

## PAPER

# Noticing and commenting on what's new: differences and similarities among 22-month-old typically developing children, children with Down syndrome and children with autism

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### Abstract

*Twenty 22-month-old typically developing children (TD), 11 children with Down syndrome (DS) and 10 children with autism (A), all functioning at a one- or two-word linguistic level, were given eight series of four toys to explore. In each series, the first three toys (i.e. Trials 1–3) were identical, but the fourth toy (i.e. Trial 4) differed on a property or in identity. The children sat beside their mother and the experimenter while exploring the toys. Of interest was whether (1) the TD children would show more exploratory and communicative behavior related to the toys on Trials 1 and 4 than 2 and 3, and (2) how the response patterns of nontypically developing children would compare. The DS group showed a pattern of responding similar to that of the TD group with respect to their attention and interest in the toys, although a much lower rate of communicating with their mother. In contrast, the A group differed significantly from both other groups with respect to both the toys they found of interest and the timing of their topic initiations. Implications for observing declarative communication among children with Down syndrome and children with autism are discussed.*

Successful communication is not only the result of knowing what the words of a language mean and how to put the words together in grammatically appropriate ways, but also of knowing how to use language in communication with others – the domain of pragmatics. One very basic pragmatic skill is the ability to comment on a topic in a way that will be of interest to a communicative partner, thereby sustaining further communicative interaction. One way in which humans accomplish this is by making comments or initiating topics that focus on new rather than given information. The definition of 'new information' varies among researchers. In its most sophisticated sense, new information is information not known by a communicative partner (e.g. Grice, 1975; Clark & Clark, 1977; Bates & MacWhinney, 1979) that requires consideration of what knowledge is shared or not shared by a communicative partner. However, especially in the context of young children's communication, new information has also been defined in a more lenient

manner as information that has been noticed and is new for the speaker alone. New information in the latter sense has been argued to be largely determined by what our attentional system is directed to: namely, the new, salient or changing aspects in a situation (e.g. Bates, 1976; Greenfield & Zukow, 1978). In the present study, the ability of 22-month-old typically developing children to comment on new information, in the more lenient sense of the term, was investigated. Their performance was compared to that of a group of children with Down syndrome and a group of children with autism who were at a similar one- or two-word language level.

A number of researchers have previously looked at the tendency of very young children to talk about new information. Greenfield and Smith (1976) and Greenfield and Zukow (1978) have argued that, in the one-word stage, 'what is taken for granted [i.e. perceived as certain] goes unstated by the child, while uncertain, informative, or changing elements are given verbal expression in the single word utterance' (Greenfield &

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Zukow, 1978, p. 290). Greenfield and colleagues present a number of findings to demonstrate that this 'principle of informativeness', as they refer to it (Greenfield & Smith, 1976; Greenfield & Zukow, 1978; Greenfield, 1979), can generally explain which element in a situation is selected and expressed verbally. Greenfield and Zukow (1978) also reanalyzed a portion of data collected by Bloom (1973) on her daughter Alison, and found that, in large part, Alison's semantic choices appeared to follow the predictions of the principle of informativeness.

In a further quasi-naturalistic experiment, Greenfield and Zukow (1978) studied the one-word utterances of four children with respect to events consisting of some entity undergoing a change produced by an agent. The children (whose mean age was 1;10) were presented with certain actions such as where certain elements stayed constant (e.g. the action of taking an article of clothing off) and other elements were varied (e.g. the article of clothing taken off). The mother described the action (e.g. Here is mommy's shoe) or asked the child to do various things (e.g. Can you take your shoes off?) and the researchers recorded the aspect of the mother's utterance imitated spontaneously by the child. The researchers found that their predictions of which element in the situation children would choose to express verbally according to the principle of informativeness were confirmed in the large majority of cases by the children's actual semantic choices. MacWhinney and Bates (1978) cite similar observations that single-word utterances tend to express new information while omitting given information from deLaguna (1927), Sechehaye (1926) and Vygotsky (1962).

Two other studies (Snyder, 1978; Rowan, Leonard, Chapman & Weiss, 1983) presented typically developing children and language disordered children at the one-word stage with a task meant to induce spontaneous declarative communication. In both studies, the children were presented with ten series of four trials. On the first three trials of each series, the children were given three similar objects (e.g. block) to perform an action with (e.g. dropping in a pail) and then, on the fourth trial, were given a different object (e.g. a doll). For each series of four trials, a different action was introduced (e.g. removing a doll from a truck, feeding a rabbit). Children's behaviors throughout the ten series of four trials were examined for instances of declarative communication such as showing, giving, pointing or naming the objects. In both studies, it was found that both groups of children demonstrated a tendency to signal the situationally new (changing) elements rather than the old (unchanging) elements, both verbally and gesturally.

Beyond the one-word stage, although children are now able to encode more information explicitly in their utterances, a number of studies have suggested that the information made explicit is that which is situationally the least redundant (Hornby, Hass & Feldman, 1970; Weisenberger, 1976; MacWhinney & Bates, 1978). At the two-word stage and beyond, several researchers have also found that children use focal stress systematically to indicate new information (Hornby & Hass, 1970; Hornby, 1971; Wieman, 1976; MacWhinney & Bates, 1978). The division of new and old information at the one-word stage is thus seen, by researchers such as Bates (1976), as the beginning of the proposition-presupposition relationship. However, as the tendency for young children may be to talk about what is new for them, rather than what is new for listeners, the major task for children in the course of pragmatic development will be, as Bates (1976) has suggested, 'to learn when *not* to presuppose, i.e. when it is necessary to provide the listener with explicit clues about the information that is being assumed as background for a comment' (p. 445). How this task is accomplished, even in adults, remains a topic of current research and debate (e.g. Grice, 1975; Clark & Marshall, 1981; Sperber & Wilson, 1986; Keysar, Barr, Balin & Paek, 1998).

Nevertheless, if we consider children in the early stages of language acquisition, one indication of pragmatic competence may be the ability to recognize those aspects in the environment that are salient and to initiate communication about them. By using the term *salient* we mean to imply information that is potentially of shared interest to others and worth communicating about. This ability to recognize elements in a situation as salient, we believe, involves more than just the operation of an automatic orienting system tuned to novel stimuli, but is not as sophisticated a pragmatic skill as the ability to consider what knowledge is shared or not shared by a communicative partner. One goal of the present study was to determine whether, when given a series of toys to play with that vary with respect to certain features in terms of givenness and newness, typically developing children at the one- and two-word stage would find the 'new' toys to be more salient and interesting than the 'old' toys, and whether children would initiate more communication (verbal and nonverbal) about these new toys.

To be more specific, in our study, children were presented with eight sets of four toys to explore in a laboratory setting. In each series, the first three toys (Trials 1–3) were identical (e.g. small yellow duck) and the fourth toy (Trial 4) differed on a property (e.g. big yellow duck) or in identity (e.g. dog). The children explored the toys while sitting at a small table with their

mother and the experimenter. Children's spontaneous behaviors and vocalizations were video recorded. Of interest was whether children would show more exploratory behavior with the toys and more communication about the toys on Trials 1 and 4 versus 2 and 3.

With its focus on spontaneous comments of children, the present study is most similar to the previous work of Rowan *et al.* (1983) and Snyder (1978). However, in these two previous studies children's nonverbal and verbal behaviors were not analyzed with respect to the trial on which they occurred, but rather were summed across all trials, inter-trial intervals and different toys. Behaviors with the toy that were not accompanied by a look to the experimenter or mother were also not scored. In the present study, in contrast, children's behavior was examined on a trial-by-trial basis and included all behaviors exhibited by children. Moreover, unlike in the previous studies in which the mothers were not restrained from initiating communication about toys (the testing took place in the living room of each child's home), the mothers in our study were specifically asked not to initiate any communication in order for us to be able to observe the ability of children to select and initiate a topic on their own.

Our study also had a second aim: to compare the interests and spontaneous topic initiations of typically developing children with those of children with Down syndrome and children with autism. We propose that children's earliest topic initiations and comments rest not only on the ability to use verbal or gestural means to communicate about the salient aspects of a situation to a communicative partner, but also on a more primary or basic ability to perceive and recognize the salient aspects of a situation. While impairment in the former ability might result in infrequent (but appropriate) topic initiation in communication with others, impairment in the latter ability might result in difficulty determining appropriate topics even when one might have the means whereby to communicate about these topics. That is, impairment in the latter ability might leave children unable to communicate about those aspects in the situation most likely to interest others and hinder further conversational interaction.

Much research has documented that individuals with autism display pragmatic impairments that include great difficulty initiating topics, choosing an appropriate topic, staying on topic, knowing when a topic should be changed, adapting their communication to the needs of a communicative partner, distinguishing new from old information, and distinguishing their own viewpoint from that of their communicative partner (Fay & Schuler, 1980; Tager-Flusberg, 1981; Baron-Cohen, 1988; Eales, 1993). Thus, for individuals with autism,

the pragmatic ability to determine what is an appropriate or good topic for conversation is not a given. To date, such communicative difficulties have largely been attributed to impairments in primary social or emotional functions. In particular, the idea that children with autism lack a theory of mind and are unable to attribute mental states to self and others has made sense of much of the pattern of intact and impaired language functions (Frith & Happé, 1994; see chapters in Baron-Cohen, Tager-Flusberg & Cohen, 1993). We would like to suggest that an idiosyncratic perception of what is salient in the environment might also play a role in the communicative impairment of individuals with autism. A fairly large body of anecdotal evidence suggests that individuals with autism may suffer from sensory-perceptual abnormalities including hypersensitivity and hyposensitivity, sensory distortion and overload, and multichannel receptivity and processing difficulties (Frith & Baron-Cohen, 1987; O'Neill & Jones, 1997). Systematic empirical research on autistic perception is lacking, although a number of studies have suggested that abnormally detail-focused information processing is characteristic of individuals with autism (Shah & Frith, 1983, 1993; Dalferth, 1989; Mottron & Belleville, 1993; Happé, 1996). Indeed, included among the DSM IV diagnostic criteria for autistic disorder is the manifestation of a 'persistent preoccupation with parts of objects' (American Psychiatric Association, 1994, p. 71). If children with autism do perceive environmental features somewhat differently from the communicative partners around them, this might contribute to communication breakdown. In the present study, we expected to see a much lower rate of declarative communication among the children with autism than among the two other groups of children as research has consistently found deficits with respect to this type of communication, in both the verbal and nonverbal realm (Mirenda, Donnellan & Yoder, 1983; Wetherby & Prutting, 1984; Loveland & Landry, 1986; Mundy, Sigman, Ungerer & Sherman, 1986; Wetherby, 1986; Stone & Caro-Martinez, 1990; McArthur & Adamson, 1996; Stone *et al.*, 1997). What was uncertain was whether children with autism would show differences in the amount and timing of their interest in the toys compared to the other children and in the timing of any occurring communicative behavior.

In contrast to individuals with autism, individuals with Down syndrome or general developmental delay are not generally thought to be impaired with respect to pragmatics, particularly in the early stages of language acquisition (Coggins & Stoel-Gammon, 1982; Owens & MacDonald, 1982; Coggins, Carpenter & Owings, 1983; Leifer & Lewis, 1984; Scherer & Owings, 1984; Fowler,

1990). Indeed research suggests that they may even be advanced in these skills relative to their syntactic abilities (Beeghly, Weiss-Perry & Cicchetti, 1990).

Interestingly, the findings of a number of studies suggest that what children with Down syndrome communicate about is, as for typically developing children, what is salient and interesting in the environment. For example, Leonard and colleagues (Leonard, Cole & Steckol, 1979) found that developmentally delayed children, who were aged 2;3 to 3;10 years and at the one-word stage, tended to label objects when they were newly presented in a situation. And the initial nouns produced by children with Down syndrome have been found to be concentrated on the same subset of categories as for typically developing children (Gillham, 1979; Mervis, 1990; Miller, 1992), a finding that has been attributed to children's similar interest in objects that can move independently, be manipulated (Guillaume, 1927/1973; Nelson, 1973), or that are novel and salient (Whitehurst, Kedesdy & White, 1982). At the two-word stage, children with Down syndrome encode much of the same thematic relations as typically developing children (Coghins, 1979). Based on this research, we did not expect to find significant differences between the typically developing children and the children with Down syndrome in terms of their interest in the toys or in the timing of their communication.

It should be noted, however, that debate exists as to the ability of children with Down syndrome to share a topic of interest with others communicatively, with some research finding few differences between children with Down syndrome and typically developing children (Beeghly *et al.*, 1990; Franco & Wishart, 1995) but other studies finding that children with Down syndrome do have difficulty sharing their interests with others communicatively. For example, children with Down syndrome have been found to exhibit delayed use of declarative gestures (Greenwald & Leonard, 1979), significant deficits in referential looking behavior (see Miller, 1987; Kasari, Freeman, Mundy & Sigman, 1995), less social play, and less responsive and initiating behavior than their cognitively matched controls (e.g. Jones, 1980; Beeghly *et al.*, 1990). Given these contradictory findings, we did not make any specific predictions about the level of communicative behavior to be seen among these children, but thought that some difficulties in this arena might be observed.

To summarize, there were three main predictions in this study. The first concerned typically developing children's attention and interest. It was expected that these children would show greater attention to a toy on Trials 1 and 4 (within a given series of four toys), when the identity of the toy was novel or the toy had changed

with respect to a property, than on Trials 2 and 3 when the toy was identical to that of Trial 1. The second hypothesis concerned typically developing children's communicative behavior. It was expected that the children would show more nonverbal and verbal communicative behavior on Trials 1 and 4 versus 2 and 3. The third hypothesis concerned the attentional and communicative behavior of the two non-typically developing groups of children compared to the typically developing children. It was predicted that the children with Down syndrome would show a pattern of responding similar to that of the typically developing children with respect to their attention and interest in the toys, but that they might show some difficulty communicating about these aspects of interest. In contrast, the children with autism were predicted to show a pattern of responding that differed significantly from both other groups with respect to both the aspects of the toys they found of interest and the timing of their topic initiations.

## Method

### *Participants*

Three groups of children and their mothers participated in this study. Twenty typically developing children (ten boys and ten girls; mean age 22 months, range 20–23 months), largely from middle-class families, were recruited from a database of volunteers at the MRC's Cognitive Development Unit in London, England. Eleven children with Down syndrome (six boys and five girls; mean age 45 months, range 21–67 months) and ten children with autism (eight boys and two girls; mean age 55 months, range 36–70 months) were recruited through advertisements placed in newsletters of the autism or Down syndrome societies in and around London. These advertisements specifically asked for children who were at the one- or two-word stage. All the children had received a diagnosis of autism spectrum disorder from an independent clinician, according to current (DSM-III-R or DSM-IV) criteria. Four typically developing children and four children with autism were dropped from the study due to excessive fussiness/inattentiveness or because the mother initiated communication during the testing trials. None of the children with autism suffered from a genetic disorder (e.g. fragile x).

At the end of the study, all parents were given the MacArthur Communicative Development Inventory (Fenson *et al.*, 1993) to complete at home and to return by mail. As recommended by the manual for the MacArthur, children reported by a parent to have fewer

than 50 words (and/or signs as five of the Down syndrome children were using Makaton signs) were given the Words and Gestures form. Children reported to have greater than 50 words and/or signs were given the Words and Sentences form. Recent research has established the validity of the MacArthur Inventories for children with Down syndrome (Miller, Sedey & Miolo, 1995) and language-impaired preschool children (O'Hanlon & Thal, 1991). Parents of children with autism were asked not to include words they considered only echolalic. Three parents of typically developing children and one parent of a child with Down syndrome did not return the form. All other parents did so within four weeks of testing.

Materials

Equipment

The children were seated at a small table (60 cm x 90 cm) with the experimenter to their right and their mother to their left. In front of the table, at a distance of about 2 m, stood a video camera which recorded the behavior of the child and the parent. A videocassette recorder equipped with frame-by-frame viewing capability was used to code the videotapes.

Stimuli

Eight series of four toys were used. In each series, the first three toys (Trials 1–3) were identical in all respects. The fourth toy (Trial 4) looked identical but differed on a *property* (e.g. size, texture) for six of the series of toys. In the remaining two series, the fourth toy differed in *identity*. Table 1 lists the eight series of toys used. In addition, a box with a chute attached to it that extended to the height of the table was constructed for children to throw the toys into once they had lost interest in them.

**Table 1** Eight series of toys used

Series	Toy used on Trials 1–3	Toy used on Trial 4
<i>Six toy series with property change on Trial 4</i>		
Duck	Small, yellow plastic duck	Big, yellow plastic duck
Bear	Intact teddybear	Teddybear with ear missing
Bells	Ring of bells	Ring of bells without sound
Pig	Squishy, light rubber pig	Heavy, plaster-filled pig
Cat	Smooth, cotton-filled felt cat	Bumpy, chick-pea filled cat
Beads	Flexible string of beads	Rigid string of beads
<i>Two toy series with identity change on Trial 4</i>		
Car–Dog	Toy car	Toy dog
Ball–Frog	Juggling ball	Plastic frog

Five other non-animal toys (e.g. block, plane) were used in the introductory trials to familiarize the children with throwing toys down the chute into the box.

Procedure

Introductory trials

Children were first given one of the five non-animal toys to explore. When their interest had waned in the toy (e.g. they no longer wanted to explore it), they were told to throw the toy in the chute. Then, the experimenter presented the next toy. This procedure was carried out with all five non-animal toys in order to familiarize children with the procedure of throwing the toy down the chute when they were no longer interested in it and then receiving the next toy.

Experimental trials

The children were then given the four toys of each of the eight series one at a time, and were free to explore each toy for as long as they wanted to before throwing it down the chute. Once they had thrown a toy in the box, they were given the next toy. The experimenter initiated as little communication as possible, communicating only between toys if needed to keep the child focused on the task (e.g. 'Let's see what else I've got for you'). Mothers were asked *not to initiate* any communication with their child at any time during the test session. They were also told that if their child initiated any communication with them, they should acknowledge their child's utterance as they normally would, but refrain from asking any questions. One child with Down syndrome used the Makaton signs for duck, cat and gorilla (for the frog) in addition to vocalizing during the procedure.

Children were first presented with the six series of four trials involving a property change, in counterbalanced order. Two final trials (counterbalanced) were added at the end of these six trials that involved an identity change and that were intended to serve as a replication of the previous procedure used by Snyder (1978) and Rowan *et al.* (1983). In total, therefore, each child received 32 trials.

Definition and coding of dependent measures from videotape

Coders

All the videotapes were coded independently by two coders. All codings relating to the time spent with the toy, vocalizations (i.e. occurrence of any vocalization,

transcription of vocalizations, and categorization of vocalization type) were carried out independently by two undergraduate research assistants who were blind to the hypotheses of the study. All codings related to the child's behavior with the toy (i.e. occurrence of any behavior with the toy and behavior directed to the self, mother or the experimenter) were carried out independently by the first author and an undergraduate research assistant blind to the hypothesis of the study and were conducted independently of the results of the codings by the other two coders. On each trial, the nonverbal and verbal components of children's behavior were coded as follows.

#### Time spent with a toy

The amount of time a child spent with a toy was measured to the nearest half-second from the time the child first picked up the toy until the time when the child released the toy to drop it down the chute. Not included in this measure was any increase in time as a result of a child dropping a toy accidentally or getting distracted temporarily (i.e. suddenly pointing to a picture on the wall). A score of 1 s or less usually represented a child who simply picked up the toy and dropped the toy down the chute without any exploration. (In three cases, it represented a child who pushed the toy away.)

#### Any behavior with a toy

This measure was defined as any manual or visual exploration of a toy, any play behavior with a toy, or any verbal or gestural communicative behavior (e.g. a look to the mother or the experimenter, a verbal utterance, a showing gesture) that the child engaged in from the time of picking up a toy until it was released into the chute. The single occurrence of any such behavior on a trial earned a child a score of 1 for that trial. Other measures described below coded certain behaviors included in this measure in greater detail (e.g. behaviors with a toy directed to self or others, brief or extended exploration of the toy). A score of 0 was given when a child performed none of the above behaviors with a toy, (i.e. they did nothing other than throw the toy immediately down the chute).

Behaviors that resulted from distraction and were not directed at the toy (e.g. pointing at a picture on the wall) were not included in this measure. The only verbal behavior not included in this measure was laughing, which was considered to be an involuntary behavior. All verbalizations were included in this measure, even if they were echolalic (in the case of the children with autism) or

seemingly unrelated to the toy (e.g. saying 'quack' when the toy pig was present).

Behaviors during the interval after a toy had been dropped in the chute and the experimenter brought out the next toy and placed it on the table in front of the child were not included in this measure, or any other coded in this study, because a preliminary analysis revealed that children did not talk about the toy or engage in any behavior related to the toy during this time. All remaining measures discussed below represent subsets of behavior included in this measure of *any behavior with a toy*.

#### Behavior with a toy for self

This measure was designed to capture a child's *own* attention to, or interest in, the toys, versus behaviors (vocal, gestural or playful) directed towards the mother or the experimenter. Two types of *behavior with a toy for self* were distinguished: (1) *extended exploration* of a toy – the child inspected a toy manually or visually for a period of more than 2 s (e.g. squeezed the pig, brought the ball up to the face area) or engaged in some play behavior with the toy (e.g. hugged the bear, made the toy dog walk); and (2) *brief exploration* of a toy – the child held a toy and inspected it visually, without any manual manipulation or playful behavior, for at most 2 s before throwing it down the chute. Both of these types of *behavior with a toy for self* occurred without any accompanying looks to the mother or the experimenter and were therefore taken as a reasonable (though imperfect) approximation of those behaviors directed mainly at the self. Because of the difficulty in categorizing the more extended types of children's play with the toys (e.g. is a child who makes the dog walk engaging in pretence or not?), the small numbers of different types of play observed overall, and the difficulty in gaining reasonable reliability between coders, occurrences of extended exploration were not coded into more detailed categories. Where appropriate, however, descriptive examples of some of the behaviors will be included to give the reader a sense of the types of activities with the toys that the children engaged in.

#### Behavior directed to the mother or the experimenter

Because a fair number of children directed behavior to the experimenter as well as to their mother, these behaviors were included as an additional dependent measure. Behavior directed to the experimenter or the mother was defined as any behavior immediately preceded by, accompanied by or immediately followed by a *look* to the experimenter or the mother. These

behaviors included such things as pushing the toy towards the mother or the experimenter; playful behaviors such as hugging the bear or making the beads snake along the tabletop; and vocalizations or nonverbal gestures such as showing the toy (all accompanied by eye gaze towards the adult). All these behaviors would have fallen under a category of *extended exploration* as described earlier (but directed to the mother or the experimenter rather than the self). Children were given a score of 1 on any trial in which any of these types of behaviors directed to the mother/experimenter occurred, and a score of 0 on every trial on which none of these types of behaviors occurred.

#### Any vocalization

This measure included any vocalization directed to self, the mother or the experimenter from the time a child first picked up a toy until the child dropped it down the chute. Among the children with Down syndrome, this measure also included three Makaton signs used by one child. Six types of vocalizations were distinguished:

- (1) *naming*: naming the identity of the toy such as 'duck' or 'pig';
- (2) *talking about the change*: saying something related to the property change on trial 4 such as 'big' for the duck or 'hard' for the pig;
- (3) *related talk*: saying something related to the toy (e.g. 'oink, oink' for the pig) or relevant with respect to the situation (e.g. 'another one');
- (4) *babbling*: any vocalization with a babbling-like repetitive consonant–vowel sound such as 'awawa' or 'dodo';
- (5) *unrelated talk*: utterances that were interpretable but did not seem related to the toy or the child's actions with the toy in any obvious way (e.g. saying 'two baby' while examining a pig);
- (6) *other*: nonword sounds other than babbling that included squeals, humming sounds, grunts, and a raspberry sound made by some of the children with Down syndrome. These vocalizations were included because they appeared to occur only when the toys were present, and were therefore judged to be meaningful. Indeed, mothers would normally have responded to these sounds as though the child was attempting to communicate something.

Note that one utterance could receive more than one classification depending on the amount of content. For example, if a child had uttered 'big duck' on the fourth trial, this would have been coded as *naming* plus *talk about the change*. Each instance of a vocalization type was considered to be one *utterance content unit*. Thus the

utterance 'big duck' would consist of two utterance content units.

All vocalizations were also classified as to whether they were directed to the self, the mother or the experimenter. A vocalization was considered to be directed to the mother or the experimenter if it was immediately preceded by, accompanied by or immediately followed by a *look* to the mother or the experimenter. For the measure of *occurrence of any vocalization*, children were given a score of 1 for any trial on which they produced at least one of the above vocalization types and a score of 0 otherwise.

#### Reliability between coders

There were very few disagreements between coders among the measures coded over all 1312 trials (i.e. the sum of the 640 trials of the typically developing children, 352 trials of the Down syndrome children and 320 trials of the children with autism). Kappa values were calculated and were 0.99 for *any vocalization* and *behavior directed to the mother*, 0.98 for *any behavior with a toy*, and 0.97 for *behavior directed to the experimenter* and *behavior with a toy for self*. In the latter category, there were eight instances of a discrepancy concerning the classification of the behavior as *brief* versus *none*, and 13 concerning the classification of the behavior as *brief* versus *extended*. For all the above measures, instances of discrepancy were distributed roughly equally between the three groups. With respect to the classification of *vocalization types*, the kappa value over all utterance content units was 0.95. For the measure *time spent with a toy*, percentage agreement was 99%. All cases of discrepancy were resolved through discussion.

#### Children's profiles on the MacArthur Inventory

Children's profiles on the MacArthur Inventories are shown in Table 2 for the measures of productive vocabulary size (number of words) and mean utterance length (MLU). For the children whose parents did not return the form, the vocabulary level reported by the parent at the time of participation is noted. MLU in morphemes was computed for each child using the three longest sentences provided by parents in Section D of the form, following the procedures adapted from Miller (1981) as recommended in the MacArthur coding manual (Fenson *et al.*, 1993). The three groups did not differ significantly with respect to the children's vocabulary sizes nor their MLU ( $F < 1$  in both cases). It should be noted that as the calculation of MLU is based solely on one question in which parents are asked to

**Table 2** Mean, standard deviation, and range of number of words produced (productive vocabulary size) and MLU as reported by parents on the MacArthur Communicative Inventories for each group

	<i>N</i>	Mean chronological age (months)	Productive vocabulary size (SD) and [range]	Mean MLU (SD) and [range]
Typically developing <sup>a</sup>	20	22	233 (143) [25–534]	3.7 (2.2) [1–7]
Down syndrome <sup>b</sup>	11	45	169 (150) [1–448]	3.2 (3.3) [1–8.7]
Autistic	10	55	244 (173) [69–585]	4.8 (3.3) [1–12.3]

Notes:

<sup>a</sup> *n* = 17.

<sup>b</sup> *n* = 9.

Of the two remaining children whose parents did not return the MacArthur, according to parent report at the time of testing, one child had a vocabulary size of 35–40 words and the other a vocabulary size of 50–100 words.

report the three longest sentences they have heard their child say recently, this estimate of MLU may indeed represent a higher level of functioning than what children typically exhibited in everyday communicative interactions, which parents reported to be one- and two-word utterances. As an added measure of syntactic development, children's scores on the MacArthur's measure of sentence complexity were compared. High correlations between this complexity scale and MLU have been found in previous research (Dale, 1991; O'Hanlon & Thal, 1991). No significant difference between the three groups was found on this measure either.

## Results

Preliminary analyses revealed no significant sex differences with respect to any variable measured for the typically developing children and the children with Down syndrome. Among the children with autism, sex differences were again not apparent, although the small number of girls precluded statistical analysis. Thus, the data were collapsed across sex in all subsequent analyses. In addition, no significant differences were found with respect to children's responding on the property versus identity change toy series, and so data were collapsed across the different types of toy series in the analyses to follow.

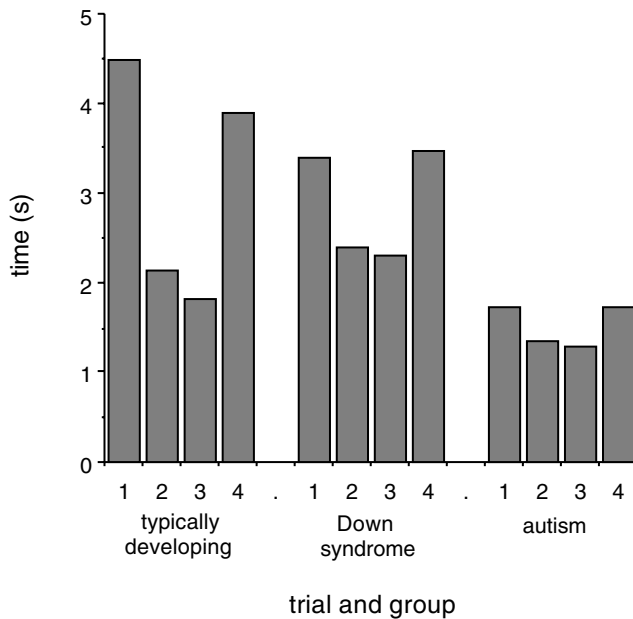
### *Time spent exploring a toy*

The amount of *time spent exploring a toy* on any given trial was extremely variable among typically developing children (0.5–133 s). However, a number of the longer times were outliers. A decision was made to cap all scores at 25 s for further analyses. This value was chosen

from an initial examination of the data and was somewhat arbitrary, but was one which resulted in only a few scores being capped and avoided the possible exaggeration of differences between the typically developing and non-typically developing groups because of outliers among the former group. These scores were not excluded altogether from the analysis as they were limited almost exclusively to a single group and we wished to retain some indication that on these trials a longer time had been spent exploring the toy. Among the typically developing group, this decision resulted in 3% of scores being capped. Among the Down syndrome group, scores ranged from 1 s to 26.5 s and one score was capped. No scores were capped among the autism group whose scores ranged from 1 to 17.5 s. Figure 1 presents the mean *time(s) spent exploring a toy* on Trials 1–4, collapsed over toy type, separately for each group.

Because children's time scores remained skewed following capping, further analyses were conducted on the logarithm of the time scores. Essentially the same results are found, however, without this transformation. A three-way repeated-measures analysis of variance (ANOVA) (group (typically developing (TD), Down (D), autism (A)) (between factor) × toy type (eight series of toys) × trial (1, 2, 3, 4) (within factors)) was conducted and this analysis indicated significant main effects of group ( $F(2, 38) = 15.12$ ,  $MSE = 0.62$ ,  $p < 0.01$ ) and trial ( $F(3, 114) = 39.22$ ,  $MSE = 0.11$ ,  $p < 0.01$ ), as well as significant interaction effects of trial × group ( $F(6, 114) = 4.83$ ,  $MSE = 0.11$ ,  $p < 0.01$ ) and trial × toy type ( $F(21, 798) = 4.73$ ,  $MSE = 0.06$ ,  $p < 0.05$ ). The significant group effect will be considered first. The mean (capped) time per child for each group, collapsed over toy type and trials, was 4.8 s (typically developing), 3.9 s (Down) and 2.0 s (autism). Contrast analysis revealed that the typically developing children and the children with Down syndrome did not differ signifi-





**Figure 1** Mean time (s) spent exploring a toy on Trials 1–4, collapsed over toy type, and shown separately for the typically developing, Down, and autism group.

cantly from each other in total mean *time spent exploring a toy* ( $F < 1$ ). However, both these groups explored the toys significantly longer than did the children with autism (TD vs A:  $F(1, 38) = 26.77, p < 0.01$ ; D vs A:  $F(1, 38) = 20.80, p < 0.01$ ). Indeed, for the children with autism, the mean amount of time spent with any toy never exceeded 3 s, whereas for both the children with Down syndrome and the typically developing children mean times twice as long (6 s) were observed. These results suggest a much lower level of interest in the toys shown overall by the autism group compared with the other two groups.

Contrast analysis clarified the nature of the significant trial and trial  $\times$  group effects found and allowed examination of our hypothesis that children should spend a greater amount of time exploring the toys on Trials 1 and 4 than on Trials 2 and 3. The contrast between the *time spent exploring a toy* on Trials 1 and 4 versus 2 and 3 was compared among the three groups of children (i.e. their U-shaped patterns of responding were compared as shown in Figure 1). The children with Down syndrome ( $F(1, 38) = 10.03, p < 0.01$ ) and the children with autism ( $F(1, 38) = 26.77, p < 0.001$ ) both exhibited a significantly flatter U-shaped pattern of responding than that of the typically developing children. But the patterns of responding among the two non-typically developing groups did not differ significantly ( $F < 1$ ). At the individual level, the typically

developing children showed a U-shaped pattern<sup>1</sup> of *time spent exploring a toy* on 45% of all 160 series of four trials, compared with 27% (of all 88 series) and 18% (of all 80 series) among the Down syndrome and autism groups, respectively.

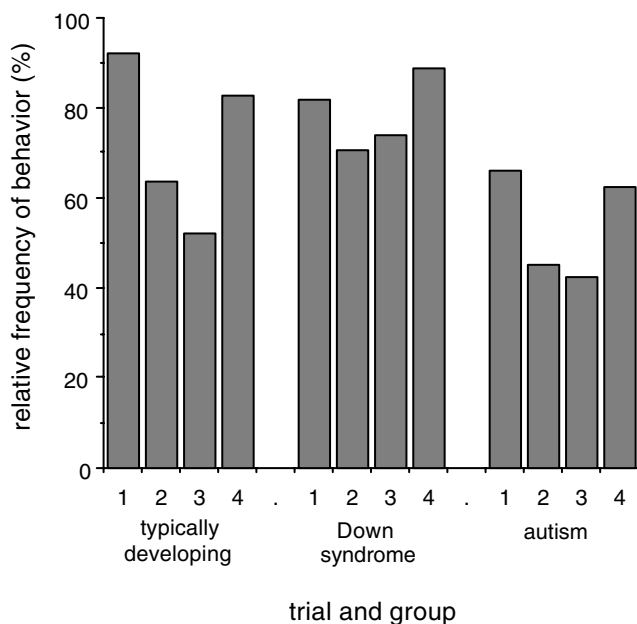
To further clarify the nature of the trial effect at the level of each group, a one-way repeated measures ANOVA with trial as the within-factor was conducted for each group separately. A significant main effect of trial was found among all three groups (TD:  $F(3, 17) = 21.36$ ; D:  $F(3, 8) = 12.96$ ; A:  $F(3, 7) = 7.05$ ; all  $p < 0.05$ ). Moreover, for all three groups, significantly more time was spent exploring the toys on Trials 1 and 4 than on Trials 2 and 3 (TD:  $t(19) = 8.39$ ; D:  $t(10) = 5.55$ ; A:  $t(9) = 5.10$ ; all  $p < 0.05$ ). However, it should be noted that this difference was of the order of only 0.4 s for the children with autism on average, compared to 2.2 s and 1.1 s on average for the typically developing children and the children with Down syndrome, respectively.

As would be expected, some property changes and some identity changes were more salient or interesting to children overall than others (e.g. duck, cat, and car  $\rightarrow$  dog series) leading to the significant trial  $\times$  toy type interaction found above. There was not a three-way interaction with group, indicating that, when children were observed to spend time with the toys, the groups did not differ with respect to which toys they spent more or less time with over the four trials.

#### Any behavior with a toy

Figure 2 displays the relative frequency (scored out of a possible eight given the eight toy types) of *any behavior with a toy* on Trials 1–4, collapsed over toy type, separately for each group. A three-way repeated measures ANOVA (group  $\times$  trial  $\times$  toy type) revealed significant main effects of group ( $F(2, 38) = 5.75, MSE = 0.97, p < 0.01$ ) and trial ( $F(3, 114) = 21.74, MSE = 0.21, p < 0.01$ ), and significant interactions for trial  $\times$  group ( $F(6, 114) = 2.43, MSE = 0.21, p < 0.05$ )

<sup>1</sup>To determine a child's pattern of responding over the four trials within a given toy series, the numerical time score coded for each trial was given a number from 1 to 4, with 1 being the shortest time spent with the toy and 4 being the longest. If two or more time durations were identical, they received the average of the numbers assigned from 1 to 4. A U-shaped pattern of responding was designated as any toy series of four trials that received the following number sequences: 4–2–1–3, 3–2–1–4, 3–1.5–1.5–4, 4–1.5–1.5–3, 3.5–2–1–3.5, 3.5–1.5–1.5–3.5, 2.5–2.5–1–4, 4–3–1–2 and 4–2.5–1–2.5. Other patterns evident in the data were a decreasing linear pattern (e.g. 4–3–2–1), an increasing linear pattern (e.g. 1–2–3–4), a 'flat' pattern of 2.5–2.5–2.5–2.5, and an 'other' pattern that did not fit any of the above four categories (e.g. 4–1–2–3, 2–1–3–4).



**Figure 2** Relative frequency of any behavior with a toy on Trials 1–4, collapsed over toy type, and shown separately for the typically developing, Down, and autism group.

and trial  $\times$  toy type ( $F(21, 798) = 2.23$ ,  $MSE = 0.12$ ,  $p < 0.01$ ). As the latter interaction was not significant at the level of the group, it will not be discussed further. The significant group effect will be considered first. The mean total score per child per group, collapsed over all toy series and trials, was 23.2 (typically developing), 25.2 (Down) and 17.3 (autism) out of a possible 32. Contrast analyses indicated that, although the typically developing children and the children with Down syndrome did not differ significantly from each other in amount of *any behavior with a toy* ( $F < 1$ ), both these groups produced significantly greater amounts of *any behavior with a toy* than did the children with autism (TD vs A:  $F(1, 38) = 7.47$ ,  $p < 0.01$ ; D vs A:  $F(1, 38) = 10.47$ ,  $p < 0.01$ ). Similar to the findings for *time spent with a toy* above, these results clearly point to an overall significantly lower level of interest in the toys by the autism group compared to the other two groups.

Given the significant trial and trial  $\times$  group effects found, contrast analyses were carried out to compare the amount of *any behavior with a toy* on Trials 1 and 4 versus Trials 2 and 3. The U-shaped pattern of responding of the children with Down syndrome was significantly flatter ( $F(1, 38) = 6.57$ ,  $p < 0.05$ ) than that of the typically developing children. The U-shaped pattern of responding of the children with autism fell in between the other two groups, neither significantly flatter than that of the typically developing children

( $F(1, 38) = 1.78$ ,  $p = 0.21$ ) nor significantly more U-shaped than that of the children with Down syndrome ( $F(1, 2) = 1.04$ ,  $p = 0.32$ ).

A significant main effect of trial was found only among the typically developing children ( $F(3, 17) = 17.44$ ,  $p < 0.01$ ). For this group, contrast analyses indicated that the amount of *any behavior with a toy* was significantly greater on Trials 1 and 4 than on Trials 2 and 3 ( $t(19) = 7.63$ ;  $p < 0.01$ ). Thus, although the children with autism did not show a significantly flatter U-shaped pattern of responding than the typically developing children, the amount of behavior with the toys produced by these children was not significantly greater on Trials 1 and 4 than on Trials 2 and 3, as it was for the typically developing children.

These differences in responding among the three groups are also clearly evident when children's individual patterns of responding are analyzed. In Table 3, it can be seen that typically developing children's scores over the four trials of a given toy series most often fit the response pattern 1111 or a pattern suggesting a decrease in behavior (habituation) over the first three trials followed by an increase (dishabituation) on the fourth trial (i.e. 1001 or 1101). The most common pattern among the children with Down syndrome was 1111, suggesting a higher level of activity throughout the four trials (i.e. a lack of habituation) which would have masked any recovery for Trial 4. Among the children with autism, the most common pattern observed was that of *other* in which children showed a pattern of increases and decreases in behavior that was not tied to the salient changes on Trials 1 and 4 (these patterns included 0111, 1011, 0011, 0100, 0010, 1110 and 1010). This finding was in agreement with the coder's perception that these children often behaved either as oblivious to any changes in the toys or as suddenly interested in a

**Table 3** The percentage of total toy series trials per subject group on which children displayed the following response patterns over Trials 1–4 with respect to the measure of any behavior with the toy

Group	Types of response patterns observed					
	1001	1100	1111	0001	0000	Other
Typically developing <sup>a</sup>	32	10	44	1	5	8
Down <sup>b</sup>	10	8	58	9	0	15
Autism <sup>c</sup>	17.5	17.5	21	9	10	25

Notes:

<sup>a</sup>Total trials, 160.

<sup>b</sup>Total trials, 88.

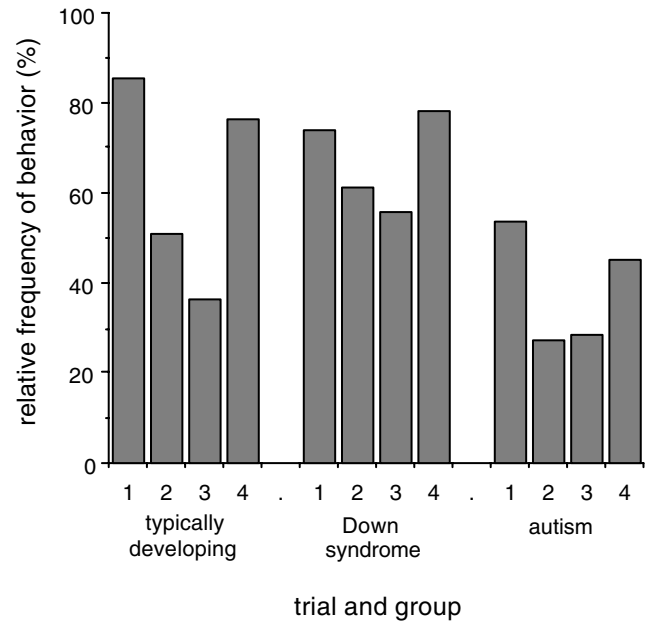
<sup>c</sup>Total trials, 80.

toy on Trials 2 or 3 when the typically developing children were usually losing interest. Moreover, it should be noted that the U-shaped pattern of responding of the children with autism found above included a large number of children who showed only a higher frequency of behavior on either Trial 1 or Trial 4 (e.g. pattern 1000 or 0001), and included only half as many children showing a 1001 or 1101 pattern *within* a toy series as compared to the typically developing children. Thus, overall, the children with autism did not show a similar level of interest in the toys, nor the same pattern of engaging in behavior with the toys over the four series of trials, compared with either of the other two groups.

*Behavior with a toy for self*

The measure of any behavior with a toy included communicative and playful behaviors directed towards the mother or the experimenter as well as instances in which children explored a toy for themselves alone. Because one of the questions of interest in this study was whether communicative difficulties might arise from different perceptions of what is salient in a given situation, it was relevant to try to determine children's *own* interest in the toys, apart from any other communicative or playful behaviors directed at others.

To look at possible differences in the tendency of children in the three groups to explore the toy for self, children were given a score of 1 on any trial in which they exhibited *behavior with a toy for self* (of a *brief* or *extended* nature as defined in the coding criteria above), and a score of 0 when neither of these behaviors was observed on a given trial. Figure 3 displays the relative frequency of *behavior with a toy for self* on Trials 1 to 4, collapsed over toy type, separately for each group. A three-way repeated measures ANOVA (group  $\times$  trial  $\times$  toy type) revealed significant main effects of group ( $F(2, 38) = 8.64$ ,  $MSE = 0.93$ ,  $p < 0.001$ ) and trial ( $F(3, 114) = 29.08$ ,  $MSE = 0.23$ ,  $p < 0.001$ ), as well as significant interactions for trial  $\times$  group ( $F(6, 114) = 2.91$ ,  $MSE = 0.23$ ,  $p < 0.05$ ) and trial  $\times$  toy type ( $F(21, 798) = 2.95$ ,  $MSE = 0.14$ ,  $p < 0.01$ ). As the latter interaction was not significant at the level of the group, it will not be discussed further. The significant group effect will be considered first. The mean score per child for each group out of a possible 32 was 19.9 (typically developing), 21.5 (Down) and 12.4 (autism). Contrast analyses indicated that both the typically developing children and the children with Down syndrome produced significantly greater amounts of *behavior with a toy for self* than did the children with autism (TD vs. A:  $F(1, 38) = 12.62$ ,  $p < 0.01$ ; D vs. A:  $F(1, 38) = 14.75$ ,  $p < 0.01$ ). The typically developing children and the



**Figure 3** Relative frequency of any behavior with a toy for self on Trials 1–4, collapsed over toy type, and shown separately for the typically developing, Down, and autism group.

children with Down syndrome did not produce significantly different amounts of such behavior for self ( $F < 1$ ). Thus, even when the behaviors of children directed at others were partialled out, the attention or interest that children with autism showed in the toys for themselves was significantly lower than that shown by the other two groups of children.

Given the significant trial and trial  $\times$  group effects found, the contrast between the frequency of *behavior with a toy for self* on Trials 1 and 4 versus 2 and 3 was examined. Both the children with Down syndrome ( $F(1, 38) = 9.82$ ,  $p < 0.01$ ) and children with autism ( $F(1, 38) = 6.16$ ,  $p < 0.05$ ) exhibited a significantly flatter U-shaped response pattern compared to that of the typically developing children. The flatter U-shaped response patterns of the two nontypically developing groups did not differ significantly ( $F < 1$ ), but occurred for different reasons. That is, the children with Down syndrome tended to continue to explore the toys for an extended amount of time throughout the four trials, whereas the children with autism showed relatively little exploration of the toys for themselves throughout the four trials.

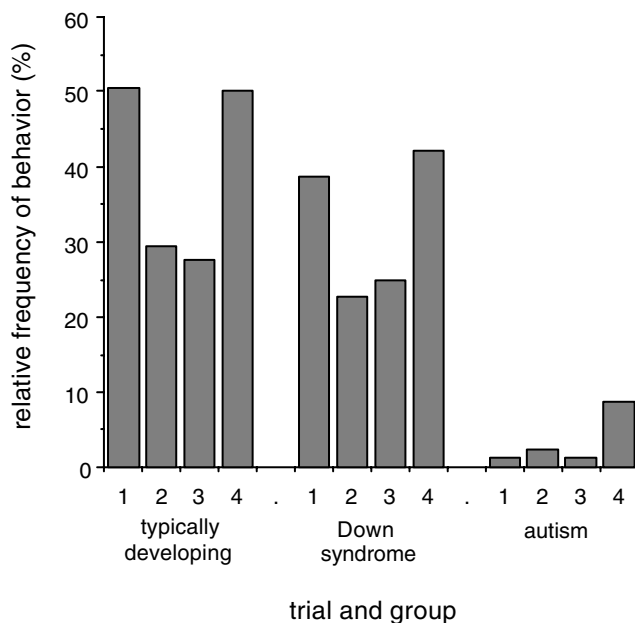
A significant main effect of trial was found for all three groups (TD:  $F(3, 17) = 24.60$ ; D:  $F(3, 8) = 9.23$ ; A:  $F(3, 7) = 7.93$ , all  $p < 0.05$ ). In addition, despite the flatter U-shaped responding pattern of the two nontypically developing groups, contrast analyses indicated

that the amount of *behavior with a toy for self* was significantly higher on Trials 1 and 4 than on Trials 2 and 3 for all three groups of children (TD:  $t(19) = 7.63$ ; D:  $t(10) = 5.43$ ; A:  $t(9) = 3.90$ ; all  $p < 0.01$ ).

The proportion of *brief* ( $\leq 2$  s) versus *extended exploration* ( $> 2$  s) of the toys for self was examined among the three groups. Extended types of play for self observed included feeling a toy, shaking it, banging it on the table, squeezing it, turning it in the hands, bringing a toy up to the face to examine it more closely (or bite or kiss it), hugging a toy, or in a few cases making the animal toys perform some action such as walking or jumping. Among the typically developing children, of all trials on which any exploration of the toy took place, the proportion of extended play observed was 0.79 compared to 0.91 for the children with Down syndrome and 0.70 for the children with autism. However, when interpreting the latter results and the results of the contrast analyses above with respect to the children with autism, it should be kept in mind that the mean amount of time spent with any toy never exceeded 3 s.

#### *Behavior directed to the mother or the experimenter*

This measure addressed the tendency of children to share their interest in the toys with their mother or the experimenter. Figure 4 displays the relative frequency of *behavior directed to the mother or the experimenter* on



**Figure 4** *Relative frequency of behavior towards others on Trials 1–4, collapsed over toy type, and shown separately for the typically developing, Down, and autism group.*

Trials 1–4, collapsed over toy type, separately for each group. A three-way repeated measures ANOVA (group  $\times$  trial  $\times$  toy type) revealed significant main effects of group ( $F(2, 38) = 15.5$ ,  $MSE = 14.17$ ,  $p < 0.001$ ), trial ( $F(3, 114) = 13.57$ ,  $MSE = 1.20$ ,  $p < 0.001$ ) and toy type ( $F(7, 266) = 2.76$ ,  $MSE = 0.63$ ,  $p < 0.01$ ), as well as a significant interaction for trial  $\times$  group ( $F(6, 114) = 2.43$ ,  $MSE = 0.36$ ,  $p < 0.05$ ). The significant group effect is attributable to the fact that both the typically developing children and the children with Down syndrome produced significantly greater amounts of behavior directed to the experimenter or their mother than did the children with autism (TD vs A:  $F(1, 38) = 30.40$ ,  $p < 0.001$ ; D vs A:  $F(1, 38) = 15.07$ ,  $p < 0.001$ ). The typically developing children and the children with Down syndrome did not differ significantly with respect to the amount of behavior directed at others ( $F(1, 38) = 1.37$ , n.s.).

Given the significant trial and trial  $\times$  group effects found, the contrast between the amount of behavior directed towards the mother or the experimenter on Trials 1 and 4 versus 2 and 3 was examined. The children with autism ( $F(1, 38) = 9.90$ ,  $p < 0.01$ ) exhibited a significantly flatter U-shaped response pattern compared to that of the typically developing children. The children with Down syndrome exhibited a response pattern that was not significantly flatter than that of the typically developing children ( $F(1, 38) = 0.95$ , n.s.), but only marginally more so than that of the children with autism ( $F(1, 38) = 3.82$ ,  $p = 0.058$ ).

A significant main effect of trial was found ( $F(3, 17) = 12.93$ ,  $p < 0.01$ ) only among the typically developing children. Contrast analyses also indicated that these children directed significantly more behavior towards their mother on Trials 1 and 4 than on Trials 2 and 3 ( $t(19) = 5.87$ ,  $p < 0.001$ ). If the analyses above are conducted for behaviors directed to the mother or the experimenter separately, the findings follow the same pattern as above.

In terms of differences in whom other-directed behavior was directed to, the typically developing children directed behavior to their mother significantly more often (mean per child 6.7 out of a total of 32 trials) than did both the children with Down syndrome (mean 1.64;  $F(1, 38) = 8.30$ ,  $p < 0.01$ ) and the children with autism (mean 0.7;  $F(1, 38) = 10.97$ ,  $p < 0.01$ ), and the latter two groups did not differ significantly from each other ( $F < 1$ ). However, both the typically developing children (mean 8.0) and the children with Down syndrome (mean 9.5) directed behavior to the experimenter significantly more often than did the children with autism (mean 0.4).

If the mean amount of behavior directed to the mother versus the experimenter is compared within each

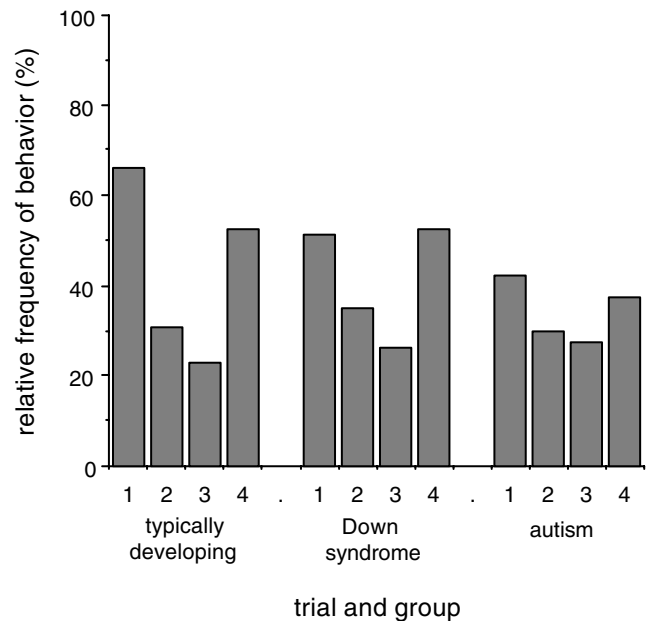
group using a paired *t* test, the children with Down syndrome are found to direct significantly more behavior toward the experimenter than toward their mother:  $t(10) = 4.28, p < 0.01$ . In contrast, the typically developing children did not display significantly different levels of behavior toward either communicative partner. The children with autism displayed little behavior toward either person. This analysis suggests that the communicative interactions engaged in by the typically developing children were often triadic in nature – involving the child, the mother and the experimenter. In stark contrast, the communicative interactions engaged in by the children with Down syndrome were largely dyadic in nature, involving only the child and the experimenter, and rarely the mother.

*Occurrence of any vocalization*

The impetus for the current study was not only to look at whether typically developing children, children with Down syndrome and children with autism might differ at the level of their interest in the toys presented, but also to investigate whether, at the one- and two-word stage, typically developing children's topic initiations would concern the salient, changing aspects of a situation. In particular, the aim was to see whether typically developing children might show a similarity amongst themselves in the timing and content of their topic initiations, and whether these similarities might extend to children with Down syndrome and children with autism.

The overall occurrence of vocalization behavior

Figure 5 displays the relative frequency of vocalization behavior (of any of the six vocalization types coded and described above) on Trials 1–4, collapsed over toy type, separately for each group. A three-way repeated measures ANOVA (group  $\times$  trial  $\times$  toy type) revealed significant main effects of trial ( $F(3, 114) = 23.15, MSE = 0.22, p < 0.01$ ) and toy type ( $F(7, 266) = 3.58, MSE = 0.29, p < 0.01$ ), as well as significant interactions for trial  $\times$  group ( $F(6, 114) = 2.54, MSE = 0.22, p < 0.05$ ), and trial  $\times$  toy type ( $F(21, 798) = 1.87, MSE = 0.13, p < 0.05$ ). More interesting, no significant difference between the groups was found with respect to the frequency of vocalization. The mean scores per child per group, collapsed over toy type and trial, were 13.8 (typically developing), 13.2 (Down) and 11.0 (autism) out of a possible 32. The fact that the children with autism did not differ from the other two groups in the occurrence of vocalization about the toys suggests that the earlier findings that these children spent significantly less time



**Figure 5** Relative frequency of any vocalization on Trials 1–4, collapsed over toy type, and shown separately for the typically developing, Down, and autism group.

engaged with the toys cannot simply be attributed to the fact that they were older in age and therefore less interested. If that were the case, the results for both these measures would be expected to follow the same pattern.

The significant effect of toy type was not unexpected and was due to the fact that some toys were easier to talk about than others (e.g. duck vs beads). As the trial  $\times$  toy type interaction was not significant at the level of the group, it will not be discussed further.

The timing of children's vocalizations

Contrast analyses clarified the nature of the significant trial and trial  $\times$  group effects found and revealed significant differences among the groups with respect to the timing of their vocalizations. The U-shaped pattern of responding among children with autism was significantly flatter compared to that of the typically developing children ( $F(1, 38) = 7.64, p < 0.01$ ). The U-shaped pattern of responding among the children with Down syndrome, however, was not significantly flatter than that of the typically developing children ( $F(1, 38) = 2.37, n.s.$ ), but at the same time was also not significantly more U-shaped than that of the children with autism ( $F(1, 38) = 1.27, n.s.$ ).

A significant main effect of trial was found ( $F(3, 17) = 12.92, p < 0.01$ ) only among the typically developing children, for whom contrast analyses also indicated that these children vocalized significantly more

often on Trials 1 and 4 than on Trials 2 and 3 ( $t(19) = 6.47$ ;  $p < 0.01$ ). Although a main effect of trial was not found for the children with Down syndrome, a more detailed examination of children's patterns of vocalizations suggests that the timing of their vocalizations was more similar to that of the typically developing children than the children with autism, who differed markedly from both these groups. From Table 4, it can be seen that both the typically developing children and the children with Down syndrome produced vocalizations over a given toy series that fit the pattern 1001, but none of the children with autism ever did. A large number of the vocalizations of the children with autism fit the pattern *other* and included 0111, 1011, 0011, 0010, 0100, 0101 and 1010. Moreover, with respect to the children with autism, the results were *not* due to a lack of vocalization behavior – no significant differences were found between the groups on the measure of the occurrence of *any vocalization* above. Rather, the children with autism differed in the *timing* of their vocalizations.

#### The content of children's vocalizations

The first finding of interest with respect to the content of children's vocalizations was the surprising similarity in content found among the typically developing children. That is, not only did these children tend to talk at similar times during the testing session, but they also showed a strong tendency to talk about the same things. This can be best illustrated by looking at the combined occurrence of *naming* the toy (e.g. 'bear', 'kitty cat') and *talk about the change* (e.g. 'heavy' for the pig, 'stones' for the beans in the cat). (Note that *talk about the change* occurred only on Trial 4.) Figure 6 displays the percentage of children in each group who produced any *naming* and/or *talk about the change* on Trials 1–4, collapsed over toy type, separately for each group. A

**Table 4** The percentage of total toy series trials per subject group on which children displayed the following response patterns over Trials 1–4 with respect to the measure of any vocalization

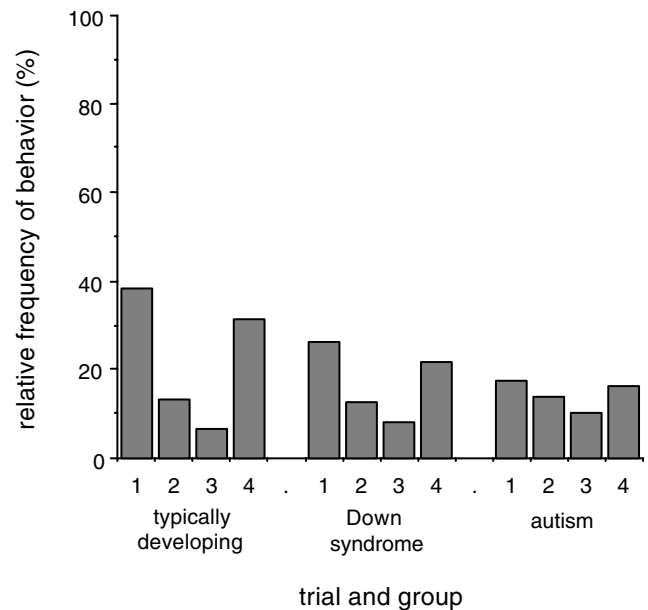
Group	Types of response patterns observed					
	1001	1000 1100	1111	0001	0000	Other
Typically developing <sup>1</sup>	25	21	17	6	25	7
Down <sup>2</sup>	17	16	15	15	24	14
Autism <sup>3</sup>	5	21	9	13	31	21

*Notes:*

<sup>1</sup> Total trials, 160.

<sup>2</sup> Total trials, 88.

<sup>3</sup> Total trials, 80.



**Figure 6** Relative frequency of naming or talking about the change on Trials 1–4, collapsed over toy type, and shown separately for the typically developing, Down, and autism group.

three-way repeated measures ANOVA (group  $\times$  trial  $\times$  toy type) revealed significant main effects of trial ( $F(3, 114) = 16.39$ ,  $MSE = 0.14$ ,  $p < 0.01$ ) and toy type ( $F(7, 266) = 9.41$ ,  $MSE = 0.18$ ,  $p < 0.01$ ), as well as significant interactions for trial  $\times$  group ( $F(6, 114) = 2.81$ ,  $MSE = 0.14$ ,  $p < 0.05$ ), and trial  $\times$  toy type ( $F(21, 798) = 2.16$ ,  $MSE = 0.09$ ,  $p < 0.01$ ). As the latter interaction was not significant at the level of the group, it will not be discussed further. Surprisingly, there was no significant difference between the groups in the overall frequency of *naming* and *talk about the change*. The mean scores per child per group, collapsed over toy type and trial, were 7.1 (typically developing), 6.4 (Down) and 4.9 (autism) out of a possible 32.

Given the significant trial and trial  $\times$  group effects found, the contrast between the occurrence of any *naming* and/or *talk about the change* on Trials 1 and 4 versus 2 and 3 was examined. It was found that the pattern of results was similar to that of the measure *any vocalization*. That is, the U-shaped pattern of children's *naming* and/or *talk about the change* was significantly flatter for the children with autism compared to that of the typically developing children ( $F(1, 38) = 9.03$ ,  $p < 0.01$ ). The U-shaped pattern of responding among the children with Down syndrome, however, was not significantly flatter than that of the typically developing children ( $F(1, 38) = 3.10$ , n.s.), nor was it significantly more U-shaped than that of the children with autism ( $F(1, 38) = 1.32$ , n.s.).

A significant main effect of trial was found ( $F(3, 17) = 12.05, p < 0.01$ ) only among the typically developing children, although this effect approached significance for the children with Down syndrome ( $F(3, 8) = 3.98, p = 0.052$ ). Contrast analyses also indicated that the typically developing children vocalized significantly more often on Trials 1 and 4 than on Trials 2 and 3 ( $t(19) = 5.66; p < 0.01$ ). These differences in the timing of children's naming on Trials 1 and 4 existed despite the fact that the children in all three groups produced similar amounts of *naming* as a percentage of the total number of utterance content units produced in each group (see Table 5).

The relationship between vocalization behavior and interest in the toys

To look at the relationship between children's interest in the toys and their communicative behavior, the co-occurrence of a significant trial effect for the measure of *behavior with a toy for self* with a significant trial effect for either of the measures of *any vocalization* or *naming and/or talk about the change* was examined for each group separately. Such a co-occurrence would suggest that children's patterns of interest in the toys over the four trials of each series mirrored the timing of their vocalizations over these four trials, and vice versa.

A significant effect of trial was found for all three groups for the variable *behavior with a toy for self*. However, only among the typically developing children was a significant trial effect also found for the two vocalization measures. These findings strongly suggest that, for typically developing children, an increase in interest and exploration of a toy for self on Trials 1 and 4 was related to an increase in vocalization behavior on those trials. Among the children with Down syndrome,

a marginally significant trial effect ( $p = 0.052$ ) was found only for the measure *naming and/or talk about the change*. Thus, the relationship between vocalization behavior and interest in the toys for children with Down syndrome appeared to be similar to that of the typically developing children, but to a lesser degree. However, in stark contrast to these two groups, despite the finding of a significant trial effect for the measure of *behavior with a toy for self* among the children with autism, no significant trial effects were found for either vocalization measure. These results suggest that, among the children with autism, any observed increase in interest and exploration of a toy for self on Trials 1 and 4 was not related to an increase in vocalization behavior on those trials.

### Discussion

Our study is the first to examine, in detail, the differences among typically developing children, children with autism and children with Down syndrome with respect to their interest in new versus old events and their subsequent communication about these novel events. Although our sample sizes were small, the findings with these groups of children with Down syndrome or autism are nonetheless interesting given that there exists relatively little work on attention, interests and communication in such young preschool children (but see Swettenham *et al.*, 1998). Thus these results, despite their shortcomings, do offer an interesting in-depth view of an area of communicative differences not explored to date in children at such an early language level.

#### Typically developing children

These results clearly demonstrate typically developing children's similarly heightened interest in the toys presented on Trials 1 and 4 and, more remarkably, the predictability in the content and timing of their topic initiations at the one- and two-word stage. These 22-month-old children were found to spend significantly more time (1) exploring a toy and engaging in behavior with a toy, (2) directing playful and communicative behavior towards their mother and the experimenter, (3) vocalizing, and (4) naming a toy or talking about the novel property or identity change in a toy on Trials 1 and 4 than on Trials 2 and 3 in which the toy was identical to the one presented on Trial 1.

Another interesting feature of typically developing children's behavior in this study was the facility with which many of these children were able to engage in a

**Table 5** The percentage of utterance content units classified into the six vocalization types, listed separately for the three groups

Vocalization Type	Group		
	Typically developing <sup>a</sup>	Down syndrome <sup>b</sup>	Autism <sup>c</sup>
Naming	35.2	34.8	36.5
Talk about change	5.0	1.8	1.6
Related talk	26.2	19.5	7.9
Babbling	25.7	29.9	33.3
Unrelated talk	3.2	0	7.1
Other	4.8	14.0	13.5

Notes:

<sup>a</sup> Total number of utterance content units 378.

<sup>b</sup> Total number of utterance content units 164.

<sup>c</sup> Total number of utterance content units 126.

triadic conversation, in the sense of being able to converse not only with the experimenter (who was handing them the toys) but with their mother as well (who was not interacting directly with the toys). This ability, as will be discussed below, was evident to a much smaller extent among the children with Down syndrome, and almost absent among the children with autism. Impairments in the ability to communicate in situations in which more than one person is present may put children at a linguistic disadvantage. Indeed, such triadic conversation situations are probably more the norm in most busy households than dyadic ones! There is not yet a large research literature pertaining to children's polyadic communication skills, but such skills appear to begin around 1 to 2 years of age (Dunn & Shatz, 1989; Barton & Vijiitchanton, 1996; Tremblay-Leveau & Nadel, 1996), and may be important in fostering more active conversational participation and advanced language skills (Barton & Tomasello, 1991; Tremblay-Leveau & Nadel, 1996).

It is interesting to speculate whether these findings with the typically developing children not only may be the result of similar interests among the children with respect to the features of the toys, but may also suggest the existence of a shared understanding, already present at the one- or two-word stage among these young children, of what is salient and relevant to communicate about with others. These findings may rest, in part, on the ability of children to assess what others around them pay attention to and communicate about. Such assessments could be based on a number of cues such as observing another person's line of regard, use of referential gestures, or actions with an object. Such behaviors could serve as a means whereby children could note regularities in what interests another person and other people in general. And research has demonstrated that children are sensitive to such cues from as early as 9 months of age (Scaife & Bruner, 1975; Murphy & Messer, 1977; Butterworth & Cochran, 1980; Leung & Rheingold, 1981; Butterworth & Grover, 1990; Baldwin, 1991; Butterworth, 1991; Butterworth & Jarrett, 1991; Hanna & Meltzoff, 1993; Corkum & Moore, 1995).

#### *Children with Down syndrome*

Down syndrome children's exploration of the toys, in terms of time spent with the toy and exploration of the toy for self, was similar to that of the typically developing children in terms of being significantly longer time-wise on Trials 1 and 4 than Trials 2 and 3. Although the children with Down syndrome did exhibit less vocal behavior than the typically developing

children, the pattern of the timing and content of their vocalizations was similar to that of typically developing children. However, overall, there was a tendency among these children to maintain a higher rate of behavior or vocalization over all four trials of a series (e.g. pattern 1111) compared to the typically developing children, which made the detection of a contrast between Trials 1 and 4 versus Trials 2 and 3 difficult to detect for some measures (e.g. *any behavior with the toy*). Nonetheless, from the *behavior with a toy for self* and *naming and/or talk about the change* measures, it would appear that the children with Down syndrome did not differ significantly as to the features of the toys they found interesting compared to the typically developing children.

The greatest difference found between the typically developing children and the children with Down syndrome was in the amount of behavior directed to others, and in particular the mother. These children rarely interacted with their mothers while the toy was present. Behavior directed toward the experimenter was observed more often, although still infrequently overall. It has been reported that children with Down syndrome engage in less joint attention, less parental referencing and less initiating behavior than typically developing children (e.g. Beeghly *et al.*, 1990; Berger, 1990; Wagner, Ganiban & Cicchetti, 1990). However, the description of each of these deficits varies among researchers. For example, accounts of children's difficulty attending jointly to another person and an object have ranged from their being 'slightly less disposed' to attend to social features of their surroundings (Krakow & Kopp, 1983) to their exhibiting 'considerable deviation' in distributing their attention between people and other foci of interest (Berger, 1990). This impairment appears to be more significant in declarative rather than imperative communicative settings (Kasari *et al.*, 1995).

In most previous studies, however, the focus was on the ability of the child to redirect their attention to the *mother's* object of interest. The current study affords a first in-depth look at the ability of the child to share their *own* foci of interest. Our results suggest that children with Down syndrome are not incapable of sharing their interest in a toy with a communicative partner: on average, children with Down syndrome communicated more often with the experimenter about the toy than did the typically developing children. What our results suggest, rather, is that, when in a situation of exploring a toy with *two* possible communicative partners, children with Down syndrome have great difficulty directing any communication about the toy to a second interactant, even if that person is their mother. This difficulty, moreover, cannot be attributed to a general tendency to ignore their mother throughout the



entire test session, as all the children communicated with her between toy trials (e.g. by smiling at her). It is the task of redirecting their attention between a foci of interest and two communicative partners that appears to be very difficult for children with Down syndrome, and seemingly effortless for 22-month-old typically developing children.

More studies are needed to clarify what is meant when children with Down syndrome are described as being 'less initiating'. In our study, the amount of vocal behavior initiated by the children with Down syndrome did not differ significantly from typically developing children at the same language level. We believe that this high rate of child-initiated communication was due to a number of factors including the relatively unstructured nature of the task, the novel and changing aspects of the toys that gave children something interesting to talk about, and the requirement that parents not initiate any communication. The latter requirement may have been particularly important, as previous research has documented that in free-play sessions children with Down syndrome are often not free to choose the topic of communication (Jones, 1977, 1980). And indeed, a parent's ability to maintain their attention to a toy selected by their child with Down syndrome (at mean age 23 months) has been found to be associated with better receptive language skills in these children 13 months later (Harris, Kasari & Sigman, 1996).

#### *Children with autism*

Compared to the typically developing children and, to a certain extent, the children with Down syndrome, the behavior of the children with autism differed both at the level of their perception of the salient changes in the toys and at the level of their communication. The results of this study support the view that individuals with autism suffer from a significant disturbance in the perceptual domain. Indeed, the results suggest, as other researchers have stated, that what normally governs fixation in normal children does not do so in children with autism (O'Connor & Hermelin, 1967) and that children with autism do not find the same features in the environment to be salient or relevant (Frith & Baron-Cohen, 1987). The children with autism spent significantly less time exploring the toys and engaged in significantly less behavior with the toys than either of the other two groups of children. Even when only behavior with the toy for self was considered, the children with autism produced significantly less behavior with the toy than either of the other two groups of children. Although a U-shaped pattern of responding was found for the measures of *time spent with a toy* and *behavior with a toy*

*for self*, there are two reasons to be cautious when interpreting this finding. First, the difference in time was very small (0.4 s) between Trials 1 and 4 versus Trials 2 and 3 and would have been hardly perceptible by a communicative partner who might have been trying, in a more naturalistic setting, to assess a child's interest in the toy and comment accordingly. Second, with respect to their behavior with a toy for self, these children rarely exhibited a behavior pattern of 1001 *within* a given toy series. Our results cannot clarify whether this difference with respect to normal patterns of salience should be explained by impairment at higher levels of cognition (Frith & Baron-Cohen, 1987; Frith, 1989) or lower level perceptual processes (Ornitz, 1989; Dawson & Lewy, 1989). The fact that these children produced the same amount of vocalization about the toys does, however, suggest that this difference was not due simply to the fact that these children were older in age and the game held no interest at all for them.

The children with autism in our study rarely produced vocal or gestural behaviors directed to their mother or the experimenter. As such, our results concur with previous results documenting a lack of spontaneous commenting behavior, either through gestures such as showing and pointing or by verbal means, among children and adults with autism (Curcio, 1978; Wetherby & Prutting, 1984; Mundy *et al.*, 1986; Mundy & Crowson, 1997; Stone *et al.*, 1997). However, in amount of vocal behavior produced overall, and even in amount of naming of the toys, the children with autism were roughly on a par with the children with Down syndrome, and not significantly different from the typically developing children. Given the few instances of behavior directed to others, as noted above, most of this vocal behavior constituted vocalizations to the self. These findings suggest that, at least for commenting at the level of the self, the biggest difference between children with autism and the children in the other two groups was not in the amount of vocal behavior observed, but in the timing of this commenting behavior. That is, for both measures related to vocal behavior, children with autism were not significantly more likely to vocalize on Trials 1 and 4 versus 2 and 3 as typically developing children were (and children with Down syndrome to some extent). Thus, it may be premature to conclude that children with autism lack all commenting ability – this description may only apply when commenting is defined as the more difficult behavior of directing another person's attention (e.g. as in Stone *et al.*, 1997). Children with autism may have an ability to comment on things to themselves. Indeed, other researchers have also observed children with autism to spontaneously initiate comments about toys,

although often without accompanying eye gaze to another person (e.g. Mundy *et al.*, 1986; Stone & Caro-Martinez, 1990). Nevertheless, whether they comment for others or for themselves, our results suggest that the timing of their comments will differ significantly from that of typically developing children or children with Down syndrome, with resultant difficulties for parents wanting to establish joint attention.

More studies are needed to confirm this finding. To date, one study (Wetherby & Prutting, 1984) found significant impairment even at the level of commenting for *self* among children with autism (particularly in labeling behavior). However, task differences may explain this discrepancy. Wetherby and Prutting's (1984) tasks included a free-play session involving sets of toys (e.g. doll and miniature doll-sized utensils) as well as more structured (but non-directive) communicative settings designed to elicit communication such as blowing bubbles, looking at a book, or placing a desired object in a jar that the child cannot open and giving the jar to the child. Some of the latter communicative situations appear to have resulted in more imperative communication rather than declarative comments directed to the self or others. Similarly, in other studies (e.g. Stone *et al.*, 1997) designed to look at the declarative commenting abilities of individuals with autism, the events designed to elicit declarative communication may have occurred too quickly or have been too far out of the child's reach, resulting in reduced commenting and/or increased imperative communication instead because the child wanted the object. For example, Stone *et al.*'s (1997) Prelinguistic Communication Assessment (derived from situations described in Wetherby, Cain, Yonclas & Walker (1988)) included such situations as a slinky dropping from the ceiling, a sudden sound of a noise-maker, a balloon flying across the room as it deflates, and a remote control car crossing the room. In the present study, in contrast, children were given the toy to play with for as long as they wished to on all trials in order to encourage the production of declarative, as opposed to imperative, communication. This design may have resulted in higher rates of commenting behavior (albeit comments rarely accompanied by a look to the mother or the experimenter). Our task also provided a large number of clear opportunities (32 trials) on which to potentially observe commenting behavior and a clear means of comparing the amount, type and timing of communication among the different groups of children. Ideally, this study should be replicated using larger samples of children, perhaps also incorporating further corroborating diagnostic criteria for the children with autism (e.g. Childhood Autism Rating Scale of Schopler, Reichler, DeVellis & Daly, 1980), permitting more refined analysis

of the contribution of language ability, especially between the autism and Down syndrome groups.

Our results, unfortunately, highlight a potential major difficulty with respect to communicative intervention with children with autism. To teach commenting, Wetherby (1986) has proposed:

Anticipatory sets can be established to highlight salient features and create a reason to comment, as suggested by Snyder (1978)...The child can be taught to comment at a prelinguistic level by pointing or showing, or at a linguistic level by labeling or describing the quality of the unexpected object. (p. 311)

Our results suggest that, even when such anticipatory sets are used, children with autism do not reliably find the same features to be salient as do typically developing children, children with Down syndrome, or, as studied by Snyder (1978) and Rowan *et al.* (1983), language-delayed children. Given that it cannot be presumed that children with autism are attending to the same salient features as other children would, efforts to teach them to comment by labeling or describing those features may not be effective. The communicative impairment in children with autism appears due not only to a decreased ability to establish joint attention, but also to an impairment at the level of perceiving the salient, changing aspects of a situation.

Overall, the findings of this study highlight the impressive ability of very young typically developing children, at only the one- and two-word stage, to share a sense of what is relevant and salient and to communicate about these things with others. Children with Down syndrome, at a similar level of language development, appear to share a similar understanding but to have difficulty expressing this communicatively, especially in situations involving two communicative partners. Sadly, the children with autism appear to remain outside of this world of shared understanding, their communication serving only to highlight this discrepancy instead of helping to build a shared world of experiences to enjoy with others.

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