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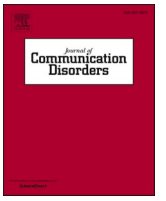

Children's communication repair strategies: Online versus face-to-face interaction

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ABSTRACT

Introduction: One's ability to repair communication breakdown is an important pragmatic language skill. The present study examined children's communication repair strategies between online and face-to-face interactions using a reading comprehension task designed to probe for persistent clarification requests. Methods: 4–6-year-old typically developing children (Age: M = 5.5years) completed a communication repair task. Online group (n = 17) completed the task online, face-to-face group(n = 22) met researchers in person. Children's responses were then categorized into verbal strategies, supplementary strategies, and nonresponses.

Results: Our results showed that children can effectively employ repair strategies when a communication breakdown occurs, regardless of the communication setting in response to a series of clarification requests. However, types and patterns of communication repair strategies varied between online and face-to-face interactions. Children in online interaction showed higher use of repetition and suprasegmental strategies than did their face-to-face peers. In contrast, children in face-to-face interaction demonstrated more frequent use of revision and addition. Also, we examined the relationship between repair strategy and children's language skills. The results showed that children with better language skills used more addition, which is a more complex strategy than suprasegmental and nonresponse, and tried to use repair strategies effectively in an attempt to repair their statements as clarification requests proceeded.

Conclusion: It is important to understand different trends of pragmatic skills of children across online and face-to-face interaction. Guidance on the effective strategy to repair communication breakdowns depending on the different contexts needs to be considered for the successful use of online learning and telepractice.

1. Introduction

A communication breakdown, defined as a failure to exchange information successfully, is caused by factors including inappropriate volume level; improper use of gestures; and phonological, lexical, and pragmatic errors (Yont et al., 2000). Communication repair is adjusting one's message to accommodate the listeners' needs and to establish a shared understanding (Barstein et al., 2018; Julien et al., 2019). Thus, communication repair requires pragmatic skills that involve identifying that the breakdown occurred, and then responding to a clarification request (Bosco & Gabbatore, 2017; Brady et al., 2005; Merrison & Merrison, 2005). Identification and correction of conversation breakdown represent metapragmatic knowledge, serving as the core ability to apply the pragmatic rules

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in conversation (Ben-Shlomo & Sela, 2021; Collins et al., 2014). Children use various repair strategies as their language and cognitive abilities continue to develop. They may simply repeat the utterance or use more sophisticated communication strategies, such as repeating the most important part of the original message, revising the grammatical structure, or adding semantic information.

In line with typical development, repair skill tends to emerge at ages around 15 to 30 months and continues to develop throughout one's early school years. For instance, children at these ages seek clarification by repeating their utterances (Gallagher, 1977, 1981). As young children gradually shift from prelinguistic to verbal communication during the second year of life, communicative repairs change from gestures (such as pointing, giving, and showing), to gesture and word combinations, to verbal repairs (Alexander et al., 1997; Golinkoff, 1986). Between the ages of five and six, children begin revising statements (e.g., 'The man is being chased by the dog' to 'The dog is chasing the man'), and start adding new information (e.g., 'The man runs' to 'The man runs to school'; Brinton et al., 1986). Children employ repair strategies more flexibly as their use of them becomes more sophisticated (Brinton et al., 1986). Thus, the ability to repair communication breakdown is a crucial developmental skill, which requires both social-cognitive and language skills (Volden, 2004).

Although communication breakdowns can occur in conversations among people of all ages, they are particularly common in young children aged 5 and below (Forrester & Cherington, 2009). This is because children at this stage are still in the process of acquiring the motor planning skills for articulation, expanding early vocabulary, and learning the rules of their native language. Thus, conversational repair is particularly useful for young children mastering their first language. The use of communication repair strategies has been a focus of study for both typically developing children (Bacso & Nilsen, 2017; Brinton et al., 1986; Gallagher, 1977; Golinkoff, 1986) and children with disabilities, including children with autism (Barstein et al., 2018; Meadan et al., 2006; Volden, 2004), children with language impairment (Brady et al., 2005; Brinton et al., 1988; Yont et al., 2002), and children with Down syndrome (Dacey & Kretschmer, 1981; Martin et al., 2020; Price et al., 2018). Previous findings have found that 3- to 6- year old children are able to repair their messages in response to listener statements indicating confusion or misunderstanding. In addition, they varied the repair strategy by adding more information as the breakdown persisted (Bacso & Nilsen, 2017; Coon et al., 1982; Deutsch & Pechmann, 1982; Nilsen & Mangal, 2012; Uzundag & Küntay, 2018).

Overall, research tends to highlight the influence that one's social context (e.g., conversational settings or partners) has on communication repair strategies. Studies indicate that repair strategies change according to contextual variables, such as one's communication partner, activities, or the type of breakdown (Abbeduto & Short-Meyerson,2002; Brady & Halle, 2002; Tomasello et al., 1990; Yont et al., 2002). For example, McDevitt's (1990) work suggests that the number of children's requests for communicative repair was greater when the task was presented by an adult speaker compared to a child speaker. Also, studies found that unfamiliar adult partners or peers resulted in more pragmatic breakdowns, as the reduced background knowledge increases the pressure on children's discourse planning and lexical selection, and decreases the available resources for resolving communication breakdowns that can lead to shared comprehension (Tomasello et al., 1990; Tye-Murray et al., 1995). Technologically mediated communication is a different social context, and it reduces opportunities for nonverbal cues, which frequently results in misunderstandings. However, no studies have examined repair strategies across online and face-to-face interactions among children.

Online communication differs in many ways from face-to-face interaction. Some researchers have expressed their concerns about the quality of online learning and highlighted that online communication offers a low degree of interaction and participation, and delayed or insufficient feedback (Biggs et al., 2022; Kelchner et al., 2021; Kim, 2020). Although there are online learning tools and video communication platforms that promote participation and learning, they do not provide exactly the same social experiences as face-to-face interactions. In online communication, there is a higher rate of informal speech than in its face-to-face counterpart (Castellá et al., 2000), as well as reduced non-verbal cues (Balvin & Tyler, 2006; Reich, 2017). Online learning may not provide sufficient or appropriate opportunities for young children, who require more interactions and hands-on activities to focus and learn. These limitations are more evident for young children or school-age students who have limited experience with computer-based learning tools (Fedynich, 2013; Wedenoja, 2020). Given these challenges, it may be likely that online communication show a distinct pattern of communication breakdown and repair strategy than traditional face-to-face interaction. An interruption in the successful exchange of information among communicative partners can happen frequently during online interaction. Children with developmental disabilities who have complex communication needs might encounter more communication breakdowns, or they might need more support from family members to ensure consistent communication support across environments (Biggs & Hacker, 2021). Effective communication may be more at risk than face-to-face communication. As such, to provide online environments and services that are appropriate for children, it is important to understand children's experience with communication breakdowns online and how these differ from face-to-face interactions.

Previous findings showed that adults perceive in-person communication as more meaningful at a higher level of interaction (Baym et al., 2004; Gonzales, 2014). They also deem it more useful for building social connections and emotional closeness (Nguyen et al., 2022; Schiffrin et al., 2010). Furthermore, suprasegmental strategies have been reported more frequently during online communication (Besser et al., 2022). For instance, some teachers try speaking more loudly and clearly when they think students cannot hear or understand them properly. What is more, 50 % of teachers indicated making more of an effort to make their voice loud enough during real-time online lectures (Isaeva & Goryunova, 2021). However, so little is known about the communication breakdowns that occur online and how young children employ strategies to repair such breakdowns.

Therefore, examining the use of repair strategies in children across face-to-face and online is both invaluable and pertinent at the current point in time, where the impact of the COVID-19 pandemic lingers. We also postulate that this is an important concept for exploring children's communication skills in various conversational settings. In the field of speech-language pathology, the use of telepractice and online learning has drastically increased after the global pandemic (Fong et al., 2021; Smith et al., 2020; Tambyraja et al., 2021; Ward & Cameron, 2023). A recent survey by Campbell and Goldstein (2022) found that 93 % of pediatric SLPs used

telepractice after the onset of the COVID-19 pandemic, and the majority of respondents predicted they would continue offering telehealth services in the future. It is likely that telepractice will retain an essential role in SLP service delivery. However, most telepractice studies have focused on intervention, and studies on online assessment are limited. Also, to our knowledge, there has been no study that directly compared children's communication repair across online and face-to-face contexts. Studies on communication repair strategies focused on breakdowns in face-to-face conversation, which is the more natural conversational setting.

To fill the gap in the academic literature, we examine children's ability to repair communication breakdowns in online settings. This study aims to investigate repair strategies produced by typically developing children aged four to six years old using a task designed to probe for different types of communication repair strategies. This study followed the administration procedures by Brinton et al. (1986), which simulates a persistent breakdown in communication in order to assess an individual's ability to respond to clarification requests, which has been proved to be more comparable to daily interactions than a response to a single request in many previous studies (Barstein et al., 2018; Brinton & Fujiki, 1991; Brinton et al., 1986; Volden, 2004). This analysis will expand the field's knowledge base of children's pragmatic skills and the type of difficulties they face in achieving successful communication. In turn, this study will offer clinical implications for assessment and online learning. Two research questions are addressed: (1) Are there differences in children's use of communication repair strategies across online and face-to-face conditions? (2) Are there significant correlations between each of the repair strategy types and expressive and receptive vocabulary?

2. Methods

2.1. Participants

Thirty-nine children aged four to six at their typical developmental stages (23 boys, 16 girls) participated in this study. Inclusion criteria were (a) nonverbal IQ within the average range (score > 85), (b) expressive and receptive vocabulary within a typical range (i.e., no greater than 1*SD* below mean), and (c) absence of a history of language disorder or developmental delay, (d) absence of hearing disorder as reported by parents. All participants completed the Korean Kaufman Brief Intelligence Test-II (KBIT-II; Moon, 2020) and the Receptive and Expressive Vocabulary Test (REVT; Kim et al., 2009) to measure their nonverbal intelligence and receptive and expressive vocabulary. All participants were asked to answer reading comprehension questions after reading a book with an examiner, to provide a context for communication breakdown.

Participants were randomly assigned into two groups. The online group ($n = 17$) performed the task virtually, and the face-to-face group ($n = 22$) did their task in a traditional in-person environment. The two groups did not differ in terms of age, receptive and expressive vocabulary, reading comprehension score, or nonverbal intelligence. Table 1 details the participants' demographic characteristics.

2.2. Procedure

All research sessions took place at the participants' homes. For the face-to-face group, an examiner visited each child's home to complete assessments. A researcher and the child met in-person and all sessions took place at the participants' homes. For the online group, participants completed assessments via Zoom, one of the most widely used video conferencing platforms. All assessments were administered by a certified speech-language pathologist.

Prior to the assessment, instructions were sent to parents via email or communicated by phone. A link for the video call was also sent to parents. They were told they needed a computer with sound and Internet access, and that the assessment should be done in a quiet room in their home. Parents were asked to be present and to assist with technical aspects but were instructed not to help their children with answers. Using Zoom's screen share function, participants viewed the pictures of test items and images from the book on a computer screen. The researcher was visible in a small box in the corner of the screen while the stimuli were being shared and the assessment was being administered.

All participants were given two standardized norm-referenced assessments. The REVT (Kim et al., 2009) measures Korean receptive and expressive vocabulary skills for children ages 2;6–16;11. The REVT-E requires children to name the picture; the REVT-R instructs them to point to the corresponding image among four choices while the target word is given.

Table 1
Participants' characteristics.

	Online ($n = 17$)	Face-to-face ($n = 22$)	*F*	*p*
Sex ratio (Male : Female)	9:8	14:8	.202	.657
Age (months)	68.063 (8.857)	64.667 (7.499)	1.318	.260
Nonverabl IQ[a](Standard score)	110.688 (20.487)	113.067 (12.198)	.152	.700
Expressive Vocabulary[b](%*ile*)	70.000 (24.221)	64.667 (33.191)	.264	.612
Receptive Vocabulary[b](%*ile*)	63.438 (32.594)	71.333 (24.382)	.577	.454
Reading Comprehension score for factual questions (%)	73.280 (16.730)	75.470(17.880)	.153	.698
Reading Comprehension score for inferential questions (%)	73.03(17.240)	67.800(18.580)	.737	.398

Values are presented as mean (SDs).
a K-BIT=Korean Kaufman brief Intelligence Test-II (Moon, 2020).
b REVT=Receptive and Expressive Vocabulary Test (Kim et al., 2009).

The Korean Kaufman Brief Intelligence Test-II (Moon, 2020) measures nonverbal intelligence for individuals between the ages of 4;0, and 90;11. The nonverbal scale is composed of a Matrices task, which is a multiple-choice exercise that requires one to recognize the relationships among visual stimuli.

In addition to standardized tests, participants completed a communication repair task. To provide a context for communication breakdown, participants were asked to answer a series of reading comprehension questions after reading two picture books with the examiner. The picture books used in this study were "Princess Unga" (Park, 2020) and "Octopants" (Senior, 2021). The presentation order was counterbalanced among the participants.

The storybooks were selected from the 2020 Seoul Metropolitan Office of Education's book recommendation list for preschoolers. They were chosen because their target audience is children, were of sufficient length to elicit inference questions, and had been recently published. Additionally, books were controlled for level of difficulty by adjusting the total number of words and length of the story. Reading comprehension questions were comprised of factual questions (i.e., the information was stated explicitly in the text) and inferential ones (i.e., information that could be inferred from the text) as described by Cain and Oakhill (1999) and Norbury and Bishop (2002). The inferential questions consisted of text-connecting inquiries (i.e., combining information that is stated in more than one sentence) and questions pertaining to emotional states (i.e., understanding the character's personality and feelings). The task was comprised of six factual and six inferential questions. One point was credited for each correct answer (possible range = 0 to 24 for the two stories considered together). Raw scores were converted into a percentage (%). Among the 24 questions, eight were selected for the communication repair task.

For the communication repair task, each child engaged with a researcher in a reading comprehension task during which the researcher feigned a misunderstanding through a series of three prompts, each of which requested clarification (e.g.,., "Huh?", "What?", and "I don't understand") to create persistent communication breakdowns. Opportunities for repair were set up by asking eight comprehension questions and three questions that ask about participants' personal information (e.g., name of the preschool, favorite color, a gift they want to get for Christmas). Based on administration procedures by Brinton et al. (1986), this task was designed to probe for persistent clarification requests to assess children's use of communication repair strategies. Following the child's answer, communication breakdowns were issued as the examiner first requested for clarification by saying 'Huh?', then asking "What?", and then saying "I don't understand" to request for clarification. After participants responded to the examiner's third clarification request, the examiner acted as if he or she finally understood the explanation(e.g., "Oh, I get it!"). The whole session lasted 60 to 90 min.

Participants' responses were transcribed and coded into nine categories (repetition, revision, addition, background, meta-comment, inappropriate, don't know, nonresponse, and suprasegmental). Codes were categorized according to verbal strategies (i.e., repetition, revision, addition, background, meta-comment, inappropriate, and don't know), supplementary strategies (suprasegmental; e.g., change in volume, gesture use), and nonresponse. Tables 2 and 3 provide the definitions of repair strategies. The mean proportion of repair strategy types across each prompt clarification was analyzed. (Table 4)

Participants' responses were transcribed by two researchers who are both Ph.D. graduate students and experienced speech-language pathologists. Inter-rater reliability was completed on 20 % ($N = 8$) of the transcribed sample of each repair strategy type. Reliability on the sample across individual repair strategy types ranged from 95 % to 100 %.

2.3. Statistical analysis

The statistical analysis was conducted using SPSS version 28.0 (SPSS Inc., Chicago, IL, USA).

In order to compare online and face-to-face repair strategy across the clarification request series, a three-way mixed ANOVA was performed with group (2) (face-to-face/online) as between-subject factor and repair strategy types (9) and prompts for clarification (3) as within-subject factors. Pearson correlations were conducted to investigate the relationship between each of the repair strategy types and expressive and receptive vocabulary.

Table 2
Types of verbal strategies.

Repair strategy	Definition	Example
Repetition	Repeats one or several words in the previous response without adding new information.	From "lives in the palace" to "palace" or "lives in the palace".
Revision	Holds semantic content/meaning constant but changes or corrects the grammar of an utterance.	From "He's in the pool swimming" to "He's swimming in the pool".
Addition	Adds specific, accurate semantic information.	Responses ranging from "shirt" to "got a blue shirt at the store".
Background	Offers context that provides a framework in which prior responses could be interpreted.	Statements ranging from "The octopus cannot wear a shirt" to "You know octopus has eight legs. The octopus cannot wear a shirt ".
Meta-comment	Acknowledges or speaks about the process of repair.	Stating "I don't know how to say it better".
Inappropriate	Telling a story that has nothing to do with the story.	Statements irrelevant to the story, such as "It's raining outside".
Don't know	A general statement indicating a lack of comprehension.	Either "I don't know" or "I don't understand."

Table 3
Definition of nonresponse and supplementary strategies.

Repair strategy	Definition
No response	Does not provide verbal/nonverbal responses to a question.
Suprasegmental	Increases loudness, emphasizes words or word junctures, or reduces the rate of speech
	Uses behaviors that represent objects or actions symbolically, such as pointing or pantomiming

Table 4
Example of a story comprehension task and a communication repair task.

Sample	Utterance	Code
Q: What did dad do for the princess when she cried?	Child: He read a book to her.	
Prompt 1	Examiner: Huh?	
Repair 1	C: Read a book to her.	Repetition
Prompt 2	E: What?	
Repair 2	C: Read a dinosaur book.	Addition
Prompt 3	E: I don't understand.	
Repair 3	C: He read her the dinosaur book.	Revision
Understanding	E: Oh, her dad read the dinosaur book to her?	

3. Results

This section first presents the full descriptive statistics of the mean proportions of repair strategies used in online and face-to-face contexts. Findings were then reported regarding the group difference in the use of repair strategy types according to clarification prompts.

Table 5 displays the descriptive statistics for the repair strategies employed by the two groups in response to each clarification prompt (i.e., "Huh?", "What?", and "I don't understand"). The descriptive statistics indicate that, in response to the first clarification request ("Huh?"), children in the face-to-face group showed the highest proportion of repetition strategy use ($M = 8.36$, SD=2.25), which was followed by addition ($M = 1.45$, SD=1.47) and then revision ($M = 0.77$, SD=0.92). Background, meta-comment, and inappropriate strategies were not observed in any participants in response to Prompt 1. For the online group, children used the repetition the most ($M = 10.05$, SD=1.14); the next most frequent strategy used was suprasegmental ($M = 0.94$, SD=1.85), with 'don't know' coming in third ($M = 0.24$, SD=0.56). In response to Prompt 1, children in both online and face-to-face setting showed the highest rate of repetition among other repair strategies. However, the online group was more likely to use various repair strategies that were not observed in the face-to-face group, such as background, meta-comment, and inappropriate.

In response to the second clarification request (the use of a Wh-question, i.e., "What?"), the face-to-face group mostly employed repetition ($M = 5.22$, SD=2.71), addition ($M = 2.18$, SD=1.56), and revision ($M = 1.77$, SD=1.63). This is a similar pattern as displayed in Prompt 1, but with an increase in addition and revision. In the online group, repetition was the most frequent ($M = 7.11$, SD=1.72), followed by suprasegmental ($M = 4.17$, SD=3.10) and revision ($M = 1.47$, SD=1.12).

In response to the third clarification request (an expression of misunderstanding, "I don't understand"), repetition was the most common for both face-to-face ($M = 5.59$, SD=3.15) and online ($M = 7.94$, SD=2.63). Both group increased in suprasegmental strategy from Prompts 1 to 3 and Prompts 2 to 3.

The results of the mixed ANOVA demonstrated significant main effects for conditions ($F_{(1, 37)}=14.332$, $p < .001$). Overall, the online group used significantly more repair strategies ($M = 1.593$, SD=0.268) than the face-to-face group ($M = 1.303$, SD=0.178) ($p < .001$). Before confirming the repeated measurement results, it was examined whether Mauchly's sphericity test was established. Mauchly's test of sphericity was violated, in the RS type ($\chi^2=337.431$, $p <.001$), Prompts ($\chi^2=8.820$, $p = .012$), and the RS type × Prompt ($\chi^2=629.169$, $p <.001$). Therefore, when reporting on the outcomes of the three-way mixed ANOVA, the Greenhouse-Geisser analysis was applied.

The mean proportion of repair strategies in response to each clarification prompt between the two groups is presented in Table 6 and Fig. 1.

The results also indicate significant main effects for the RS types ($F_{(3.189, 117.990)}=148.357$, $p < .001$). The post hoc Bonferroni test outcomes revealed that repetition was significantly more common at the $p <.001$ level than other strategies (revision, addition, background, meta-comment, inappropriate, don't know, suprasegmetal, and non-response).

The main effect among prompts was statistically significant ($F_{(1.643, 60.790)}=18.311$, $p <.001$). The results of the post hoc Bonferroni tests revealed that all three prompts differed. Among them, the third ($M = 1.623$) was found to be significantly higher than the first ($p <.001$) and second ($p = .002$); the second prompt ($M = 1.433$) was significantly higher than the first ($M = 1.288$) ($p < .001$).

The two-way interaction between repair strategy types × conditions was significant ($F_{(3.189, 117.990)}=8.129$, $p <.001$). Fig. 2 shows participants' use of each communication repair strategy type in both the face-to-face and online conditions. The online group showed repetition and suprasegmental strategy (increasing loudness, emphasizing words, reducing the rate of speech, pointing, pantomiming) at a higher rate than the face-to-face group. For the face-to-face group, children used significantly more revision and addition than the online group. No group differences were observed for any other repair strategy(background, meta-comment, inappropriate, don't

Table 5
Descriptive statistics.

RS types	Repetition					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	8.364	2.258	5.227	2.707	5.591	3.157
Online	10.059	1.144	7.118	1.728	7.941	2.633
RS types	Revision					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	.773	.922	1.773	1.631	1.773	1.601
online	.176	.393	1.471	1.125	.765	.903
RS types	Addition					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	1.455	1.471	2.182	1.563	1.909	2.287
online	.176	.393	1.176	.883	.706	.772
RS types	Background					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	.000	.000	.000	.000	.409	.908
online	.059	.243	.059	.243	.000	.000
RS types	Meta-comment					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	.000	.000	.045	.213	.182	.395
online	.118	.332	.059	.243	.059	.243
RS types	Inappropriate					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	.000	.000	.136	.467	.136	.467
online	.118	.332	.059	.243	.294	.588
RS types	Don’t know					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	.364	.727	.091	.426	.182	.395
online	.235	.562	.353	.702	.235	.752
RS types	Suprasegmental					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	.091	.294	1.136	1.833	2.409	2.631
online	.941	1.853	4.176	3.107	5.000	3.606
RS types	Nonresponse					
Prompts	1 (“Huh?”)		2 (“What?”)		3 (“I don’t understand”)	
Conditions	M	SD	M	SD	M	SD
Face-to-face	.136	.640	.318	1.287	.500	1.921
online	.118	.332	.412	1.227	1.118	2.233

Note. *M*=Mean, SD=Standard deviation, RS types=Repair Strategy types (repetition, revision, addition, background, meta-comment, inappropriate, don’t know, suprasegmental, and nonresponse), Prompts=series of three prompts requesting clarification (“Huh?”, “What?”, and “I don’t understand”), Conditions=(face-to-face and online).

know, and nonresponse), as these repair strategies were employed at a low rate.

The two-way interaction between prompts × conditions was significant ($F_{(1.643,\ 60.790)}$=5.255, p = .012). When comparing the face-to-face and online conditions with regard to the first (“Huh?”), second (“What?”), and third prompts (“I don’t understand”), there was no group difference in the mean proportion of repair strategies for the first prompt. However, there was a significant group difference for Prompts 2 to 3. For Prompt 1, no group differences were observed. Across the series of prompts (2 and 3), the online group increased in repair strategy, thus demonstrating an increase in their use of repair strategies across the series of prompts.

Fig. 3 details the interaction effect between the two groups across all three prompts.

The two-way interaction between repair strategy types × prompts was significant ($F_{(6.321,\ 233.880)}$=25.429, p <.001). Mean proportions of repair strategy type across the series of prompts (Prompt 1, 2, 3) was compared. The difference between repetition and the other RS types was the greatest in response to Prompt 1, and the difference between repetition and suprasegmental, revision, and

Table 6
Results of the ANOVA between the two groups in response to the Prompt and the RS type.

		Type III SS	*df*	MS	F	*p*
Between	Conditions	21.710	1	21.710	14.332**	.001
	Error	56.047	37	1.515		
Within-	RS types	5068.247	3.189	1589.329	148.357***	.000
	RS types × Condition	277.717	3.189	87.088	8.129***	.000
	Error (RS types)	1264.013	117.990	10.713		
	Prompts	19.467	1.643	11.848	18.311***	.000
	Prompts × Condition	5.586	1.643	3.400	5.255*	.012
	Error (Prompts)	39.335	60.790	.647		
	RS types × Prompts	433.825	6.321	68.631	25.429***	.000
	RS types × Prompts × Condition	29.962	6.321	4.740	1.756	.105
	Error (RS types × Prompts)	631.219	233.880	2.699		

Note. Type III SS=Type III Sum of Squares, *df* =degree of freedom, MS=Mean Square, RS types=Repair Strategy types (repetition, revision, addition, background, meta-comment, inappropriate, don't know, suprasegmental, nonresponse), Prompts=series of three prompts requesting clarification ("Huh?", "What?", "I don't understand"), Conditions=(face-to-face, online).
*** $p < .0001$, ** $p < .001$, * $p < .005$.

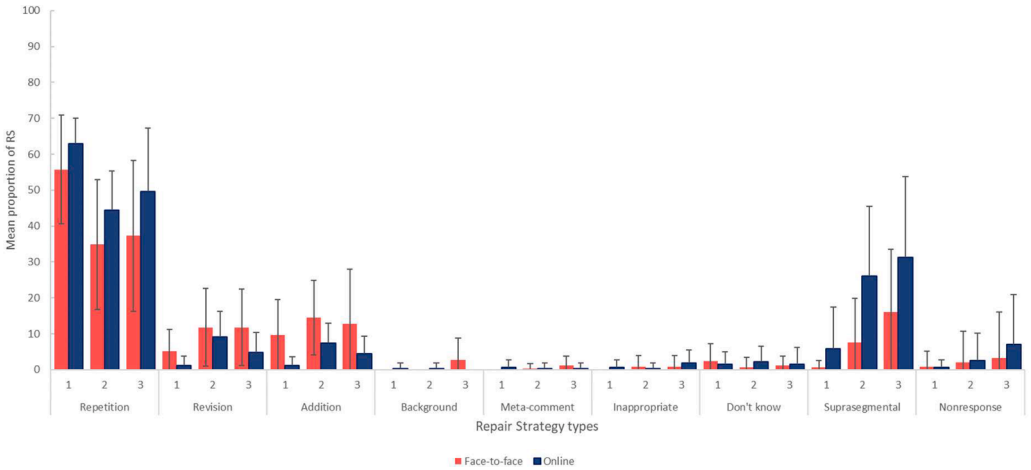

Fig. 1. Frequency of RS use according to Prompt between conditions (face-to-face/online). *Note.* RS types=Repair Strategy types (repetition, revision, addition, background, meta-comment, inappropriate, don't know, suprasegmental, nonresponse), Prompts=series of three prompts requesting clarification (1="Huh?", 2="What?", 3="I don't understand"), conditions=(face-to-face, online).

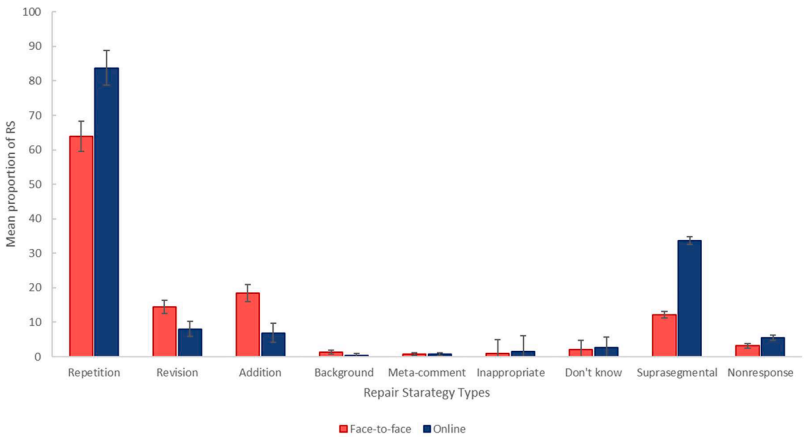

Fig. 2. Graph of interaction effects between the two conditions on the RS types. *Note.* RS types=Repair Strategy types (repetition, revision, addition, background, meta-comment, inappropriate, don't know, suprasegmental, nonresponse), conditions=(face-to-face, online).

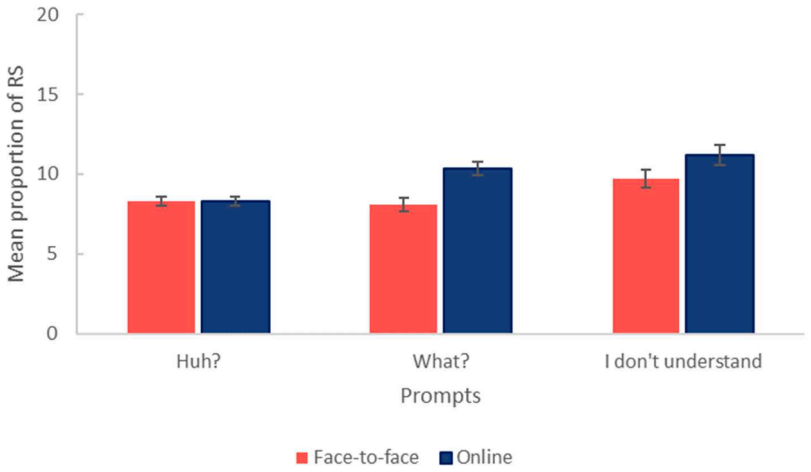

Fig. 3. Graph of interaction effects between the two groups across all prompts. *Note.* conditions=(face-to-face, online).

addition, and the other types was observed in Prompt 2. For prompt 3, there was a difference between repetition and suprasegmental, and other RS types.

For Prompt 1 ("Huh?"), repetition was employed the most, and other repair strategies (revision, addition, background, meta-comment, inappropriate, don't know, suprasegmental, nonresponse) were employed at a very low rate. However, for Prompts 2 ("What?") and 3 (I don't understand), the use of various strategies such as revision, addition, suprasegmental, and nonresponse increased compared to Prompt 1, indicating that the type of repair strategy children employ frequently differed across the series of prompts. Fig. 4 shows the interaction effect between the RS types across three prompts.

The three-way interaction effect on the difference between the two conditions according to the RS types and the prompts was not significant ($F_{(6.321,\ 233.880)}$=1.756, p = .105).

3.1. Correlation of communication repair skills and receptive and expressive vocabulary

In the face-to-face group, receptive vocabulary was significantly correlated with addition, suprasegmental, and nonresponse. Higher receptive vocabulary was associated with a greater tendency to add information in responses (r = 0.661, p=.007), whereas higher receptive vocabulary was associated with fewer suprasegmental strategy (increasing loudness, emphasizing words, reducing the rate of speech, pointing, pantomiming) (r = -0.633, p=.011), and fewer nonresponse (r = -0.674, p=.006).

In the online group, higher receptive vocabulary was associated with fewer suprasegmental strategies (r = -498, p = .050). While in the face-to-face group, a negative correlation was observed between receptive vocabulary and nonresponse, a positive correlation was observed between receptive vocabulary and nonresponse in the online group across the series of prompts.

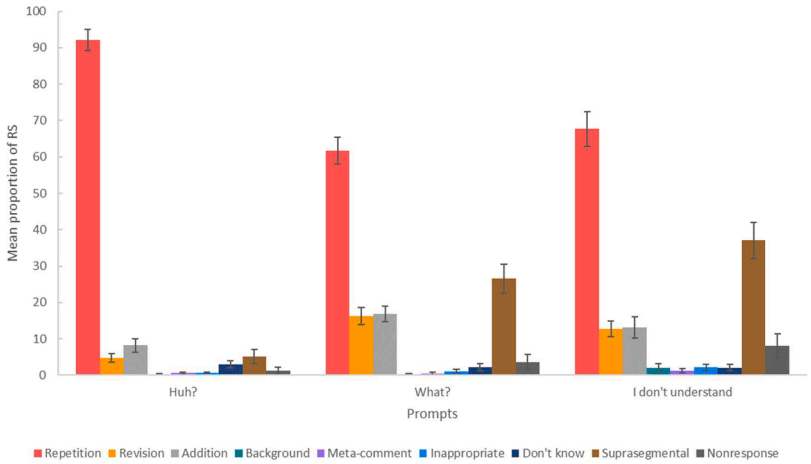

Fig. 4. Graph of interaction effects between the RS types on prompts. Note. RS types=Repair Strategy types (repetition, revision, addition, background, meta-comment, inappropriate, don't know, suprasegmental, nonresponse), Prompts=series of three prompts requesting clarification (1="Huh?", 2="What?", 3="I don't understand").

4. Discussion

The current study examined children's use of communication repair strategy in response to three clarification requests, in online and face-to-face interactions. The aim was to provide evidence for the impact of online and in-person interaction on the use of communication repair strategy.

Our first research question addressed whether the children's communication repair strategy differed depending on the online settings and face-to-face settings. Overall, the online group showed a higher proportion of repair strategies than the children in the face-to-face group. Online communication can pose a challenge for young children, where misunderstandings may be frequent due to reduced nonverbal cues, delayed feedback, and technical issues (Balvin & Tyler, 2006; Biggs et al., 2022; Fedynich, 2013; Kelchner et al., 2021). Thus, as requests for clarification proceeded, the online group may have assumed that a breakdown was due to unintelligibility, which is a common experience for online communication. These findings suggest that children in online interaction deploy various strategies for repairing communication breakdowns, including repeating words, revising statements, and adding more information.

Of the nine repair types used in our analyses, children during online interaction and face-to-face interactions differed in their use of four strategies: repetition, suprasegmental, revision, and addition. In their online communication, children showed higher rates of repetition and suprasegmental strategies, whereas the face-to-face group showed higher rates of revision and addition, which are considered more complex and sophisticated strategies (Brinton et al., 1986; Gallagher, 1977). These results provide insights that the mode of interaction has an impact on the type of communication repair children use when communication breakdowns occur.

One possible explanation for the greater frequency of suprasegmental strategy use is that the online group may have assumed that a breakdown happened due to technical issues, such as reduced sound or unstable internet connection, which can affect speech intelligibility. This can be seen in the same context as the studies of Besser et al. (2022) and Isaeva and Goryunova (2021). Just as adult teachers use suprasegmental strategies to speak more loudly and more clearly when they think they cannot hear or understand well, it can likewise be concluded that children make similar efforts to increase their volume or use gestures in an online setting when communication breakdowns occur. However, children in face-to-face interaction did not show higher rates of suprasegmental strategy and rather had a tendency to add more information or correct an utterance in an effort to repair communication breakdown. These results suggest that during face-to-face interaction, individuals assume that the communication breakdown is due to their lack of information and not due to their reduced sound or technical issues, therefore responding with additional information that can help the communicative partner understand the message.

Also, patterns across all the prompts revealed differences and similarities between the two groups. First, the online group showed no difference from the face-to-face group in Prompt 1, but the online group showed significantly greater use of repair strategy in Prompt 2 and 3. To be specific, the online group increased their total use of repair strategy as the series of prompts persisted. These findings suggest that, although both groups are typically developing children with comparable language abilities, persistent breakdowns in communication led to greater rates of communication repair in the online group.

In terms of the type of repair strategy across a series of prompts, following Prompt 1, both groups showed the highest rate of repetition among other repair strategies. In response to the second clarification request (the use of a Wh-question, i.e., "What?"), strategies that the online group used frequently were repetition, suprasegmental, and revision, whereas strategies that the face-to-face group used frequently were repetition, addition, and revision. In response to the third clarification request(an expression of misunderstanding, "I don't understand"), the online group showed repetition, suprasegmental, and non-response at a high rate, and the face-to-face group showed repetition, suprasegmental, and addition. To sum up, the online group increasingly became nonresponsive as the series of prompts persisted, and a trend of increased suprasegmental was also observed. For the face-to-face group, children had a tendency to repeat, revise, and add an utterance. This finding suggests that children's repair strategies become more varied as requests for clarification proceed. As the examiner uses more direct expressions of misunderstanding, it becomes clearer to the children that a misunderstanding has occurred. Thus they employ various strategies other than repetition to clarify misunderstandings.

Our second research question addressed the relationship between the repair strategy and children's language skills as indexed by receptive and vocabulary across groups. In the face-to-face group, receptive vocabulary correlated with addition, suprasegmental, and nonresponse. However, in the online group, receptive vocabulary was associated with suprasegmental strategy. The results indicate that for the face-to-face group, deficits in language skills would relate to higher use of suprasegmental and nonresponse, whereas better language skills are associated with higher use of adding more information. The online group showed a different association, in that higher receptive vocabulary was associated with fewer suprasegmental strategies. As suggested by Brinton et al. (1986), there appears to be a progression of repair behaviors with language skills, the ability to add new information increases with age, and additions become more detailed. Also, previous studies examining repair strategies have revealed higher use of gestures and nonresponse in individuals with developmental disorders (Alexander, 1995; Barstein et al., 2018). Our findings show that children with better language skills used more addition, which is a more complex strategy than suprasegmental and nonresponse, and tried to use repair strategies effectively in an attempt to repair their own statements as clarification requests proceeded. These findings suggest that children with low language skills may not be able to employ repair strategies effectively. For example, children with lower receptive vocabulary skills may be more likely to fail in understanding the communication partner's message and providing pragmatically appropriate responses. The fact that typically developing children with better receptive vocabulary chose this more complex strategy over a simpler one suggests that they were able to comprehend the adult's requests for clarification and actively attempt to communicate their intended meaning to a communication partner.

In conclusion, the online and face-to-face context differently influence repair strategies in typically developing children. The results suggest it is important to understand different trends of pragmatic skills of children across online and face-to-face interaction and

guidance on the effective strategy to repair communication breakdowns depending on the different contexts needs to be considered for the successful use of online learning and telepractice. Future studies are needed to investigate effective strategies to improve communication repair skills in children with communication disorders, as this study focused only on typically developing children. Considering many challenges when delivering telepractice to children with communication disorders, such as, appropriateness of assessment tools (Farmer et al., 2021), availability of hands-on activities and interactions (Biggs et al., 2022; Kim, 2020) technical issues(i.e., poor audio, internet connection) (Garg et al., 2020; Kelchner et al., 2021; Tenforde et al., 2020), and also the deficits in pragmatic abilities of children with communication disorders, it is likely that this group of children shows different patterns in their use of repair strategies across online and face-to-face conditions. Future studies should examine further the communication skills in these populations across different contexts, different types of tasks, and different conversational partners to further investigate the impact of the online versus face-to-face environment on the repair strategies used by young children.

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CRediT authorship contribution statement

Haeun Chung: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Kyungrang Baik:** Formal analysis, Investigation, Visualization. **Jihye Cheon:** Data curation, Investigation, Resources. **Young Tae Kim:** Methodology, Validation. **Dongsun Yim:** Supervision, Writing – review & editing.

Declaration of competing interest

None.

References

Abbeduto, L., & Short-Meyerson, K. (2002). Linguistic influences on social interaction. H. Goldstein, L. A. Kaczmarek, & K. M. English (Eds.). *Promoting social communication: Children with developmental disabilities from birth to adolescence* (pp. 27–54). Paul H. Brookes Publishing Co.

Alexander, D.G. (1995). The emergence of repair strategies in chronologically and developmentally young children (Order No. 9529597). Available from ProQuest Dissertations & Theses Global. (304194565). Retrieved from https://www.proquest.com/dissertations-theses/emergence-repair-strategies-chronologically/docview/304194565/se-2.

Alexander, D., Wetherby, A., & Prizant, B. (1997). The emergence of repair strategies in infants and toddlers. *Seminars in Speech and Language, 18*(3), 197–212.

Bacso, S. A., & Nilsen, E. S. (2017). What's that you're saying? Children with better executive functioning produce and repair communication more effectively. *Journal of Cognition and Development, 18*(4), 441–464.

Balvin, N., & Tyler, C. M. (2006). Emotions in cyberspace: The advantages and disadvantages of online communication. *Organisational Psychologist*, 5–8.

Barstein, J., Martin, G. E., Lee, M., & Losh, M. (2018). A duck wearing boots?! Pragmatic language strategies for repairing communication breakdowns across genetically based neurodevelopmental disabilities. *Journal of Speech, Language, and Hearing Research, 61*(6), 1440–1454.

Baym, N. K., Zhang, Y. B., & Lin, M. C. (2004). Social interactions across media: Interpersonal communication on the internet, telephone and face-to-face. *New Media & Society, 6*(3), 299–318.

Ben-Shlomo, O. R., & Sela, T. (2021). Conversational categories and metapragmatic awareness in typically developing children. *Journal of Pragmatics, 172*, 46–62.

Besser, A., Flett, G. L., & Zeigler-Hill, V. (2022). Adaptability to a sudden transition to online learning during the COVID-19 pandemic: Understanding the challenges for students. *Scholarship of Teaching and Learning in Psychology, 8*(2), 85–105.

Biggs, E. E., & Hacker, R. (2021). Engaging stakeholders to improve social validity: Intervention priorities for students with complex communication needs. *Augmentative and Alternative Communication, 37*(1), 25–38.

Biggs, E. E., Rossi, E. B., Douglas, S. N., Therrien, M. C., & Snodgrass, M. R. (2022). Preparedness, training, and support for augmentative and alternative communication telepractice during the COVID-19 pandemic. *Language, Speech, and Hearing Services in Schools, 53*(2), 335–359.

Bosco, F. M., & Gabbatore, I. (2017). Theory of mind in recognizing and recovering communicative failures. *Applied Psycholinguistics, 38*(1), 57–88.

Brady, N., & Halle, J. W. (2002). Breakdowns and repairs in conversations between beginning AAC users and their partners. J. Reichle, D. R. Beukelman, & J. C. Light (Eds.). *Exemplary practices for beginning communicators: Implication for AAC* (pp. 323–351). Paul H. Brookes Publishing Co.

Brady, N. C., Steeples, T., & Fleming, K. (2005). Effects of prelinguistic communication levels on initiation and repair of communication in children with disabilities. *Journal of Speech, Language and Hearing Research, 48*(5), 1098–1113.

Brady, N. C., Steeples, T., & Fleming, K. (2005). Effects of prelinguistic communication levels on initiation and repair of communication in children with disabilities. *Journal of Speech, Language, and Hearing Research, 48*(5), 1098–1113.

Brinton, B., & Fujiki, M. (1991). Responses to requests for conversational repair by adults with mental retardation. *Journal of Speech, Language, and Hearing Research, 34*(5), 1087–1095.

Brinton, B., Fujiki, M., Loeb, D. F., & Winkler, E. (1986). Development of conversational repair strategies in response to requests for clarification. *Journal of Speech, Language, and Hearing Research, 29*(1), 75–81.

Brinton, B., Fujiki, M., & Sonnenberg, E. A. (1988). Responses to requests for clarification by linguistically normal and language-impaired children in conversation. *Journal of Speech and Hearing Disorders, 53*(4), 383–391.

Cain, K., & Oakhill, J. V. (1999). Inference making ability and its relation to comprehension failure in young children. *Reading and Writing, 11*(5), 489–503.

Campbell, D. R., & Goldstein, H. (2022). Evolution of telehealth technology, evaluations, and therapy: Effects of the COVID-19 pandemic on pediatric speech-language pathology services. *American Journal of Speech-Language Pathology, 31*(1), 271–286.

Castellá, V. O., Abad, A. Z., Alonso, F. P., & Silla, J. P. (2000). The influence of familiarity among group members, group atmosphere and assertiveness on uninhibited behavior through three different communication media. *Computers in Human Behavior, 16*(2), 141–159.

Collins, A., Lockton, E., & Adams, C. (2014). Metapragmatic explicitation ability in children with typical language development: Development and validation of a novel clinical assessment. *Journal of Communication Disorders, 52*, 31–43.

Coon, R. C., Lipscomb, T. J., & Copple, C. E. (1982). Effects of listener feedback on the messages of kindergarten children in a referential communication task. *Journal of Applied Developmental Psychology, 3*(4), 337–346.

Dacey, D. A., & Kretschmer JR, R. R. (1981). A study of the clarification strategies of mentally retarded children. *Journal of Childhood Communication Disorders, 5*(1), 23–34.
Deutsch, W., & Pechmann, T. (1982). Social interaction and the development of definite descriptions. *Cognition, 11*(2), 159–184.
Farmer, R. L., McGill, R. J., Dombrowski, S. C., Benson, N. F., Smith-Kellen, S., Lockwood, A. B., et al. (2021). Conducting psychoeducational assessments during the COVID-19 crisis: The danger of good intentions. *Contemporary School Psychology, 25*(1), 27–32.
Fedynich, L. V. (2013). Teaching beyond the classroom walls: The pros and cons of cyber learning. *Journal of Instructional Pedagogies, 13*, 1–7.
Fong, R., Tsai, C. F., & Yiu, O. Y. (2021). The implementation of telepractice in speech language pathology in Hong Kong during the COVID-19 pandemic. *Telemedicine and e-Health, 27*(1), 30–38.
Forrester, M. A., & Cherington, S. M. (2009). The development of other-related conversational skills: A case study of conversational repair during the early years. *First Language, 29*(2), 166–191.
Gallagher, T. M. (1977). Revision behaviors in the speech of normal children developing language. *Journal of Speech and Hearing Research, 20*(2), 303–318.
Gallagher, T. M. (1981). Contingent query sequences within adult–child discourse. *Journal of Child Language, 8*(1), 51–62.
Garg, S., Aggarwal, D., Upadhyay, S. K., Kumar, G., & Singh, G. (2020). Effect of COVID-19 on school education system: Challenges and opportunities to adopt online teaching and learning. *Humanities & Social Sciences Reviews, 8*(6), 10–17.
Golinkoff, R. M. (1986). 'I beg your pardon?': The preverbal negotiation of failed messages. *Journal of Child Language, 13*(3), 455–476.
Gonzales, B. M. (2014). Online tutorials and effective information literacy instruction for distance learners. *Journal of Library & Information Services in Distance Learning, 8*(1–2), 45–55.
Isaeva, T., & Goryunova, E. (2021). University teacher's speech and self-presentation in e-learning and distance professional communication. *E3S Web of Conferences, 273*, 12147.
Julien, H. M., Finestack, L. H., & Reichle, J. (2019). Requests for communication repair produced by typically developing preschool-age children. *Journal of Speech, Language, and Hearing Research, 62*(6), 1823–1838.
Kelchner, L. N., Fredeking, J. C., & Zacharias, S. C. (2021). Using telepractice to deliver pediatric voice care in a changing world: Breaking down challenges and learning from successes. *Seminars in Speech and Language, 42*(1), 54–63.
Kim, J. (2020). Learning and teaching online during Covid-19: Experiences of student teachers in an early childhood education practicum. *International Journal of Early Childhood, 52*(2), 145–158.
Kim, Y. T., Hong, G. H., Kim, K. H., Jang, H. S., & Lee, J. Y. (2009). *Receptive & expressive vocabulary test (REVT)*. Seoul Community Rehabilitation Center.
Martin, G. E., Barstein, J., Patel, S., Lee, M., Henry, L., & Losh, M. (2020). Longitudinal analysis of communication repair skills across three neurodevelopmental disabilities. *International Journal of Language & Communication Disorders, 55*(1), 26–42.
McDevitt, T. M. (1990). The influences of speakers' characteristics and mothers' informal listening instruction on children's evaluations of messages. *Learning and Individual Differences, 2*(3), 353–369.
Meadan, H., Halle, J. W., Watkins, R. V., & Chadsey, J. G. (2006). Examining communication repairs of 2 young children with autism spectrum disorder: The influence of the environment. *American Journal of Speech-Language Pathology, 15*(2), 57–71.
Merrison, S., & Merrison, A. J. (2005). Repair in speech and language therapy interaction: Investigating pragmatic language impairment of children. *Child Language Teaching and Therapy, 21*(2), 191–211.
Moon, S. B. (2020). *Korean Kaufman Brief Intelligence Test–II (KBIT-II)*. Seoul: Hakjisa.
Nguyen, M. H., Hunsaker, A., & Hargittai, E. (2022). Older adults' online social engagement and social capital: The moderating role of Internet skills. *Information, Communication & Society, 25*(7), 942–958.
Nilsen, E. S., & Mangal, L. (2012). Which is important for preschoolers' production and repair of statements: What the listener knows or what the listener says? *Journal of Child Language, 39*(5), 1121–1134.
Norbury, C. F., & Bishop, D. V. (2002). Inferential processing and story recall in children with communication problems: A comparison of specific language impairment, pragmatic language impairment and high-functioning autism. *International Journal of Language & Communication Disorders, 37*(3), 227–251.
Park, J. H. (2020). *Princess Unga*. A Thousand Hope.
Price, J. R., Vizoso, A., Ellerbee, T., Roberts, J. E., & Sideris, J. (2018). Communication breakdowns and repair strategies of children with Down syndrome. *Advances in Neurodevelopmental Disorders, 2*, 16–24.
Reich, S. M. (2017). Connecting offline social competence to online peer interactions. *Psychology of Popular Media Culture, 6*(4), 291–310.
Schiffrin, H., Edelman, A., Falkenstern, M., & Stewart, C. (2010). The associations among computer-mediated communication, relationships, and well-being. *Cyberpsychology, Behavior, and Social Networking, 13*(3), 299–306.
Senior, S. (2021). *Octopants*. Little Tiger Press (M. Han, Trans.)(C. Powell, Illus.)(Original work published 2018).
Smith, A. C., Thomas, E., Snoswell, C. L., Haydon, H., Mehrotra, A., Clemensen, J., et al. (2020). Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). *Journal of Telemedicine and Telecare, 26*(5), 309–313.
Tambyraja, S. R., Farquharson, K., & Coleman, J. (2021). Speech-language teletherapy services for school-aged children in the United States during the COVID-19 pandemic. *Journal of Education for Students Placed at Risk, 26*(2), 91–111.
Tenforde, A. S., Borgstrom, H., Polich, G., Steere, H., Davis, I. S., Cotton, K., et al. (2020). Outpatient physical, occupational, and speech therapy synchronous telemedicine: A survey study of patient satisfaction with virtual visits during the COVID-19 pandemic. *American Journal of Physical Medicine & Rehabilitation, 99*(11), 977–981.
Tomasello, M., Conti-Ramsden, G., & Ewert, B. (1990). Young children's conversations with their mothers and fathers: Differences in breakdown and repair. *Journal of Child Language, 17*(1), 115–130.
Tye-Murray, N., Witt, S., & Schum, L. (1995). Effects of talker familiarity on communication breakdown in conversations with adult cochlear-implant users. *Ear and Hearing, 16*(5), 459–469.
Uzundag, B. A., & Küntay, A. C. (2018). Children's referential communication skills: The role of cognitive abilities and adult models of speech. *Journal of Experimental Child Psychology, 172*, 73–95.
Volden, J. (2004). Conversational repair in speakers with autism spectrum disorder. *International Journal of Language & Communication Disorders, 39*(2), 171–189.
Ward, E. C., & Cameron, A. E. (2023). Telepractice in adult speech-language pathology during Covid-19. L. Cummings (Ed.). *COVID-19 and Speech- Language Pathology* (pp. 183–198). Routledge.
Wedenoja, L. (2020). *What do you expect when you weren't expecting online classes*. Rockefeller Institute of Government. http://rockinst.org/blog/what-to-expect-when-you-werent-expecting-online-classes.
Yont, K. M., Hewitt, L. E., & Miccio, A. W. (2000). A coding system for describing conversational breakdowns in preschool children. *American Journal of Speech-Language Pathology, 9*(4), 300–309.
Yont, K. M., Hewitt, L. E., & Miccio, A. W. (2002). What did you say'?: Understanding conversational breakdowns in children with speech and language impairments. *Clinical Linguistics & Phonetics, 16*(4), 265–285.