TOPIC TITLE

Maternal teaching behaviour and pre-verbal development of children with Down syndrome and typically developing children

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The objective of the current study was to identify and compare maternal teaching behaviours in interactions with infants with Down syndrome and typically developing infants, in relation to their pre-verbal development. Teaching behaviours defined based on a mediational theory perspective, were videotaped and examined in interactions with 38 infants with Down syndrome and 38 typically developing infants, in relation to their Pre-verbal Communication development from 7-9 to 20-22 months. The gap in the development of Pre-verbal Communication between the two groups in favour of typically developing children became clearly apparent at 14-16 months and coincided with a gap in frequency of maternal teaching behaviours provided to each group. Mothers of children with Down syndrome used more 'isolated' Focusing which was negatively related to measures of Pre-verbal Communication and less Affecting and Expanding which were positively related to Pre-verbal Communication as compared with mothers of typically developing children. For children with Down syndrome, Regulation of behaviour and Affecting observed at 14-16 months were the best predictors of pre-verbal development at 20-22 months. For children with Down syndrome and typically developing children, sequences of parental behaviour including Focusing accompanied by Affecting or Expanding, observed at 14-16 months, predicted pre-verbal development and Bayley scores, at 20-22 months, whereas 'isolated' Focusing behaviour was a negative predictor of the above. These findings suggest the need to direct teaching behaviour in meaningful sequences rather than in isolation.

The complexity of research on maternal interactions with children with Down syndrome: An overview

There is a considerable amount of paradoxical findings in research on mother-child interactions with children who have Down syndrome. On the one hand it was found that mothers of children with Down syndrome are sensitive and responsive, trying to match their behaviour with their children's behaviour and show more rigorous attempts at eliciting responses from their children who are more passive and unresponsive[1]. Mothers of children with Down syndrome also demonstrate more supportive object behaviour and are generally more directive and supportive than mothers of typically developing children[2]. On the other hand, it was reported that mothers of children with Down syndrome are more controlling than mothers of typically developing children, rarely allowing the children to initiate actions (e.g. REFS 3,4,5). More specifically, mothers of children with Down syndrome were found to produce a high number of requests for their children to perform actions, including actions that were relatively difficult, and asked their children to attend to information that was not directly related to the children's current focus of attention[5,6].

Two additional issues make it even more difficult to decide whether mothers of children with Down syndrome respond or do not respond appropriately to their children's behaviour:

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1. It is difficult to decode non-verbal interactive behaviours of infants with Down syndrome. Infants with Down syndrome may be more difficult to 'read' not just because of the delay in verbal language but also because their non-verbal signals may be more difficult to disentangle unambiguously[7].

   Differences were found between typically developing and infants with Down syndrome in relation to basic components of interactive behaviour like eye contact, vocalisation, turn taking and expression of feelings. Eye contact in interactions with infants with Down syndrome is delayed and, once it appears, infants tend to fixate on the mother's eyes and avoid looking at objects in the environment[8,9], making it more difficult to achieve joint attention requiring shifts of attention from the mother's eyes to an object and back. Their vocalisation is characterised by many vocal clashes with the mother's vocalisation, probably because their vocalisation is dense and does not leave the mother many opportunities for turn taking[8,10]. Infants with Down syndrome look less at objects out of their reach and do not request assistance to get them. They use less pointing, touching or giving objects to elicit adult assistance[11], and show more expression of neutral-apathetic affect as opposed to neutral affect expressing focus and interest in the environment[12].
2. Specific characteristics of an interaction i.e. its structure, content, and process affected children with Down syndrome more and/or differently from typically developing children[13,14]. Thus, findings may be relevant to specific situations and not to others.

The controversial nature of research on mother-child interactions with children with Down syndrome leaves many questions unanswered. One of these questions is related to the role of directive behaviours such as telling or asking children to do things, i.e. directing their behaviour. The role of directives in interaction with children with Down syndrome is particularly confusing. Whereas few studies highlighted the benefits of directives[15], most studies reported its disadvantages (e.g. REFS 16-20). It was suggested that mothers of children with Down syndrome perceived their role as teachers rather than interactive play partners[5] thus using high levels of directive behaviour in play and teaching interactions with their children[3,21]. In addition, most mothers of young children with Down syndrome commonly participate in early intervention programmes which motivate them to be even more actively involved and increase their directive behaviour[22,23].

The causes of language problems in children with Down syndrome may be examined in light of various models relating to physiological problems like neuromotor deficits[24], auditory dysfunction[25], hypotonic tongue and poor muscle control[26], or poor cognitive abilities, i.e., memory, generalisation, perception and conceptualisation[27]. Each of the mentioned factors may explain variability in language development of children with Down syndrome, but none of them suffice to explain why some children with Down syndrome with seemingly the same problems have better communication skills than others. In line with the transactional model[28,29], Fischer[30] suggested that a communicative deficit in children with Down syndrome might result from a breakdown in the interactive process between a child and his or her environment. The breakdown may be due, in part, to the child's cognitive, linguistic, motivational, affective and/or attentional responses to the environmental input, particularly that of the primary caregiver. Recent studies on predictors of expressive language development in children with language delay, including children with Down syndrome, highlighted the importance of optimal care-giving (e.g. REFS 31,32). These studies identified components of optimal care-giving such as reinforcing the child's verbal behaviour, for example, by responding to it meaningfully or imitating the child's vocalisation[31] and timing the mothers' responses to their children's utterances[32].

Potential contributions and objectives of the current study

The particular contribution of the current study becomes apparent in view of the fact that most of the studies carried out in the last decade on mother-child interaction and development of children with Down syndrome focused on language development rather than on pre-verbal communication. Many existing studies dealt with children of a wide age range, for example, 12 to 36 months[33], 16 to 30 months[2], and 30 to 70 months[1]. Some relate to children with learning difficulties of various aetiologies including only a few children with Down syndrome (e.g. REFS 1,33). The current study focuses on pre-verbal development in a relatively large sample of 7-22 month old infants with Down syndrome and their mothers.

It is quite clear that mothers of children with Down syndrome are highly motivated to teach their children and use many directives. In light of the controversy around the role of directives in interactions with children with Down syndrome, it was hypothesised that directives could have a positive or a negative effect depending on the sequence of other teaching behaviours

with which they appear. An attempt was made in the current study to identify maternal teaching behaviours in interactions with Down syndrome and typically developing infants and toddlers, using the perspective of a mediational theory[34-37]. This approach enables a focus on the effects of specific maternal teaching behaviours both in terms of their frequency as well as their effects when they appear in a sequence of other maternal behaviour rather than in isolation.

Maternal teaching behaviour

Maternal teaching behaviours occur when the adult actively and intentionally modifies the environment, or their own behaviour, in order to assure that the child perceives and learns the meaning of an experience as well as relates the newly learned experience with other experiences in her or his past, present and future. The basic five processes of mediated learning measured in the current study were empirically defined[35,36] and include three basic processes:

1. **Focusing,** namely, catching the child's attention.
2. **Affecting,** holding attention through a process of endowing it with affect and meaning.
3. **Expanding,** 'stretching' the mediated experience, by associating it with other experiences.

One of the most commonly found sequences of maternal teaching behaviour in interactions with young children[35,36,38,39], particularly in Western cultures, include Focusing, Affecting and Expanding[40].

These categories of teaching behaviour are cumulative; in other words, the first involves only the achievement of joint attention and is referred to as Focusing. The second includes Focusing and Affecting and is referred to as Affecting, and the third includes Focusing, Affecting and Expanding (for example: "Look, see this bea-u-ti-ful red rose") and is referred to as Expanding. High frequencies of Focusing mean that the mother has attempted over and over again to achieve joint attention but has repeatedly 'lost' or 'wasted' it, since she did not proceed to 'use' the captured attention. Affecting and Expanding represent longer sequences of maternal behaviour including either verbal or non-expressive cues to meaning and affect or behaviours intended to cognitively expand meaning of the immediate episode by associating it with other objects or experiences.

In addition to the sequence of behaviours described (1, 2 and 3), two other types of behaviours are frequently observed:

4. **Encouraging.** Communicating to children that they have done well and that the adult is pleased with their behaviour.
5. **Regulation of behaviour.** Conveying the intent to help the child do things. Regulation of behaviour involves clarifying or demonstrating actions, with the intent to teach the child strategies or ways to carry out an action or a sequence of actions. It should be noted that Regulation of behaviour is different from demands for action, which are intended to have the child do something in order to have it done, rather than teach the child how to do it. Behaviours are viewed as teaching behaviours only if the child and the adult appear to achieve joint attention, i.e. to be focused on the same object or experience. Thus, parental behaviours are considered teaching behaviours only if the child appears to show any sign of joint attention.

Since mothers of children with Down syndrome use more teaching behaviour[41] than mothers of typically developing children, two major questions emerge: 1. Are they using types and sequences of teaching behaviours which were found effective in interactions with typically developing children? and 2. Are those mediational behaviours effective predictors of children with Down syndrome's pre-verbal communication and cognitive development?

Since the degree of adaptability or effectiveness of maternal behaviours in interactions with children with Down syndrome may vary as children grow and develop (i.e. REF 42) and since a gap in their communication development, as compared to typically developing children, was expected around 14-16 months[43], the current study focuses on the above questions using a longitudinal design, following children with Down syndrome and typically developing children from 7-9 to 20-22 months.

Method

Participants

Participants in this study were 76 infants and their mothers. The sample included 38 infants with Down syndrome comprising the entire population of 7-9 months old infants recruited from all Well-Baby Centres in Israel and 38 typically developing infants randomly selected from the population of 7-9 months old typically developing infants seen at the same Well-Baby Centres, and their mothers. All infants came from two-parent families. There were no significant differences between the two groups with regard to parental years of education (M=14, SD=2.7) and ethnic origin (72% Jewish and 28% Arabic and other minorities). Fathers and mothers of the infants with Down syndrome were significantly older than those of the typically develop-

Definition	Examples
Focusing Any act or sequence of acts that appear to be directed toward Focusing a child's attention to something or someone. These behaviours are considered reciprocal when the child responds vocally, verbally or nonverbally.	Selecting, exaggerating, accentuation, scheduling, grouping, sequencing, or pacing stimuli. Talking or handing a toy to a child is seen as focusing only when it is apparent that the teacher's behaviour is intentional and not accidental, and when there is an observable response from the child that he or she saw, heard or felt the intentional behaviour. Examples of Focusing may include making a visible effort to bring an object to the child, cover or otherwise eliminate distracting objects, intensify or exaggerate responses or stimuli to assure that the child focuses on them.
Affecting (exciting) Behaviours that express verbal or nonverbal excitement, appreciation, or affect, in relation to child himself or herself, people, animals or objects or processes.	These behaviours may include facial gestures or expressions and vocalisation (e.g., a sigh or scream of surprise), verbal expressions of affect, or labelling, (e.g., "Look at this beautiful flower", or "Wow, this is nice").
Expanding Behaviour directed toward the expansion of a child's cognitive awareness, beyond what is experienced directly through sensory perception, or what is necessary to satisfy the immediate need that triggered the interaction.	Talking to a child about the food he or she eats, telling what it is and describing it (e.g. sweet, salty, smooth, soft, hard). Expanding may be provided through the process of comparison, clarification and explanation. Talking to a child about the qualities of building blocks is considered expansion since it is beyond what is needed for using them.
Encouraging Any verbal or nonverbal behaviour that expresses satisfaction with a child's behaviour and identifies for the child components of behaviour that contribute to that success.	Careful timing of a verbal or gesture expressing of satisfaction, (smile, pat, hug, praise, clapping of hands when the child successfully completes a task or part of it. Verbal and nonverbal expressions (i.e., saying "good", "wonderful", "great", "yes").
Regulating of behaviour Behaviours that model, demonstrate, and/or verbally guide the child's actions in relation to specific requirements of a task, or to any other cognitive process required prior to overt action.	The process of matching the task requirements with the child's capacities and interests, as well as through organising and sequencing steps leading toward success. For example, "Slowly, you are almost done. Let's add this part carefully so you do not move all other part". "Slowly! Not so hard! It is delicate, do it gently", or "First, push then turn…". Mediated regulation of behaviour may be related to the processes of perception (e.g., systematic exploration), to the process of elaboration (e.g., planning behaviour), or to the process of expressive behaviour (e.g., reducing egocentric expressions and regulating intensity and speed of behaviour).

Table 1 | **Definitions and examples of basic parental teaching behaviour (Mediation)**

ing infants. Mothers of 73.7% of the typically developing children were 30-40 years old and only 2.5% were 40-50 years old, whereas 50% of mothers of infants with Down syndrome were 30-40 years old and 36.8% were 40-50 years old. Fathers' ages followed a similar distribution with only 8.1% of the fathers of the typically developing infants 40-50 years old as compared to 44% in the Down syndrome group. The socio-economic status level of the families, based on parental years of education and income, was almost equal in both groups. The largest number of parents (40%) were High School graduates, 30% had 1 or 2 years of college, 20% were college graduates and 10% had 8 years of schooling or less.

Measures

The following measures were used:

1. The frequencies of basic maternal teaching behaviours were assessed based on 30 minutes of videotaped observations of mother-child interactions at home during free play, feeding and bathing (10 minutes each). These behaviours were assessed using the OMI (Observing Mediational Interaction[35,36,38,39]. Definitions of the coding criteria are presented in TABLE 1. An average of 103 events was coded per observation. Twenty percent of all the videotapes were randomly chosen for independent coding by two observers. The agreement between observers was 89%. Cohen's kappa was 0.87 ($p<0.001$).
2. Infants' and toddlers' level of pre-verbal communication development was assessed using the PVCS (Pre-Verbal Communication Schedule[45]) translated and adapted for use in Israel, by Dromi[46,47]. Cronbach's Alpha for the PVCS items is presented in TABLE 2. The PVCS requires rating of infant behaviour representing four levels of pre-verbal communication:
   (a) Conditions preceding communication,

Level of Performance	Functions	No. of item	Alpha
Conditions preceding communication	1. Eye contact	9	0.84
	2. Use of visual cues	7	0.74
	3. Social interaction	7	0.71
	4. Motor imitation	12	0.88
	5. Vocal imitation	10	0.75
	6. Body movement	5	0.78
	7. Understanding non verbal communication	8	0.79
	8. Expression of feelings	5	0.51*
Pre-Verbal communication	9. Communication through use of objects or pictures	3	0.71
	10. Communication through pointing	8	0.83
	11. Gestural communication	11	0.80
	12. Communicative use of sounds	8	0.81
3. Language comprehension	13. Language comprehension	9	0.89
4. Expressive language	Number of words used	inter rater	0.92
* These items were excluded from the analysis due to low Alpha values.			

Table 2 | **Alpha values for the PVCS items**

including behaviours such as eye contact, use of visual cues (i.e. child identifies familiar people and objects in person or in pictures), social interaction, including approaching other people, smiling, participating in turn-taking; expression of feelings including smiling and crying; motor and vocal imitations;

(b) pre-verbal communication, including communication involving objects (i.e. handing the bottle when wanting to drink), understanding and using of pointing behaviour and vocalisation as a means of communication;

(c) verbal comprehension, including items such as responds when called by name, understands simple commands, can point at objects or body parts in response to the question "where is……?"; and

(d) expressive language (based on maternal report of the number of words used by the child). The first three levels of the PVCS are assessed on a four-point scale ranging from 1 – not at all, to 4 – frequently. All ratings were transformed to percentage scores. Agreement between observers was 92%. Cohen's kappa was 0.89 ($p<0.001$).

3. The Mental Scale of The Bayley Scales of Infant Development, 2nd edition[48] was administered individually, at the children's homes, as a general measure of cognitive performance.

Procedure

The parents of 7-9 month old children with Down syndrome, identified through the national network of Well-Baby Centres in Israel, were contacted by mail and invited to participate in a study on the development of communication and language of their children. Parents were offered a copy of all videotapes of their child and a report on their performance on the Bayley Scales of Mental Development. Following the selection of the infants with Down syndrome, typically developing infants were randomly chosen out of all same-aged, typically developing, healthy infants seen at the same Well-Baby Centres. Of all parents contacted, 72% agreed to participate in the study. Most of the refusals were by parents who were unwilling to be videotaped. Participants were 80 mother-child dyads at the onset of the study; the rate of attrition was 5% (two children with Down syndrome and two typically developing children) and was due to illness of the child or parent. The study was carried out at the children's homes. Children were visited at home at 7-9 months, 14-16 months, and 20-22 months, by female early childhood development workers with 3 or more years of experience in work with mothers and infants. The following procedures were carried out at the 7-9 months home visit: Videotaped observation of mother-child interaction during feeding, bathing and play, Pre-verbal Communication Scale (PVCS) and Bayley Mental Scale. At the 14-16 months visit, mother-child interaction was videotaped during play and the PVCS was administered. At the 20-22 months visit, mother-child interaction was videotaped during feeding, bathing and play, the Bayley and PVCS were administered. The instructions given to the mothers prior to videotaping was "Play with your child and do things as you normally do, please try to ignore me (the observer)".

Results

Maternal teaching behaviour in interactions with children with Down syndrome and typically developing children

Maternal teaching behaviour during play was analysed using MANOVA (2 groups x 3 assessment stages) with repeated measures (see TABLE 3). Main effects for group and age were found as expected, with typically developing children receiving more teaching behaviour than children with Down syndrome, $F(5,70) = 5.58$, $p<0.001$, and older children in both groups receiving more teaching behaviour than younger children, $F(5,70) = 43.96$, $p<0.001$. A significant group by age interaction was found in favour of 20-22 months old typically developing children, $F(5,70) = 5.52$, $p<0.001$. More specifically, different profiles of teaching behaviour were found in interactions with typically developing as compared with children with Down syndrome. A decline in Focusing behaviour (i.e. catching attention without 'using' it), was noted for both groups over time but was greater in the typically developing group, $F(2,148) = 17.34$, $p<0.001$. Both Affecting and Expanding significantly increased from 7-9 to 14-16 months. The increase for the children with Down syndrome was smaller than for the typically developing children (group by age interactions were $F(2,148) = 4.71$, $p<0.01$, for Affecting and $F(2,148) = 12.99$, $p<0.001$, for Expanding).

Similarly, for caregiving situations (feeding and bathing) a 2 x 2 MANOVA (groups x assessment stages) showed more Affecting, $F(1,74) = 9.62$, $p<0.01$, Expanding, $F(1,74) = 18.04$, $p<0.001$, and Regulating behaviour, $F(1,74) = 5.34$, $p<0.05$, in the typically developing group (see TABLE 4). As was found for play interactions, mothers increased their teaching behaviour as their children grew from 7-9 to 20-22 months, $F(5,70) =$

		7-9 months			14-16 months			20-22 months		
		DS	TD	*F*	DS	TD	*F*	DS	TD	*F*
Focusing	*M*	7.74	7.47	0.05	6.66	4.24	2.65	4.97	1.76	10.70**
	SD	5.39	4.17		8.24	3.75		5.72	1.97	
Affecting	*M*	4.32	7.58	4.13*	8.71	18.00	11.64***	11.47	20.90	14.24***
	SD	4.80	4.89		13.36	4.89		8.21	13.02	
Expanding	*M*	0.61	0.45	0.34	1.55	4.29	13.59***	1.95	6.55	16.44***
	SD	1.33	1.01		2.23	4.00		2.78	6.43	
Regulating	*M*	4.53	4.68	0.02	11.84	14.37	1.29	15.16	12.18	1.97
	SD	5.22	3.17		10.29	9.05		11.24	6.63	
Encouraging	*M*	2.58	1.45	3.71	6.00	8.00	2.09	5.90	6.79	0.37
	SD	2.80	2.30		6.47	5.57		7.70	4.82	

*p<0.05 **p<0.01 ***p<0.001

Table 3 | **Means and SD of maternal teaching behaviour in interactions with infants with Down syndrome and typically developing infants during play at 7-9, 14-16, and 20-22 months**

43.96, p<0.001. A significant age by group interaction was found for Focusing, $F(5,70) = 5.52$, p<0.01; Post Hoc tests revealed that typically developing 20-22 month old children received less Focusing than all other children.

At 14-16 months, typically developing children used more vocalisation as compared to motor behaviour in attempts to communicate with their mothers, $F(1,74) = 30.48$, p<0.001. Children with Down syndrome used more motor behaviour as compared to vocalisation, $F(1,74) = 5.99$, p<0.05. It should be noted however that, starting at 14-16 months, the rate of vocalisation of the children with Down syndrome in feeding and bathing interactions, was significantly higher as compared to that found during play, $F(1,74) = 6.99$, p<0.05.

Mothers' interactions with young children, including children with Down syndrome, have been found to be related to the children's level of cognitive performance. The data on maternal teaching behaviours at 7 to 9 months and at 20 to 22 months, presented in TABLES 3 and 4, were therefore reanalysed with the children's concurrent cognitive level as a controlled variable. Significant differences were found in the mothers' behaviours in interactions with children with Down syndrome compared to typically developing children in these analyses. At 7 to 9 months, children with Down syndrome received more Encouraging during play and during care-giving situations than typically developing children, ($F(1,72) = 4.79$, p<0.05, $F(1,72) = 4.01$, p<0.01, respectively), and at 20 to 22 months they received more Regulation of behaviour during play ($F(1,72) = 3.98$, p<0.01).

Pre-verbal communication development and maternal teaching behaviours

Significant correlations between children's pre-verbal performance and maternal teaching behaviour were found (see TABLE 5). As expected,

		7-9 months N = 38			20-22 months N = 38		
		DS	TD	*F* (1,74)	DS	TD	*F* (1,74)
Focusing	*M*	1.82	2.05	0.27	1.43	0.61	5.79*
	SD	1.76	1.97		1.96	0.82	
Affecting	*M*	5.14	8.02	7.23**	7.14	10.68	7.63**
	SD	4.01	5.23		5.82	5.33	
Expanding	*M*	0.10	0.39	3.08	0.67	2.77	19.56***
	SD	0.49	0.88		1.13	2.70	
Regulating	*M*	1.14	1.14	0.00	3.23	5.71	7.70**
	SD	1.77	1.15		3.11	4.52	
Encouraging	*M*	0.51	0.21	3.52	1.43	1.68	0.35
	SD	0.93	0.34		2.06	1.58	

*p<0.005 **p<0.01 ***p<0.001

Table 4 | **Mean and SD of teaching behaviour in mother-child interaction with infants with Down syndrome and typically developing infants in care-giving situations at 7-9 months and 20-22 months**

PVCS	Age in Months	Maternal Teaching Behaviour				
		Focusing	Affecting	Expanding	Regulating	Encouraging
Conditions preceding communication	7 - 9	0.03	0.34**	0.11	0.13	-0.04
Pre-verbal communication		-0.02	0.30**	0.02	0.05	-0.17
Language comprehension		-0.11	0.20**	-0.03	-0.01	-0.12
Conditions preceding communication	14 - 16	-0.34**	0.56***	0.43**	0.30**	0.30**
Pre-verbal communication		-0.28**	0.56***	0.39**	0.27*	0.28**
Language comprehension		-0.25*	0.53**	0.34**	0.30**	0.26*
Verbal expression		-0.22*	0.50***	0.30**	0.03	0.18
Conditions preceding communication	20 - 22	-0.38**	0.48***	0.48***	0.29*	0.22*
Pre-verbal communication		-0.35**	0.47***	0.49***	0.25*	0.16
Language comprehension		-0.37**	0.47***	0.48***	0.25**	0.16
Verbal expression		-0.32**	0.49***	0.54***	-0.09	0.12

*p<0.005 **p<0.01 ***p<0.001

Table 5 | **Pearson correlations between maternal teaching behaviour and Pre-Verbal Communication Schedule (PVCS)**

		Group				Factor		
Measures of Pre-Verbal Communication Schedule (PVCS)	**Age in months**	**DS children** N=38		**TD children** N=38		**Group**	**Age**	**Age × Group Interaction**
		M	*SD*	*M*	*SD*	*F*(1,4)	*F*(2,146)	*F*(2,146)
Conditions preceding communication	7-9	39.46	6.59	54.23	6.40	177.42***	901.55***	12.85***
	14-16	57.04	8.10	79.52	7.36			
	20-22	69.43	8.89	87.59	4.91			
Pre-verbal communication	7-9	26.79	3.79	37.35	4.40	176.51***	553.52***	45.95***
	14-16	37.61	7.80	63.45	10.91			
	20-22	49.94	9.65	76.44	10.57			
Language Comprehension	7-9	26.83	4.05	33.99	5.10	184.28***	396.49***	65.46***
	14-16	37.57	10.29	76.68	17.61			
	20-22	55.63	18.49	93.20	7.74			

***$p<0.001$

Table 6 | **Means, SDs and values of comparing children with Down syndrome and typically developing children on three measures of pre-verbal communication, at 7-9 months, 14-16 months and 20-22 months**

significant differences were found between children's pre-verbal performance at 7-9, 14-16 and 20-22 months in both groups, and significant group by age interactions were found for each of the first three measures of the PVCS, (see TABLE 6) confirming the existence of differences in the rate of pre-verbal development between the two groups from 7-9 to 20-22 months. The developmental gap between the two groups increased at 14-16 as compared to 7-9 months and continued to increase thereafter (The assessment of Expressive language level 4 of the PVCS, was not used at the first stage of the study when the infants were 7-9 months old since verbal communication was not expected at that age).

At 20-22 months all the typically developing children and 35.9% of the children with Down syndrome used 3 words or more. Stepwise multiple regression analysis, with the 5 types of basic teaching behaviours observed at 14-16 months as predictors, and the 4 measures of PVCS assessed at 20-22 months as criterion, was carried out for the Down syndrome and typically developing children.

For typically developing children, language comprehension and expressive language (levels 3 and 4 of the PVCS), were positively predicted by maternal behaviours of Affecting and negatively predicted by Focusing, observed at 14-16 months, $R^2 = 0.22$, $F(2,35) = 4.95$, $p<0.05$, for language comprehension, with Affecting ($\beta = -37$, $p<0.05$) and Focusing ($\beta = 0.32$, $p<0.05$) as predictors, and $R^2 = 0.24$, $F(2,35) = 5.64$, $p<0.01$, for Expressive language, with Focusing ($\beta = -29$, $p<0.05$) and Affecting ($\beta = 0.42$, $p<0.05$) as predictors. It should be noted that more Affecting and less Focusing predicted both language comprehension and expressive language of typically developing children.

For children with Down syndrome, maternal teaching behaviour observed at 14-16 months significantly contributed to variability on all levels of PVCS assessed at 20-22 months: For conditions preceding communication, $R^2 = 0.22$, $F(2,35) = 4.95$, $p<0.05$, with Focusing ($\beta = -27$, $p<0.05$) and Regulation of behaviour ($\beta = 0.38$, $p<0.05$) as significant predictors. More Regulation of behaviour and less Focusing contributed to better performance of children with Down syndrome on the measure of conditions preceding communication. A low predictability was found for the pre-verbal communication (level 2 of PVCS) of children with Down syndrome, $R^2 = 0.09$, $F(1,36) = 3.46$, $p<0.05$, with Regulation of behaviour as the only contributor to the variability in this measure, ($\beta = 0.30$, $p<0.05$). Regulation of behaviour was also significantly predictive of the language comprehension (level 3 of the PVCS) of children with Down syndrome ($\beta = 0.28$, $p<0.05$), $R^2 = 0.08$, $F(1,36) = 3.10$, $p<0.05$. Maternal teaching behaviours predicted the expressive language (level 4 of PVCS) of children with Down syndrome better than any of the other pre-verbal measures, $R^2 = 0.38$, $F(2,35) = 10.79$, $p<0.001$. Affecting ($\beta = 0.30$, $p<0.05$) and Regulation of behaviour ($\beta = 0.41$, $p<0.05$) were significant contributors to the variability in this measure. More Affecting and Regulation of behaviour received by children with Down syndrome at 14 to 16 months were associated with the use of more words at 20 to 22 months.

The comparison between language skills of the two groups, presented in TABLE 6, was reanalysed with the children's cognitive level as a controlled variable. These analyses pertained to ages 7 to 9 months and 20 to 22 months (when Bayley

scales were assessed). Analyses were performed on data from the first 3 levels of the PVCS while co-varying for Bayley scores at both time points. Significant group differences were found for all three levels of the PVCS (*F*s(1.74) >7.28, *p*s<0.01), and a significant group x age interactions was noted for language comprehension ($F(1,74) = 6.14$, $p<0.02$), indicating the increase in the gap between the two groups with children's age.

An additional regression analysis of the maternal teaching behaviours as predictors of PVCS levels, controlling for concurrent PVCS levels was conducted. This analysis suggested that maternal behaviours assessed at 14 to 16 months predicted expressive language at 20 to 22 months for both groups, beyond the predictability based on their expressive language at 14 to 16 months. For typically developing children, $\Delta R^2 = 0.08$, $F(1,35) = 4.39$, $p<0.05$ with Expanding as a significant contributor to variability ($\beta = 0.28$, $p<0.05$). For children with Down syndrome, $\Delta R^2 = 0.08$, $F(2,34) = 4.16$, $p<0.05$ with Affecting ($\beta = 0.26$, $p<0.05$) and Regulation of behaviour ($\beta = 0.27$, $p<0.05$) as significant contributors to variability.

Maternal teaching behaviour and Bayley scores

MANOVA comparing the Bayley scores of the children with Down syndrome and typically developing children at 7-9 months and at 20-22 months revealed significant differences between the two groups at both ages. At 7-9 months, the mean Bayley score for the typically developing children was 90.68 (*SD* = 4.20), and for the children with Down syndrome 63.66 (*SD* = 6.86), $F(1,73) = 35.24$, $p<0.001$). At 20-22 months, the mean for the typically developing children was 106.05 (*SD* = 7.33) and for the children with Down syndrome, 64.05 (*SD* = 11.62), $F(1,73) = 202.12$, $p<0.001$). As can be seen in TABLE 7, the maternal teaching behaviours most consistently predictive of the children's Bayley scores was Encouraging, for typically developing children, and Regulating behaviour for children with Down syndrome. Both of these behaviours observed at 7-9 months and at 14-16 months predicted Bayley scores at 20-22 months. For both typically developing and children with Down syndrome, Affecting and Expanding observed at 14-16 months as well as at 20-22 months correlated significantly with Bayley scores at 20-22 months. It should be noted that Regulation of behaviour assessed at 7 to 9 months correlated with Bayley scores at 1;8 to 1;10 for children with Down syndrome, also after controlling for concurrent Bayley scores assessed at 7 to 9 months ($r = 0.34$, $p<0.04$).

Discussion

Within the complex and contradictory body of research on the nature, causes and outcomes of parental interaction with children with Down syndrome as compared to typically developing children, the current study attempted to focus on the nature of maternal teaching behaviour in both groups, between 7-9 to 20-22 months, in relation to the children's pre-verbal communication development.

Maternal teaching behaviour in interactions with children with Down syndrome and typically developing children

Maternal teaching behaviour increased for both groups with age. However, children with Down syndrome received less teaching behaviour and a different profile of this when compared to typically developing children. These differences widened at 14-16 months and thereafter, and paralleled the growing gap in their communication development as well as in their general cognitive performance assessed by the Bayley scales. At this age, pre-verbal development of typically developing children clearly exceeds that of children with Down syndrome (see TABLE 6), possibly inviting more maternal interaction and teaching behaviour. Mothers of children with Down syndrome used more Focusing, i.e. more attempts to direct their child's attention but less Affect-

		Maternal Teaching Behaviour									
		Focusing		Affecting		Expanding		Regulating		Encouraging	
Children's age (in months) at the Observation	Bayley testing	TD	DS	TD	DS	TD	DS	TD	DS	TD	DS
7-9	7-9	0.05	-0.20	0.40*	0.14	0.21	0.11	0.20	0.41*	0.33*	0.12
7-9	20-22	-0.12	- 0.15	0.23	0.25	0.02	0.06	0.03	0.33*	0.40*	0.14
14-16	20-22	-0.17	-0.17	0.45**	0.32*	0.29*	0.27*	-0.09	0.33*	0.40*	0.30*
20-22	20-22	-0.17	-0.20	0.51**	0.30*	0.53**	0.42*	0.18	0.27*	0.30*	0.12
*$p<0.05$ **$p<0.01$ ***$p<0.001$											

Table 7 | **Pearson correlations between maternal teaching behaviours and Bayley scores of typically developing children and children with Down syndrome, at 7-9, 14-16 and 20-22 months**

ing, and Expanding behaviour particularly around 14-16 months and thereafter. Affecting, namely endowing things with affect and meaning, and Expanding, i.e. broadening the immediate experience by associating it with other experiences, comparing, contrasting, explaining etc., suggest longer communication chains that involve focusing, and were singled out as the teaching behaviours most predictive of later cognitive and language development in a sample of US[39], Israeli[36] and Ethiopian[49] infants and young children. In the current study, both of these behaviours were positively associated with measures of PVCS, whereas Focusing was negatively associated with the same measures in both groups. In other words, children with Down syndrome received less teaching behaviour, which is potentially contributive and more Focusing, which may impact negatively on their pre-verbal development. These findings coincide with previous findings that less competent children receive more direct structuring[50] which may include more directing of attention, whereas more competent children receive more distal support[51,52]. It is possible that parental attempts to compensate for their children's tendencies to be less active, show less initiative and relatively greater need for concrete direction and guidance, led parents to be more directive. This latter hypothesis is supported by the finding that that at 20-22 months mothers to children with Down syndrome used more regulation of behaviour, as indicated by the analysis that controlled for children's cognitive level.

In addition to the different profile of teaching behaviours found in maternal interactions with children with Down syndrome as compared to typically developing children, the current study offers a different way of looking at the possible effects of maternal directives, particularly attention directives in both groups. When maternal attempts to direct children's attention (Focusing) is not accompanied by attempts to sustain that attention through expressions of affect (which would then be coded as Affecting) or attempts to expand it (coded as Expansion), they are not contributive to children's pre-verbal development and may even have a potentially negative effect on its development. However, when Focusing is accompanied by Affecting and Expanding, it is positively related to pre-verbal development. These findings support earlier findings[35,36,39] and suggest the need to study parental directives not as isolated behaviours, independent of other parental behaviours, but rather in a meaningful sequential context of other maternal behaviour that modify the initial directives and determine their final destination and effects on the child. It appears that while prolonging the sequence of teaching behaviour beyond Focusing, to include Affecting and Expanding, is contributive to both Down syndrome and typically developing children, children with Down syndrome also need Regulation of behaviour namely, mediation related to their motor behaviour.

Mothers of children with Down syndrome probably sense the importance of relating to the actions of their children as an affective teaching procedure and use it frequently. Mahoney et al. found that for mothers of children with Down syndrome, 50% of the directives were action requests and 27% were attention requests whereas for mothers of children without learning difficulties, 25% of directives were action requests and 50% were attention requests[5].

The special role played in the current study by maternal Regulating behaviour, in interactions with children with Down syndrome could be related to the fact that the effectiveness of maternal mediation was found to be at least partially determined by the timing of her responses to her child's behaviour. The mother's verbal responses occurring while the child is initiating an action were found effective while those occurring following it were found ineffective, possibly since they were not associated spontaneously by the child with Down syndrome with the object or action they were meant to represent and were thus irrelevant[53]. Mothers of children with Down syndrome were characterised as interacting at a disproportionately faster rate than their children[5]. It is possible that interactions that involve Regulation of behaviour, i.e. attempts to modify children's actions were more matched in rate of response to that of the children, contributing to a potentially more effective teaching interaction. Mothers' active involvement in regulating the behaviour of their child with Down syndrome and endowing it with meaning, (Affecting) observed at 14-16 months, accounted for 38% of the variability in the number of words used by the children at 20-22 months. These results remained even after controlling for children's concurrent expressive language abilities, i.e., affecting and regulation of behaviour at 14-16 months contributed to these children's expressive language at 20-22 months, beyond what would be expected based on their expressive language at 14-16 months.

Following the child's lead by allowing the child to control the focus of joint attention and maintaining longer average episodes of joint attention were found by Harris et al.[55] to contribute more to language development than the total amount of separate episodes of joint attention. How do mothers maintain longer periods of joint atten-

tion? One possible answer suggested by Harris et al.[55] is that following the child's lead, i.e. relating to child-selected objects possibly prolongs joint attention. The current findings suggest the possibility that sequences of parental teaching behaviour, including, a combination of focusing accompanied by Affecting, Expanding or Regulating children's behaviour, regardless of whether they relate to child-chosen or mother-chosen objects, may sustain joint attention and predict pre-language development of children with Down syndrome.

In summary, for children with Down syndrome as well as for typically developing children, merely focusing attention without helping the child connect this experience with affect or meaning is not contributive to either communication development or cognitive development in general. For typically developing children Focusing in combination with Affecting i.e. assuring that the child focuses on something and endowing it with meaning supports pre-verbal communication development. The results of the current study suggest that a child with Down syndrome needs to experience Affecting (meaning) associated with more direct action oriented mediation as found in Regulation of behaviour.

Relations between maternal teaching behaviour and pre-verbal development from 7-9 to 20-22 months

Since the degree of adaptability or effectiveness of maternal behaviours in interaction with children with Down syndrome may vary as children grow and develop[42], the current study focused on these relations longitudinally, from 7-9 to 20-22 months.

The increase in the significance of the correlations found in the current study between maternal teaching behaviour and measures of pre-verbal communication, from 7-9 to 20-22 months, suggest that parental teaching behaviour become more effective as the infant grows and is more capable of becoming an active partner in the mother-child interaction. As children mature, so does their repertoire of behaviour, which opens more opportunities for interactions and learning from parents.

These findings are in line with previous findings suggesting that around 12 to 18 months the criteria of teaching behaviour used in the current study, are more predictive of children's cognitive performance than the same type of behaviours observed at a younger or an older age[35,36,37,39]. Whereas at 7-9 months only Affecting is significantly correlated with children's pre-language communication development, at 14-16 months almost all teaching behaviour were significantly and meaningfully correlated with the PVCS, correlations ranged from 0.50 to 0.56 for Affecting and from 0.30 to 0.43 for Expanding.

These findings may be explained at least partially by the fact that as children approach the age of 2 years, their more mature thinking processes as well as higher maternal expectations, encouraged mothers to use more Affecting and Expanding in their interactions with them.

Based on the current findings, the gap in pre-language communication development between the children with Down syndrome and the typically developing children increased at the age of about 14-16 months and continued through 20-22 months, as expected[43], with the exception of conditions preceding communication. The latter includes behaviours such as; eye contact, visual focusing, turn taking, motor and vocal imitation. By the time the children with Down syndrome were 20-22 months old, most of them developed the above behaviours. The typically developing children however, reached a ceiling effect on this measure before the age of 14 months and continued to develop other more advanced stages of communication thus widening the developmental gap between the two groups. It should be noted that the gap increased even after controlling for cognitive ability. Why do gaps between pre-verbal development of typically developing and children with Down syndrome open at the age of 14-16 months?

Pre-verbal communication skills are acquired through a process involving the transition from early social interactions, which are primarily face-to-face interactions to interactions with objects[54]. For children with Down syndrome, the transition from the stage of face to face communication to the stage of communication through and with objects does not occur as smoothly as it does for typically developing children since it involves several of their typical motor and cognitive difficulties. It may be hypothesised that, for children with Down syndrome, looking at an object and attempting to shift their visual focus to their mother may be such a slow process that in the interim they may lose memory of the object they had focused on initially. This process may lead to a fragmented, perception of the world, one which does not enable associating objects with other objects or processes, and is detrimental to joint attention and joint action. Such attention is basic to learning from adults, namely, learning through the active involvement of another person. One of the objectives of the current study was to identify the frequency and type of maternal teaching behaviour in interactions with children with Down syndrome and typically developing children during this tran-

sitional period.

The most typical sequence of maternal teaching behaviour found in previous studies[35,36] and in the current study is opening a communication sequence by an attempt to focus the child's attention, followed by an attempt to hold that attention by raising the level of affect expressed towards an object (Affecting), and then, trying to associate or link (Expand) that experience with other experiences. This sequence is believed to strengthen the child's awareness of relations between things and his or her need to seek information about them beyond what is perceived through the senses without adult involvement[34]. Since significant relations between maternal teaching behaviour and pre-verbal development were found in the current study for children with Down syndrome, it cannot be argued that they need less Affecting and Expanding as compared with typically developing children. It appears however, that they get a lower frequency of both Expanding and Affecting and a higher frequency of Focusing, namely isolated behaviours of catching attention which was negatively related to their pre-verbal and cognitive development. In addition, another specific characteristic of the type of teaching behaviour typically useful for children with Down syndrome was identified as Affecting accompanying their actions and supporting them, namely, from Affecting accompanying Regulation of behaviour, whereas typically developing children were found to benefit from Affecting in general, not specifically related to their actions.

It is interesting to note that children with Down syndrome vocalised more in care-giving situations such as feeding and bathing, as compared to play situations. The latter finding, combined with the previously reported findings that parents of toddlers in Israel tend to mediate less during care-giving situations as compared to play[36], raises the question: do parents of children with Down syndrome make good use of this vocalisation? Based on the observations in the current study the answer to this question is negative. Most parents of children with Down syndrome do not view care-giving situations as teaching opportunities. The direct physical involvement of infants with Down syndrome in feeding or bathing may lead to more vocalisation during those situations and could possibly be used for further, more complex teaching and learning, particularly prior to and at the age of 14-16 months when the gap between children with Down syndrome and typically developing children widens.

The findings of the current study should be considered with the study's limitation. The study involved 38 children with Down syndrome; however, future studies may use even larger samples. In the current study it was possible only partially to control for developmental differences between the two groups, and future studies may carry out developmental assessments concomitantly with language development and mother-child interaction assessments to further investigate relations between these variables. Group differences found in analyses that do not control for general developmental differences may be related to differences in mental age between children with Down syndrome and typically developing children, rather than to group membership. Furthermore, to better understand development of children with Down syndrome, future studies should include a more varied population to enable comparison to other developmental aetiologies.

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