


Do gestures pave the way?: A systematic review of the transitional role of gesture during the acquisition of early lexical and syntactic milestones in young children with Down syndrome

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Abstract

Expressive language problems are common among children with Down syndrome (DS). In typically developing (TD) children, gestures play an important role in supporting the transition from one-word utterances to two-word utterances. As far as we know, an overview on the role of gestures to support expressive language development in children with DS is lacking. This systematic review aims to synthesize the current state of empirical evidence on the role of gestures during the acquisition of early lexical and syntactic milestones in young children with DS. A systematic literature search was performed using Pubmed, Scopus, PsycINFO and Web of Science databases. A total of 12 studies met the inclusion criteria. Results show that children with DS produce the same gestures and go through the same early expressive language stages of development as TD children. For children with DS, however, developmental stages are significantly delayed and, most importantly, the stage of supplementary gesture-plus-word combinations is rarely observed. Incorporating both verbal communication and gestures in daily communication between the child with DS and his/her parent might facilitate the child's transition from one-word utterances to

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two-word utterances. Such activities should be incorporated into early language intervention programs.

Keywords

Down syndrome, early language development, gestures, syntax, vocabulary, syntax

I Introduction

There is converging evidence that gesture and spoken language are closely linked in young typically developing (TD) children (Capirci and Volterra, 2008). With their Bridging Hypothesis, Fenson et al. (1994) argued that 'deictic' gestures (e.g. SHOWING, GIVING, POINTING) connect the transition from verbal comprehension to verbal production. At the end of the first year of life, the emergence of first words is preceded and accompanied by such deictic gestures to draw attention to objects or events (Capone and McGregor, 2004). At approximately 12 months of age, 'representational' gestures emerge. These gestures are symbolic in nature and are used to convey the meaning of an object or event to a social partner (e.g. flapping arms for BIRD). Gestures not only precede early language development but also predict children's later verbal language development (Capirci et al., 1996; Iverson and Golden-Meadow, 2005). For instance, the onset of pointing production is a reliable predictor of the appearance of the first word, and the production of gesture-word combinations, which emerge around the age of 18 months, predicts the appearance of two-word utterances (Butcher and Goldin-Meadow, 2000; Camaioni et al., 1991). Moreover, semantic relationships conveyed in gesture-speech combinations seem to be one of the first combinations observed in two-word combinations (Capirci et al., 1996; Iverson and Golden-Meadow, 2005; Özçalışkan and Golden-Meadow, 2005). Therefore, the production of gesture-plus-word combinations seems to pave the way for the onset of combining words. In particular, the onset of supplementary gesture-word combinations (e.g. POINT AT A BIRD and say 'fly'), as distinguished from equivalents (WAVE BYE and say 'bye') and complementary combinations (POINT AT A BIRD and say 'bird'), seems to predict the later emergence of word combinations in TD children (Bates and Dick, 2002; Capirci et al., 1996; Iverson and Goldin-Meadow, 2005).

Although gesture seems to be of major importance in the development of spoken language in TD children, the question arises whether gestures play a similar role in children with developmental disabilities involving impaired linguistic abilities. For instance, when children are limited in cognitive, linguistic and articulation skills they may compensate for these limitations with gestures (Capone and McGregor, 2004). For example, in a longitudinal study in children with an intellectual disability (ID) the authors reported an increase in the use of spoken words for children with an ID and TD children, but in TD children gesture use decreased over time whereas it remained fairly stable in children with ID (Vandereet et al., 2011). For both groups, however, gesture-word combinations typically preceded two-word utterances. Children with Down syndrome (DS) constitute a large group within the population of children with ID, and many studies have shown that the linguistic abilities of children with DS are below what is expected based on the overall cognitive level of functioning (Chapman, 1997; Martin et al., 2009). Children with DS show a preference for nonverbal communication as they use more gestures than TD children. It is, however, unclear what role gestures plays in the development of spoken language in children with DS. Is this role similar to that in TD children? To our knowledge, no systematic reviews have been conducted to date on this topic.

Table 1. Search terms and respective yields.

Search source	Search terms	Number of abstracts
Pubmed, Scopus, PsycINFO and Web of Science	('gestures') AND ('language' OR 'vocabulary' AND ('Down's syndrome' OR 'Down syndrome'))	130 OR 'syntax')
Published reviews	References from Abbeduto et al., 2007; Martin et al., 2009; Roberts et al., 2007	1
Ancestral search	References from identified studies	0
Total number of abstracts reviewed		131

The aim of the present study is to systematically review the literature on the relationship between gestures and spoken language in children with DS. The systematic review was carried out according to the EPPI-Centre guidelines (EPPI-Centre, 2007).

II Methods

1 Identification of studies

Prior to the identification of studies, inclusion criteria concerning participant characteristics and outcome measures were determined. Using these criteria, three methods were applied to identify studies that measured gesture and preverbal language development and/or early language development (i.e. lexical and/or syntactic development) in children with DS. First, a literature search was conducted in Pubmed, Scopus, PsycINFO and Web of Science databases for the period 1979 to 2013. The key words used in these searches are listed in Table 1. Of the 142 articles retrieved, 12 were duplicates. Second, the reference list of previous literature reviews (Abbeduto et al., 2007; Martin et al., 2009; Roberts et al., 2007) were reviewed for studies that met the inclusion criteria. Finally, the reference lists of all retrieved studies were examined.

We selected studies according to the explicit and rigorous methods described by the EPPI-Centre for carrying out systematic reviews (EPPI-Centre, 2007). We included studies that met two inclusion criteria: (1) the study included children with DS aged 0–7 years, and (2) the study measured gesture and preverbal language development and/or early language development (i.e. lexical and/or syntactic development). Only articles published in English were selected.

As shown in Table 1, the search yielded 131 unique abstracts for review. The first and second authors (DK and MJ) read the abstracts and determined whether each article met the inclusion criteria. A total of 119 articles were excluded for one of the following reasons: review study ($n = 12$), participants were not exclusively children with DS ($n = 20$), participants were adults with DS ($n = 3$), articles were not available ($n = 3$), or the study did not measure gestures and early language development (i.e. no measure of vocabulary and/or syntax development) ($n = 81$). This systematic review reports on the 12 remaining studies (Table 2).

2 Description of included studies

a Participant characteristics. In almost all studies ($n = 11$) the children with DS were aged from 8 months to 5;9 years. The exception was one study in which the children were aged from 3;8 to 8;3 years (Stefanini et al., 2007).

Table 2. Studies involving gestures and early language development of children with Down syndrome published from 1979 to 2013.

Study/subject	Design	Aim	Participants	Instruments	Results
<i>Deictic gestures:</i>					
Franco and Wishart (1994)	Cross-sectional correlation study	Examine the frequency and nature of pointing by children with DS	22 DS (14 girls / 8 boys) <ul style="list-style-type: none"> • CA 1;9–3;11 years • MA (not reported) • Severe sensory or motor impairment excluded 	Video recordings of different communicative contexts Reynell	Children with DS produced different gesture patterns in different communicative contexts
Mundy et al. (1995)	Longitudinal comparison study	To compare the use of nonverbal requesting in children with DS and MA-matched TD children	37 DS (19 girls / 18 boys) <ul style="list-style-type: none"> • CA 1;3–2;5 years • MA 0;11–1;9 years • No known gross visual or auditory impairments 25 TD (13 girls / 12 boys) <ul style="list-style-type: none"> • CA 0;10–1;7 years 	CIIS Reynell BSID MAI ESCS	Children with DS showed a disturbance in nonverbal requesting. Individual differences in nonverbal requesting were associated with subsequent expressive language development
Ramrutton and Jenkins (1998)	Cross-sectional Comparison study	Compare pre-linguistic communication skills in children with DS and non-delayed children. Participants matched for one-word comprehension level on the Derbyshire Language Scheme	10 DS (4 girls / 6 boys) <ul style="list-style-type: none"> • CA 1;9–4;5 years • MA 1;7–1;9 years • No severe motor or sensory impairments 10 TD (5 girls / 5 boys) <ul style="list-style-type: none"> • CA 1;7–1;9 years 	PPECS Video recordings of mother-child dyad	Children with DS showed significant delays in using referential eye contact and words
<i>Gestures and early lexical development:</i>					
Caselli et al. (1998)	Cross-sectional Comparison study	Compare early communicative and linguistic development in children with DS and TD children matched on comprehension of words	40 DS (15 girls / 25 boys) <ul style="list-style-type: none"> • CA 0;10–4;1 years • MA not reported • WCA 0;5–1;11 years 40 TD (15 girls / 25 boys) <ul style="list-style-type: none"> • CA 0;8–1;5 years 	CDI	No significant differences were found on verbal production between children with DS and TD children matched for lexical comprehension

Table 2. (Continued)

Study/subject	Design	Aim	Participants	Instruments	Results
Chan and lacono (2001)	Longitudinal correlation study	Investigate role of gestures in emergent language	3 DS (3 girls) <ul style="list-style-type: none"> • CA 1;5–1;7 years • MA 0;8–1;0 years • adequate auditory and visual skills, 	gestures, communicative functions, comprehension, vocalizations and first words	Most frequent gesture types were conventional, deictic and enactive naming. The most frequent functions were comments, acknowledgements and requests. Gesture production occurred prior to the production of words
Galeote et al. (2011)	Cross-sectional comparison study	Compare lexical development of children with DS and MA matched TD children	186 DS (89 girls / 97 boys) <ul style="list-style-type: none"> • CA 0;1–5;9 years • MA 0;8–2;5 years • adequate auditory and visual skills, 186 TD (89 girls / 97 boys) <ul style="list-style-type: none"> • CA 0;8–2;5 years 	Brunet-Lézine CDI	No significant differences in oral production were found. Only significant differences were found between children with DS and children with TD regarding gestural production with a gestural advantage in the DS group
Galeote et al. (2008)	Cross-sectional comparison study	Compare the vocal and gestural modalities in lexical development in children with DS and MA matched TD children	66 DS (26 girls / 40 boys) <ul style="list-style-type: none"> • CA 2;1–4;8 years • MA 1;2–2;4 years • adequate auditory and visual skills, 66 TD (26 girls / 40 boys) <ul style="list-style-type: none"> • CA 1;2–2;4 years 	CDI	Number of words produced by children with DS and TD children was similar when words and gestures were combined. Children with DS showed a preference for gesture use
<i>Gestures and early lexical development:</i> Kay-Raining Bird et al.(2000)	Longitudinal comparison study	Compare input modality on the acquisition of new words in children with DS and MA matched TD children	10 DS (girls/boys) <ul style="list-style-type: none"> • CA 2;1–5;2 years • MA 1;2–2;6 years • adequate auditory and visual skills, 10 TD (girls/boys) <ul style="list-style-type: none"> • CA 1;2–2;6 years 	Audio- and videotapes BSID CDI (Toddler version)	Children with DS comprehended fewer words than TD children. There was no difference in learning novel words across modality conditions (signed, spoken or signed and spoken)

(Continued)

Table 2. (Continued)

Study/subject	Design	Aim	Participants	Instruments	Results
Stefanini et al. (2007)	Cross-sectional comparison study	Compare lexical production, speech and gestures in children with DS and MA matched TD children	15 DS (7 girls / 8 boys) <ul style="list-style-type: none"> • CA 3;8–8;3 years • MA 2;6–4;3 years • adequate auditory and visual skills, 30 TD (14 girls / 16 boys) <ul style="list-style-type: none"> • CA 2;6–4;4 years 	Lexical production task Videotaped observation session	Children with DS were less accurate in speech and produced more gestures. Of these gestures they used significantly higher percentage of iconic gestures.
Zampini and D'Odorico (2009)	Longitudinal correlation study	Investigate relationship between gesture production and vocabulary development	20 DS (13 girls / 7 boys) <ul style="list-style-type: none"> • CA 2;9–3;2 years • MA 1;0–2;3 years • adequate auditory and visual skills 	CDI Mother-child spontaneous gesture production Videotaped semi-structured play session CDI	Gesture production appeared to be related to psychomotor development and to word comprehension but was not related to word production Gesture production was identified as a reliable predictor of later vocabulary size when children were both 24 and 36 months old. The production of crossmodal transitional forms (i.e. gesture-word associations) was a significant predictive index of later two-word production
Zampini and D'Odorico (2011)	Longitudinal correlation study	Investigate individual developmental trajectories of gesture production in a group of children with Down syndrome. To evaluate the role of gestures and of gestures associated with words as predictive indexes of children's later language development	8 DS (7 girls / 1 boy) <ul style="list-style-type: none"> • CA 2;1–2;2 years • MA 1;0–1;8 years • adequate auditory and visual skills 		

Table 2. (Continued)

Study/subject	Design	Aim	Participants	Instruments	Results
<i>Gesture plus word combinations:</i>					
Iverson et al. (2003) VOC/GEST	Cross-sectional comparison study	Compare gesture and language development in children with DS and MA matched TD children	5 DS (2 girls / 3 boys) <ul style="list-style-type: none"> • CA 3;1–4;8 years • MA 1;6–2;3 years • hearing not reported • vision not reported 5 TD (2 girls / 3 boys) <ul style="list-style-type: none"> • CA 1;6–2;3 years 	Videotapes of communicative and intelligible gestures, and words	No difference in use of gesture. Children with DS did not produce deictic words. Complementary gesture–word combinations were uncommon and supplementary gesture–word combination did not occur in the DS group
Zampini and D’Odorico (2011)	Longitudinal correlation study	Investigate individual developmental trajectories of gesture production in a group of children with Down syndrome. To evaluate the role of gestures and of gestures associated with words as predictive indexes of children’s later language development	8 DS (7 girls / 1 boy) <ul style="list-style-type: none"> • CA 2;1–2;2 years • MA 1;0–1;8 years • adequate auditory and visual skills 	Videotaped semi-structured play session CDI	Gesture production was a reliable predictor of later vocabulary size when children were both 24 and 36 months old. The production of crossmodal transitional forms (i.e. gesture–word associations) was a significant predictive index of later two-word production

Notes. DS = Down syndrome; WS = Williams syndrome; ID = intellectual disability; LD = Learning disabilities; M = Mean; CA = chronological age; MA = mental age; WCA = word comprehension age; Brunet-Lézine = Brunet-Lézine Psychomotor Development Scale-Revised; BSID = Bayley Scales of Infant Development; CDI = MacArthur Communicative Development Inventory; CUIS = Cattell Infant Intelligence Scale; CDHS = Communication Development Inventory Infant Scale; ESCS = Early Social-Communication Scales; MAI = Movement Assessment Inventory; PPECS = Pragmatics Profile of Early Communication Skills; CSBS = Communication and Symbolic Behavior Scales; Reynell = Reynell Developmental Language Scales.

b Design. Five studies used a longitudinal research design (Chan and Iacono, 2001; Kay-Raining Bird et al., 2000; Mundy et al., 1995; Zampini and D'Odorico, 2009, 2011) and seven studies used a cross-sectional research design (Caselli et al., 1998; Franco and Wishart, 1995; Galeote et al., 2008, 2011; Iverson et al., 2003; Ramrutten and Jenkins, 1998; Stefanini et al., 2007). The sample sizes in all but two studies never exceeded $n = 40$ participants. In a 2008 article, Galeote and associates included 66 participants and in their 2011 article they included 186 participants.

Eight studies were comparison studies in which the expressive language skills of children with DS were compared with mental-age (MA) matched TD children (Caselli et al., 1998; Galeote et al., 2008, 2011; Iverson, et al., 2003; Kay-Raining Bird et al., 2000; Mundy et al., 1995; Ramrutten and Jenkins, 1998; Stefanini et al., 2007). Four studies were correlation studies on the relationship between gestures and language development in children with DS (Chan and Iacono, 2001; Franco and Wishart, 1995; Zampini and D'Odorico, 2009; 2011).

c Outcome measures. All studies used an observational assessment of the frequency of targeted language stages as the outcome variable. In three studies the frequency of deictic gestures (pre-linguistic behaviours such as joint attention, canonical babbling and nonverbal requesting) was observed during child–parent interactions. Eight studies investigated the role of gestures in early lexical development and focused on vocabulary in vocal and/or gestural modality. Five of these studies used the (MacArthur) Communicative Developmental Inventory, and the remaining three studies used data derived from the analysis of recorded interactions. The two studies that investigated the role of gestures in syntax development used videotaped observations of communicative and intelligible gestures and words.

III Results

Results are presented according to the developmental stages as described in the introduction: deictic gestures, representational gestures and gesture-plus-word combinations. Given that these elements are crucial for understanding the link between gesture and language development in children with DS, we describe the results at length in the following sections.

1 The role of deictic gestures

The frequency and variation of deictic gestures (e.g. showing, giving, and pointing) do not differ significantly between children with DS and MA matched TD children (Ramrutten and Jenkins, 1998). However, children with DS show an attenuated tendency in non-verbal requesting and initial variance in non-verbal requesting for objects was a significant predictor of individual differences in expressive language development of children with DS (Mundy et al., 1995). In other words, children with DS who use fewer non-verbal requests may show deficits in expressive language development. This deficit in non-verbal requesting was also reported in a correlation study by Franco and Wishart (1995), in which the use of pointing and other deictic gestures in the presence of two different social partners (the mother and a peer with DS) was investigated. Results showed that children with DS predominately produced pointing gestures for both verbal and non-verbal requests and no reaching gestures, while reaching gestures are expected in non-verbal requesting situations.

In summary, these findings suggest that the use of deictic pointing gestures in children with DS does not differ from that of TD children. However, a decreased tendency of non-verbal requesting seems present among children with DS and non-verbal requesting is correlated with later language development.

2 *The role of representational gestures*

Comparison studies with MA matched TD children showed no significant difference in lexical development in children with DS as long as the study included data on gestures (Caselli et al., 1998; Galeote et al., 2008, 2011; Kay-Raining Bird et al., 2000; Stefanini et al., 2007). Caselli et al. (1998) investigated verbal comprehension, verbal production and gesture production in 40 children with DS and 40 TD children matched with the DS group for lexical comprehension. No significant difference for verbal production was found, but the DS group was more advanced in gesture production than the TD group. These findings were supported by Galeote and colleagues (2008, 2011) who reported no significant differences in vocabulary production between children with DS and MA matched TD children.

Correlation studies report that children with DS have a preference for gestures over vocal productions (Chan and Iacono, 2001; Zampini and D'Odorico, 2009, 2011). All three studies noted that the most frequently produced gestures were deictic gestures (showing, giving and pointing) and that gestures use emerged prior to word production. Zampini and D'Odorico (2011) noted that the pattern of gesture development by children with DS was similar to that of TD children: Gesture tokens (i.e. the total number of gestures produced during the observation session) at 24 months significantly correlated with the size of spoken vocabulary at 36 months, and the correlation with word production at 48 months was just below the statistical significant level. In an earlier study the same researchers (Zampini and D'Odorico, 2009) noted that the production of gestures occurred prior to the productions of words and that gesture production at 36 months was significantly correlated to vocabulary production at 42 months.

In summary, there seems to be no significant difference between the vocabulary of children with DS and MA matched TD children. However, children with DS show a slight preference for gestures over vocal production whereas TD children show a preference for vocal productions. For both groups of children, there is a predictive relationship between gestures production and later spoken word production.

3 *The role of gestures-plus-word combinations*

Only one study compared the use of gestures-plus-word combinations of children with DS with that of TD children (Iverson et al., 2003), and another study evaluated the role of gestures and of gestures associated with words as predictive indexes of later language development (Zampini and D'Odorico, 2011). The comparison study showed no significant differences in the total number of gesture-plus-word combinations between the groups, but there were large differences between the groups for the types of gesture-plus-word combinations (Iverson et al., 2003). The majority of gesture-plus-word combinations made by children with DS were equivalents, whereas complementary combinations were uncommon and supplementary combinations did not occur. In contrast, TD children made complementary and supplementary gesture-plus-word combinations. Looking at syntactic development, none of the children with DS produced two-word utterances.

The correlation study reported that the production of gesture-plus-word combinations was a significant predictor of the emergence of two-word production in children with DS (Zampini and D'Odorico, 2011). At 24 months of age, the number of gesture-plus-word combinations produced was the only index that was significantly correlated with word combinations at 36-months and 48-months of age. At 36 months, both gestures-plus-word combinations and two-word combinations were significant predictive indices of the number of word combinations produced at 48 months.

In summary, similar to TD children, children with DS produce gesture-plus-word combinations but the type of gesture-plus-word combinations are mostly equivalent gesture-plus-word

combinations. Furthermore, gesture-plus-word combinations seem to predict the onset of the first two-word utterance.

IV Discussion

The aim of the present study was to systematically review the current state of empirical evidence on the transitional role of gestures during the acquisition of early lexical and syntactic structures in children with DS. In essence, children with DS use the deictic pointing gesture similar to TD children but children with DS also use this gesture instead of the reaching gesture in situations of non-verbal requesting. For this reason, decreased non-verbal requesting seems present in children with DS. Furthermore, the frequency of gesture production of children with DS is higher compared to MA matched TD children. There also seems to be a predictive relationship between gesture production and later spoken word production. There are no differences in frequency of gesture-plus-word combinations between children with DS and MA matched TD children, but it is interesting to note that children with DS predominately use equivalents, and complementary and supplementary gesture-word combinations are rarely used. Similar to TD children, the use of gesture-plus-word combinations in children with DS appears to predict the onset of two-word utterances.

Our review shows that the role of gestures during the preverbal and early language development phase in children with DS differs slightly to that of TD children. First, the role of deictic gestures in children with DS is somewhat different compared to TD children. An interesting finding of our review was the discrepancy between the findings reported by Ramrutten and Jenkins (1998) and those of Franco and Wishart (1995) and Mundy and colleagues. (1995). We believe this contradiction about whether or not significant differences were found in the use of deictic gestures can be explained. These different findings can be explained by differences in type of the communication that was measured. Ramrutten and Jenkins (1998) investigated general non-verbal communicative behaviours whereas the other studies investigated specific non-verbal communicative skills. An interesting finding of the specific skills was that children with DS predominately used deictic pointing gestures for both sharing attention on 'interesting' things and for requesting an object that is out of reach (Franco and Wishart, 1995; Mundy et al., 1995). According to Mundy and colleagues, the attenuated tendency to display non-verbal requesting might be typical for children with DS. The researchers concluded this based on the results of an earlier study in which a nonverbal requesting deficit was observed in young children with DS but not in a MA-matched sample of children with intellectual impairments of unknown etiologies. This finding is supported by Franco and Wishart's (1995) results in which the researchers reported reduced non-verbal requesting. Furthermore, Mundy and colleagues also found a relationship between non-verbal requesting and later language development in children with DS. Deficits in non-verbal requesting were found to be related to subsequent delays in later expressive language development in children with DS.

The second way gesture development differs between TD children and children with DS is that children with DS appear to show a preference for gesture over vocal productions during the early phase of lexical development (Chan and Iacono 2001; Kay-Raining Bird et al., 2000; Stefanini et al., 2007). For example, children with DS use gesture more frequently than TD children (Galeote et al., 2008, 2011). In other words, there is evidence suggesting that children with DS have no general impairment in vocabulary development but have specific difficulties with expressive language development. This is likely due to oral motor difficulties that negatively impact articulation, phonology development and speech intelligibility (Miller and Leddy, 1998; Stoel-Gammon, 1997). Structural and functional differences in oral-motor functioning of children with DS are thought to

affect speech production and result in, for instance, a reduced speed of speech, limited range of motion, and difficulty with coordination of the speech articulators (Miller and Leddy, 1998; Stoel-Gammon, 1997). As a consequence, children with DS have difficulties producing precise speech sounds, an important skill for word production. It is understandable that if a child's spoken modality is under developed, he/she prefers to use gesture to communicate with his/her communication partner. As Vandereet and colleagues (2011) noted, bimodal vocabulary acquisition is consistent with the DS specific phenotype, namely strengths in imitation, gesture use and visual memory and weaknesses in auditory memory and production of intelligible speech.

A third finding was reported by Iverson and colleagues (2003). The finding that children with DS aged 3;11 years old hardly used complementary or supplementary gesture–word combinations is an interesting one and relates to the findings by Zampini and D'Odorico (2011) who claimed that gesture-plus-word combinations are a significant predictor of later two-word production in children with DS. If such gesture–word combinations are important in the onset of two-word development, as was suggested in TD children, it might explain the delay in syntax development of children with DS. On the other hand, the children in Zampini and D'Odorico's study did not produce any two-word utterances so we can make no conclusions about the specific role of supplementary gestures-plus-word combinations and the onset of the first two-word utterance.

Nevertheless there is evidence that children with DS might have a specific delay in the transition from communication in which the information between the gesture and word is the same (complementary) to communication in which the information between gesture and word is different (supplementary) (Iverson et al., 2003). For instance, the frequency of gesture-plus-word combinations made by children with DS did not significantly differ to that of TD children. However a significant difference was found between the groups on the frequency of supplementary combinations (children with DS did not make many of these combinations). Since complementary and especially supplementary gestures-plus-word combinations are cognitively more sophisticated (i.e. convey greater amounts of information) than equivalent combinations, this could mean, given their cognitive limitation, that children with DS are more at risk to become delayed in the production of supplementary combinations compared to TD children (Iverson, et al., 2003), and hence, in the onset of the emergence of two word utterances. The clinical implication then would be that it is of importance to monitor the types of gesture-plus-word combinations a child with DS uses. This monitoring can guide appropriate intervention goal setting. It could be very useful to observe and facilitate the use of gestures-plus-word combinations when a child does not make any two-word utterances. Not only can gestures be used to compensate for limitations in spoken language, but these gestures may also facilitate language learning (Capone and McGregor, 2004).

1 Limitations of the study

The results of a systematic review are only as strong as the studies included in the review: only 12 studies were included and as all studies had small sample sizes, this can hamper the statistical power of a study and the ability to detect real effects. Future research studies should consider a larger sample size to increase power and to account for large differences within the participant groups. For example, the range in chronological age and mental age in all studies was considerable and not all studies reported the non-verbal mental age of the children with DS (Caselli et al., 1998; Ramrutten and Jenkins, 1998). In fact, there was one study that did not include information about the hearing status of the participants (Iverson et al., 2003). Including information on participant mental age and medical status (e.g. hearing skills) is essential when trying to explain group differences.

2 Clinical implications

The results of our systematic review support the idea of a relationship between gestures and spoken language in children with DS. Particular gesture types appear to be relevant for the development of expressive language. For instance, non-verbal requesting, representational gestures and gesture–word combinations may enhance expressive language development. Our findings could be useful for understanding the role of gestures during the expressive language development of children with DS. Likewise, these findings can be used for appropriate intervention goal setting. In clinical practice, these transitional gestures may play a valuable role in diagnosis, prognosis, goal selection, and intervention for children with DS (Capone and McGregor, 2004). For example, it may be necessary to focus on non-verbal requesting during therapy to stimulate the expressive language development of a child with DS. Clinicians should keep in mind that gesture use is important in children with DS as gesture provides the child with a non-verbal communication option (Capone and McGregor, 2004). It is important that the communication partners in the child's environment learn to use gestures and to recognize a child's gestures. When a parent does not recognize and respond to a gesture made by a child with DS, the child is less likely to re-initiate the communication attempt (Chan and Iacono, 2001). This suggests that children with DS may be missing crucial opportunities for communication and language learning (Capone and McGregor, 2004).

V Conclusions

There is evidence that gesture plays an important role in the expressive language development of children with DS. It appears that gestures enhance language development and can be used for appropriate intervention goal setting. For example, for a child with DS who does not produce two-word utterances it is useful to observe, and perhaps facilitate, his or her use of gestures-plus-word combinations. Further research is needed to examine the role of supplementary gesture-plus-word combinations and its relationship with the onset of two-word utterances in children with DS.

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Note. The references marked with an asterisk are the 12 studies that this review reports on.

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