Analysis of the Relationship Between the Content and Effectiveness of an Intervention based on the Layered Communication Model to Improve Communication

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Abstract

The Layered Communication Model (LCM) describes intersubjective development based on eight different communicative behaviors in three consecutive layers. Earlier studies showed that when the model is used in an intervention, the presence of many LCM behaviors increases from before to after the intervention. The present study aims to relate the content of the intervention to its effectiveness to learn whether and how the LCM can be used to improve communication. 15-minute videos of four student-teacher dyads were coded in ten-second intervals for the presence and absence of the eight LCM behaviors before, during and after the intervention. The intervention was divided into two phases: self-assessment and video feedback coaching. Intervention content was described based on the behaviors that were targeted for improvement during the two phases. Effectiveness was measured by calculating the percentage increase in presence between phases and by calculating effect sizes using a nonoverlap of all pairs method. Results showed that the second intervention phase (video feedback coaching) was most effective in terms of increasing the presence of LCM behaviors and creating larger effect sizes. Effectiveness measures decreased during the follow-up phase but were still higher than at baseline. Furthermore, effectiveness was higher for targeted behaviors than for untargeted behaviors. In conclusion, the LCM can be used as a tool to improve communication, especially when specific behaviors are clearly targeted and video feedback coaching is used to clarify how to work on improving the presence of those behaviors. The self-assessment phase needs adjustments to increase its effectiveness.

Keywords

Introduction

Children with congenital deafblindness (CDB) are a very heterogeneous population. Their hearing and vision impairments vary widely and almost none of them are completely blind and completely deaf (Dalby et al., 2009). Deafblindness can be defined based on the level of hearing and vision impairments (Ask Larsen & Damen, 2014). Congenital Deafblindness is defined in different ways in the literature. Both chronological cut-off points (e.g. from birth or before age 2) and developmental cut-off points (e.g. before language development) are used (Ask Larsen & Damen, 2014). This study uses the Nordic definition of deafblindness, which is recently international used more to emphasize that deafblindness is a distinct disability with a pervasive impact of the impairment on daily life. It states that deafblindness is a combined vision and hearing disability that limits a person's activities and restricts full participation in society to such a degree that society is required to facilitate specific services, alternations to their environment and/or technology (Dammeyer & Ask Larsen, 2016).

Communication is a major issue that restricts children with CDB from fully participating in society. In general, children with CDB can use basic signals to express what they want, but most struggle to acquire a kind of formal language (Bruce, 2005). Many educational intervention studies on people with CDB have directed their focus on improving communication in *practice-based* studies (Daelman et al., 1999; Janssen & Rødbroe, 2007; Rødbroe & Souriau, 1999) and, more recently, in *evidence-based* interventions (Bloeming-Wolbrink et al., 2015, 2018; Boers, 2015; Damen et al., 2014, 2015; Janssen et al., 2007, 2010, 2011; Martens et al., 2014a, 2014b). In this study communication is defined as 'a form of interaction, in which meaning is transmitted by the use of signals that are perceived and interpreted by the partner" (Bjerkan, 1996; Janssen et al., 2003; p.198; Wolthuis et al. 2019). However, it remains difficult to report about the communication level and development of a person with CDB, although such reporting is needed to be able to set appropriate goals and further support development (Bruce, 2005). Wolthuis et al. (2019) introduced a Layered Communication Model (Table 1) to describe and monitor communication development among people with CDB. That model was based on the theory of innate intersubjectivity developed by Bråten and Trevarthen (2007).

Table 1

The Layered Communication Model: Characteristic Behaviors for Each Layer of Intersubjective Communication Development

Layer of intersubjective development	Average age in typical development	Characteristic behaviors	Description	References from studies on typically developing children[a]	References from children with CDB
Primary layer	0-9 months	(Neonatal) imitation	Imitating other people's facial expressions and other movements	Kugiumutzakis, 1998; Meltzoff & Moore, 1977; Nagy & Molnar, 2004; Trevarthen & Aitken, 2001	Hart, 2006
		Mutual attention	Sharing attention to each other or to the shared activity	Trevarthen & Hubley, 1978	Bloeming-Wolbrink et al., 2015, 2018; Boers, 2015; Janssen et al., 2003a, 2003b
		Affective involvement	Sharing positive and negative emotions	Bråten & Trevarthen, 2007	Bloeming-Wolbrink et al., 2015, 2018; Boers, 2015; Damen et al., 2014, 2015; Janssen et al., 2003a, 2003b; Martens et al., 2014a, 2014b, 2017
		Turn-taking	Alternating turns in interactions like songs and games	Bråten & Trevarthen, 2007; Trevarthen, 1979	Janssen et al., 2003a, 2003b, 2007, 2010, 2011
Secondary layer	9-18 months	Joint attention	Focusing on an object or sharing it with others outside the dyadic child-parent interaction	Tomasello, 1995	Hart, 2010

		Imitative learning	Learning to use objects by imitating others who are using those objects	Trevarthen & Aitken, 2001	
		Naming objects	Using and understanding symbols for objects or people that are directly present	Bråten & Trevarthen, 2007	Daelman et al., 1999; Souriau et al., 2009
Tertiary layer	From 18 months	Symbolic communi-cation	Making and understanding conversations about absent things and people Talking about future and past events Talking about wishes and desires	Bråten & Trevarthen, 2007; Linell, 2009	Boers, 2015; Damen et al., 2014, 2015, 2017
	From 3-4 years to 6 years	Perspective taking	Discovering deceit (lying and joking) Attributing false beliefs to others Understanding others' minds and emotions Exhibiting prosocial behavior Roleplaying	Bråten & Trevarthen, 2007 Linell, 2009	

[a] The references listed here are all relevant sources from the running text and do not present an exhaustive overview.

The theory provides researchers, clinical support staff and parents with a coherent set of principles, insights and skills that can guide them in understanding the development of communication and can help them improve their skills in communicating with people with deafblindness (Damen et al., 2015). The theory describes communication in three subsequent layers of early development.

The primary layer focuses on the earliest interactions between children and parents without objects or other people involved. Primary layer behaviors, such as *imitation* and *turn-taking* (see Table 1 in Chapter 2), were found in comparable frequencies between dyads with students with CDB of varying developmental ages (Wolthuis et al., 2019, 2020). This confirmed the assumption of Janssen et al. (2003a) that the primary layer serves as a basic communication layer.

The secondary layer of the LCM describes communication between a dyad and shared objects or other people. The developmental pattern of the LCM starts from this layer, as students with lower developmental ages exhibit the secondary layer behaviors *joint attention* and *naming objects* less often than students with higher developmental ages (Wolthuis et al., 2019, 2020). Imitative learning could not be scored with sufficient interobserver agreement and was therefore omitted from the coding scheme (Wolthuis et al., 2019)

The tertiary layer of the LCM describes communication between the dyad and objects or other people that are not directly present. Communicative behaviors emerging in this layer include the capacity of the dyad to communicate about future or past events (*symbolic communication*) or to describe and discuss their own wishes and desires or those of others (*perspective taking*). Students with lower developmental ages did not exhibit these behaviors (Wolthuis et al., 2019, 2020). Both studies showed that the LCM can be used as a tool to describe a dyad's communicative level.

Besides this function, the LCM was also examined as a tool for monitoring communication development over time. Wolthuis et al. (2019) first studied communication development in four student-teacher dyads over a half-year period. Every time period of one and half month one video recording was made. In this first study no specific intervention other than daily education was involved. The results demonstrated no pattern of increase in the presence of LCM behaviors. The authors discussed whether this was caused by an absence of development or because only one recording per time period was analyzed, which could have been unrepresentative of the dyad's potential (Damen, 2015). In the second study Wolthuis et al. (2020) analyzed multiple recordings per time period and compared four videos of interactions before intervention (baseline phase), and four videos after intervention (follow-

up phase). Quantitative results from this second study demonstrated that the presence of LCM behaviors increased over a half-year period. The difference in presence was often low for primary layer behaviors (an increase or decrease of 0–5% between baseline and follow-up recordings), but larger differences between phases were found at the secondary and tertiary layers, with increases up to 20% for one dyad on the presence of *symbolic communication* from the baseline to the follow-up phase.

Since both studies analyzed development over a half-year period but only the second study that used an intervention found an increase in the presence of behaviors (Wolthuis et al., 2020), it could be argued that there is a relationship between the intervention and communication development. However, since that second study did not focus on the content of the intervention, the cause of the increase in the presence of LCM behaviors remains unclear. Therefore, the *aim of the current study* is to analyze the relationship between the content of the intervention and the change in presence of LCM behaviors over time, to discover the extent to which the LCM can be used as a tool to *improve* communication development.

The general structure of the intervention conducted in this study is the same for all participating dyads (N=4) but, since children with CDB form a very heterogeneous population (Dalby et al., 2009), the content of the intervention was adjusted per dyad to fit each child's needs and opportunities. The LCM is based on Bråten and Trevarthen's (2007) intersubjectivity theory, so it has a strong focus on interpersonal communication. This means that a change in behavior by either person in the dyad changes the presence of LCM behaviors for the dyad as a whole. The intervention focuses on changing the teacher's behavior, which can lead to changes in communication by both the teacher and student in the dyad. Different strategies were used to change the teachers' behavior in two intervention phases. Both phases can be analyzed separately, which makes it possible to relate changes in the presence of LCM behaviors to the content of the different intervention phases.

The first intervention phase consists of self-assessment of the teachers' ability to improve communication. Specifically, that is the ability to evaluate or judge one's own performance and to identify one's strengths and weaknesses to improve learning outcomes (Klenowski, 1995). Self-assessment can help learners observe and interpret their behavior, which allows them to focus on their own behavior, judge it, learn how to interpret it and discover what actions need to be taken to improve it (Ross, 2006). The fact that learners assess their behavior and set goals to improve it themselves results in greater motivation and confidence (see also intervention design; Locke & Latham, 2006, McMillen & Hearn, 2008).

Self-assessment can be made even more useful when combined with feedback and help on improving the assessed behavior (Ross, 2006). Video feedback coaching has proven to be an effective method for coaching teachers and changing behavior (Fukkink et al., 2011), so it was used in the second phase of the intervention (see also intervention design). Benefits

of this method are that videos of natural communication moments can be analyzed, replayed and evaluated to improve behavior. A coach can select fragments that can "stimulate reflection, gain insight and motivate change" (Fukkink, 2008, p. 905) at the start of an intervention and can use fragments at a later stage to highlight progress or change that occurs during the intervention. Communicative behaviors of children with CDB are often difficult to understand, and utterances can be easily missed or misinterpreted. The benefit of replaying videos to better analyze behavior makes video feedback coaching an oft-used and proven effective method in intervention studies of children with CDB (Bloeming-Wolbrink, 2018; Damen et al., 2015; Damen, et al., 2020; Haakma, et al., 2017; Janssen, et al. 2003b, 2014; Martens et al., 2014a; Martens et al., 2017)

Two questions were posed to analyze the relationship between the content of the intervention and the increase in the presence of LCM behaviors. The first question is whether differences in effectiveness can be found between the intervention phases (self-assessment and video feedback coaching). The second question is whether differences in effectiveness can be found between behaviors that were or were not targeted during any phase of the intervention. Both questions help us understand the extent to which the LCM can be used as a tool to improve communication.

Methods

Participants

Four dyads of students with CDB and their teachers participated in this study. Those four dyads participated also in the first study and in the second study by Wolthuis et al. (2019, 2020). In this third study research data on four (of the eight) dyads from the second study are analyzed on the relationship between the content of the intervention and the effectiveness of the intervention. (This differs from the second study (Wolthuis, et al, 2020) in which only quantitative data were measured before and after intervention.)

Participants displayed behaviors at all three layers of the LCM. The students' developmental ages varied from 12 months to 14 years but, since there are no diagnostic tests specially developed for children with CDB, these developmental ages are estimates. Students with CDB also often score very disharmoniously on various subscales of tests, which explains the range of developmental ages in Table 2. On average the teachers had more than 20 years experience working with children with CDB and all teachers had worked for at least one year with the student described in the study.

The coach, the first author, was trained by two experts in deafblindness: the third author for training in theory and a graduate PhD researcher for training in practical video feedback

Table 2

Characteristics of the Participating Dyads

	Dyad 1	Dyad 2	Dyad 3	Dyad 4
Estimated developmental age of the student[a]	18–24 months	12–25 months	5 years	8-14 years
Estimated layer of intersubjectivity[b]	2-3	2-3	3	3
Hearing impairment[c]	Slight hearing impairment in both ears, no hearing aids	Slight hearing impairment when wearing hearing aids	Moderate hearing impairment in one ear, slight in other when wearing hearing aids	Moderate hearing impairment in one ear, profoundly deaf in the other ear
Visual impairment[d]	Blind in both eyes	Blind in one eye, low vision in the other eye	Blind in one eye, low vision in the other eye	Mild visual impairment
Description of communicative situation	Planning the afternoon activities and working on hands and crafts	Word learning activities and games	Communicating about weekend activities with the use of (enlarged) photos	Communicating about one topic chosen by the student and one chosen by the teacher

[a] Based on test results of the SON-R (Tellegen & Laros, 2011), the Dutch version of the BSID-II (Ruiter et al., 2003) and the SCOSD (Ashurst et al., 1985). Since those tests were not specially developed for children with CDB, the developmental ages of our participants are estimates.

[b] Based on school files and the students' educational psychologist.

[c] Slight hearing impairment: 26-40 dBHL, Moderate hearing impairment: 41-60 dBHL, Severe hearing impairment: 61-80 dBHL, Profound hearing impairment/deafness: 81 dBHL and greater (World Health Organization, 2001).
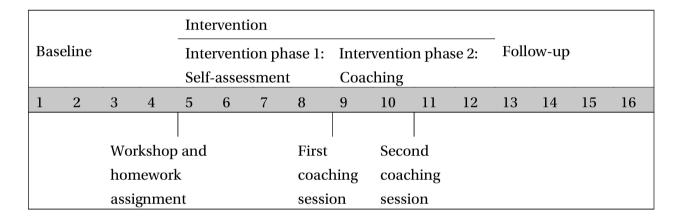
[d] Normal vision: visual acuity 1.0-0.8, Mild visual impairment: 0.63-0.32, Low vision-blindness: 0.3-0.0 (World Health Organization, 2003).

coaching (Damen, 2015). Furthermore, the coach trained herself in the coaching of CP's focused on creating ownership of target setting.

Intervention Design

Dyads participated in an intervention that consisted of a baseline, two intervention phases and a follow-up phase. Each phase lasted four weeks and was video recorded once a week. That means that the real intervention, the self-assessment phase and the coaching phase, lasted eight weeks in total (see Figure 1.)

Figure 1: Overview of the 16 Videos Recorded Weekly During the Four Intervention Phases

Baseline				Intervention								Follow-up			
				Intervention phase 1: Self-assessment				Intervention phase 2: Coaching							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		Workshop and homework assignment						First coaching session	Second coaching session						

In the four weeks before the start of the first intervention phase, we recorded baseline videos that showed the teaching as conducted every day. Teachers were unbiased about the study's purpose, as they had no knowledge about the research other than that it was "research on communication."

After the baseline, the first intervention phase started with a theoretical section (see Table 3 for an overview of the intervention phases). The first intervention phase was the self-assessment phase. It consisted of a workshop and a homework assignment. The purpose of this phase was to educate teachers about the content and use of the LCM and to let them assess their own behavior and that of their client. Assessing your own behavior and setting goals for improvement can contribute to greater motivation and confidence (McMillen & Hearn, 2008). First, teachers participated in an interactive workshop at the end of the baseline phase. Workshops were attended by the participating teachers, and to increase the interactive nature and to share knowledge within the organizations, colleagues and managers were invited to attend as well. In the theoretical part of the workshop, participants learned about the three layers of the LCM and how the eight communicative behaviors build up in typical development. Next, they broke into small groups to discuss what the LCM behaviors look like for people with CDB. Finally, they came back together to discuss possible appearances of LCM behaviors in people with CDB.

After the workshop, teachers received a homework assignment that consisted of two tasks. First, they were asked to rate the frequency of appearance of each LCM behavior on a three-point scale (dyads 1 and 2) or a five-point scale (dyad 3) and to describe what the behaviors looked like and whether the student used a behavior actively or was only able to respond to a behavior initiated by the caregiver. Second, teachers were asked to choose one behavior that was infrequently present and answer two questions about it: why was it infrequently present, did they want to increase its presence.

The second intervention phase was the coaching phase. It consisted of two video feedback coaching sessions between the caregiver and the first author of this study (hereafter referred to as the coach). This phase was used to support the teachers in changing their behavior and that of their student. Video feedback offers viewers the opportunity to analyze and evaluate videos and allows the coach to show the teacher fragments that can "stimulate reflection, gain insight and motivate change" (Fukkink, 2008, p. 905).

The coach analyzed the videos recorded during baseline and the first intervention phase and followed a script to coach and support the teacher. At the start of the first coaching session, the coach asked three questions about recent weeks in which the teacher had worked with the student: 1) what had the teacher learned most from the workshop, 2) did they change their own behavior in communicating with the student, and 3) had they looked differently at the student's behavior. Next, the homework assignment was discussed by looking at all LCM behaviors and their frequency of appearance according to the teacher. If there were discrepancies between the homework assignment and the coach's observations, video examples were shown and discussed until the teacher and coach agreed on the appearance of the dyad's behaviors. The coach then evaluated the targeted behavior chosen by the teacher and discussed whether it should remain the main point of focus, other behaviors should be added, or the target behaviors should be changed. Deciding which behavior's presence could be improved and the purpose of doing so was a joint process between the coach and caregiver. The second coaching session started with an evaluation of the targeted behavior in which the coach and teacher discussed how the suggested alterations had worked in practice. The coach showed video examples of moments of improvement to stimulate the teacher to keep improving the presence of the behavior (as Fukkink, 2008, recommends for video feedback coaching).

The follow-up phase consisted of four videos recorded in the weeks after the intervention ended. After follow-up videos were recorded, the teacher and coach evaluated the intervention in a final session that was also scripted. The coach began this evaluation session by summarizing the behaviors that had been chosen for improvement and the suggestions that had been made for achieving that improvement during the intervention.

Table 3

Overview of the Two Intervention Phases Following the Baseline

Intervention phase 1: Teacher's self-assessment

Education	Group assignment	Homework assignment (self-assessment)
Teachers learned about the three layers of the model and the corresponding LCM behaviors with (video) examples of typically developing children.	In small groups, teachers discussed the appearance of the LCM behaviors in communication with children with CDB, followed by plenary feedback and a discussion session.	Each teacher had to individually describe the LCM behaviors they could find in a recording of themselves and their student with CDB. Next, they had to describe behaviors that were infrequently or absent and in need of improvement.

Intervention phase 2: Video feedback coaching

First coaching session	Second coaching session
The coach gave feedback on the homework assignment and shared which behaviors were infrequently present in the recordings of the baseline and first intervention phases. The coach and teacher then discussed how the presence of two behaviors could be improved.	The coach and teacher evaluated the two behaviors that were targeted in the first session and changed them (if jointly agreed on). The coach showed and analyzed video examples of the dyad to support the improvement of targeted behaviors.

The coach then asked the teacher to evaluate their progress during the entire intervention. Finally, they looked back at the homework assignment the teacher had completed at the start of the intervention and discussed whether and how the appearance of each LCM behavior had improved during the intervention.

Data Collection

Content of the Intervention

Data on the content of the intervention was collected separately for the two intervention phases. For the first intervention phase (self-assessment), the teacher's homework assignment was analyzed to discover which behaviors the teacher had worked to improve. Teachers described which behavior was infrequently present and what strategy they

would use to improve the presence of the behavior(s). However, some teachers were unclear about which behavior(s) they wanted to improve or their homework assignment did not clearly describe how they were going to work on improving the behavior. Therefore, we also analyzed audio transcripts of the first coaching session to gather data on the content of the first intervention phase. During this first coaching session, teachers were asked to evaluate which behaviors they had worked on and how they did that in the weeks of the first intervention phase. Those answers and the answers from the homework assignment were used to describe the content of the first intervention phase.

For the second intervention phase (coaching), we analyzed audio transcripts of the two coaching sessions to discover which behaviors the coach and teacher discussed improving. We analyzed the mentioned behaviors and the suggestions made to improve their presence.

For the follow-up phase, we collected no specific data about the content of the intervention because the intervention ended after the second intervention phase.

Effectiveness of the Intervention

The effectiveness of the intervention was quantitatively analyzed. Videos were recorded every week during each phase of the intervention and were coded to measure changes in the presence of LCM behaviors during the intervention phases.

Recording Videos

Each phase was video recorded by the first author and two volunteers with a handheld camera on a tripod. The camera operator was in the background in the classroom and recorded the student's and teacher's entire bodies. Teachers were asked to choose the moment in their weekly schedule that was most dedicated to communication and interaction. The chosen activity differed: one dyad did hands and crafts, another dyad played games and practiced vocabulary, and two dyads communicated about their weekends or made plans.

Four videos (one per week) were recorded in each phase, resulting in 16 recordings per dyad. Due to unexpected circumstances, one recording is missing for dyad 2 in the follow-up phase, and one recording of the baseline and one of the follow-up phase are missing for dyad 3. In the second intervention phase, two videos were recorded in the weeks after the first coaching session and two videos after the second coaching session. Video recording of the follow-up phase started three weeks after the last coaching session (see Figure 1).

The average length of the recordings was 32 minutes (ranging from 25–42 minutes), from which 15-minute fragments were cut for coding in this study. These fragments consisted of five minutes from the start of the recording (when both were in sight and one person started the lesson), five minutes before the end (when one person ended the lesson) and five from the exact middle of the remainder of the recording.

Coding Videos

The cut fragments were coded quantitatively with partial interval coding (MacLaren, Chorney et al., 2014). For each LCM behavior, its presence or absence was coded during a ten-

second interval. Two coders, one the first author and one graduated master in Pedagogical Sciences coded the selected videos independent of each other. The first author trained the second coder. They trained for each dyad till > 80% interrater reliability was reached for three fragments. Interrater reliability was obtained by a second coder (first and second coder were alternated per dyad), who coded 25% of the recordings of each dyad. Recordings per dyad were renamed and randomized in such a way that both coders were unaware of which recording belonged to which intervention phase. Sufficient agreement between coders is considered to exist when percentage agreement exceeds 80% and Cohen's Kappa (Cohen, 1960) is higher than .60 (Prain et al., 2012). Percentage agreement in this study varied from 86% to 97% and Kappa scores varied from .80 to .92.

Data Analysis

Content of the Intervention

For the first intervention phase, we analyzed the teachers' answers on the homework assignment and the evaluative part of the first coaching session. The behaviors the teachers worked on and the strategy they used were described as the targeted behaviors for the content of the first intervention phase. For the second intervention phase, we analyzed the audio transcripts of both coaching sessions. The behaviors targeted for improvement and accompanying strategy discussed during coaching were described as the targeted behaviors for the content of the second intervention phase.

Effectiveness of the Intervention

Effectiveness of the intervention was calculated based on two effectiveness measures: increase in the presence of behaviors and effect sizes found between phases.

Increase in presence between phases was calculated for each of the eight LCM behaviors. The mean percentage of presence per behavior was calculated for the combined recordings from the baseline and compared to the mean percentage of presence in each subsequent phase (intervention phases 1 and 2 and the follow-up phase). A positive outcome signified an increase in the presence of an LCM behavior between phases, and a negative outcome signified a decrease in presence. Since this study focuses on improvement in communication, only increases in presence were presented as an effectiveness measure in this study.

Effect sizes were calculated for all LCM behaviors by a Non-Overlap of All Pairs (NAP) analysis (Parker & Vannest, 2009). A NAP analysis calculates the percentage of each data point in the baseline that is lower than each data point in the following phases. The higher the NAP percentage, the less overlap is found between the baseline and an intervention phase, which indicates that the presence of a behavior has increased in one of the phases following the baseline. NAP percentages between 0-65% signify a small treatment effect, between 66-92%

signify a medium treatment effect and between 93-100% signify a large treatment effect (Parker & Vannest, 2009). Only medium and large intervention effects were presented as effectiveness measures in this study as these indicate a substantial change in communication development.

The effectiveness measures were used in three steps to relate the content of the intervention to its effectiveness. In the first step, the number of increases and effect sizes were related to the total number of LCM behaviors (eight) and multiplied by 100. This ratio showed the effectiveness of the different phases regardless of which behaviors were targeted for improvement during the intervention. In the second step, the number of increases and effect sizes were related to the number of LCM behaviors that were targeted during the intervention phases and multiplied by 100. This ratio shows the effectiveness of the intervention for targeted behaviors. For the follow-up phase, the behaviors targeted during both intervention phases were combined. In the third step, the number of increases and effect sizes were related to the number of LCM behaviors that were not targeted during intervention and multiplied by 100. This ratio shows the side effects of the intervention. Again, for the follow-up phase, the behaviors that were not targeted during both intervention phases were combined.

Group analysis

Given the heterogeneity of the population and the fact that the intervention is adapted to each dyad's specific needs, the intervention used a baseline logic so each participant served as their own control for evaluating change (Gast & Hammond, 2010). Results were analyzed for each dyad separately. However, a group analysis was also performed to learn more about possible patterns in the relationship between the content and effectiveness of the intervention for the four dyads together. The group analysis was described to analyze the difference between the effectiveness of the two intervention phases and between targeted and untargeted behaviors.

Results

Dyad 1

Content of the Intervention

Intervention Phase 1. Both the homework assignment and the evaluative part of the first coaching session were used to describe the LCM behavior(s) targeted by the teacher.

In the homework assignment, the teacher from dyad 1 described tertiary layer behaviors as infrequently present (*symbolic communication)* or completely absent (*perspective taking*). The teacher believed that the presence of *symbolic communication* could possibly be improved, but judged *perspective taking* to still be too difficult for the student.

The LCM behavior targeted by the teacher was therefore *symbolic communication*. The teacher said she was going to work on improving this behavior by adding a narrative to the hands and crafts activity. The teacher used the hands and crafts lesson to recreate activities that she and the student had experienced together. For example, an outdoor activity of walking up a hill covered in wooden chips was recreated in the lesson by making a scale model of the hill from wooden chips glued onto a box. During the lesson, the dyad used their hands and fingers to replay the story of walking up and running down the tangible hill.

In the homework assignment, the teacher was clear about the targeted behavior. In the evaluation of the assignment during the first coaching session, the teacher gave similar answers to which behavior she targeted and to how she worked on improving *symbolic communication*.

Intervention Phase 2. Both audio transcripts of the video feedback coaching sessions were analyzed to describe the behaviors targeted during coaching in the second intervention phase. The coach noticed that primary and secondary layer behaviors were frequently present in the recordings of the baseline and first intervention phase. Therefore, *symbolic communication* and *perspective taking* were targeted for improvement during the second intervention phase. For *symbolic communication* behavior, the coach suggested that the teacher continue adding narratives, not only during hands and crafts, but also at the beginning and end of the lesson. The beginning of the day could be made more narrative by asking questions about the content of the activities instead of only planning them. For example, the teacher could ask the student with whom he is going to do the activity, whether he likes it or what he is going to eat during the lunch activity.

In terms of *perspective taking*, the coach suggested that the teacher ask questions to find out what the student liked and whether he understood what others liked. Making jokes is another way of showing the other-your perspective. The coach suggested that the teacher deliberately make mistakes in planning the order of pictograms for the next activities. This way, she could try to evoke a reaction from the student and pretend she made a joke; if the student did not understand what happened, she could say that she made a mistake.

Effectiveness of the Intervention

Intervention Phase 1. The presence of six of the eight LCM behaviors increased between baseline and the first intervention phase by 1–14% (see Table 4). Three effect sizes were also found (one large effect for *naming objects*). Therefore, the effectiveness ratio for all LCM behaviors combined was 75% for the measure of increase and 37.5% for the measure of effect sizes.

The effectiveness ratio for targeted behaviors was 100% for both the measure of increase and effect size, since the one behavior targeted by this teacher (*symbolic communication*) increased by 4.4% and showed a medium effect size between baseline and the first intervention phase.

The side effect ratio was measured for the number of untargeted behaviors that showed increases or effect sizes. Seven behaviors were untargeted between baseline and the first intervention phase: the presence of five increased and two treatment effects were found. This means that the side effect ratio was 71% for the measure of increase and 29% for effect sizes.

Intervention Phase 2. The presence of six of the eight LCM behaviors increased by 1–11% and treatment effects were found for five behaviors between baseline and the second intervention phase (see Table 4). Therefore, the effectiveness ratio (regardless of targeted behaviors) was 75% for the measure of increase and 62.5% for the measure of effect size.

Symbolic communication and *perspective taking* were the two targeted behaviors during the second intervention phase. The presence of both behaviors increased between baseline and this phase: *symbolic communication* by 8.3% and *perspective taking* by 0.8%. Treatment effects were found for both behaviors as well (including a large effect of 100% for *symbolic communication*). This means that effectiveness ratios on targeted behaviors were 100% for both the measure of increase and effect size.

Of the six behaviors that were not targeted in the second intervention phase, the presence of four increased between phases and medium treatment effects were found for three: *affective involvement* and *mutual attention* (both 68.8%) and *naming objects* (78.1%). Therefore, the side effect ratios for untargeted behaviors were 67% for the measure of increase and 50% for the measure of effect size.

Follow-Up Phase. The presence of six of the eight LCM behaviors increased between baseline and follow-up, and treatment effects were found for three behaviors. This means that effectiveness ratios (regardless of targeted behaviors) were 75% for the measure of increase and 37.5% for the measure of effect size.

No specific behaviors were targeted during follow-up since the intervention had ended, but *symbolic communication* and *perspective taking* were targeted during the intervention. The presence of both these behaviors increased from baseline to follow-up (2.8% and 2.2%, respectively) and medium treatment effects were found for both behaviors as well. This means that effectiveness ratios on targeted behaviors were 100% for both the measure of increase and effect size.

Six behaviors were not targeted during either intervention phase, but the presence of four of them did increase between baseline and follow-up. A large effect size (96.9%) was found for the untargeted behavior *naming objects*. Therefore, the side effect ratios for untargeted behaviors were 67% for the measure of increase and 17% for the measure of effect size.

Dyad 2

Content of the Intervention

 Intervention Phase 1. In the homework assignment, the teacher found no tertiary layer behaviors in the ten-minute fragment she analyzed. She explained that *symbolic communication* is absent from the fragment but is something that the student knows how to use. For instance, the student is capable of expressing that she wants to talk about Christmas and she can ask when it is and what gifts she will receive.

 The teacher did not clearly indicate a target behavior in the homework assignment but she said that the presence of *symbolic communication* could be improved. Although she gave no suggestions for how she would work on improving this behavior, the target behavior for this teacher was *symbolic communication.*

 In the evaluation of the first intervention phase, the teacher said that she changed her behavior by paying more attention to the student's initiatives and taking more time for them. Again, she did not mention if and how she specifically worked on improving the target behavior *symbolic communication.*

 Intervention Phase 2. The coach noticed that *symbolic communication* and *affective involvement* were infrequently present in the recordings of the baseline and the first intervention phase. The student had quite a large (tactile) sign language vocabulary, but the lesson was mainly focused on practicing concrete words and signs. Language was rarely used for conversation or to communicate about absent things or people. Since the lesson was mostly about practicing vocabulary, emotions were infrequently shared.

 The coach therefore suggested two target behaviors: *symbolic communication* and *affective involvement.* Both could be improved by changing the word learning games into stories about the words they were practicing. For example, instead of practicing the word 'swing' by connecting a picture of a swing with the written and signed word, the teacher could also ask if the student liked to go on the swing, if she remembered the fun they shared on the swing some other day, or similar questions. That would teach the student to communicate about abstract things, events and people (*symbolic communication*) and, at the same time, more emotions could be shared (*affective involvement*).

Effectiveness of the Intervention

 Intervention Phase 1. The presence of four of the eight LCM behaviors increased by 0.8–3% between baseline and the first intervention phase and no treatment effect was found (see Table 5). Therefore, the effectiveness ratios when targeted behaviors were not regarded was 50% for the measure of increase and 0% for the measure of effect size.

 The teacher targeted *symbolic communication* in the first intervention phase. The presence of this behavior increased by 0.8% and no effect size was found. Therefore, the effectiveness ratio was 100% for the measure of increase and 0% for the measure of effect size.

Table 4

Content and Effectiveness of the First and Second Intervention Phases and the Follow-Up Phase, Compared to the Baseline for Dyad 1

| LCM behaviors | Intervention Phase 1 | | | Intervention Phase 2 | | | Follow-Up Phase | | |
| | Content | Effectiveness Measures | | Content | Effectiveness Measures | | Content | Effectiveness Measures | |
	Target	% increase	ES	Target	% increase	ES	Target	% increase	ES
Affective involvement	-	1.1	68.8	-	2.0	68.8	-	-	
Imitation	-	1.4	-	-	-	-	-	2.0	
Mutual attention	-	2.8	-	-	1.4	68.8	-	2.0	
Turn-taking	-	-	-	-	5.6	-	-	-	
Joint attention	-	1.1	-	-	-	-	-	1.4	
Naming objects	-	14.0	93.8	-	11.4	78.1	-	11.6	96.9
Symbolic communication	X	4.4	68.8	X	8.3	100	X	2.8	68.8
Perspective taking	-	-	-	X	0.8	75	X	2.2	75

For the seven behaviors that were not targeted, small increases between the baseline and first intervention phase were found (2.5–3% increase on *mutual attention, turn-taking* and *joint attention*) but no effect sizes were found. Therefore, the side effect ratios were 43% for the measure of increase and 0% for the measure of effect size.

Intervention Phase 2. The presence of six of the eight LCM behaviors increased between baseline and the second intervention phase, and four medium treatment effects were found (see Table 5). This means that the effectiveness ratio (regardless of targeted behaviors) was 75% for the measure of increase and 50% for the measure of effect size .

Symbolic communication and *affective involvement* were targeted during the second intervention phase. The presence of both behaviors increased (by 1.4% and 5%, respectively) and medium treatment effects were found for them as well. Therefore, the effectiveness ratio for targeted behaviors was 100% for both the measure of increase and effect size.

Of the six behaviors that were not targeted during coaching in the second intervention phase, the presence of four increased between phases. Two treatment effects were also found. This means that the side effect ratio was 67% for the measure of increase and 33% for the measure of effect size.

Follow-Up Phase. The presence of two of the eight LCM behaviors increased between baseline and follow-up (see Table 5), and two medium treatment effects were found. This means that the effectiveness ratio regardless of targeted behaviors was 25% for the measure of increase and the measure of effect size.

No behaviors were specifically targeted during follow-up, but *affective involvement* and *symbolic communication* were targeted during the intervention. No increase or effect size was found for the first behavior, but the presence of *symbolic communication* increased during follow-up compared to the baseline. This means that the effectiveness ratio for targeted behaviors was 50% for the measure of increase and 0% for the measure of effect sizes.

Six behaviors were not targeted during the intervention. The presence of only one of them increased between baseline and follow-up (1.1% for *perspective taking*) and two medium treatment effects were found. Therefore, the side effect ratio was 17% for the measure of increase and 33% for the measure of effect size.

Dyad 3
Content of the Intervention

Intervention Phase 1. In the homework assignment, the teacher did not clearly describe LCM behaviors that were infrequently present or which could be improved and how. She wrote that she thought the student did not show many emotions. She wanted to work on that by naming the emotions that he showed, as well as those of others. Based on the homework assignment, the teacher targeted *affective involvement.*

In the audio transcript of the evaluation of the first intervention phase, the teacher explained that she tried to share more of her own feelings with the student, to let him know how she felt about situations or other people. She also started thinking about *perspective taking* after the workshop, while before she thought that behavior was out of reach for this student. She worked on the behavior by explaining differences between the student and herself (e.g., he could not borrow his teacher's shoes because he wears specially adapted shoes). Based on these descriptions from the evaluation, *perspective taking* was added to the teacher's targeted behaviors.

Intervention Phase 2. The audio transcripts of the coaching sessions showed that the coach noticed that apart from *perspective taking*, behaviors from all three layers of the LCM were present and frequently occurred. Therefore, *perspective taking* was targeted as a behavior for which presence could be improved in the second intervention phase. The coach suggested improving the presence of this behavior in two ways that were both connected to the teacher sharing more about herself. Thus far, it had mainly been the student who told the teacher about his weekends by showing her enlarged pictures from home; they never talked about the teacher's weekend. The first suggestion was that the teacher more frequently share how she felt about things and share her wishes and desires whenever the student talked about his. The second suggestion was that the teacher bring (enlarged) pictures from her own home to school to share with the student and talk about her weekend. Both suggestions were intended to give the student more insight into the interests of others, thus increasing the presence of *perspective taking*.

Effectiveness of the Intervention

Intervention Phase 1. The presence of three of the eight LCM behaviors increased between baseline and the first intervention phase (see Table 6), and intervention treatment effects were found for one behavior. This means that effectiveness ratios for all LCM behaviors (regardless of targeted ones) was 37.5% for the measure of increase and 12.5% for the measure of effect size.

The LCM behaviors targeted by the teacher in the first intervention phase were *affective involvement* and *perspective taking*. Neither behavior increased in presence between the recordings of the baseline and the first intervention phase, and no effect size was found. Therefore, the effectiveness ratios for targeted behaviors were 0% for both measures of increase and effect size.

Of the six behaviors that were not targeted by the teacher, the presence of three increased between baseline and the first intervention phase: two by less than 1% (*mutual attention* and *turn-taking*) and one by 7.3% (*joint attention*). One of the six untargeted behaviors (*joint attention*) showed a medium treatment effect. This means that side effect ratios were 50% for the measure of increase and 17% for the measure of effect size.

Table 5

Content and Effectiveness of the First and Second Intervention Phases and the Follow-Up Phase, Compared to the Baseline for Dyad 2

LCM behaviors	Intervention Phase 1			Intervention Phase 2			Follow-Up Phase		
	Content	Effectiveness Measures		Content	Effectiveness Measures		Content	Effectiveness Measures	
	Target	% increase	ES	Target	% increase	ES	Target	% increase	ES
Affective involvement	-	-	-	X	1.4	75	X	-	-
Imitation	-	-	-	-	-	-	-	-	-
Mutual attention	-	3.0	-	-	2.8	-	-	-	66.7
Turn-taking	-	2.5	-	-	2.8	-	-	-	-
Joint attention	-	2.8	-	-	-	-	-	-	-
Naming objects	-	-	-	-	2.5	81.3	-	-	-
Symbolic communication	X	0.8	-	X	5.0	69	X	0.3	-
Perspective taking	-	-	-	-	1.7	75	-	1.1	66.7

Intervention Phase 2. The presence of six of the eight LCM behaviors increased between baseline and the second intervention phase (see Table 6), and four treatment effects were found. This means that the effectiveness ratios on all LCM behaviors were 75% for the measure of increase and 50% for the measure of effect size.

Perspective taking was the only behavior targeted during coaching in the second intervention phase. Its presence increased by 3.7% between baseline and coaching but no treatment effect was found for it. This means that the effectiveness ratios on targeted behaviors were 100% for the measure of increase and 0% for the measure of effect size.

Of the seven behaviors that were not targeted during coaching, the presence of five increased between phases and medium treatment effects were found for four of them (*mutual attention, turn-taking, naming objects* and *symbolic communication*). Therefore, the side effect ratios were 71% for the measure of increase and 57% for the measure of effect size.

Follow-Up Phase. The presence of seven of the eight LCM behaviors increased and seven treatment effects were found between baseline and the follow-up (see Table 6). This resulted in effectiveness ratios of 87.5% for all LCM behaviors combined for both increase and effect sizes.

No specific behaviors were targeted during follow-up, but *affective involvement* and *perspective taking* were targeted during intervention. The presence of both behaviors increased between baseline and follow-up (Table 6). Also, a medium treatment effect was found for *affective involvement* and a large effect of 100% for *perspective taking*. This means that effectiveness ratios on targeted behaviors were 100% for the measures of increase and effect size.

For the six behaviors that were not specifically targeted during intervention, the presence of all but one (*joint attention*) increased between baseline and follow-up. Also, medium or large (*symbolic communication*) treatment effects were found for five of the six untargeted behaviors. This means that side effect ratios were 83% for the measures of increase and effect size.

Dyad 4
Content of the Intervention

Intervention Phase 1. In the homework assignment, the teacher wrote that all LCM behaviors were present in the ten-minute fragment, but *perspective taking* was difficult for the student. She wrote that it had always been the student who chose the conversation topic, and she wanted to know what strategy to follow in terms of *perspective taking*. However, the teacher described three other behaviors to target during intervention: *affective involvement, turn-taking* and *naming objects*. For *affective involvement,* she wanted to emphasize the student's emotions and her own and explain the meaning of feelings to help the student understand them better. For *turn-taking,* she wanted to improve the number of turns taken by

the student. The teacher wanted the student to take the initiative instead of taking it herself. For *naming objects,* she wrote that the student was making longer sentences and she sometimes wondered whether the student's concept of signs was the same as her own.

In the evaluation of the first intervention phase, the teacher said that she did not focus on improving the developmentally highest behaviors of the model but looked at behaviors on lower layers. Although those behaviors were present in communication, the teacher thought that the content of the behaviors *affective involvement, turn-taking* and *naming objects* could be improved, and she explained how she would work on that in the homework assignment. These answers from the evaluation confirmed that the teacher targeted these three behaviors in the first intervention phase.

Intervention Phase 2. In the coaching sessions, the coach noticed that this student-teacher dyad showed all LCM behaviors, but *perspective taking* was less frequently present than the other behaviors. Therefore, the behavior targeted during coaching was *perspective taking.* The coach's strategy aimed at teaching the student how to understand emotions better. The coach suggested that the teacher ask about the student's feelings in certain situations and also show her own emotions and feelings in different situations. The teacher was asked to introduce role plays to be able to reflect on emotionally loaded situations (e.g., when the student exhibited inappropriate behavior toward other students, like taking away their belongings). All suggestions were aimed at giving the student insight into how different people can have different opinions and feelings and thereby teaching her to take the perspective of others.

Effectiveness of the Intervention

Intervention Phase 1. The presence of two of the eight LCM behaviors increased between baseline and the first intervention phase, and only one treatment effect was found between these phases (see Table 7). This means that effectiveness ratios on all LCM behaviors combined were 25% for the measure of increase and 12.5% for effect sizes.

The teacher targeted *affective involvement, turn-taking and naming objects* in the first intervention phase. The presence of none of these behaviors increased between phases, and no intervention treatment effects were found. This resulted in effectiveness ratios for targeted behaviors of 0% for both the measures of increase and effect sizes.

Of the five behaviors that were not targeted by the teacher, the presence of two increased: *symbolic communication* by 2.8% and *perspective taking* by 8.6%. A medium treatment effect was found for one of the five untargeted behaviors (*perspective taking*). This means that side effect ratios were 40% for the measure of increase and 20% for the measure of effect sizes. The teacher mentioned that *perspective taking* was infrequently present, but she did not describe it as a target behavior nor give examples about how to work on it.

Table 6

Content and Effectiveness of the First and Second Intervention Phases and the Follow-Up Phase, Compared to the Baseline for Dyad 3

	Intervention Phase 1			Intervention Phase 2			Follow-Up Phase		
	Content	Effectiveness Measures		Content	Effectiveness Measures		Content	Effectiveness Measures	
LCM behaviors	Target	% increase	ES	Target	% increase	ES	Target	% increase	ES
Affective involvement	X	-	-	-	-	-	X	4.5	78
Imitation	-	-	-	-	1.8	-	-	6.3	67
Mutual attention	-	0.7	-	-	7.9	67	-	9.6	67
Turn-taking	-	0.3	-	-	7.5	67	-	10.0	67
Joint attention	-	7.3	67	-	-	-	-	-	-
Naming objects	-	-	-	-	9.9	75	-	12.7	89
Symbolic communication	-	-	-	-	13.9	92	-	22.9	100
Perspective taking	X	-	-	X	3.7	-	X	18.4	100

Intervention Phase 2. The presence of five of the eight LCM behaviors increased between the baseline and second intervention phase (see Table 7) and two medium treatment effects were found. This means that the effectiveness ratios of all the LCM behaviors combined were 67.5% for the measure of increase and 25% for the measure of effect size.

Perspective taking was targeted during coaching. Its presence improved by 6.6% compared to the baseline recordings, and a medium treatment effect of 81.3% was found for this behavior as well. This means that effectiveness ratios on targeted behaviors were 100% for both the measures of increase and effect sizes.

Of the seven behaviors that were not targeted during coaching, the presence of four increased between phases and a medium treatment effect was found for one (*symbolic communication*). This means that side effect ratios were 57% for the measure of increase and 14% for the measure of effect size.

Group Analysis

For the group analysis, we will address the two questions raised in the introduction: whether differences in effectiveness could be found between the two intervention phases and follow-up and whether differences in effectiveness could be found between behaviors that were or were not targeted.

Differences in Effectiveness Ratios Between the Phases of the Intervention

Effectiveness ratios on increase related to all LCM behaviors and to those that were targeted were highest in the second intervention phase for most dyads (see Table 8). Only dyad 3 had higher effectiveness ratios in the follow-up phase than in the other phases. Differences between effectiveness ratios for effect sizes were small between the second intervention phase and the follow-up phase. In some cases, the second intervention phase was higher (dyad 2); in others, the ratios were equal (dyad 1) or the follow-up phase was slightly higher (dyads 3 and 4). In all cases, the effectiveness ratios for the measures of increase and effect sizes were much lower in the first intervention phase than in the second intervention phase or follow-up phase.

When the results of the four dyads were combined, effectiveness ratios related to all LCM behaviors and those that were targeted were lowest in the first intervention phase. They were highest in the second intervention phase.

Side effect ratios exhibited a similar pattern between phases when the results of the dyads were combined. The side effect ratio on increase was highest in the second intervention phase, followed by the follow-up and was lowest in the first intervention phase. However, there were large differences between dyads. For example, for dyad 1, the side effect ratios were equal in the second intervention phase and follow-up, and slightly higher in the first intervention

phase. For dyad 2, the side effect ratio was very low in the follow-up phase compared to the other phases. Differences between dyads were also great for the side effect ratios on effect sizes, but for most dyads this ratio was lowest in the first intervention phase.

Differences in Effectiveness Between Targeted and Untargeted Behaviors

For most dyads, effectiveness ratios were higher for targeted behaviors than for untargeted behaviors (see Table 8). This can be seen in the effectiveness measure increase for most of the dyads. An exception occurred in the first intervention phase, where dyads 3 and 4 showed lower ratios on increase for the targeted behaviors (0% for both dyads) than the untargeted ones (50% and 40%, respectively).

On effect sizes, the first intervention phase resulted in higher ratios for untargeted behaviors than targeted behaviors for three dyads (dyads 2, 3 and 4). In the second intervention phase, only dyad 3 had lower ratios on effect sizes for the targeted behaviors (0%) than the untargeted ones (57%). During follow-up, dyad 2 had lower ratios on the targeted behaviors (0%) than the untargeted ones (33%).

When dyads and phases of the intervention were combined, effectiveness ratios for both measures were higher for targeted behaviors (77% for increase and 54% for effect size) than untargeted behaviors (59% for increase and 32% for effect size). This pattern was different in only the first intervention phase, when the ratio for untargeted behaviors (51%) was slightly higher than the ratio for targeted behaviors (50%) for the measure of increase in presence.

Discussion

The aim of this study was to discover the extent to which the LCM can be used as a tool to improve communication. The content of the intervention was described in terms of behaviors that were targeted during two separate intervention phases, which was related to effectiveness measures that showed the change in presence of LCM behaviors during different phases of the intervention. Results showed increases in the presence of LCM behaviors in both phases of the intervention and during follow-up, which suggests a relationship between the intervention and its effectiveness. Differences in effectiveness between phases and between targeted and untargeted behaviors were discussed to learn more about this relationship between the content and effectiveness of the intervention.

Table 7

Content and Effectiveness of the First and Second Intervention Phases and the Follow-Up Phase, Compared to the Baseline for Dyad 4

LCM behaviors	Intervention Phase 1			Intervention Phase 2			Follow-Up Phase		
	Content	Effectiveness Measures		Content	Effectiveness Measures		Content	Effectiveness Measures	
	Target	% increase	ES	Target	% increase	ES	Target	% increase	ES
Affective involvement	X	-	-	-	-	-	X	-	-
Imitation	-	-	-	-	-	-	-	7.8	-
Mutual attention	-	-	-	-	1.1	-	-	1.7	-
Turn-taking	X	-	-	-	0.8	-	X	2.5	-
Joint attention	-	-	-	-	-	-	-	-	-
Naming objects	X	-	-	-	0.6	-	X	6.1	81.3
Symbolic communication	-	2.8	-	-	6.7	68.8	-	11.4	81.3
Perspective taking	-	8.6	84.4	X	6.6	81.3	X	8.6	100

Table 8

Effectiveness Ratios Regardless of Targeted Behaviors, for Targeted and Untargeted Behaviors, for the Four Dyads and the Three Phases Separately and Combined

		All LCM Behaviors		Targeted Behaviors		Untargeted Behaviors	
		Increase	ES	Increase	ES	Increase	ES
Intervention phase 1	Dyad 1	75%	37.5%	100%	100%	71%	29%
	Dyad 2	50%	0%	100%	0%	43%	0%
	Dyad 3	37.5%	12.5%	0%	0%	50%	17%
	Dyad 4	25%	12.5%	0%	0%	40%	20%
	Dyads combined	*47%*	*15.6%*	*50%*	*25%*	*51%*	*17%*
Intervention phase 2	Dyad 1	75%	62.5%	100%	100%	67%	50%
	Dyad 2	75%	50%	100%	100%	67%	33%
	Dyad 3	75%	50%	100%	0%	71%	57%
	Dyad 4	62.5%	25%	100%	100%	57%	14%
	Dyads combined	*72%*	*46.9%*	*100%*	*75%*	*66%*	*39%*
Follow-up	Dyad 1	75%	37.5%	100%	100%	67%	17%
	Dyad 2	25%	25%	50%	0%	17%	33%
	Dyad 3	87.5%	87.5%	100%	100%	83%	83%
	Dyad 4	75%	37.5%	75%	50%	75%	25%
	Dyads combined	*66%*	*46.9%*	*81%*	*63%*	*61%*	*40%*
Phases combined		*62%*	*36.5%*	*77%*	*54%*	*59%*	*32%*

Relationship between the Content of the Different Phases and the Effectiveness of the Intervention

The group analysis showed that for the four dyads combined, the intervention was most effective in the second intervention phase (i.e., video feedback coaching phase). The ratios for increase and effect sizes were both about 10% higher in the second intervention phase than in the follow-up phase and up to more than 30% higher than in the first intervention phase. Differences between effectiveness ratios of the three phases were even larger when results were related to targeted behaviors. Ratios for increase and effect size in the second intervention phase were 20–30% higher than in the follow-up phase and more than 50% higher than in the first intervention phase for targeted behaviors.

These high effectiveness ratios in the second intervention phase can be explained based on the content of this intervention phase but can also be related to the way the intervention was structured. The content of the second intervention phase differed from the first in terms of who targeted behaviors and how, and how strategies to improve communication were created. In the second intervention phase, video feedback was used to determine which behaviors could be targeted to improve and how. The strength of this phase was the ability of the coach and teacher to discuss and evaluate changes together. Earlier studies also showed the effectiveness of using video feedback coaching to stimulate behavioral change (Bloeming-Wolbrink, 2018; Damen et al., 2015; Damen, et al., 2020; Haakma, et al., 2017; Janssen, et al. 2003b, 2014; Martens et al., 2014a; Martens et al., 2017)

The structure of the intervention refers to the order in which the two intervention phases followed each other. For all dyads, the self-assessment phase preceded the coaching phase, which means that teachers had already worked for four weeks with the student on improving their self-assessed behavior(s) before the second intervention phase began. Since communication development in students with CDB occurs at a slow pace, the extra time between baseline and the second intervention phase might explain the higher effectiveness of this phase compared to the first intervention phase, in which the intervention had just started. However, following this line of reasoning, the follow-up phase should have been the most effective phase of the intervention. Since that was not the case, it can be argued that the high effectiveness of the second intervention phase benefited from the structure of the intervention, but it should be related to its content as well.

After the second intervention phase, effectiveness ratios were highest in the follow-up phase for the four dyads combined. This was found for ratios for increase as well as effect sizes, and regardless of whether they were related or unrelated to the targeted behaviors. No specific behaviors were targeted in the follow-up phase, since the intervention had ended. However, the fact that effectiveness measures were still found in this phase suggests that the teachers actively continued working on the behaviors that were targeted earlier in the intervention.

This is further supported by the finding that effectiveness ratios were higher when related to targeted behaviors than when related to all LCM behaviors in general. This means that teachers still focused on the behaviors that were targeted during the intervention. Earlier studies showed that the effectiveness of interventions on certain behaviors can diminish after they end, such as affective involvement and confirmation or imitation (e.g. Janssen et al., 2003b). The results of our study show that effectiveness is lower in the follow-up phase than during the second intervention phase, but still much higher than in the first intervention phase, so the effects of the intervention endured during follow-up.

While the first intervention phase was the least effective of the three phases, the effectiveness ratios were still around 50% for increase and around 20% for effect sizes for the four dyads combined. Effectiveness ratios were slightly higher when related to targeted behaviors than when unrelated to targeted behaviors (50% versus 47% for increase and 25% versus 15.6% for effect sizes). This means that the content of the intervention (the targeted behaviors) had influence on the increase in presence of LCM behaviors. Even though this self-assessment phase was less effective at improving communication than the coaching phase, it still contributed to increasing the presence of behaviors and therefore had a positive influence on improving communication.

Relationship between Targeted Behaviors and the Effectiveness of the Intervention

In addition to relating the effectiveness of the intervention to the different intervention phases, it was also related to behaviors that were and were not targeted. When the results of all the phases and dyads were combined, the effectiveness ratios were higher for targeted behaviors than for untargeted behaviors. Ratios for both increase and effect size were around 20% higher when related to the targeted behaviors than to the untargeted ones, which showed that targeting behavior(s) is important to increasing the presence of LCM behaviors. Setting specific and challenging goals can contribute to better task performance and increase motivation (Locke & Latham, 2006; McMillen & Hearn, 2008). In future research, more focus could be put on targeting specific LCM behaviors, especially in the first intervention phase.

When the effectiveness of targeted behaviors was analyzed per intervention phase, we found that effectiveness was 50% higher in the second intervention phase than in the first one. This means that not only was the method used in the second intervention phase (video feedback coaching) more effective than the one in the first intervention phase (self-assessment), but also that the choice of which behaviors to target and how to work on improving them influenced the change in presence of LCM behaviors. This is best reflected in the results when they are analyzed per dyad. For the dyads combined, the second phase was more effective, but when dyads were analyzed separately, it showed that the way behaviors were targeted could be related to the effectiveness of the first intervention phase.

Some teachers were clear in describing a target behavior and how to work on it, while others were a bit vague in the assignment or interpreted it differently. For example, the teacher

from dyad 1 chose one behavior to target and clearly described how she was going to work on improving its presence. For this dyad, effectiveness ratios were 100% for both increase and effect sizes. In dyads 2 and 3, the teachers were less obvious about targeting a behavior or did not clearly describe how they were going to work on improving it. This resulted in effectiveness ratios of 0% (dyad 3) and 50% (dyad 2) for increase and 0% for effect size. The teacher in dyad 4 initially targeted three behaviors, but none of them increased or showed effect sizes. During coaching sessions, the teacher and coach agreed that it would be more useful to target another behavior. And, in fact, effectiveness ratios for this jointly chosen other behavior increased to 100% in the second intervention phase. The differences in clarity between teachers when targeting a behavior and the effectiveness of the intervention show that it is important to not only target a behavior, but also to clearly describe how teachers will work on improving it.

Methodological Reflections and Recommendations for Future Research

Apart from the arguments that were discussed above about the higher effectiveness of the second intervention phase, the lower effectiveness of the first intervention phase can also be related to some of our methodological choices. The first intervention phase comprised a self-assessment by the teachers. We chose to let the teachers fill out and hand in the assignment individually at the start of the intervention phase. That allowed us to ascertain that the goals were completely self-set and unbiased by the coach. For that reason, teachers received no feedback about how they completed the assignment. In hindsight, the assignment was not always completed as expected, so feedback would have helped teachers set appropriate goals, which in turn could have increased the effectiveness of the first intervention phase.

Another methodological choice was the coding system we used. Our theoretical framework is based on the theory of intersubjective communication development (Bråten & Trevarthen, 2007), which has a strong focus on interpersonal communication. For that reason, our coding system was designed to code behavior that occurs between a dyad, instead of coding the behavior of the student or teacher separately. Although this has proven to be beneficial in describing a dyad's communication level (Wolthuis et al., 2019, 2020a) and has been helpful in determining which behaviors to target, it has one downside. Just coding the presence or absence of a behavior leaves out information about which person contributed most to the presence of a behavior. For example, the teacher in dyad 4 targeted *turn-taking* because she wanted to increase the number of turns made by the student. Because we coded only the presence of *turn-taking* regardless of whose turn it was, we could not analyze any increase in the number of turns taken by the student separately. The finding that the presence of the behavior *turn-taking* did not increase does not necessarily mean that the number of turns by the student did not increase. In cases in which specific targets are set *within* a LCM behavior (for one person in the dyad instead of the dyad as a whole), it is recommended that

the researcher perform an extra video analysis to evaluate change for that specific person in the dyad.

For future research it is recommended to replicate the use of this intervention in different settings, also for caregivers and parents. It could be necessary to adapt the workshop and home assignment to the knowledge level of caregivers and to that of parents and siblings. Adaptation of vide feedback coaching would be less relevant because that method has already proven to be useful in working with caregivers and parents (Fukkink, 2008; Janssen et al., 2010).

Another suggestion for further research would be to let other coaches conduct this intervention, and analyze the effectiveness on the intervention with different coaches, as in other deafblind studies (Damen et al., 2020). It would be even more effective to train CPs from educational or care settings to coach colleagues and thereby further monitoring the implementation of the intervention in practice.

Conclusion

This first study on the application of the LCM as a tool to improve communication showed that with a short-term intervention, communication can be improved when LCM behaviors are targeted to increase their presence. The LCM serves as a tool to describe the dyad's current level, which can help in setting goals to improve communication. Even though video feedback coaching was found to be more effective than self-assessment in this study, both phases resulted in increases in the presence of targeted behaviors and the effects endured during follow-up.

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