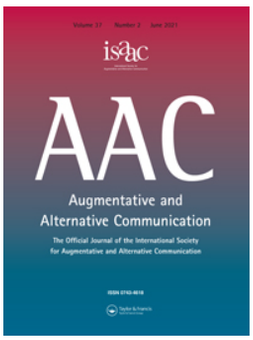
In search of a novel way to analyze early communicative behavior

Dhondt, Ann; Van Keer, Ines; Nijs, S; van der Putten, Annette; Maes, Bea

Published in:
AAC: Augmentative and Alternative Communication

DOI:
10.1080/07434618.2021.1928283

Publication date:
2021



Augmentative and Alternative Communication

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/iaac20

In search of a novel way to analyze early communicative behavior

Ann Dhondt, Ines Van keer, Sara Nijs, Annette van der Putten & Bea Maes

To cite this article: Ann Dhondt, Ines Van keer, Sara Nijs, Annette van der Putten & Bea Maes (2021) In search of a novel way to analyze early communicative behavior, Augmentative and Alternative Communication, 37:2, 87-101, DOI: 10.1080/07434618.2021.1928283

To link to this article: https://doi.org/10.1080/07434618.2021.1928283

Published online: 07 Jun 2021.

AUGMENTATIVE AND ALTERNATIVE COMMUNICATION
2021, VOL. 37, NO. 2, 87–101
https://doi.org/10.1080/07434618.2021.1928283

Taylor & Francis
Taylor & Francis Group

RESEARCH ARTICLE

In search of a novel way to analyze early communicative behavior

Ann Dhondt[a], Ines Van keer[a], Sara Nijs[a], Annette van der Putten[b] and Bea Maes[a]

[a]Faculty of Psychological and Educational Sciences, Parenting and Special Education Research Unit, Catholic University of Leuven, Leuven, Belgium; [b]Faculty of Behavioral and Social Sciences, University of Groningen, Groningen, Netherlands

ABSTRACT

The aim of this study was to develop a coding scheme that enables researchers and practitioners to conduct a detailed analysis of the communicative behavior of young children with significant cognitive and motor developmental delays. Currently, there is a paucity of methods to do conduct such an analysis. For the study, video observations of three different scenarios from 38 children with significant cognitive and motor developmental delays aged between 12 and 54 months, were used. Findings from the video observations served as the primary means for development of the coding scheme, which comprises three main categories – context, partner behavior, and individual behavior – and several subcategories. The coding scheme was used to document the early expressive communicative behavior of persons with significant cognitive and motor developmental delays in a detailed manner. This fine-grained information is necessary to differentiate children based on their communicative abilities, to monitor their communicative development longitudinally, and to inform person-centered communicative interventions.

ARTICLE HISTORY
Received 17 January 2020
Revised 28 April 2021
Accepted 2 May 2021

KEYWORDS
Coding scheme; early expressive communicative behaviors; profound intellectual and multiple disabilities; significant cognitive and motor developmental delays; young children

Introduction

Communication enables individuals to obtain valued quality of life outcomes in the domains of learning and development, interpersonal relations, and social participation (Light et al., 2019; Light, McNaughton, & Caron, 2019). Individuals with limited communicative abilities are at risk of experiencing low quality of life outcomes (Forster & Iacono, 2008; Nakken & Vlaskamp, 2007; Petry, Maes, & Vlaskamp, 2007). This is case for children with significant cognitive and motor developmental delays (among others), who have severe developmental delays in both the cognitive and motor domains and are likely, later in life, to be further categorized as having profound intellectual and multiple disabilities (Nakken & Vlaskamp, 2007). For the purpose of the current study, "children with a significant cognitive and motor developmental delays" and "children with profound intellectual and multiple disabilities" are used interchangeably.

The communication of young children with significant cognitive and motor developmental delays is severely impaired as a result of congenital conditions, such as pre-, peri- or postnatal brain injuries and genetic syndromes (Olswang, Feuerstein, Pinder, & Dowden, 2013). Communicative repertoires of these children are delayed because communication occurs mainly at a pre-symbolic level, through facial expressions, changes in muscle tone, body movements, and vocalizations (Granlund & Olsson, 1999; Stephenson & Dowrick, 2005). Similar communicative behaviors are reported in adults with profound intellectual and multiple disabilities who additionally occasionally exhibit challenging behavior (Griffiths & Smith, 2016; Hostyn, Daelman, Janssen, & Maes, 2010; Poppes, Van der Putten, & Vlaskamp, 2010). All these behaviors are considered to be communicative because communication may (a) be intentional or unintentional, (b) involve conventional or unconventional signals, (c) take linguistic or nonlinguistic forms, and (d) occur through spoken or other modes (National Joint Committee for the Communication Needs of Persons with Severe Disabilities (NJC), 1992).

According to Grove, Bunning, Porter, and Olsson (1999), communication is about two or more people working together and coordinating their actions in an ongoing response to each other and the context (Bunning, 2009). Communication partners thus play an essential role in enhancing or hindering children's communicative development by facilitating or reinforcing communicative behavior, or failing to recognize that a communicative attempt has occurred (Greathead et al., 2016; Nelson, van Dijk, McDonnell, & Thompson, 2002). The latter may lead to frustrating communicative attempts and ceasing endeavors to communicate on the children's side as well as on the partners' side (Greathead et al., 2016; Grove et al., 1999; Halle, Brady, & Drasgow, 2004).

Children with significant cognitive and motor developmental delays rely on the competencies of their communication partners to detect, recognize, and respond to their communicative attempts, which is challenging because of the previously described idiosyncratic and restricted behaviors (Granlund & Olsson, 1999). Knowledge about early communicative behaviors and development of these children is essential to the provision of effective support; however, different factors challenge reliable and valid assessments of

CONTACT Ann Dhondt ann.dhondt@kuleuven.be Vanderkelenstraat 32, bus 3765, 3000 Leuven, Belgium

individual capabilities. For example, the use of standardized developmental tests is not easily feasible because of the severity, multiplicity, and complexity of the limitations involved (Carnaby, 2007; Vlaskamp & Cuppen-Fonteine, 2007; Wessels & van der Putten, 2017). Often, items to assess communicative abilities also rely on cognitive, motor, and/or sensory skills, which are limited. Furthermore, there is a paucity of instruments available to assess expressive communicative abilities of these children (Chadwick, Buell, & Goldbart, 2019). A list of instruments used or mentioned in the literature is presented in the Appendix, each with a brief description of aim and target group.

Despite the challenges, some important principles in assessing communicative abilities in children with significant cognitive and motor developmental delays have become clear. First, considering the delay-difference paradigm, it should not be assumed that the developmental pathways of these children are the same as those of children with typical development (Carnaby, 2007; Visser, Vlaskamp, Emde, Ruiter, & Timmerman, 2017). Given that the severe motor and sensory impairments interfere not only with the execution but also with the development of communicative behavior, a qualitatively different and highly individual communicative development is likely (Houwen, Visser, van der Putten, & Vlaskamp, 2016; Olswang et al., 2013). Nevertheless, instruments to assess communicative abilities are often designed based on the typical developmental pathway.

Second, early communicative behaviors in individuals with profound and multiple disabilities are described as idiosyncratic and difficult to interpret and are most often not intentionally communicative (Atkin & Lorch, 2016; Hogg, Reeves, Roberts, & Mudford, 2001; McLean, Brady, McLean, & Behrens, 1999; Olsson, 2004). Still, in many of the available observational instruments, the individual's behavior is valued according to the interpretation of their communication partners, despite the difficulties with and precariousness of these interpretations (Granlund & Wilder, 2006). As a result, there is a danger that assessors interpret the behavior (e.g., wants something) instead of first observing the behavior (e.g., reaches for the object and smiles). Assessment of early communicative abilities should entail, first and foremost, observation of the behaviors, and only then be followed by interpretation of these behaviors. The assessor should also look at the sequence of these behaviors, in order not to miss any aspects such as persistence or reciprocity in the behavior, that are linked with the progression from the perlocutionary act to the illocutionary act (Sigafoos et al., 2000).

Third, communicative behavior is always embedded in an interaction between two or more persons. According to the ecological and transactional framework, social context is constructed by the interaction partners and the physical context and therefore determines the ongoing interaction (Batorowicz, King, Mishra, & Missiuna, 2016; Hostyn & Maes, 2009; Sameroff & Fiese, 2000; Siegel-Causey & Bashinski, 1997). Hence, both the interaction partners and the context should be part of the assessment of communicative behaviors in young children with cognitive and motor developmental delays (Griffiths & Smith, 2016; Hostyn & Maes, 2009; Hostyn et al., 2010; Ogletree & Pierce, 2010; Ogletree, Turowski, & Fischer, 1996; Wilder, 2008). Yet, many instruments only focus on the individual's behavior. Furthermore, it is preferable to observe these individual's behaviors across multiple activities and with different communicative partners, in order to have a comprehensive view of the person's performance (Greathead et al., 2016; Lohrmann-O'Rourke, Browder, & Brown, 2000).

Often used or mentioned in research and practice are the Early Social and Communication Scales (ESCS; Mundy et al., 2003), the Communication Matrix (Rowland, 2011), the Communication Complexity Scale (CCS; Brady et al., 2012, 2018) and the Communicative and Symbolic Behavior Scales (CSBS; Wetherby & Prizant, 2003); however, each of these instruments seems to neglect one or several of the principles previously noted. Both the ESCS and the Communication Matrix, for instance, meticulously describe in their codes or items how specific functions are communicated, and therefore invoke interpretation rather than observation, regardless of the idiosyncracy of the behaviors. The codes used in the ESCS include behavior that is not (yet) realizable for young children with multiple and profound disabilities. The items in the Communication Matrix are based on research on typically developing children between the ages of 0 and 24 months, which does not take into account potential qualitative differences in the communicative development of children with significant cognitive and motor developmental delays. The CSBS focuses on the communicative functions but does not question the behavior used for the function, while the Communication Complexity Scale does encourage the observation and not interpretation of the specific behavior but does not take into account the orientation of the behavior; assigning potential functionality or even only a preference in focus afterwards is precluded. Furthermore, children with significant cognitive and motor developmental delays all tend to perform similarly poorly on all of the scales reviewed, which implies that intra-individual or inter-individual differences are not reflected in the results (Olswang et al., 2013). Research by Dhondt, Van Keer, van der Putten, and Maes (2020), for instance, has demonstrated the lack of differentiation within this group for the early communicative behaviors using the Communication Matrix (Rowland, 2011).

Given the shortcomings of existing scales for this population, the aim of the current study was to develop a new coding scheme for detailed analyses of the early expressive communicative behaviors of young children with significant cognitive and motor developmental delays. To cater to the behavioral complexity of population, the scheme had to be consistent with (a) the difference-delay paradigm (questioning whether children with developmental disabilities develop in a way that is only delayed or also qualitatively different compared to typically developing children, Visser et al., 2017), (b) considerations regarding the tension between observation and interpretation, and (c) the ecological and transactional framework. The following research questions were addressed: (a) How does one define behavioral units in the early communicative behavior of young children with significant cognitive and motor developmental delays that

do not necessarily need to meet the requirements for intentional communication (this information is essential in order to develop a coding scheme)? (b) What coding categories and codes are essential to analyze these behavioral units, considering the ecological perspective on interaction (including aspects of context and partner) and the idiosyncratic nature of communication in this group (this is needed in order to make small but meaningful differences visible between children and over time)?

Method

This study is embedded in and used data from the first of five data points of a longitudinal project that is following the development of young children with significant cognitive and motor developmental delays, conducted at both the universities of Leuven and Groningen.

Participants and setting

Participants for the longitudinal project had to meet the following inclusion criteria: (a) aged between 6 and 59 months; (b) significant cognitive delay characterized with a discrepancy between functional and chronological age with a ratio of 1 to 4 or less (functional age was defined by the Tandemlijst, a questionnaire used by professionals to estimate children's overall developmental age; Stadeus, Windey, Raman, Vermeir, & Van Driessche, 1994); and (c) severe motor dysfunctions (i.e., functioning at Level IV or V, or Level III for participants under the age of 24 months, on the Gross Motor Function Classification System; Palisano et al., 2008). Participants were not excluded if they had additional challenges (e.g., a visual impairment). Neither was cause of the developmental delay a reason for exclusion. All participants were primarily non-speaking and functioned at a pre-symbolic and non- or pre-intentional communication level. All showed idiosyncratic communicative behaviors, making parents and caregivers question whether those behaviors were intentionally communicative (cf. field notes from conversations during home visits). At the outset of this project, 45 children participated. In designing the coding scheme, only the data of the 38 participants who provided complete data (at the time of this study) with regard to the coding scheme (all video observations) at the first data point were included. Table 1 presents detailed information about the participants. Data were collected during home visits or in the care facility where the participant lived during the week.

Table 1. Participants information ($N = 38$).

Characteristics	*n*
Nationality	
Belgium	18
The Netherlands	20
Gender	
Male	16
Female	22
Etiology	
Acquired brain injury	3
Genetic defect	14
Perinatal asphyxia	2
Unknown	18
Missing data	1
Vision – Hearing[a]	
Good	11 – 27
Quite good	4 – 4
Not so good	14 – 1
Blind/deaf	2 – 2
Unknown	2 – 1
Missing data	1 – 3
Motor functioning[b]	
<0.5	10
0.5 to < 1	10
1 to < 1.5	8
≥ 1.5	5
Missing	2
Additional health problems	
Gastro-oesophageal problems/digestion	18
Cardiovascular problems	2
Respiratory problems	11
Epilepsy	23
Other health issues	15

Participants were on average 36.24 months in age (range: 12.72–58.68, M = 36.24, SD = 12.68).

[a]Caregivers were given the possible options regarding their children's visual and auditory functioning in the questionnaire by means of checkboxes. No explicit operational definitions of the categories were given. In fact, all information in this table is collected by means of a questionnaire, and is therefore reflecting the caregiver's view on the participant;

[b]Motor functioning is operationalized by the mean score on a questionnaire based on the motor questions of the Portage Program. The average score on motor functioning was 0.89 (range: 0.003–1.68, M = 0.89, SD = 0.5). The questionnaire consisted of 145 items scored on a 3-point scale: score 2 when a child masters the skill, score 1 when a child is almost mastering the skill and score 0 when a child does not master the skill. A total score was calculated by adding up the item scores and a mean score was calculated. Mean score <0.5: developing toward turning head and obtaining some control over upper limbs (e.g., turning head or moving arm toward stimulus). Mean score 0.5 to <1: showing a development toward sitting independently for a short period of time and using upper limbs in a more controlled way (e.g., touching and holding objects). Mean score 1 to <1.5: developing toward being able to move independently, standing with support and using their upper limbs in a more exploratory way (e.g., pushing and taking objects). Mean score 1.5 to < 2: developing toward walking independently and using upper limbs in a more functional way (e.g., picking up a toy and putting it in a box).

Research design

A qualitative approach was used in this study. Literature on assessment tools used with the target group and several discussions with fellow researchers on the administration and scoring of the instruments used in the longitudinal research project served as sources of support. The decision was made to develop a coding scheme based on participants' behavior emerging from the data. The coding scheme had to meet the following criteria: (a) have the potential to demonstrate differences among children with significant cognitive and motor developmental delays in their early communicative abilities; (b) be able to describe communicative behaviors even before intentional communication is established (which is usually not yet present in the target group of children); (c) be able to take into account the idiosyncratic character of their communicative behaviors; (d) be able to include components with regard to the participants themselves, the interaction partners, and the context; and (e) be applicable across multiple activities and with different interaction partners.

The choice was made to use three different observations: (a) a structured situation with an unfamiliar interaction partner (i.e., a researcher), (b) a semi-structured situation with an unfamiliar interaction partner assisted by a familiar

interaction partner, and (c) a free-play situation with a familiar caregiver. First, in every video observation, behavioral units (excerpts) were delineated by the first author, based on an observed change in behavior in the participant. For every behavioral unit, thick descriptions were given. According to the Qualitative Research Guidelines Project (Lincoln & Guba, 1985), thick descriptions are defined as phenomena described in sufficient detail to enable the evaluation of the extent to which the conclusions drawn are transferable to other times, settings, situations, and people (Cohen & Crabtree, 2006). These accurate descriptions of the behavioral units should facilitate the understanding of particular patterns that are embedded in them (Griffiths, 2013). Second, these thick descriptions of the behavioral units were coded within several coding categories relating to context, partner behavior, and individual behavior.

Ethical approval for the longitudinal project was obtained at both participating universities' ethics Review Boards (S566510, ML10383).

Researchers

The first author delineated the behavioral units, retained and sorted all memos during the development of the coding scheme, and coded all thick description. Two master students assisted in the development of the coding scheme, first by attending several discussions and later as double coders. Fellow researchers (second and third authors) and study supervisors (fourth and fifth authors) were consulted on a regular basis with regard to the research design and procedures and operationalization of coding categories and codes.

Materials

Data from the first data point of the longitudinal project were used for each of the participants with a complete dataset. Parents and caregivers were asked to fill in some online questionnaires preceding the home visits. Three types of video observations utilizing different tools took place during the home visits: (a) an adapted version of the ESCS (Mundy et al., 2003), and (b) the Behavior Appraisal Scales (BAS; Vlaskamp, van der Meulen, & Smrkovsky, 1999) both executed by a researcher unfamiliar to the participants, and (c) a free-play situation with a familiar caregiver.

Mediacoder 2009 was used as the coding software to mark the behavioral units to code. This software was specifically developed for behavioral coding in media files, and was developed at the faculty of Behavioral and Social Sciences of the University of Groningen. The actual coding was performed in Microsoft Excel. Video footage was obtained from two different perspectives (frontal and overview) with two Sony HDR-CX405 Handycams on a tripod.

Procedures

Several researchers affiliated with the research units of the two universities involved in the project were tasked with the home visits, and committed to follow a strict protocol. A home visit took about 3 to 4 hr, and was completed in one or two visits (depending on the particular visit) over a 2-week period.

The ESCS is a videotaped standardized observation protocol to elicit early nonverbal communication skills, specifically, joint attention, behavioral requests, and social interaction. The adapted protocol is available upon request and encompasses mainly an abridgement of the original protocol, motivated by the severity of the disabilities and the limited attention span of the target group. Administration of the BAS entails an observation in a semi-structured situation in order to evaluate the participants' emotional communication, receptive language, general communicative behavior, visual behavior and explorative behavior. The procedure requires the participants to be provided with a number of objects and tasks, for which the researcher may provide as much encouragement as needed to obtain a representative image of the participants' functioning. The BAS allows for the caretaker to assist in the eliciting process and to provide additional verbal information throughout the observation. During the approximate 15-min unstructured free-play interaction between the participants and a familiar caregiver, the caregiver was instructed to act and play according as they would during a familiar interaction such as a play activity.

Data collection and analysis

All three videos of each of the participants were approached in the same way with regard to the coding procedure. The behavioral units (potential communicative acts, see Results) were marked by the first author in the original footage (ESCS, BAS, and free-play situation) with a timestamp of the onset of the unit. The procedure of the ESCS generated 10 hr 47 min 2 s of video in total, with an average of 17 min 2 s per participant (SD = 5 min 10 s). The total duration of BAS recordings was 17 hr 5 min 36 s, with an average of 26 min 59 s per participant (SD = 9 min 9 s). The free-play situation aimed observational data of 10 to 15 min, what resulted in 8 hr 5 min 34 s of video, on average 12 min 47 s per participant (SD = 2 min 19 s). In total, 6770 behavioral units were detected in 35 hr 58 min 12 s of video recordings. Each of those units was subsequently labeled with the number of the participant and the name of the video (ESCS, BAS of free-play) and included a timestamp of the onset of the unit.

The first author began by describing the demarcated behavioral units qualitatively (thick descriptions). Based on the ecological considerations, the description included not only information regarding the behavior of the participants but also the behavior of the communication partners (kind of prompt and other behavioral aspects such as commands, addressing other people in the room, scaffolding behavior) and specific aspects of the context (i.e., physical and social aspects of context such as used objects and present persons). This detailed description represents a thick description, inasmuch that a thickly described unit facilitates the visualization of what exactly happened.

Second, the thick descriptions were used for the actual development of the subcategories and codes, always starting

from the three main coding categories: Context, Partner Behavior, and Individual Behavior. Units were compared against each other and additional subcategories with new codes were created in order to make the differences between the units clear and to cater to the richness of the details and nuances in the thick descriptions. If there were any occasions when the need for a new category or code arose, coding started all over again; this was always noted in researcher's memos.

The codes emerged from the data in an iterative process until all coding categories were defined and codes were considered saturated. The process of drawing from existing research, consulting experts, systematically going back to the data, and repeating this process until saturation is met, shows significant resemblance to the methods described in the study of Griffiths (2013). Furthermore, all actions were documented in memos during the whole process of the development of the coding scheme. Inter-rater agreement (IRA) was calculated to find out whether codes and coding categories were self-evident and was discussed and reported on in these memos.

Trustworthiness

According to the Qualitative Research Guidelines Project (Cohen & Crabtree, 2006), working with thick descriptions is described by Lincoln and Guba (1985) as a way of achieving a type of external validity. First, the process began with three participants for whom the marking the behavioral units and providing a thick description happened in consensus with two master student; this was done in order to attune the way the behavioral units were identified and thickly described, and also permitted the master students to get acquainted with the procedure. Second, the coding process, together with development of the coding scheme, then began. Three different coders (the first author and two master students) coded the same three participants. They discussed differences and parallels in the codes and adjusted coding categories and codes based on those discussions. In the case of doubt or sense of incompleteness of the thick descriptions, the videos were checked again. For instance, this occurred if the description of the used modalities by the participant did not make sense to one of the coders, if the focus of the child was not mentioned in the thick description, or if one of the coders could not visualize what actually happened based on the description, etc. These units were traced back again in the video footage by the first author, who performed all of the thick descriptions; were adjusted as necessary, and then discussed with the other two coders until consensus was achieved for these first three participants. The definitions of coding categories and codes were then fine-tuned and the final coding scheme was determined. For the remaining 35 participants, the behavioral units were delineated and thickly described by the first author.

Inter-rater agreement

During Phase 2, the coders (i.e., two master students) each coded the thick descriptions of five participants with the coding categories and codes of the coding scheme. Inter-rater agreement (IRA) was calculated for the 10 participants that were double coded (five for each coder) on eight sub-coding categories. After the IRA calculations and discussions, coding categories were preserved and consolidated. The codes within these categories were considered saturated for the 13 participants already coded, but are considered to be potentially non-exhaustive. As part of the development of the coding scheme, all considerations and discussions with fellow researchers and coders were reported in researcher's memos and checked with findings from the literature. This was an ongoing iterative process of going back and forth in both in data and literature. The first author then completed the identification and description of the behavioral units for all other participants.

Results

Results are described in terms of (a) inter-rater agreement; (b) defining of behavior units (i.e., the potential communicative act); and (c) coding categories.

Inter-rater agreement

Cohen's Kappa between researcher and Students A and B was calculated for eight coding subcategories for each student separately. Inter-rater agreement scores with respectively Student A and Student B were as follows: for the category of Context with subcategory Setting (0.873, 0.857); for the category of Partner Behavior with subcategories Prompt (0.846, 0.984) and Scaffolding Behavior (0.69, 0.85); for the category of Individual Behavior with subcategories Focus (0.841, 0.965); Sum of 3 Undirected behaviors (Body, Head, Limbs; 0.75, 0.792), Sum of 4 Directed behaviors (Body, Head, Limbs, Visual; 0.55, 0.917), Sum of additional behaviors (Facial expressions and Early Sounds; 0.961, 0.994), Communication complexity (0.778, 0.969), initiative (0.837, 0.932), Signs of functionality (general codes; 0.750, 0.804), Signs of intentionality (general codes;0.420, 0.857), Level of behavior (general codes; 0.078, 0.527). The last subcategory, Level of behavior, was omitted in the final coding scheme because IRA was too low.

The potential communicative act

The first research question was about how to define behavioral units in the early communicative behavior of young children with significant cognitive and developmental delays. A communicative act is defined by Prizant and Wetherby (1987) as a sequence of observable behavior with three elements: the individual must (a) show a signal, form, or change in behavior; (b) that is directed toward another individual; and (c) can indicate some communicative function. As previously noted, the behaviors of children with significant cognitive and motor developmental delays are often very idiosyncratic and limited, which made the second and third elements of the definition difficult to achieve and even more difficult to recognize. Therefore, the notion of a *potential* communicative act (PCA) from the Inventory of Potential

Communicative Acts (Sigafoos et al., 2000) was adopted because it made a discussion of whether a specific behavior was intentional obsolete, that is, a PCA acknowledges the possibility that informal and idiosyncratic behaviors could be, or might become, effective forms of communication if communication partners consistently recognize and respond to particular actions as if they were, indeed, an individual's way of expressing a specific message (Downing & Siegel-Causey, 1988). The behavioral units for the current coding scheme were labeled as PCAs, with the operational definition of PCA being "any observable change in the (idiosyncratic) behavior exhibited by the individual that might have a communicative purpose or that can be interpreted by communication partners as such" (Sigafoos et al., 2000, p. 79). But, because children with significant cognitive and motor developmental delays are not always in control of the execution of their behaviors, neither the morphology or the contemporaneous performance nor the pace of their behaviors were, by definition, considered to be determining the PCAs. For this reason, there were no time restrictions with regard to the PCAs. The change in (a cluster of) behavior(s) was considered to be the onset of the PCA.

Coding categories

The second research question concerned what coding categories and codes are essential to analyze the behavioral units. The coding scheme includes three main coding categories: Context, Partner Behavior, and Individual Behavior and associated subcategories. Initial coding was used within each of these subcategories, after which the codes were clustered into broader secondary codes and labeled based on concepts from the literature (see Table 2).

The Context category is composed of the subcategories Instrument and Setting. The Partner Behavior category is comprised of the subcategories Prompt (provided by the

Table 2. Coding scheme used to code the thick descriptions (PCAs).

Category and subcategories	Specific codes and descriptions of codes with examples	General codes
Context		
Instrument (overall context in which the observation takes place)	ESCS (Early Social Communication Scales, Mundy et al., 2003): Structured protocol, unfamiliar interaction partner, elicitation tasks.	*Structured*
	BAS (Behavior Appraisal Scales, Vlaskamp et al., 1999): Semi-structured protocol, unfamiliar interaction partner caretaker can assist, elicitation tasks.	*Semi-structured*
	Free-Play Situation: Unstructured playing situation a with familiar caretaker.	*Un-structured*
Setting (the task or setting during which the interaction takes place)	Object (ball – document – foil – mirror – etc.): The interaction is set up in the light of two individuals interacting about an object (e.g., the wind-up toy from the ESCS is placed in front of the individual, playing with ball, etc.).	*Object related task*
	Book: A book is being introduced or present during the interaction.	
	Social interaction: The interaction takes place between individual and researcher/caregiver, no objects involved or presented by researcher/caregiver 'e.g., the partner is singing songs in front of individual, or they are dancing around).	*Social Interaction*
	Food/Drink: Eating or drinking situation (most probably not tube feeding).	*Food*
	Personal care: a situation of personal care toward the individual (e.g., changing, bathing, etc.).	*Personal Care*
	Intermezzo: The setting is changing from one of the previous codes to another (e.g., researcher is looking for some new toys).	*Intermezzo*
	Other: Settings that do not fit in any of the descriptions mentioned above.	*Other*
Partner Behavior		
Prompt (the specific prompt the interaction partner confronts the individual with)	Person presence: The partner is near the individual but does not do anything specific to attract the attention of the individual, such as doing some administration, or waiting.	*Person-related Prompt*
	Person activity: The partner is doing something in front of the individual without touching the individual (singing, talking, dancing, etc.).	
	Activity: The partner is doing something with the individual that includes touching, carrying, or any other activity that requires contact (e.g., dancing around).	*Activity-related Prompt*
	Object presentation: An object is given or shown to the individual.	*Object-related Prompt*
	Object presence: An object has been in front of the individual some time without moving or without being activated.	
	Object activity: An object is being moved in front of the individual (up and down, left to right, circles, etc.).	
	Object activation: An object is activated in front of the individual (light, music, movement, etc.).	
	In case the activated object is moved around: object activity.	
Scaffolding behavior (next to presenting the prompt, the additional actions the interaction partner uses in order to facilitate the interaction or to stimulate engagement in the interaction of the individual)	Next to presenting the prompt to the individual, the partner does not use any additional interaction-stimulating behavior.	*No code for Scaffolding Behavior*
	Attention: The partner draws the attention on self or on object.	*Code for Scaffolding Behavior*
	Affection: The partner shows some affection toward the individual.	
	Conversation: The partner askes the individual questions, addresses the individual, has a conversation with a third person, etc.	

(*continued*)

Table 2. Continued.

Category and subcategories	Specific codes and descriptions of codes with examples	General codes
	Obstruction: The partner hinders the individual by taking objects away, by restraining arm movements, etc. Interactional strategies: The partner uses a classic interactional strategy such as imitating the individual, facilitating turn taking, following actions or eye-gaze, etc. Instructing/rewarding: The partner is instructing the individual, encourages the individual, verbally rewards the individual, etc.	
Individual Behavior		
Concrete behavior (observed modalities used by the individual)	Undirected behaviors: Behaviors that show no orientation toward a focus, rather reflexive, early responses on internal and external stimuli: Body movement (tension, rocking), Head movement (banging, rocking), Limb movement (banging). Directed behaviors: There is a direction/orientation of the behavior. Body movement (leaning toward or moving away), Head movement (turning head toward or away something, someone), Limb movement (taking, touching, hitting, pushing, throwing, reaching toward, moving in the direction, etc.). and Visual behavior (eye-gaze). Additional potential communicative behavior: Facial expression (grimace, smile, frowning, etc.), Early sound (heavily breathing, screaming, laughing, clicking, etc.).	Code *0* or *1* for each body part or modality (9 coding categories: 3 undirected behaviors −4 directed behaviors- 2 additional behaviors)
Focus (orientation of the individual, established by looking, but also by touching, orienting face or leaning toward something or someone, etc.)	Activity: The individua is initiating or continuing a certain activity, repeating a part of the activity e.g., falling backwards on the lap of his communication partner.	*Activity*
	Object: The individual is looking, moving toward or touching an object.	*Object*
	Person: The individual is orienting toward (the face of) the communication partner.	*Person*
	Other person: The individual is orienting toward a person that is not immediately involved in the current interaction. Person-hands: The individual is orienting toward the hands of the interaction partner. Person-hands-self: The individual is orientating toward his or her own hands.	
	Condition: No specific orientation to be observed (e.g., reaction of reflex on internal or external stimulus without an expressed or observable focus).	*Condition*
Initiative (whether the individual or the interaction partner initiates the interaction)	If the behavior of the individual immediately follows a prompt or relates to a prompt from the partner, the behavior is prompted.	*Prompted*
	If the behavior is initiated by the individual, such as taking something that was already there, or the behavior is unexpected, such as orienting to the partner or vocalizing, the behavior is considered unprompted. Also, behavior in a reaction on an inner stimulus is considered to be unprompted by the partner (i.e., expressing discomfort without a focus).	*Unprompted*
Signs of functionality (the extent of idiosyncrasy of the behavior (better readable or interpretable), or the consistency of the relation between used modalities and potential meaning of the behavior	No signs of functionality.	*No Functionality*
	Attention: The individual draws the attention of the partner to oneself or to an object. Affection: The individual shows affection toward another person. Response: The individual shows a response to an instruction, question, conversation of the interaction partner (even if this response is minimal, such as looking at the object that is subject of the instruction). Intentional behavior: the individual shows intentional behavior (anticipating, action-reaction awareness, instrumentally using an object or the hands of a person to obtain something, making a choice between possibilities, etc.) without including the other in the interaction by a triadic eye-gaze or attention-shift (a mere instrumental use or another person).	*Positive code for Functionality*
	Indicating no: Showing discomfort, protesting (against something), rejecting something, etc.	*Negative code for Functionality*
Signs of emerging intentionality (the extent to which the behavior of the individual shows characteristics of intentional communication)	No signs of emerging intentionality.	*No code for Intentionality*
	Persistence: The behavior is being repeated, the individual does something over and over again, such as pushing something away, trying to take something, making sounds, etc. Goal-directed: The individual's movements or focus are decisive in nature or are clearly targeted toward the focus. Satisfaction: The individual shows satisfaction when a goal is met. Reciprocity: The individual's actions show a degree of reciprocity by imitating the interaction partner or by maintaining or initiating turn taking, etc.	*Code for Intentionality*
Communication complexity score	Assigned to all PCAs, whether or not initiated by the individual. See Brady et al., 2018).	*1–11*

Note: Presented codes fit with used sample. In none of the coding categories the codes are exhaustive. According to the specific situation used for the analysis of the communicative behavior, codes can be added or replaced as required, admittedly well-considered and motivated.

interaction partner) and the subcategory scaffolding behavior. The Individual Behavior category includes the subcategories of Concrete behavior, Focus, Initiative, Signs of functionality and Signs of emerging intentionality. Finally, there is the summative Communication complexity score (Brady et al., 2012, 2018).

Context

As previously mentioned social context is constructed by the interaction partners and the physical context (Batorowicz et al., 2016; Hostyn & Maes, 2009; Sameroff & Fiese, 2000; Siegel-Causey & Bashinski, 1997). Each of the PCAs was coded according to the administration of the instrument (1.1) in which the PCA is registered. Codes in the subcategory of Instrument were therefore *Structured* (ESCS), *Semi-Structured* (BAS) and *Un-structured* (Free-play situation). This provided concrete contextual information, because the protocol (high-structured or low-structured), and the persons present in the room (i.e., interaction partners) are known for each instrument. In the subcategory of Setting (1.2) the nature of the task the individual is confronted with (including used objects and present persons, i.e., physical context) is coded. Examples are *social interaction* or *Object related task*, or the kind of activity the individual is involved in, such as book reading *(Book),* or eating or drinking situation (*Food*). These codes are generic and can be used in almost any kind of setting because they were developed for the three different instruments with regard to design, structure, and communication partner.

Partner behavior

The category of Partner Behavior is divided into two subcategories. The first subcategory is the actual Prompt (2.1). This code reflects what actually happens nearest to, with or in front of the individual. Codes in this category are very concrete (i.e., *object presentation, object activation, person activity, activity*, etc.) and have a concise operational definition when to assign. The second subcategory is Scaffolding behavior (2.2), which was used when the communication partner actually used scaffolding behaviors, such as addressing (Scaffolding code: *drawing attention to something*) while presenting a new toy (Prompt code: *object presentation*), or encouraging the individual (Scaffolding code: *instructing/ rewarding*) who is trying to knock over the tower (Prompt code: *object presence*), caressing the individual (Scaffolding code: *showing affection*) while singing a song (Prompt code: *person activity*), presenting an object (Prompt code: *object presentation*) and deliberately preventing the individual to take it (Scaffolding code: *obstructing*).

Individual behavior

The Individual Behavior category (3.1), utilized behavioral categories in the Communication Matrix (Rowland, 2011) as a guideline for the subcategories of Concrete Behaviors: Body movements, Limb movement, Head movement, Early sound, Facial expressions and Visual behavior. Each subcategory was coded as either observed (Code 1) or unobserved (Code 0). For the subcategories of Limb, Head and Body movement, there is an additional division between Directed and Undirected behavior. For example, individuals rocking their body or shaking their head (the subcategories of Undirected Body or Undirected Head movement in the Communication Matrix) were coded differently than individuals leaning with the body toward something/someone or deliberately shaking yes/no (subcategories Directed Body or Directed Head movement). A similar consideration can be made regarding the difference between slapping of the arms (subcategory Undirected Limb movement) and reaching for or taking something (subcategory Directed Limb movement).

Other subcategories of Individual Behavior are designed to characterize the behavior of the individual in as much aspects as possible to observe. For example, the subcategory Focus (3.2) defines the orientation of the individual, and the different codes are *person, object*, and *activity*. In addition, the code *condition* is used in this subcategory of Focus in PCAs in which there is no specific observed focus: the change in behavior is in fact a reaction or a reflex to an internal or external stimulus without an expressed or observable orientation. It is possible to further differentiate within the code *person,* according to the body part the individual is focusing on (e.g., *hands* or *face* vs. *self* or *other*). This focus can be established by looking, but also by touching, orienting the face, or leaning toward something or someone. If necessary, a second and third focus can also be provided with a code.

The next subcategory, Initiative, defines whether the behavior of the individual is observed as prompted by the communication partner or initiated by the individual. The code *prompted* reflects some degree of responsivity of the individual to the behavior of the partner. The code *unprompted* is used in case the behavior is observed as more spontaneous and initiated by the individual (internal stimulus is possible here).

Finally, the need for ways to code more qualitative information regarding individual behavior which emerged from the data justifies additional differentiating subcategories of Signs of functionality (3.4) and Signs of emerging intentionality (3.5). These qualitative differences are linked with the emergence of intentional communication (Jansen et al., 2013; Neerinckx, Vos, Van Den Noortgate, & Maes, 2014; Paavola, Kunnari, & Moilanen, 2005; Prizant & Wetherby, 1987; Rowland, 2011). Signs of functionality (3.4) is applicable in case the behavior of the individual is less idiosyncratic, thus, assigning a function is less ambiguous. Examples of associated specific codes are *expressing discomfort, protest, etc.* (general code*: negative code for sign of functionality),* and *attention drawing, showing affection*, etc. (general code: *positive code for sign of functionality*). Because these behaviors are more recognizable for communication partners, they are more likely to generate a response and therefore facilitate the emergence of intentional communication (Greathead et al., 2016; Nelson et al., 2002; Prizant & Wetherby, 1987; Wong & Kasari, 2012). Signs of emerging intentionality (3.5) contains the specific codes for behaviors that show a certain character, such as *goal-directedness, persistence,* and *turn*

taking (general code*: code for intentionality)*, which might provide evidence of emerging intentionality (Bruce & Vargas, 2007; Prizant & Wetherby, 1987; Vandereet, Maes, Lembrechts, & Zink, 2010). Adding these subcategories permits differentiation between PCAs that otherwise would receive the same codes but are qualitatively different from each other. For example, a PCA of an individual taking a toy and dangling it in front of the communication partner while looking at the partner (signs of the functionality specific code *drawing the attention*) differs from an individual who merely takes the toy and looks at the partner (no code for signs of functionality). Another example is a PCA in which an individual throws a toy away for the third time (signs of the emerging intentionality specific code *persistence*), compared to individual touching a toy and the toy accidentally falling off the table (no code for signs of emerging intentionality).

Communication complexity score

After verifying all thick descriptions and codes for every category, the final step in the administration of the coding scheme was to assign a communication complexity score to the PCAs, which provided a summative and ordinal score for each PCA. According to the Communicative Complexity Scale (CCS; Brady et al., 2012, 2018), a score was applied to each PCA, including those that were elicited by an interaction partner. The intention was not to determine the communication complexity in a general way, as is the case with the CCS; rather, use of the CCS scales is designed to reflect the range of the communication complexity of the PCAs the participant exhibits in all contexts. To illustrate the application of the coding scheme, two potential communicative acts with thick description and codes are presented in Table 3.

Discussion

The aim of this study was to develop a coding scheme to analyze the early communicative behaviors of young children with significant cognitive and motor developmental delays. The scheme had to enable a detailed analysis and be in line with specific guiding principles found in literature. Video observations were used to identify behavioral units that were subsequently defined as PCAs. In order to analyze the thick descriptions of these behavioral units, coding categories and codes were created that characterized the units within the main categories of Context, Partner Behavior, and Individual Behavior. By focusing on PCAs (Sigafoos et al., 2000) rather than on communicative acts (Prizant & Wetherby, 1987), the question of whether the behavior was intentional was eliminated. By using this definition of PCA, the amount and type of behaviors to analyze were expanded to allow for the inclusion of even the most idiosyncratic and restricted behaviors reported in literature to be difficult to detect, recognize, and interpret. In the coding scheme, several subcategories are defined within the three main categories; in this way, the scheme enables fine-grained analysis of individuals' early communicative behavior, embedded in an interaction with a communication partner in a specific context.

Another strength of the coding scheme is that it meets the guiding principles for the analysis of early communication in children with significant cognitive and motor developmental delays as defined in the introduction of this paper. First, communicative behaviors are not measured in comparison with the communicative behaviors of typically developing children. Instead of taking codes top-down from existing developmental theories, codes were created bottom-up. Second, because of the focus on observation rather than interpretation of the behaviors, the main categories and codes were derived from objective descriptions of observations. The addition of the two subcategories - Signs of functionality and Signs of emerging intentionality – might obscure the fine line between observation and interpretation. However, this does not influence codes in the other categories because these categories could be considered only as additional qualitative information, at the level of specific individuals rather than group. Additionally, by first detecting the PCAs and describing them thoroughly in thick descriptions

Table 3. Two examples of coded potential communicative acts.

Thick descriptions Coding category/subcategory	Suzanne sits in her hair. Mother approaches in front of her and looks at her. Suzanne puts her hands on her mother's shoulders. Suzanne looks at her mother and vocalizes. Suzanne pulls her mother closer to her, closes her eyes. Codes for Suzanne	Flamingo stands still on the table in front of Rosie and is not activated. The researcher looks at Rosie and asks: 'Give it back'. Rosie frowns, moves her hands that are in front on her on the table slowly against flamingo, there's a little motion in the flamingo, Rosie looks at flamingo. Codes for Rosie
Context		
Instrument	*Un-structured (Free-play Situation; 0 min 29 s 585 ms)*	*Structured (ESCS; 1 min 36 s 818 ms)*
Setting	*Social interaction*	*Object related task*
Partner Behavior		
Prompt	*Person activity* (comes closer to individual)	*Object presence* (flamingo)
Scaffolding	*None*	*Instructing/rewarding*
Individual Behavior		
Concrete behavior	*Directed Limb movement, Visual behavior, Early sound*	*Directed Limb movement, Visual behavior, Facial expression*
Focus	*Person*	*Object*
Initiative	*Unprompted (arms)*	*Prompted*
Signs of functionality	*Affection*	*None*
Sings of emerging intentionality	*Goal-directed*	*None*
Communication Complexity score	*4* (single focus + 2 additional potential communicative behaviors)	*4* (single focus + 2 additional potential communicative behaviors)

and only later coding them within the subcategories of the three main categories, the tendency to interpret the behaviors of individuals is highly reduced. Third, three aspects of the ecological and transactional framework were included in the main categories, i.e., Context, Partner Behavior and Individual Behavior, each with two or more subcategories. Fourth, important components or perspectives of highly valued instruments were used in the coding scheme, such as the PCA concept from the IPCA (Inventory of Potential Communicative Acts; Sigafoos et al., 2000), the behavioral categories of the Communication Matrix (Rowland, 2011), and the CCS score (Communication Complexity Scale; Brady et al., 2012, 2018) to provide a summative score for each of the PCAs. Finally, because delayed reaction times are typical for children with significant cognitive and motor developmental delays, it is never possible to know for certain if an individual's behavior is elicited by any particular action of the communication partner or what is happening in the environment (Neerinckx et al., 2014). By eliminating time restrictions in determining the PCA, the effect of the possible delayed reaction is partly circumvented.

Clinical implications

The coding scheme developed in this study is by no means a replacement for existing and highly valued instruments, nor is it designed to discourage the ascribing of meaning to behaviors of children with significant cognitive and motor developmental delays in daily interactions. Rather, the scheme is intended to be an additional instrument in the assessment and detailed analysis of early communicative behavior in this target group. As such, this analysis can provide insights into the communicative behaviors of children with significant cognitive and motor developmental delays and uncover patterns that could enhance the validity of interpretations made during daily interactions. Furthermore, the coding scheme can be used to help clarify how aspects of communication within this group of children differ and how they have evolved over time or show signs of regression. Additionally, the coding scheme can be used as an outcome measure to evaluate the effects of a pre-symbolic intervention. For example, it may help in the analysis of possible different developmental routes of children with additional severe visual or hearing impairments or limited mobility.

The coding scheme in this study was mainly developed as an instrument for researchers. However, the scheme could also serve as a framework for professionals. They might use this scheme to evaluate their clients, aiming at assessing either their general communicative development or to focus on specific aspects, such as a change in behaviors or a shift from a focus on individuals to a greater focus on objects.

Limitations and future directions

The coding scheme shows potential to conduct a fine-grained analysis of early communicative behavior of young children with significant cognitive and motor developmental delays; however, a number of limitations must be considered. First, a relatively small group of participants were included in this study, for whom there was limited objective information available on their motor and cognitive functioning. Still, recruiting more participants and integrating even more instruments and questionnaires would not only have been very time-consuming but also would likely not have yielded much additional information. Considering that this is a very specific low-incidence population, 38 participants is actually a sizeable group, and the research apparatus (three different video-observations) was already extensive. Approximately 1 hr of video was analyzed for each of these 38 participants, which generated very detailed and qualitatively rich data regarding their communicative behaviors.

Second, the overall quality of the videos was not always high-standard, as the data was not always purposively collected to analyze early communicative behaviors. Still, a range of different observational protocols was used to collect information on the participants' development, thus, a large amount of data for each was available. For example, in some cases, only the overview of the situation and the face of the participant were filmed rather than the whole body, which made it difficult to evaluate undirected body movements. In addition, the specific tasks with which the participants were confronted were sometimes designed to elicit general rather than specific communicative behavior. Nonetheless, this variation actually made it possible to analyze the communicative behaviors of the participants in different settings with different partners, both familiar and unfamiliar. Furthermore, during double coding, the coders did not experience much doubt or uncertainties and managed to unambiguously assign codes in the different categories. This suggests that the codes did indeed reflect what was described in the thick description of the PCAs, but with the proviso that neither the reduction nor the cessation of a behavior could be captured with the coding scheme because this would result in a code "0" – although this does indicate a change in behavior. By performing a sequential analysis on the PCAs, those with the absence of a certain concrete behavior in comparison with previous or next PCAs could be analyzed. This would be specifically relevant at the individual level.

Third, because the coding scheme starts from the concept of the PCA, the coding procedure can be categorized as an *event coding strategy*, that is, the event to be coded is the description of the change of behavior. As a result, aspects of context and partner behavior are only taken into consideration in case of this event. Therefore, no conclusions can be made with regard to the context or partner behavior the participants confronted. Further analysis using, for instance, sequential analysis (Munde, Vlaskamp, Maes, & Ruijssenaars, 2014) might be a very interesting track to explore.

Fourth, it is not clear how thick a thick description should be. Both the thick descriptions and the coding may have been biased by the video footage or the perspective of the researcher, despite the strong focus on objectivity. Measures to minimize this bias might include consensus descriptions; however, this would make the process even more time-intensive. A stricter protocol on how to label and define the thick description might also be a potential solution.

Fifth, unlike Boundy, Cameron-Faulkner, and Theakston (2016), the coding scheme developed in this study does not involve a fine-grained analysis of motor aspects because children with severe developmental delays are not always in control of the execution and morphology of their behaviors. At this time, it is not yet clear if and how much a communicative behavior is related to a motor restriction. Therefore, the focus is on the presence or absence and the orientation of the behavior, directed toward or not toward something or someone, rather than on the quality of the execution of the behavior. It is very relevant, however, to explore the relationship between motor and early communicative behavior among children with severe developmental delays in future research, especially from a longitudinal perspective.

Finally, there is a concern regarding adding the Brady et al. (2012, 2018) CCS score to the current coding scheme. With the CCS, scores of 5 and higher indicate intentional communication. Yet, in order to receive such a score, individuals must demonstrate a dual focus, that is, shifting from person to object or activity, or vice versa. Although the attention shift from person to object is observable if exposed as a visual shift, the attention shift from person to activity is harder to observe. In addition, this way of scoring seems to imply that intentional communication can only occur if – in addition to a communication partner – there is also an object or activity involved. This complies with definitions of intentional communication in which coordinated attention between object and another person is regarded as a salient marker (Iacono, Carter, & Hook, 1998); however, intentional communication can also occur in the case of a single focus on the communication partner. According to Bruce and Vargas (2007), intentional communication is demonstrated when an individual understands that they have an impact on others. There are no objects or activities mentioned in this definition. Wetherby and Prizant (2003) summarized behavioral indicators for intentionality in prelinguistic individuals, such as alternating eye gaze between a goal and an interaction partner, awaiting a response from the receiver, etc. Despite these explicit criteria, however, it is not clear how many such indicators must be present in order to legitimately consider behavior as intentional communication. For this reason, the coding scheme developed in the current study included the optional category of signs of emerging intentionality. This category can provide additional information to motivate the potentiality of intentional communication, even in the case of single focus.

The coding scheme presented here aims to enable researchers to differentiate between young children with significant cognitive and motor developmental delays and identify very small steps within their communicative development. Further analysis of the codes in a subsequent study will indicate variations in the PCAs. Although it can be assumed that there are different communicative profiles and different developmental trajectories in the population studied, there is no evidence for such a conclusion in the existing literature. Analyzing the codes on an individual level, both cross-sectionally and longitudinally, will help to understand what pre-intentional communication looks like in children with significant cognitive and motor developmental delays and how their communicative abilities develop over time. Furthermore, as Iacono et al. (1998) advocate, it is necessary to modify the criteria for intentional communication in children with significant cognitive and motor developmental delays and to either look for alternative signals of intentionality that include modifications or changes in magnitude of behaviors or use clusters of behavior, which could differ somewhat across individuals. Likewise, Sigafoos (1997) suggest that intentionality could also be inferred by comparing the rate of specific behavior patterns in different social contexts. By analyzing the results of the coding scheme, we expect to deliver some of those alternative signals of intentionality. Finally, as previously noted, the coding scheme could be also be potentially helpful to clinicians however, feasibility will require additional research.

Conclusions

This study has described the development of a new tool that enables a very detailed analysis of early communicative behavior of young children with significant cognitive and motor developmental delays. The coding scheme considers the behavior of both the individual and their communication partner and as such respects the ecological perspective on interaction. Unlike other instruments, the newly developed coding scheme is tolerant for the idiosyncratic behaviors of the target group and aims at precisely describing the observed behavior, rather than interpreting the behavior.

Acknowledgements

The authors are grateful to Gertruud Schalen, Kristien Hermans, Lien Vanderkerken, Minou Nauta, Riëtte Krijgsheld and Stephy Colla for their contribution to the broader project in which this study is embedded. Lastly, the authors thank all participating families for their time, effort and enthusiasm.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The authors gratefully thank the Research Foundation Flanders, the Steunfonds Marguerite-Marie Delacroix (Belgium) and JKF Kinderfonds (The Netherlands) for their financial support for this project.

ORCID

Ann Dhondt http://orcid.org/0000-0003-1855-8718
Ines Van keer http://orcid.org/0000-0002-7848-1276
Sara Nijs http://orcid.org/0000-0002-6672-1009
Annette van der Putten http://orcid.org/0000-0003-4226-8147
Bea Maes http://orcid.org/0000-0002-5011-1134

References

Atkin, K., & Lorch, M. P. (2016). An ecological method for the sampling of nonverbal signalling behaviors of young children with profound and multiple learning disabilities (PMLD). *Developmental Neurorehabilitation*, *19*, 211–225. doi:10.3109/17518423.2014.935822

Batorowicz, B., King, G., Mishra, L., & Missiuna, C. (2016). An integrated model of social environment and social context for pediatric rehabilitation. *Disability and Rehabilitation*, *38*, 1204–1215. doi:10.3109/09638288.2015.1076070

Boundy, L., Cameron-Faulkner, T., & Theakston, A. (2016). Exploring early communicative behaviors: A fine-grained analysis of infant shows and gives. *Infant Behavior and Development*, *44*, 86–97. doi:10.1016/j.infbeh.2016.06.005

Brady, N. C., Fleming, K., Romine, R. S., Holbrook, A., Muller, K., & Kasari, C. (2018). Concurrent validity and reliability for the Communication Complexity Scale. *American Journal of Speech-Language Pathology*, *27*, 237–246. doi:10.1044/2017_AJSLP-17-0106

Brady, N. C., Fleming, K., Thiemann-Bourque, K., Olswang, L., Dowden, P., Saunders, M. D., & Marquis, J. (2012). Development of the communication complexity scale. *American Journal of Speech-Language Pathology*, *21*(1), 16–28. doi:10.1044/1058-0360

Bruce, S. C., & Vargas, C. (2007). Intentional communication acts expressed by children with severe disability in high-rate contexts. *Augmentative and Alternative Communication*, *23*, 300–311. doi:10.1080/07434610601179960

Bunning, K. (2009). Making sense of communication. In J. Pawlyn & S. Carnaby (Eds). *Profound intellectual and multiple disabilities: Nursing complex needs*. London: Wiley-Blackwell.

Carnaby, S. (2007). Developing good practice in the clinical assessment of people with profound intellectual disabilities and multiple impairment. *Journal of Policy and Practice in Intellectual Disabilities*, *4*(2), 88–496. doi:10.1111/j.1741-1130.2007.00105

Chadwick, D., Buell, S., & Goldbart, J. (2019). Approaches to communication assessment with children and adults with profound and multiple learning disability. *Journal of Applied Research in Intellectual Disabilities*, *32*, 336–358. doi:10.1111/jar.12530

Cohen, D., & Crabtree, B. (2006). Qualitative research guidelines project. Retrieved from http://www.qualres.org/HomeThic-3697.html

Coupe, J., Barton, L., Collins, L., Levy, D., & Murphy, D. (1985). *The affective communication assessment*. Manchester, UK: M.E.C.

Coupe-O'Kane, J., & Goldbart, J. (1998). *Communication before speech: Development and assessment*. London, UK: David Fulton.

Dewart, H., & Summers, S. (1988). *The pragmatics profile of early communication*. Windsor, UK: NFER Nelson.

Dhondt, A., Van Keer, I., van der Putten, A., & Maes, B. (2020). Communicative abilities in young children with a significant cognitive and motor developmental delay. *Journal of Applied Research in Intellectual Disabilities*, *33*, 529–541. doi:10.1111/jar.12695

Downing, J. E., & Siegel-Causey, E. (1988). Enhancing the nonsymbolic communicative behavior of children with multiple impairments. *Language, Speech, and Hearing Services in Schools*, *19*(4), 338–348. doi:10.1044/0161-1461.1904.338

Fenson, L. (2007). *MacArthur-Bates communicative development inventories*. Baltimore, MD: Paul H. Brookes Publishing Company.

Forster, S., & Iacono, T. (2008). Disability support workers' experience of interaction with a person with profound intellectual disability. *Journal of Intellectual and Developmental Disability*, *33*, 137–147. doi:10.1080/13668250802094216

Granlund, M., & Olsson, C. (1999). Efficacy of communication intervention for presymbolic communicators. *Augmentative and Alternative Communication*, *15*(1), 25–37. doi:10.1080/07434619912331278545

Granlund, M., & Wilder, J. (2006). Studying interaction between children who do not use symbols in interaction and their parents within the family system–methodological challenges. *Disability and Rehabilitation*, *28*, 175–182. doi:10.1080/09638280500077903

Greathead, S., Yates, R., Hill, V., Kenny, L., Croydon, A., & Pellicano, E. (2016). Supporting children with severe-to-profound learning difficulties and complex communication needs to make their views known. *Topics in Language Disorders*, *36*(3), 217–244. doi:10.1097/TLD.0000000000000096

Griffiths, C. (2013). Using grounded theory to analyze qualitative observational data that is obtained by video recording. *Grounded Theory Review*, *12*, 26–36.

Griffiths, C., & Smith, M. (2016). Attuning: A communication process between people with severe and profound intellectual disability and their interaction partners. *Journal of Applied Research in Intellectual Disabilities*, *29*, 124–138. doi:10.1111/jar.12162

Grove, N., Bunning, K., Porter, J., & Olsson, C. (1999). See what I mean: Interpreting the meaning of communication by people with severe and profound intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities*, *12*(3), 190–203. doi:10.1111/j.1468-3148.1999.tb00076

Halle, J., Brady, N. C., & Drasgow, E. (2004). Enhancing socially adaptive communicative repairs of beginning communicators with disabilities. *American Journal of Speech-Language Pathology*, *13*(1), 43–54. doi:10.1044/1058-0360

Hogg, J., Reeves, D., Roberts, J., & Mudford, O. C. (2001). Consistency, context and confidence in judgements of affective communication in adults with profound intellectual and multiple disabilities. *Journal of Intellectual Disability Research*, *45*(1), 18–29. doi:10.1111/j.1365-2788.2001.00289

Hostyn, I., Daelman, M., Janssen, M. J., & Maes, B. (2010). Describing dialogue between persons with profound intellectual and multiple disabilities and direct support staff using the scale for dialogical meaning making. *Journal of Intellectual Disability Research*, *54*, 679–690. doi:10.1111/j.1365-2788.2010.01292.x

Hostyn, I., & Maes, B. (2009). Interaction between persons with profound intellectual and multiple disabilities and their partners: A literature review. *Journal of Intellectual and Developmental Disability*, *34*, 296–312. doi:10.3109/13668250903285648

Houwen, S., Visser, L., van der Putten, A., & Vlaskamp, C. (2016). The interrelationships between motor, cognitive, and language development in children with and without intellectual and developmental disabilities. *Research in Developmental Disabilities*, *53-54*, 19–31. doi:10.1016/j.ridd.2016.01.012

Iacono, T., Carter, M., & Hook, J. (1998). Identification of intentional communication in students with severe and multiple disabilities. *Augmentative and Alternative Communication*, *14*(2), 102–114. doi:10.1080/07434619812331278246

Iacono, T., West, D., Bloomberg, K., & Johnson, H. (2009). Reliability and validity of the revised Triple C: Checklist of Communicative Competencies for adults with severe and multiple disabilities. *Journal of Intellectual Disability Research*, *53*(1), 44–53. doi:10.1111/j.1365-2788.2008.01121.x

Jansen, R., Ceulemans, E., Grauwels, J., Maljaars, J., Zink, I., Steyaert, J., & Noens, I. (2013). Young children with language difficulties: A dimensional approach to subgrouping. *Research in Developmental Disabilities*, *34*, 4115–4124. doi:10.1016/j.ridd.2013.08.028

Kiernan, C., & Reid, B. (1987). *Preverbal communication schedule (PVCS)*. Windsor, UK: NFER.

Lincoln, Y., & Guba, E. (1985). *Naturalistic Inquiry*. Newbury Park, CA: Sage Publications.

Light, J., McNaughton, D., Beukelman, D., Koch Fager, S., Melanie Fried-Oken, M., Jakobs, T., & Jakobs, E. (2019). Challenges and opportunities in augmentative and alternative communication: Research and technology development to enhance communication and participation for individuals with complex communication needs. *Augment Altern Commun)*, *35*(1), 1–12. doi:10.1080/07434618.2018.1556732

Light, J., McNaughton, D., & Caron, C. (2019). New and emerging AAC technology supports for children with complex communication needs and their communication partners: State of the science and future research directions. *Augment Altern Commun*, *35*(1), 26–41. doi:10.1080/07434618.2018.1557251

Lohrmann-O'Rourke, S., Browder, D. M., & Brown, F. (2000). Guidelines for conducting socially valid systematic preference assessments. *Journal of the Association for Persons with Severe Handicaps*, *25*(1), 42–53. doi:10.2511/rpsd.25.1.42

Mar, H., & Sall, N. (1999). *Dimensions of communication. Part I: Developing a Communication Profile [and] Part II: Designing an Intervention Plan. An Instrument To Assess the Communication Skills and Behaviors of Individuals with Disabilities*.

McLean, L. K., Brady, N. C., McLean, J. E., & Behrens, G. A. (1999). Communication forms and functions of children and adults with severe mental retardation in community and institutional settings. *Journal of Speech, Language, and Hearing Research*, *42*, 231–240. doi:10.1044/jslhr.4201.231

Munde, V. S., Vlaskamp, C., Maes, B., & Ruijssenaars, A. J. J. M. (2014). Catch the wave! Time-window sequential analysis of alertness stimulation in individuals with profound intellectual and multiple disabilities. *Child: Care, Health & Development*, *40*(1), 95–105. doi:10.1111/j.1365-2214.2012.01415.x

Mundy, P., Delgado, C., Block, J., Venezia, M., Hogan, A., & Seibert, J. (2003). *Early Social Ccommunication Scales (ESCS)* [Manual]. Coral Gables, FL: University of Miami.

Nakken, H., & Vlaskamp, C. (2007). A need for a taxonomy for profound intellectual and multiple disabilities. *Journal of Policy and Practice in Intellectual Disabilities*, *4*(2), 83–87. doi:10.1111/j.1741-1130.2007.00104.x

National Joint Committee for the Communication Needs of Persons with Severe Disabilities (NJC). (1992). *Guidelines for meeting the communication needs of persons with severe disabilities* [Guidelines]. Retrieved from www.asha.org/policy or www.asha.org/njc. doi:10.1044/policy.GL1992-00201

Neerinckx, H., Vos, P., Van Den Noortgate, W., & Maes, B. (2014). Temporal analysis of attentional processes in spontaneous interactions between people with profound intellectual and multiple disabilities and their support workers. *Journal of Intellectual Disability Research*, *58*, 721–733. doi:10.1111/jir.12067

Nelson, C., van Dijk, J., McDonnell, A. P., & Thompson, K. (2002). A framework for understanding young children with severe multiple disabilities: The van Dijk approach to assessment. *Research and Practice for Persons with Severe Disabilities*, *27*(2), 97–111. doi:10.2511/rpsd.27.2.97

Ogletree, B. T., & Pierce, H. K. (2010). AAC for individuals with severe intellectual disabilities: Ideas for nonsymbolic communicators. *Journal of Developmental and Physical Disabilities*, *22*(3), 273–287. doi:10.1007/s10882-009-9177-1

Ogletree, B. T., Turowski, M., & Fischer, M. A. (1996). Assessment targets and protocols for nonsymbolic communicators with profound disabilities. *Focus on Autism and Other Developmental Disabilities*, *11*(1), 53–58. doi:10.1177/108835769601100107

Olsson, C. (2004). Dyadic interaction with a child with multiple disabilities: A system theory perspective on communication. *Augmentative and Alternative Communication*, *20*(4), 228–242. doi:10.1080/07434610400005622

Olswang, L. B., Feuerstein, J. L., Pinder, G. L., & Dowden, P. (2013). Validating dynamic assessment of triadic gaze for young children with severe disabilities. *American Journal of Speech-Language Pathology*, *22*(3), 449–462. doi:10.1044/1058-0360

Paavola, L., Kunnari, S., & Moilanen, I. (2005). Maternal responsiveness and infant intentional communication: Implications for the early communicative and linguistic development. *Child: Care, Health and Development*, *31*, 727–735. doi:10.1111/j.1365-2214

Palisano, R., Rosenbaum, P., Walter, S., Russell, D., Wood, E., & Galuppi, B. (2008). Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Developmental Medicine & Child Neurology*, *39*(4), 214–223. doi:10.1111/j.1469-8749.1997.tb07414

Petry, K., Maes, B., & Vlaskamp, C. (2007). Support characteristics associated with the quality of life of people with profound intellectual and multiple disabilities: The perspective of parents and direct support staff. *Journal of Policy and Practice in Intellectual Disabilities*, *4*(2), 104–110. doi:10.1111/j.1741-1130.2007.00107.x

Poppes, P., Van der Putten, A. J. J., & Vlaskamp, C. (2010). Frequency and severity of challenging behavior in people with profound intellectual and multiple disabilities. *Research in Developmental Disabilities*, *31*, 1269–1275. doi:10.1016/j.ridd.2010.07.017

Prizant, B. M., & Wetherby, A. M. (1987). Communicative intent: A framework for understanding social-communicative behavior in autism. *Journal of the American Academy of Child & Adolescent Psychiatry*, *26*, 472–479. doi:10.1097/00004583-198707000-00002

Rowland, C. (2011). Using the communication matrix to assess expressive skills in early communicators. *Communication Disorders Quarterly*, *32*(3), 190–201. doi:10.1177/1525740110394651

Sameroff, A. J., & Fiese, B. H. (2000). Transactional regulation: The developmental ecology of early intervention. In J. P. Shonkoff & S. J. Meisels (Eds). *Handbook of early childhood intervention* (2nd ed.). pp. 135–159. Cambridge, UK: Cambridge University Press.

Seibert, J. M., & Hogan, A. E. (1982). *Procedures Manual for the Early Social-Communication Scales (ESCS)*. Mailman Center for Child Development, University of Miami.

Siegel-Causey, E., & Bashinski, S. M. (1997). Enhancing initial communication and responsiveness of learners with multiple disabilities: A trifocus framework for partners. *Focus on Autism and Other Developmental Disabilities*, *12*(2), 105–120. doi:10.1177/108835769701200206

Sigafoos, J. (1997). A review of communication intervention programs for people with developmental disabilities. *Behaviour Change*, *14*(3), 125–138. doi:10.1017/S0813483900003430

Sigafoos, J., Woodyatt, G., Keen, D., Tait, K., Tucker, M., Roberts-Pennell, D., & Pittendreigh, N. (2000). Identifying potential communicative acts in children with developmental and physical disabilities. *Communication Disorders Quarterly*, *21*(2), 77–86. doi:10.1177/152574010002100202

Smidt, A. (2017). Mosaic. A Model of Observational Screening for the Analysis of Interaction and Communication. https://www.mosaiccommunication.com.au/pvcs

Stadeus, A., Windey, K., Raman, M., Vermeir, G., & Van Driessche, S. (1994). *Tandemlijst voor jonge kinderen met ontwikkelingsmoeilijkheden: Handboek voor de begeleider [Manual]*. Maklu, Garant.

Stephenson, J., & Dowrick, M. (2005). Parents' perspectives on the communication skills of their children with severe disabilities. *Journal of Intellectual & Developmental Disability*, *30*(2), 75–85. doi:10.1080/13668250500125031

Vandereet, J., Maes, B., Lembrechts, D., & Zink, I. (2010). Eliciting proto-imperatives and proto-declaratives in children with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities*, *23*(2), 154–166. doi:10.1111/j.1468-3148.2009.00517.x

van der Gaag, A. (1988). *CASP: The communication assessment profile for adults with a mental handicap*. London, UK: Speech Profiles Limited.

Visser, L., Vlaskamp, C., Emde, C., Ruiter, S. A., & Timmerman, M. E. (2017). Difference or delay? A comparison of Bayley-III Cognition item scores of young children with and without developmental disabilities. *Research in Developmental Disabilities*, *71*, 109–119. doi:10.1016/j.ridd.2017.09.022

Vlaskamp, C., & Cuppen-Fonteine, H. (2007). Reliability of assessing the sensory perception of children with profound intellectual and multiple disabilities: A case study. *Child: Care, Health and Development*, *33*, 547–551. doi:10.1111/j.1365-2214.2007.00776.x

Vlaskamp, C., van der Meulen, B. F., & Smrkovsky, M. (1999). *GedragsTaxatie-Instrument GTI: Voor personen met ernstige meervoudige beperkingen*. Groningen: Stichting Kinderstudies.

Wessels, M. D., & van der Putten, A. A. (2017). Assessment in people with PIMD: Pilot study into the usability and content validity of the Inventory of the Personal Profile and Support. *Cogent Psychology*, *4*(1), 1340082–1340010. doi:10.1080/23311908.2017.1340082

Wetherby, A., & Prizant, B. (2003). *Communication and Symbolic Behavior Scales Developmental Profile (CSBS DP) Infant-Toddler Checklist and Easy-Score [Manual]*. Baltimore, MD: Paul H. Brookes Publishing.

Wilder, J. (2008). Video observations of dyadic interaction: Behavior style of presymbolic children. *Scandinavian Journal of Disability Research*, *10*(2), 104–124. doi:10.1080/15017410801900390

Wong, C., & Kasari, C. (2012). Play and joint attention of children with autism in the preschool special education classroom. *Journal of Autism and Developmental Disorders*, *42*, 2152–2161. doi:10.1007/s10803-012-1467-2

Appendix.

Overview of instruments for the assessment of early communicative behaviors

Assessment and authors	Type of instrument	Target group	Description
(Abridged) Early Social Communication Scales (ESCS; Mundy et al., 2003) (Original version; Seibert et al., 1982)	Observation (highly structured)	Children with autism spectrum disorder (ASD); children with typical development with developmental age between 8 and 30 months	Videotaped structured observation to provide measures of individual differences in nonverbal communication skills that typically emerge in children between 8 and 30 months of age. Measure is designed to elicit early nonverbal communication skills, more specifically joint attention, behavioral requests, and social interaction.
Affective Communication Assessment (ACA; Coupe et al., 1985)	Observation	Individuals with profound and multiple disabilities	Observation protocol for pre-intentional communication (physical, facial, and vocal responses to an individualized set of stimuli; events, people actions, sensations). A practical tool to enable practitioners to recognize how their clients react to experiences, by responding to the behaviors seen in association with positive and negative preferences.
Communication Assessment Profile (CASP; van der Gaag, 1988)	Questionnaire and checklist	Individuals with cognitive disabilities	Based on the premise that caregiver and professional have an equal status in the assessment procedure. The profile is divided into three parts. Part 1 is a questionnaire filled out by the caregiver. Part 2 consists of several sections: conversational skills, intelligibility, receptive and expressive skills at word level and sentence level, a scale of communicative functions, a checklist of expressive skills. Part 3 is jointly completed by both caregiver and professional, during which information gathered by both assessors is analyzed and a list of priorities for change is drawn up.
Communication Complexity Scale (CCS; Brady et al., 2018, 2012)	Observation	Individuals with intellectual and developmental disabilities	A 12-point scale to measure expressive communication, ranging from alerting responses to two-word/symbol combinations. Based on participant behavior toward objects, people, and events of interest (referents) and explicitly states need to rely on well-developed and researched theories of early communication development.
Communication Dimensions (Mar & Sall, 1999)	Observation	Individuals with severe disabilities	Natural observations and structured one-to-one interactions are rated for six specific qualities, or dimensions, of expressive and receptive communication behaviors: symbol use, intent, complexity, social action, vocabulary use and comprehension.
Communication Matrix (Rowland, 2011)	Questionnaire (online)	Individuals with severe or multiple disabilities	An assessment tool designed to develop communicative profiles. The Matrix provides a clear overview of the expressive communicative abilities of the individual, with an emphasis on abilities (i.e., the functional use of communication). Structured around seven levels of communication development (pre-intentional behavior, intentional behavior, unconventional behavior, conventional communication, concrete symbols, abstract symbols, language) and four global reasons to communicate (refuse things, obtain things, engage in social interaction, seek/provide information).
Communicative and Symbolic Behavior Scales Developmental Profile & Behavior Sample (CSBS) (Wetherby & Prizant, 2003)	Questionnaire and direct observation	For children with ASD whose functional age is between 6 and 24 months, but also for preschool children with a chronological age of up to 5–6 years if their developmental level of functioning is younger than 24 months	This caregiver questionnaire is an informant- report measure that includes pre-symbolic items. It consists of 41 multiple-choice items covering the following areas: emotion and eye gaze, communication, gestures, sounds, words, understanding, and object use. Designed to be filled out independently by parents in about 20 min. A few measures of pre-symbolic communication involve directly observing child communication behaviors. The behavior sample from provides opportunities for children to communicate with gestures and vocalizations in addition to words.
Early Communication Assessment (Coupe O'Kane & Goldbart, 1998 Reprinted in 2018)	Checklist for observation	Individuals with profound and multiple disabilities	Six levels of communication are defined in the Assessment, which correspond broadly with the six sensori-motor stages of cognition; organized in 13

(*continued*)

Continued.

Assessment and authors	Type of instrument	Target group	Description
			areas of communication. Based on a video and items (372) within the 13 areas of communication.
Inventory of Potential Communicative Acts (Sigafoos et al., 2000)	Questionnaire (interview)	Individuals with developmental and physical disabilities and severe communication impairment	Interview schedule to be completed by parents, teachers, and therapists. It consists of 53 questions asking informants to indicate how the child communicates 10 distinct pragmatic functions.
MacArthur-Bates Communicative Development Inventories (Fenson, 2007)	Interview	Children from 8 to 37 months	Standardized, parent-completed report forms that track young children's language and communication skills. The checklists yield reliable information on the course of language development from children's first nonverbal gestures and early signs of comprehension to the expansion of vocabulary and the early stages of grammar.
Pragmatics Profile of Everyday Communication (Dewart & Summers, 1995)	Interview	Children (2 versions: 0–4 years old and 5–10 years old)	A pragmatic approach to communication development, focusing on how the child communicates in everyday life. Includes two structured interviews (one for 0–4 year-olds and one for 5–10 year-olds) to be administered to parents and/or teachers. The interviews comprise four sections: Communicative Functions; Response to Communication, Interaction and Conversation, and Contextual Variation.
Preverbal Communication Schedule (PVCS) (Kiernan & Reid, 1987)	Checklist	Non-verbal communicators	The PVCS is a checklist and rating scale that allows teachers to analyze the ways in which students communicate through non-verbal means and evaluate their particular strengths.
Updated version by Smidt, Andy (2017) www.mosaiccommunication.com.au/pvcs	Checklist	Non-verbal communicators	The PVCS schedule consists of 195 items divided into 27 sections, the majority of which ask whether a particular ability or behavior is shown by the individual. Some items, mostly concerned with imitation skills and the understanding of non-vocal communication, ask the teacher to test the pupil on simple tasks.
Triple Checklist of Communication Competencies – Revised (Triple C) (Iacono et al., 2009)	Checklist	Adolescents and adults with severe or multiple disabilities	A screening tool to help recognize unique behaviors, skills, and abilities and determine o person's current stage of communication. Divided into six stages: The first three show skills seen in pre-intentional (unintentional) communicators; the final three show skills seen with individuals who communicate intentionally.

This list is not exhaustive.