiar and unfamiliar to the child. The Intelligibility in Context Scale: Dutch (ICS-NL) (McLeod, Harrison, & McCormack, 2013) was used to measure the intelligibility of children in relation to different communication partners as judged by their parents representing the Participation level of the ICF. The ICS-NL, thus, reflects the parents' perception of the intelligibility of their child. The second intelligibility rating, the Intelligibility Rating (IR) developed by Dobinson (2007), is a general measure of intelligibility as judged by a panel of naive listeners, using the samples of recorded speech of the children in an experimental setting. The IR represents the Body Functions level and the Activities and Participation level of the ICF.

Although Flipsen, Hammer, and Yost (2005) questioned the reliability of the use of intelligibility ratings from specialised listeners, such as SLPs, several authors have shown that an overall estimate of speech intelligibility can be obtained reliably using rating scales. Brunnegård, Lohmander, and van Doorn (2009) concluded that experts and untrained listeners were able to differentiate normal and disordered speech. In their study, Brunnegård et al. (2009) showed that untrained listeners considered information about perceptions in daily life and, on the other hand, experts recognised more characteristics of disordered speech. Combined, this information provided a basis for clinical decisions regarding intervention (Brunnegård et al., 2009). This is in line with earlier findings from Huttunen and Sorri (2004) who recommended using rating scales for assessing the need for remediation of speech and monitoring effectiveness of intervention. Also, Lousada et al. (2014) used listeners who were unfamiliar to disordered speech who were sensitive to changes in the phonological system of the child. In accordance with these findings it is proposed that overall intelligibility represents the different levels of the ICF. Listeners might consider perception of phonemes and errors (Body Functions), intelligibility and their general idea about how the child participated in talking with the researcher (Activities and Participation), in their overall judgment of intelligibility.

According to McLeod and McCormack (2007), assessment of disordered speech at the level of Body Functions should consider segmental and suprasegmental characteristics and include the phonetic and phonemic repertoire of vowels and consonants, phonological processing, syllable structures and evaluation of intelligibility. The

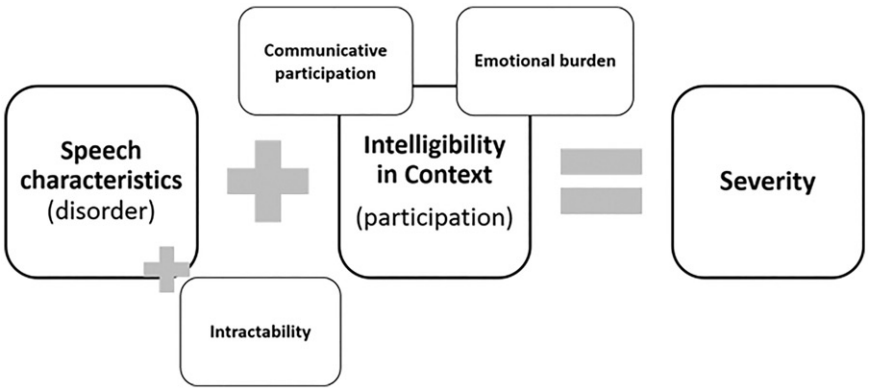

Figure 1. Severity model: SPEECH, the Dutch study regarding the severity of speech sound disorders.

most commonly used measure at the Body Functions level is the segmental measure, percentage consonants correct (PCC), proposed by Shriberg and colleagues (Shriberg, Austin, Lewis, McSweeny, & Wilson, 1997; Shriberg & Kwiatkowski, 1982). But, whole word measures are also used, such as percentage of whole-word correct (PWC), proportion of whole-word proximity (PWP), proportion of whole-word variability (PWV) (Ingram, 2002; Ingram & Ingram, 2001), percentage of words understood (PWU) (Gordon-Brannan & Hodson, 2000), as well as the phonological mean length of utterance (pMLU) and combinations of speech characteristics (Brancalioni, Magnago, & Keske Soares, 2012). Research on reliability, sensitivity and specificity of PCC has shown it to be a reliable measure to assess SSD (Johnson et al., 2004), and PCC is effective in discriminating and identifying children with and without SSD (Barrozo, Pagan-Neves, Pinheiro da Silva, & Wertzner, 2017; Shriberg et al., 1997).

Other research has concentrated on intelligibility as a measure in speech assessments regarding the nature and severity of SSD, and the evaluation of intervention (Donicht, Pagliarin, Mota, & Keske Soares, 2009). A study on a wide range of segmental and whole word measures used in speech assessments, including PCC and intelligibility, did not report one measure in particular that could address the severity of SSD (Flipsen et al., 2005). Lousada, Jesus, Hall, and Joffe (2014) have emphasised the use of intelligibility in combination with speech characteristics as an outcome measure for evaluation of speech-language pathology.

In the present study, different outcome measures at the Body Functions level and Participation level, that were supposed to be influenced more or less by familiarity, were combined. The impact of familiarity on the measures used in this study is still unknown. Furthermore, it is unclear whether parents of children with SSD judge their children's intelligibility similarly to parents of typically developing children.

Aims of the study

The aim of the current study was to examine the role of communication partner familiarity on the perception of intelligibility by parents of Dutch children who are typically developing (TD) or children who have SSD. The current study is part of the Dutch SPEECH project (Van Doornik, Gerrits, McLeod, & Terband, 2015) that aims to develop a severity index of SSD in children aged 4–7, addressing the ICF levels of Body Functions, and Activities and Participation, as is illustrated in Figure 1. In the SPEECH study, the Intelligibility in Context Scale (ICS) is an outcome measure. The premise of the ICS (McLeod, Harrison, & McCormack, 2012a, 2012b) (and the Dutch translation – ICS-NL (McLeod, Harrison, & McCormack, 2013)) is that a caregiver will rate the intelligibility of their child with different communication partners (i.e. immediate family, teachers and strangers) and may score a child's intelligibility differently with different communication partners according to context and familiarity. Parents in the SSD group are frequently exposed to disordered speech, but most of the parents of typically developing children are not. Because of different exposure to disordered speech, it is unclear whether parents of children in the TD and SSD groups are similarly influenced by the level of familiarity between their child and a communication partner, and how that familiarity impacts their judgment of their child's intelligibility. Familiarity with the child may be an important factor in the parents' perception of their child's intelligibility as expressed in the judgments of the different ICS-NL items. To provide a deeper understanding of the interpretation of the ICS-NL, the present study examined the following questions:

(1) Are there systematic differences in intelligibility judgments between parents of children with SSD compared to parents of children with TD (a) in overall ICS-NL score and (b) between the seven ICS-NL items that reflect familiarity between children and their communication partners?
(2) Is there an association between parents' perception of the intelligibility of their child with TD/SSD with partners of different familiarity and (a) unfamiliar

raters' judgments of their child's intelligibility (i.e. intelligibility rating, IR) or (b) a standard measure of their child's speech accuracy (i.e. percentage of consonants correct-adjusted, PCC-A)?

In general, typically developing children would be expected to receive higher intelligibility scores compared to children with SSD. Based on the results of Baudonck et al. (2009) and Flipsen (1995), however, it was hypothesised that parents of children with SSD would understand their children better than people who are unfamiliar with the child's speech. Though parents in the SSD group might not be conscious of their advantage in understanding their child's speech more easily than others, this advantage would be expressed in relatively higher ratings of the intelligibility of their child on the ICS-NL. Additionally, parents might be aware that people who are in a close relationship to their child, understand their child better than people who are unfamiliar to the child. In that case, a relatively higher rating would be expected from parents in the SSD group compared to parents in the TD group specifically on the items representing intelligibility for people who are familiar to the child.

Due to differences in speech accuracy, it was hypothesised that children in the TD group will receive higher IR ratings than children in the SSD group. Whilst speech accuracy was measured by the calculation of the PCC-A from the naming task, IR was expected to be closely related to PCC-A. Because both IR and ratings for items 5–7 on the ICS-NL (i.e. acquaintances, teachers and strangers) were being addressed as less familiar to the children's speech, a close association was expected between the IR and these ICS-NL items for the SSD group, relative to the TD group.

Method

Context of the study

The current study combines data from two studies of children with SSD in the Netherlands: (a) the development of the Computer Articulation Instrument (CAI) and (b) the SPEECH study that aims to develop a severity index of SSD. The CAI-SPEECH research group included linguists, SLPs, and neuropsychologists who aimed to improve assessment and diagnosis of SSD in children aged 4–7 years.

Ethical approval

Ethical approval was obtained from the Medical Research Ethics Committee of Radboud University Medical Centre Nijmegen (approval number: 2016-2985) and the internal review board ETCL of de faculty of Humanities Utrecht University (approval number: doorn026-01-2017). Parents and listeners provided informed consent for participation.

Participants

Children

The current study is part of the Dutch SPEECH project investigating the different aspects of severity of SSD in children aged 4.0–6.11. The parents of all children in grades 1 and 2 of four schools were sent a letter inviting them to participate. Additionally parents of children with SSD who were attending speech–language pathology practices or audiology clinics were invited to participate. Schools and practices were located in four different regions (provinces) of the Netherlands, in which standard Dutch is spoken. Those who agreed completed a consent form and online questionnaires. The questionnaires included the ICS-NL and other questions that were relevant for different phases of the SPEECH study.

Participants for the current study were 67 children aged 4.0–6.11 years ($M = 60.46$ months, $SD = 8.73$ months) in the first two years of formal schooling in the Netherlands. There were 30 (44.8%) boys and 37 girls (55.2%). All participants spoke Dutch as their most used language and eight children (11.9%) spoke at least one other language (including English, Malay, Arabic and Turkish). Exclusion criteria for this study aside from age were structural hearing problems, co-morbidity such as Autism Spectrum Disorder (ASD) or severe Attention Deficit Hyperactivity Disorder (ADHD) and known neurological damage.

Following the definition of SSD by the International Expert Panel on Multilingual Children's Speech (IEPMCS, 2012), participants were classified as TD ($n = 48$; 71.6%) or having SSD ($n = 19$; 28.4%) based on the phonological and/or phonetic features of their speech. Two groups of children with SSD were combined for the purpose of this study: (a) children with phonological disorders who were identified as having Computer Articulation Instrument (CAI) scores below the age-expected normative value (Maassen et al., 2017); and (b) children with articulation (phonetic) disorders who were identified as having consistent misarticulations persisting beyond the age expected norms for Dutch (Stes, 2001). When it was not clear whether a child should be classified in the TD or SSD group, speech samples were discussed by the SLP-researchers and consensus was reached. There were no significant differences between the TD group and the SSD group for age (TD: $M = 60.7$, $SD = 8.65$; SSD: $M = 59.8$, $SD = 9.14$), $t(65) = 0.364$, $p = 0.717$ and sex (TD: $M = 1.6$, $SD = 0.50$; SSD: $M = 1.5$, $SD = 0.51$), $t(65) = 0.265$, $p = 0.792$.

Adult listeners

In the listening experiment, 49 listeners participated, distributed over two panels (22 and 27 listeners). Their mean age was 23.7 years (range 18–52 years). More women than men participated (female, $n = 42$;

male, $n = 7$). Listeners were all students from the Linguistics Department of Utrecht University, Dutch native speakers, with self-reported normal hearing, naive to the children in the experiment and naive to disordered speech in general.

Instruments

Intelligibility in Context Scale: Dutch

The ICS (McLeod et al., 2012a) is a parent report 7-item questionnaire designed to screen intelligibility in the daily lives of pre-school children (Table I). The construct of the ICS is based on the ICF (WHO, 2001). The ICS has been translated into over 60 languages and is freely available at http://www.csu.edu.au/research/multilingual-speech/ics. The ICS has been normed for Australian English (McLeod, Crowe, & Shahaeian, 2015) and validated for Cantonese (Ng, To, & McLeod, 2014), German (Neumann, Rietz, & Stenneken, 2017), Vietnamese (Phạm, McLeod, & Harrison, 2017), Jamaican (Washington, McDonald, McLeod, Crowe, & Devonish, 2017) and with children in Fiji (Hopf, McLeod, & McDonagh, 2017; Sprunt & Marella, 2018). The ICS-NL was translated into Dutch in 2013 (McLeod, Harrison, & McCormack, 2013). To complete the ICS, parents judge the intelligibility of their child with TD or SSD with seven different communication partners: (1) parents, (2) immediate family, (3) extended family, (4) friends, (5) acquaintances, (6) teachers and (7) strangers. Intelligibility is rated on a 5−point Likert scale (1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *usually*, 5 = *always*) and the average total score (mean score) is calculated by totalling the score on each ICS item and dividing by 7. The items of the ICS-NL correspond with different communication partners who were presumed to be more or less familiar to the child. For example, immediate family is likely to talk more frequently with the child than acquaintances, and therefore, immediate family might be more familiar with the speech and speech difficulties of the child. The majority of parents in the current study completed the ICS-NL in a digital format as one of a series of parent questionnaires.

Computer Articulation Instrument (CAI)

The Computer Articulation Instrument (CAI) (Maassen et al., 2017) is a Dutch assessment tool for the evaluation of speech development that is currently being normed in the Netherlands. Norms for 4–7 year olds, available from the CAI research group, were used in the current study. The CAI was administered by computer, presented over headphones (Philips SBC HP800, Amsterdam, the Netherlands), and recorded by an omnidirectional externally powered table microphone (Shure 2XU, Culemborg, the Netherlands). The CAI contains five tasks: (1) picture naming, (2) word imitation, (3) nonword repetition, (4) nonword consistency and (5) diadochokinesis (DDK). In the CAI, broad transcription is used for analysis. Phonetic features such as distortions are not transcribed and therefore not counted as errors in the CAI analysis. As a result, common clinical consonant distortions are scored as correct (cf. Shriberg et al., 1997b). CAI calculations, therefore, provide the PCC-A computed on the phonological features of the target words. In the current study, the picture-naming task was used to generate PCC-A. The CAI was transcribed and scored by the first author using the standardised procedures outlined in the CAI examiner's manual (Maassen et al., 2017).

Spontaneous speech samples for listener intelligibility ratings

Spontaneous speech samples were elicited during conversation between the child and the researcher about daily topics such as pets, friends and hobbies. The researcher was unknown to the child and so their relationship was comparable to ICS-NL strangers (item 7). The speech samples were audio-recorded using a Shure 2XU omnidirectional externally powered table microphone. For each of the 67 children, two brief segments (∼30 s total; total of 134 segments) were selected from the audio

Table I. Participant scores on the Intelligibility in Context Scale (ICS-NL) ($n = 67$).

	Typically developing group ($n = 48$)			Speech sound disorders group ($n = 19$)		
	Total			Total		
	M	SD	Range	*M*	SD	Range
Question						
1. Do you understand your child?	4.65	0.48	4–5	4.42	0.51	4–5
2. Do immediate members of your family understand your child?	4.63	0.49	4–5	4.32	0.48	4–5
3. Do extended members of your family understand your child?	4.44	0.54	3–5	4.05	0.71	3–5
4. Do your child's friends understand your child?	4.54	0.50	4–5	3.95	0.62	2–5
5. Do other acquaintances understand your child?	4.38	0.53	3–5	3.84	0.77	3–5
6. Do your child's teachers understand your child?	4.52	0.51	4–5	4.00	0.58	3–5
7. Do strangers understand your child?	4.35	0.53	3–5	3.53	0.91	2–5
Total score (max 35)	31.50	3.07	25–35	28.11	3.87	22–35
Average total score (max 5)	4.50	0.44	3.57–5	4.01	0.56	3.14–5

Note. Total scores and Average total scores were generated from parent ratings on a 5-point scale where 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *usually*, 5 = *always* (McLeod et al., 2012a).

Table II. Mean participant scores on the Intelligibility Rating (Dobinson, 2007) ($n = 67$).

			Typically developing group ($n = 48$)					Speech sound disorders group ($n = 19$)				
Intelligibility	Effort	Score	*n*	*M*	Min	Max	SD	*n*	*M*	Min	Max	SD
Able to fully understand what the person was telling you	Easy	(9)	0	–	–	–	–	0	–	–	–	–
	Pay a little attention	(8)	5	8.49	8.23	8.75	0.21	0	–	–	–	–
Able to fully understand what the person was telling you, but had to take extra care in listening	Listen carefully	(7)	21	7.50	7.02	7.87	0.23	1	7.26	7.26	7.26	0
	Concentrate hard	(6)	9	6.64	6.09	6.98	0.28	6	6.47	6.05	6.86	0.31
Able to understand part of what the person was telling you	Nearly all (75% or more)	(5)	8	5.45	5.05	5.89	0.26	4	5.61	5.25	5.85	0.26
	Most (over 50%)	(4)	6	4.42	4.09	4.76	0.25	3	4.13	4.05	4.25	0.09
	Not much	(3)	0	–	–	–	–	4	3.23	3.07	3.67	0.23
Able to understand some individual words, but unable to understand what the person was telling you		(2)	0	–	–	–	–	2	2.36	2.2	2.52	0.16
Able to understand nothing at all		(1)	0	–	–	–	–	0	–	–	–	–
Total			49	6.73	4.09	8.75	1.26	19	4.90	2.20	7.26	1.63

Note. Mean scores were generated from 67 participants' mean scores on two samples, rated by at least 22 listeners unfamiliar with the children.

recordings for later scoring by unfamiliar listeners with the IR instrument (Dobinson, 2007), that was translated into Dutch (Dobinson, 2013) (see Table II). The IR is a 9-point Likert scale ranging from (1) *completely unintelligible* to (9) *completely intelligible* and takes into account the effort made to understand the child. The IR has sufficient inter-rater reliability according to Dobinson who found no significant differences between scores ($F(9) = 1.411$, $p = 0.181$) of a panel of 10 judges, rating samples of four different adult speakers with speech disorders (Dobinson, 2007).

Procedure

The children were assessed in a quiet room by one of two qualified SLPs, with the majority being assessed at their school. The CAI was administered and the conversational speech sample collected.

For the unfamiliar listener intelligibility-rating task, listeners were seated in an Acoustair sound-proof cabin in the phonetics laboratory UIL-OTS of the Utrecht University. Zep Experiment Control Application computer software (Veenker, 2014, 2017) was used to conduct the experiment. Listeners wore Beyerdynamic DT250/80 Ohm headphones and the speech signal was delivered through a RME digi96/8 PAD sound module and 2 Marantz MA6100 mono amplifiers. The sound level was fixed at a comfortable level (approximately 70 dBA). The 30-s conversational speech segments were randomly presented to listeners. In the first experiment, 62 segments from 31 children were rated by one listening panel and, in the second experiment with a different listening panel, 72 segments from 36 children were rated. The rating task was undertaken during a 1-h session.

The inter-rater reliability between the panels was examined by presenting 16 control segments from the first listening experiment, to the second panel. To learn how the panels resembled each other, intra-class correlation (ICC) was calculated for panel 1 and panel 2. Since excellent reliability was found between the panels, ICC = 0.955 ($p < 0.001$; 95% CI = 0.685–0.988), the ratings from both experiments were treated as one group in the statistical analysis.

Data analysis

Data were entered into the IBM SPSS Statistics for Windows version 24 (IBM, 2016) and analysed in three steps. First, independent *t*-tests were used to identify any group differences on the ICS-NL mean, IR or PCC-A. Second, associations between (a) ICS-NL mean, IR and PCC-A, and associations between (b) ICS-NL items 1–7, IR and PCC-A, were investigated using correlational analyses.

Finally, the effect of differences in communication partner familiarity on parents ratings between the separate ICS-NL items was explored using a repeated measures analysis of variance (RM-ANOVA). This analysis examined the between-subjects effect of Group (parents of children with TD or SSD) and the within-subjects effect of Familiarity (ICS-NL items 1–7), as well as the Group × Familiarity interaction. The dependent variable was the ICS-NL item score. Note that the seven items of the ICS-NL are an operationalisation of the familiarity concept. Where applicable, Bonferroni corrections for multiple comparisons were applied.

Result

Group differences in intelligibility and speech accuracy

As hypothesised, there was a significant difference between the groups for the average total score of the

ICS-NL, with higher scores for the TD than SSD groups ($t(65) = 3.86$, $p < 0.001$; TD: $M = 4.5$, SD $= 0.44$; SSD: $M = 4.0$, SD $= 0.56$). Similarly, there was a significant difference for the average total score of the IR with higher ratings for the TD than SSD groups ($t(65) = 4.92$, $p < 0.001$; TD: $M = 6.8$, SD $= 1.24$, SSD: $M = 4.9$, SD $= 1.63$). For speech accuracy, using PCC-A from the CAI, there was a significant difference between groups with accuracy higher in the TD group ($t(65) = 6.74$, $p < 0.001$ TD: $M = 97.9$, SD $= 2.67$; SSD: $M = 86.0$, SD $= 11.67$).

Correlation analyses

As expected, in both the TD group and the SSD group, there was a significant correlation between the IR and PCC-A (see Table III). In the SSD group, additionally, there was a significant correlation between the IR and the ICS-NL mean score. The correlations between the IR and the ICS-NL item scores were different for the TD group and the SSD group (see Table IV). IR for the TD group was significantly correlated with ICS-NL item scores concerning parents and acquaintances (items 1 and 5). In the SSD group, significant correlations were found between IR and the item scores concerning acquaintances, teachers and strangers (items 5, 6 and 7) (see Table IV). For the SSD group only, PCC-A score was correlated with ICS-NL item score on item 7, concerning strangers (see Table IV).

Table III. Pearson correlations between percentage of consonants correct (PCC-A), the Intelligibility Rating (IR) and mean scores on the Intelligibility in Context Scale (ICS-NL) for the typically developing and speech sound disorder groups.

	PCC-A	IR	ICS-NL mean
Typically developing group (TD)			
PCC-A			
r	1	0.551*	0.117
p	–	0.000	0.427
IR			
r	–	1	0.368
p	–	–	0.010
Speech sound disorder group (SSD)			
PCC-A			
r	1	0.590*	0.539
p	–	0.008	0.017
IR			
r	–	1	0.708*
p	–	–	0.001

*Significant after Bonferroni correction $\alpha = 0.0083$.

Relationship of group and communication partner familiarity

The differences between the parental perceptions of their children's intelligibility in the TD and SSD groups on each of the ICS-NL items are presented in Figure 2. Statistical analysis using RM-ANOVA with Familiarity (ICS-NL items 1–7) as the within-subjects factor, and Group (TD or SSD) as the between-subjects factor, yielded a main effect of Group [$F(1, 65) = 14.285$, $p < 0.001$, $\eta^2 = 0.180$]. The results from the RM-ANOVA indicate that there was an overall difference between the ratings of the parents in the TD and SSD groups, where parents of children with SSD tended to give relatively higher lower scores on the ICS-NL items. Up to 18% of the variance of the differences on the ICS-NL items could be explained by Group and not by Familiarity.

The main effect of Familiarity was also significant [$F(3.981, 258.773) = 21.596$, $p < 0.001$, $\eta^2 = 0.249$], with familiarity explaining almost 25% of the variance. More importantly, there was a significant Group × Familiarity interaction [$F(3.981, 258.773) = 5.334$, $p < 0.001$, $\eta^2 = 0.076$]. Contrasts revealed that greater familiarity raised parents' perception of their child's intelligibility in the SSD group more than in the TD group [$F(1, 65) = 13.100$, $p < 0.001$, $\eta^2 = 0.168$].

Discussion

The aim of the current study was to investigate the influence of familiarity in three speech-related measures for children with and without SSD: (a) parental perceptions of intelligibility using the ICS-NL, (b)

Table IV. Pearson correlations between the item scores on the Intelligibility in Context Scale (ICS-NL), percentage of consonants correct (PCC-A) and the Intelligibility Rating (IR) and, for the typically developing and speech sound disorder groups.

	ICS-NL1	ICS-NL2	ICS-NL3	ICS-NL4	ICS-NL5	ICS-NL6	ICS-NL7
Typically developing group (TD)							
IR							
r	0.480*	0.330	0.352	0.275	0.417*	0.143	0.264
p	0.002	0.022	0.014	0.059	0.003	0.334	0.070
PCC-A							
r	0.092	0.171	0.099	0.082	0.09	0.112	0.052
p	0.534	0.246	0.503	0.581	0.510	0.450	0.727
Speech sound disorder group (SSD)							
IR							
r	0.317	0.486	0.499	0.514	0.688*	0.663*	0.828*
p	0.185	0.035	0.030	0.024	0.001	0.002	0.000
PCC-A							
r	0.276	0.302	0.459	0.406	0.584	0.346	0.655*
p	0.253	0.209	0.048	0.085	0.009	0.147	0.002

ICS-NL1: parents; ICS-NL2: immediate family; ICS-NL3: extended family; ICS-NL4: friends; ICS-NL5: acquaintances; ICS-NL6: teacher; ICS-NL7: strangers.
*Significant after Bonferroni correction $\alpha = 0.004$.

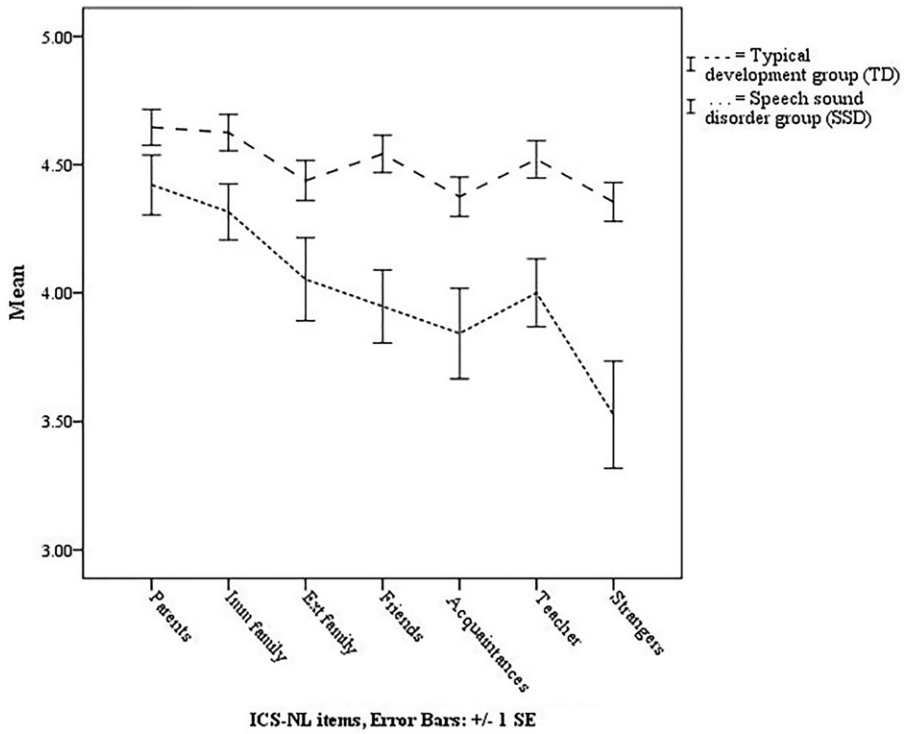

Figure 2. Parent's mean ratings of intelligibility, using the Intelligibility in Context Scale (ICS-NL), for their child with typically developing speech (TD) or child with speech sound disorder (SSD) with communication partners of differing familiarity; (Imm = immediate, Ext = extended).

the IR, carried out by a panel of naive listeners and (c) calculation of the PCC-A *via* direct assessment using the Computer Articulation Instrument. In the present study, it was hypothesised that parents with children with SSD would understand their children better than people who were unfamiliar to their child and to their child's speech. As a result, we expected that parents of children with SSD would provide relatively higher ratings on the ICS-NL items that were related to close relationships with the child (e.g. parent, immediate family).

The findings of the present study confirmed this hypothesis and showed that parents of children with SSD rated the intelligibility of their children relatively higher in general than was expected from the ratings of the listening panel. Additionally, the differences between the TD group and the SSD group, on the ICS-NL representing close relationships (parents, immediate family and extended family) were smaller than the differences on the ICS-NL items representing distant relationships (friends, acquaintances, teachers and strangers).

These findings are consistent with prior research on intelligibility and add specific knowledge regarding understanding the role of familiarity in intelligibility judgments. Familiarity with disordered speech may influence the number of words understood. For example, Baudonck et al. (2009) and Flipsen (1995) found that mothers were significantly better at understanding their child's words (Brunnegård et al., 2009; Klein et al., 2012; Munson et al., 2012). Results of the current study support the notion that familiarity matters in parents' judgment of intelligibility. To be more specific, there appears to be a systematic, relatively higher rating of the perception of their child's intelligibility by parents in the SSD group. Additionally, there seemed to be specific higher rating of the items regarding those who were in a close relationship to the child. These results suggest that children with SSD are being understood better by people who are familiar with their disordered speech. These findings are consistent with the study of McLeod et al. (2013), who found that SSD had little impact on daily functioning when children were with close family members. Similarly, the findings are consistent with those by Sprunt and Marella (2018) who found that questions regarding how the child was understood in situations outside home and school (main classroom), were the most sensitive in recognising children's communicative difficulties. The present study, as well as the studies from McLeod et al. (2013) and Sprunt and Marella (2018), supports the idea that children with SSD might participate better in situations with people who have a close relationship to them.

The other main finding from this study is that PCC-A and intelligibility each has its own impact on understanding children's functioning in daily life. This supports the conclusion of Lousada et al. (2014) who emphasised that the use of intelligibility in combination with speech characteristics should be used as a measure for evaluation of speech therapy. These findings also support the severity model that

is being used in SPEECH, in which both speech characteristics and intelligibility in daily life are included.

Limitations

There were a few limitations of the current study. First, because different instruments with different scales and different methods of measuring (objective vs subjective) were used, the results of this study need to be treated with some caution. It is promising that the results are consistent with other research on communicative abilities in different contexts. Second, in the TD group (children of 4 years of age and older), a ceiling effect in the data was found, because these children had almost completed their phonological development. It is unsure how this influenced the parents' judgments of intelligibility for the TD group. While it is expected that parents in the SSD group consider speech sound accuracy when answering the questions about intelligibility, parents in the TD group may have different considerations answering the same questions.

Clinical implications

The findings of the current study have implications for daily practice for SLPs working with children with SSD regarding better understanding of parents' perspectives. The results indicate that parents may understand children with SSD well at home, although these children may not be understood within the community. It is important to consider the children's relationships to understand who might be more familiar with the child and which communicative environments support the child and which do not.

In the Netherlands, the ICS-NL is used in clinical practice and research. One of the problems with the interpretation of the ICS-NL is that when participants do not complete one of the seven questions, an average total score cannot be created and results cannot be compared with the normative data. For example, McLeod et al. (2015) excluded 47 of 852 participants because the parents did not complete each item on the ICS. The current study provides insight in dealing with missing items regarding the ICS-NL average total score. The conclusion is that all items are needed in order to calculate an unbiased average total score. Different missing items will influence the average total score differently due to the difference between parental judgments of intelligibility with different communication partners. Missing an item from the ICS-NL close relationship items (parents, immediate family and extended family – items 1–3) will generally lower the average total score, while missing an item from ICS-NL distant relationship items (friends, acquaintances, teachers and strangers – items 4–7) will raise the average total score. The results also help to understand how the average total score should be interpreted for children with SSD as compared to children with TD.

The results of the present study show that parents of children with SSD may rate the intelligibility of their child relatively higher or, that parents of children with TD may rate the intelligibility of their child relatively lower compared with naive listeners. When used as a screening tool, differences in parental judgments across the groups should be considered regarding sensitivity and specificity of the ICS-NL. A validation and norming study on the ICS in English has shown optimal cut-off of 4.6 with adequate sensitivity of 0.82 and adequate specificity of 0.58 to identify children with/without SSD (McLeod et al., 2015). The lower specificity might be influenced by the relatively lower ratings by parents of children with TD. Sensitivity however, may not have been impacted by general relatively higher ratings in the SSD group because for children with SSD the average total score used to determine the cut-off score, any relative overestimation is already included.

The results from the current study show that all items are needed for calculation of the total average score on the ICS-NL. Future research should determine how a total average score could be calculated in the case of missing items. The findings from this study reflect Dutch culture and Dutch language. Therefore, application of the results to other languages and different cultures should be validated. From this study we cannot reveal why parents of children with TD gave relatively lower ratings to their children's intelligibility; however, a possible explanation may be that parents are more particular about typically developing speech. On the other hand, parents of children with SSD may judge the intelligibility of their children relatively higher because they have learned to understand their child's unique speech, or they may believe that their child's problem is less severe than it actually is. Future studies could explore underlying processes to clarify the differences between the perception of speech by parents with children with and without SSD. The results of this study are encouraging and will be validated in a larger cohort of children with and without SSD.

Conclusion

To conclude, intelligibility is an important contributing factor to children's participation in daily life. The results of the present study showed that parental perceptions of their children's intelligibility were influenced by the listeners' familiarity with the child's speech. Children were rated to be more intelligible with parents, close family members and extended family members, and this was particularly the case for children with SSD. At the participation level, intelligibility thus is a mutual effort of speaker and listener. In contrast, speech production

measures such as of PCC-A were not correlated with the intelligibility judgments by the parents, irrespective of the listeners' familiarity. PCC-A reflects purely the speaker's speech characteristics and is not influenced by a listener's effort or skill in communication. Accordingly, PCC-A may not be a reliable predictor of children's participation in the broader community.

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Declaration of interest

The first, second and fourth authors report no declarations of interest. The third author is a co-author of the Intelligibility in Context Scale.

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