Journal of Intellectual Disability Research

VOLUME 48 PART 3 pp 225–238 MARCH 2004

Predictors of parent–child language during novel task play: a comparison between typically developing children and individuals with Down syndrome

M. C. Johnson-Glenberg & R. S. Chapman

Waisman Center, University of Wisconsin-Madison, Madison, WI, USA

Abstract

Three questions were asked that explored the linguistic fine-tuning hypothesis and how parents might model language: (i) do parents significantly tune to their children's productive language or non-verbal cognition during play? (ii) is the level of the linguistic tuning different in the Down syndrome (DS) population compared to a typically developing (TD)-match group population? and (iii) do the two populations differ in requests for labels and the scaffolding responses to the requests? In an exploratory play condition, parents of children with DS used a mean length of utterance (MLU) significantly higher than the MLU used by the parents of younger TD children who were matched for MLU. Thus, the DS parents have a higher baseline MLU, but the non-significant correlations in the DS group do not support parental MLU tuning. There was evidence, however, for parental tuning to the children's lexicon using a number of different words when the DS children were at lower and average levels of receptive syntax and non-verbal cognition. In addition, DS and TD parents requested labels for novel toys with the same frequency, perhaps indicting that all groups of parents are still probing and building their children's lexicons. This is an important finding because it may help to explain why adolescents and young adults with DS have vocabulary comprehension skills greater than one would predict from measures of their production and non-verbal cognition.

Keywords Down syndrome, fine-tuning, mother–child interaction, language development, language input, request for label

Correspondence: Dr Mina C. Johnson-Glenberg, Waisman Center, 1500 Highland Ave., Madison, WI 53705, USA (e-mail: johnsonglen@waisman.wisc.edu)

Introduction

Individuals with Down syndrome (DS) have a specific deficit in expressive language, over and above their levels of listening comprehension (or receptive syntax) and non-verbal cognition (Chapman 1995, 1997a,b, 1999; Chapman & Hesketh 2000; Chapman *et al.* 1991, 1998; Hesketh & Chapman 1998). This divergence of comprehension and production skill offers the possibility of addressing the question of whether parents 'tune', or adjust, their sentence length and lexical diversity to their children's receptive or expressive language levels.

The 'fine-tuning' hypothesis

Previous research has indicated some measure of parent 'tuning' of their utterances to characteristics of

children's language (Chapman 2000; Richards 1994; Snow 1995; Sokolov 1993). Average parent mean length of utterance (MLU) tends to increase as the average MLU of the group of children increases (Chapman 1981); Chapman (1981) estimated that group parent MLUs averaged approximately two morphemes more than child MLUs during the preschool period. Although Newport *et al.* (1977) revealed that the range of syntactic structures in mothers' child-directed speech were not closely tuned to children's productions, their notion of complexity was based on transformational grammar analysis rather than MLU.

Retherford *et al.* (1981) found that the semantic relations expressed in mother's play with their 2- and 3-year-old children included the full range of relationships that the children were learning to express, and included about 15% of instances of complex syntax well above their children's levels of production. Although parent language did not reveal frequency differences fine-tuned to the child's current level of complexity, mothers offered models of language that children were learning to produce and mothers appeared to probe for comprehension of levels above this. Sachs (1979) demonstrated that parent talk contained topics and WH-questions (e.g. what, why, when) not yet responded to by the child at a fairly stable and low frequency of occurrence. However, the frequency of a particular topic and question type increased sharply when the child began responding to the topic. She argued that input necessarily contained both language at, and above, the child's current level of production, thus 'probing' the child's growing discourse skills and allowing fine-tuning as these skills emerged. Snow (1995) points out that the early correlational studies, which simply related mother and child MLU, might have missed fine-tuning related to different baselines – the child's cognitive growth, chronological age and comprehension levels surely constituting such candidate baselines. Nor, she points out, did some studies consider the lexical level of tuning.

More sophisticated growth analyses of children's MLU in longitudinal data have shown that growth in child MLU predicts growth in parent MLU (Pan *et al.* 1993, manuscript cited in Snow 1995), in the 14–32 month range. Recent studies of children's vocabulary development using structural equation modelling (Bornstein *et al.* 1998) have shown that the mother's vocabulary in spontaneous speech uniquely predicts child comprehension vocabulary at 20 months, and that a single latent variable of underlying child vocabulary competence (mostly expressive) appears to account for child performance (Bornstein & Haynes 1998). The child's vocabulary variable significantly predicted verbal and performance IQ at 48 months. However, Rescorla (1984) found child word comprehension to be a better future performance predictor. Rescorla followed six typically developing (TD) children (aged 12–20 months) for approximately 12 sessions and two follow-up sessions at 2 and 3 years. Her naturalistic study revealed that word comprehension, rather than expressive vocabulary, was a better predictor of the child's later intellectual and language mastery [as measured by the Stanford-Binet Intelligence Scale (Thorndike *et al.* 1986)].

Recent experimental intervention studies have revealed the effectiveness of maternally responsive linguistic interactions that are fine-tuned, particularly expansion and recasting of children's utterances, which accelerate their children's syntactic progress (Yoder & Warren 1998; Yoder *et al.* 1996). More generally, there is evidence of a strong relationship between amount of parental input and subsequent child language growth (Clarke-Stewart 1973; Clarke-Stewart *et al.* 1994; Gallaway & Richards 1994; Hampson & Nelson 1993; Harris 1992; Hart & Risley 1995; Messer 1994).

We conclude that there is evidence for a rough tuning of mother's sentence length and lexical content to children's language levels; whether this tuning is fine enough to reveal differences at differing comprehension and production levels is one of the topics of this study. We return to this older question of overall tuning in the context of the population with DS, where syntactic comprehension and production skills diverge, to ask if parents' tuning reflects their children's production, using both MLU and number of different words (NDW); syntactic comprehension; or non-verbal cognitive levels. We used MLU to look at syntactic complexity and NDW as a measure of diversity of vocabulary accessed during conversation. We speculated that if parents of those with DS are not tuning syntactically, then they may be tuning using vocabulary (NDW) because there is evidence that adolescents with DS possess comprehension of more vocabulary

words than would be expected from their linguistic production and non-verbal cognition.

If we do not see evidence of tuning for the DS dyads on these three aggregate levels, then perhaps parents are still shaping the language of their children with DS at a moment by moment lexical level. We chose to analyse 'requests for labels' as a type of scaffolding. We posited that parents were requesting the labels for novel toys in order to support the childrens' linguistic independence. Among children's earliest speech acts are the protodelaratives and protoimperatives (Bates 1979) that comment on aspects of environment and make requests. These speech acts, accomplished as vocalizations and gesture, may precede first words and become the source of a wide variety of representations and requests (Searle 1976) in the speech of adults. Among the earliest expressive language deficits reported in infants with DS is the less frequent use of non-verbal requesting (Mundy *et al.* 1995), but not commenting. Here we have provided a conversational context of exploration of novel toys in which comments and requests about the toy might be made by either partner. Of particular interest is whether the participant with DS requests labels less frequently than the TD controls; and whether parents of the participants with DS are more likely than parents of the controls to request or to offer labels. We examine both label possibilities because it is unclear which speech act should be regarded as more effective scaffolding. Requesting a label may be viewed as supportive linguistic scaffolding, and we categorize scaffolding into two different types. If the child fails to respond to the request, that is, the child doesn't respond with an answer, or says 'I don't know', and the parent then supplies the label this may be viewed as informative scaffolding. In a scenario where the child does not respond to the request with content, the parent might also re-request the label, offering the child another chance to guess at a label, or to supply descriptive phrases, or to give the children wait time. This repetition instance may be considered a more facilitative scaffolding.

Although scaffolding of early language has been intensively studied in TD children (Ninio & Bruner 1978), in which parents first request labels and then provide them, the expected form of scaffolding for more language-competent individuals is less clear. Burch (2001) reports that mothers are more likely to invite the child's talk rather than to provide labels when picture-book reading with 3-year-olds (as opposed to when the children were 1- and 2-year-olds). Thus, we predict that the parents of the children with DS will request labels in a frequency that is similar to the parents of the TD controls, but that the parents of those with DS will be more facilitative in their requests than the other parents, such that, if the child with DS does not answer or says 'I don't know' the parents will re-request the label. This may occur because the parents of the children with DS believe that their children (who are older and possess more world knowledge than the match group children) are capable of at least using descriptive phrases if pushed or shown expectations for such.

To this end, this paper is driven by three questions:
1 Do parents significantly tune to their children's productive language or non-verbal cognition during play?
2 Is the significance of the tuning different in the DS compared to the match group TD population?
3 Do the two populations differ in requests for labels and scaffolding responses to the requests for labels?

Method

Participants

Thirty-two adolescents and young adults with DS (verified Trisomy 21), ages 12.20–26.10 years, and 96 typically developing children, ages 2.2–8.5 years, were recruited from Wisconsin and Northern Illinois. These represent a subset of the children studied by Chapman *et al.* (1990, 1991, 1998). The term 'children with DS' will be used throughout the article, but some of these children are in their twenties. We wish to highlight their relationship with their parents and so we do not use the term participants. Individually, and as a group, the children with DS are much older than the TD children.

Children with DS were excluded if sign language was their primary means of communication, if they had a moderate hearing loss (pure tone average for the frequencies 500, 1000 and 2000 Hz greater than 45 dB in the better ear on the day of testing), or, for this study, if they produced fewer than nine complete and intelligible utterances during 6 min of play with a parent.

Typically developing participants have been analysed in three separate matched groups. These three

Table 1 Descriptive statistics for group matching and experimental variables, standard deviation in parentheses

	Down syndrome	MLU-match	ReceptSyn-match	NonVerbCog-match
Age	18.84 (4.48)	3.50 (1.71)	4.64 (1.31)	5.42 (1.56)
Number	32	32	32	32
Matching variables				
MLU-morpheme (narrative)	4.29 (1.89)	4.15 (1.89)	6.02 (2.40)	6.77 (2.14)
Receptive syntax	4.91 (1.27)	4.08 (2.18)	4.84 (1.32)	6.39 (1.98)
Non-verbal cognition	5.67 (1.68)	3.84 (2.00)	4.80 (1.91)	5.62 (1.72)
Experimental variables				
Child MLU-morpheme (play)	2.29 (0.65)	3.15 (1.02)	3.48 (0.64)	3.59 (0.76)
Parent MLU-morpheme (play)	4.97 (0.75)	4.64 (0.62)	4.86 (0.53)	4.93 (0.84)
Child NDW (play)	43.07 (21.94)	58.77 (28.61)	77.47 (20.20)	82.54 (25.89)
Parent NDW (play)	140.52 (31.02)	121.77 (23.70)	132.22 (22.29)	131.04 (25.10)

MLU, mean length of utterance; NDW, number of different words.

control groups were created by matching to the DS group on one of three variables:

- MLU in morphemes, based on a 12-min narrative language sample;
- receptive syntax (ReceptSyn) – Test of Auditory Comprehension of Language-Revised (Carrow-Woolfolk 1985). This measure incorporated comprehension of vocabulary, morphology, grammatical and syntactic structure;
- non-verbal cognition (NonVerbCog) – mean age-equivalent scores on pattern analysis and bead memory subtests of the Stanford-Binet Intelligence Scale (Thorndike *et al.* 1986).

Subject characteristics by group are described in Table 1.

Procedures

Narrative language sample. Twelve minutes of narrative were elicited from all children with four tasks. Matching groups on MLU-morphemes was done with the MLU value computed from this sample.

1 Frog story book: *Frog Where Are You?* (Mayer 1969), a picture book was presented. Each participant was given similar instructions with slight variations depending on participants' age or language level: 'Have you ever seen this book before? I'd like you to look at the pictures and tell me the story. The story starts "Once upon a time there was a boy, a dog, and a frog . . ."' The book's 24 pictures were shown one at a time eliciting 'on-line' story production. When participants did not talk about a picture, they were prompted to do so.

2 Cookie theft picture: participants viewed and described a line drawing depicting a complex event in which a mother is washing dishes while water pours onto the floor and a child behind her is stealing cookies.

3 Short story stems: using open-ended stems (Stein & Glenn 1982), participants were asked to complete three story clauses that provided a protagonist and a setting.

4 Favourite stories: participants were asked whether they had favourite stories, movies or TV shows and then asked to tell the stories.

Parent–child free play. The parent and the participant were given the opportunity to interact for 6 min or more while playing with a set of six toys that included two items likely to be novel and unnamed. The toys included (in order of most played with): a blue velcro doll with attachable facial features and clothing items called 'The Roomies', a segmented twisting plastic circle called 'The Tangle' (novel toy 1), a magnetic spinning toy (novel toy 2), a 3D abstract animal building set called 'Wizbits', a plastic sticker box called 'Colorforms-New Shapes' and a box of small, colourful building blocks. These toys were all very engaging for the younger TD children, as well as for the older children with DS – some of whom were in their twenties. The toys were not conceptually too complex. Before the child and parent were

led into the examination room where the six toys were randomly arrayed on a table, the examiner said, 'One more thing. We would like for you two to look at these things and then tell us in the end which one you like best'. The first 6 min of play were analysed.

Transcription. Audio- and video-taped narrative samples and child-play samples were transcribed and entered into SALT (Systematic Analysis of Language Transcripts; Miller & Chapman 1990). Transcribers could re-listen to an utterance up to three times to transcribe. Grammatically bound morphemes were marked and omitted words and morphemes indicated. An intonation contour was used to segment utterances into sentences except where run-on co-ordinating conjunctions of clauses occurred; then segmentation was marked after each pair of clauses.

Transcription reliability. As described in Chapman *et al.* (1998), disagreements in morpheme transcription, maze identification and utterance segmentation were tallied for the narrative transcripts. A second transcriber reviewed and corrected all transcripts; the mean number of morpheme changes per transcript was 2.5 per 522.6 words (0.4%) and the mean number of segmentation changes per transcript was 0.64 per 127.6 utterances (0.5%).

Results

The results for this study are presented and discussed in three analytical sections. First, the language variable of MLU is analysed in the following order: (i) DS group only, (ii) DS group and the three TD-match groups combined in regression equations including higher order interactions, and if warranted, (iii) individual DS group comparisons with TD-match groups. Second, the language variable of NDW is analysed in the same order. Third, the request for label data is analysed.

Section 1: mean length of utterance

Parent mean length of utterance

The mean and standard deviation (SD)of the DS parents' MLU was 4.97 (0.75). The mean and SD of the child's MLU was 2.29 (0.65). A paired sample *t*-test revealed these to be significantly different, $t(31) = 15.34$, $P < 0.0005$. Table 2 lists the simple correlations between parent and child variables. Parent MLU does not correlate significantly with any of the child's variables for the DS group.

Table 2 Simple correlations between parent and child variables by group

Group/child's variable	Parent MLU	Parent NDW
Down syndrome group		
MLU-morpheme	0.002	0.10
Receptive syntax	0.07	–0.09
Non-verbal cognition	0.08	–0.05
NDW	–0.16	0.12
MLU-match group		
MLU-morpheme	0.16	–0.12
Receptive Syntax	0.13	0.16
Non-verbal cognition	0.11	0.18
NDW	0.13	–0.001
ReceptSyn-match group		
MLU-morpheme	0.09	–0.07
Receptive syntax	0.17	–0.02
Non-verbal cognition	0.45**	0.02
NDW	–0.08	0.04
NonVerbCog-match group		
MLU-morpheme	0.37*	0.07
Receptive syntax	0.18	0.09
Non-verbal cognition	0.35*	0.17
NDW	–0.14	–0.11

*$P = 0.02$, **$P = 0.005$. MLU, mean length of utterance; NDW, number of different words.

Mean length of utterance – between group comparisons

The main finding of this section was that the parents of the MLU-match group children used a significantly smaller MLU compared to the parents of the children with DS. An ANOVA revealed that the MLUs used by the DS parents and parents of the other two match groups, that is, NonVerbCog- and ReceptSyn-match groups, were not significantly different during the exploratory play task. These three sets of parents used the same syntactic complexity (for further details refer to the 'Parents' subsection below).

The next question was whether the TD and DS groups' correlational differences were statistically significant. To answer this question, the entire sample was regressed together with the DS and TD groups

categorically coded.[1] The regressions are described in the footnotes because they often did not reach significance but we wish to demonstrate thoroughness, and to point out that we created and used the three hierarchical models consistently in the first two results subsections. The regression served to reinforce the results in Table 1, that is, that non-verbal cognition was the most significant predictor for parent MLU. However, this relationship did not appear to be significantly different between the DS and TD groups when they were regressed together, probably because the low-MLU-match group brought the entire TD group's correlation down.

Down syndrome vs. mean length of utterance match groups. The TD group was split into the three match groups. Because the omnibus ANOVA had revealed that the children's MLUs during play differed significantly across the groups, $F(3, 124) = 18.22$, $P < 0.0005$. A *post-hoc* comparison with Tukey's HSD was run, which revealed that the DS group produced significantly smaller MLUs than all three TD groups (all P-values < 0.0005), but that the TD children's groups did not differ significantly from one another in MLU during play (this is interesting because the TD groups' MLU did differ during the more structured narrative task which was used for matching; Table 1). This suggests that the play task may elicit less sophisticated syntax overall.

Parents. The parent's play MLU means are similar to means reported in the literature, although they are slightly lower than the mean mother MLU that Davidson & Snow (1996) found in their play study of 12 children (mean age 5.3 years) where mother MLU = 5.20. One of the reasons to break the TD group down into match groups was to create a comparison group that was similar in terms of production. The MLU-match group was created using the narrative task which encouraged children to use more complicated expressive syntax. A single degree t-test between parents revealed a significant difference between the DS and TD MLU-match parents, $t(61) = 2.04$, $P < 0.05$. This suggests that TD parents of children who in general may have the same MLU as those with DS, actually use less syntactically complex language with their children, as compared to the DS parents during free-form play.

Down syndrome and typically developing match group – between group regressions. Three separate Model I equations and three separate Model II regressions (with interactions) were run predicting parent MLU using a categorical code for the DS and the specific TD-match group. The two questions of interest were whether the group differences on MLU were significant and whether the group by linguistic variable interactions were significant. None of the analyses revealed significant group differences.

Conclusions for Section 1. The parents of the children with DS used a significantly higher MLU (more syntactically complex language) with their children than did the parents of the TD children who were matched for MLU. Although there was no real evidence for tuning within sample, the parents of the children with DS appear to have a higher baseline when in discourse with their children compared to parents who discourse with TD children matched for MLU.

Section 2: number of different words

There were two main findings in this section. The first was that the parents of the children with DS were more variable in their NDW than the parents of TD children. The second finding was that the relationship between parent and child NDW was significantly different between the DS- and MLU-matched group when the variables were mean-deviated. Thus, at the children's relative lower and average receptive language and non-verbal cognitive levels, the parents of the children with DS showed tuning, and they used significantly greater NDW when compared to the

[1] To ascertain whether any significant interactions existed between the variables and the two groups, three hierarchical regression models were created. Model I consisted of the three lower order variables, that is, Child MLU, ReceptSyn and NonVerbCog, as well as a group variable (coded DS = 0, TD = 1). The dependent variable was parent MLU. NonVerbCog was the significant predictor overall, $t = 2.68$, $P = 0.008$. There were no significant group effects when the fixed slopes were compared. In Model II the second-order interactions of group × Child MLU, group × NonVerbCog and group × ReceptSyn were added to the lower order variables. Thus, the group slopes were allowed to vary. None of the interaction variables were significant. In Model III the three-way interaction of group × ReceptSyn × MLU was added. Inclusion of this interaction allowed us to ask the question of whether parent MLU was differentially predicted by group membership and the children's varying receptive syntactic skills and MLU. This interaction was not significant. In addition, the lower order variables in Models II and III were mean-deviated.

MLU-match dyad. This suggests that parents of those with DS were moderately tuning their NDW to their children's NDW, and that they may have been modelling an expanded lexicon.

Parent number of different words

The simple correlations in Table 2 would lead us to believe that nothing interesting is going on with NDW, but more sophisticated analyses reveal that this was not the case. An ANOVA comparing the four groups of parents' NDW revealed that the means were not significantly different. However, Levene's test for the equality of variances revealed that the groups' variances were unequal, $F = 9.58$, $P < 0.01$. This result suggests that the DS parent's SD of 32.96 was significantly greater than the TD group's overall SD of 23.85. The DS parents were far more variable in the NDW that they used during play than were the TD parents.

Groups number of different words

A *t*-test comparing the children's NDW revealed that the TD and DS children's NDW were significantly different $t(126) = 5.65$, $P < 0.0005$. The TD children used significantly more different words during play.

Regressions. Regressions were run between the DS group and all three of the TD groups, as in Section 1 non-significant results are presented in the footnote.[2] The first regression aggregated the three match groups and when these groups were mean-deviated a significant difference between the DS group and three aggregated TD-matched groups was seen.

Further regressions were then run between the DS group and the match groups individually. Using equations predicting parent NDW, there were no statistically significant group differences when comparing the DS group to the ReceptSyn-match group and to the NonVerbCog-match group. However, when Model II (with all two-way interactions) was analysed using the DS group compared to the MLU-match group, two interactions became trends: NDW by group, $t(54) = -1.86$, $P = 0.068$, and NDW by ReceptSyn, $t(54) = 1.68$, $P = 0.098$.

Deviating Down syndrome and mean length of utterance match groups. Because the NDW by group interaction resulted in a trend in the analyses performed on the aggregated TD groups, we decided to look closer at the most divergent TD group – the MLU-match group. Both the MLU-match group and the children with DS groups were grand mean-deviated[3] for ReceptSyn and NonVerbCog; however, NDW scores were deviated to a place where the DS children had relatively high levels of NDW (110) as this appeared to be the area on the function where the groups might differ. The resulting regression compared the DS group to the MLU-match group and included all lower order predictors and the interactions of NDW by group and ReceptSyn by group; it revealed one significant difference for group and one trend: (i) group, $t(56) = -2.17$, $P < 0.05$ and (ii) NDW by group interaction, $t(56) = -1.73$, $P = 0.089$. The overall r^2 was 0.15. This result suggests that even at higher levels of NDW, the DS parents used a significantly greater NDW with their children than the MLU-match group parents, and that the overall functions for the two groups were marginally different.

[2]Results of all groups in regression: as with MLU, three hierarchical regression models were created to see if the two main groups differed in how they predicted parent's NDW. Model I consisted of the four lower order variables: group, child NDW, NonVerbCog, and ReceptSyn. The dependent variable was parent NDW. In Model I no variable was a significant predictor of parent NDW (group was marginal) and the regression overall was not a significant fit, $F(4, 123) = 1.59$, $P = 0.18$. In Model II the second-order interactions of group × Child NDW, group × NonVerbCog and group × ReceptSyn were added to the lower order variables. This model reached marginal significance, $F(8, 119) = 1.80$, $P = 0.09$.

NDW – mean deviation: are the two groups statistically significantly different at the average of ReceptSyn and NDW? A final model was created to answer this question and the independent variables were deviated by the grand means of the total sample (NDW = 65.19, ReceptSyn = 5.06, NonVerbCog = 4.99). The mean-deviated model was essentially Model II run without the NDW by group interaction. The only significant predictor in the model was group, $t(120) = -2.24$, $P = 0.027$, revealing that on average DS parents use significantly more NDW with their children after controlling for all other variables in the model.

[3]Why is it important to mean-deviate the independent variables? In Models II and III where group interactions are added to the regression equations, the slopes for the groups are allowed to vary depending on the levels of the independent variables. In equations containing interactions, the significance level of the group variable reveals whether the distance between the slopes of the two groups is statistically significant at the intercept. (Without deviation the intercept is where all lower order independent variables are equal to zero; this is not a meaningful concept in this dataset as no child produced linguistic or cognitive scores equal to zero.) The grand means are subtracted from each individual's score causing the model's intercept to fall at a interpretable place, that is, at average performance values.

Conclusions for Section 2. Reviewing the function for the final model reveals that at lower to average levels of ReceptSyn and NonVerbCog the parents of the children with DS children correlate their NDW with their children (in a positive linear form). The parents of the MLU-matched children show no correlation (the function was a flat line). Hence, the two different groups display a trend for a difference in function. At relatively higher levels of NDW the parents of the children with DS used significantly greater NDW when compared than the MLU-match dyad. This suggests that parents of those with DS were moderately tuning their NDW to their children's NDW, and that they may have been modelling an expanded lexicon. This significant result emerges only at the children's average and better levels of NDW. We also see that the parents of the children with DS are liable to use more different words with their children, there is greater variability in the Down dyad than in the MLU-match population dyad and some of this must be because of age and world knowledge of the older DS children.

Section 3: requests for labels

We have looked at the production variables of MLU and NDW and have discovered some evidence for a difference of ongoing aggregate tuning of NDW between the MLU-match group and DS group. It is now appropriate to query the data with more moment by moment analyses in order to assess whether parents of DS children may still be modelling the acquisition of new lexical items for their children. Our exploratory play task provided an excellent venue in which to research 'requests for labels' for some of the novel toys. In addition, prompted by Snow's (1995) comment that aspects of child-directed speech may not be reflected in global linguistic variables, we targeted the specific lexical class of label requests for more than one speech turn.

One important question was whether parents of those with DS were requesting labels in a manner more similar to parents with children matched for expressive language (MLU), or matched for mental age (MA – previously referred to as NonVerbCog). Thus, this set of analyses uses only the two most divergent TD child variable groups for comparison: MLU-match and NonVerbCog-match. One specific hypothesis to be addressed involves the degree of scaffolding parents provide for toy labels. In studies of TD toddlers in a book-reading paradigm, parents have been observed to request labels and then provide them in response to the child's turn involving vocalizations or gesture (Bruner 1974–5). Corrections were only offered if the parent believed the child knew the answer. Thus, one might expect repeated questioning from the DS parents familiar with their children's more diverse comprehension lexicon. In addition, the children with DS are older than the TD children and possess more world knowledge. The parents of these older, although developmentally delayed, children may expect them to be more adept at guessing and so the parents might repeat their requests for a label a second time, even when children explicitly say that they do not know the label. We characterize this re-request condition as facilitative scaffolding by the parents.

The context of novel toys, however, also creates a context for vocabulary teaching. We might expect frequencies of label provision more typical of the MLU-matched language learning children, as one aspect of the input experience leading to increased comprehension. With this analysis we will be able to assess how many parents directly requested information, and how the parents responded when their children either did not reply, or replied 'I don't know'.

Labels method

Transcripts from the play task were cut after the first 50 utterances of the parent. Unambiguous requests for labels were defined as requests that could not be answered with a gesture (requests such as 'Which one should we play with next?; What's your favorite toy?; What's next?' were excluded). The following were acceptable unambiguous requests: 'What is that?; What do you think the name of this is?; What's in here?; What else do you see?; What are you making?; What do we have here?'

The request discourse sequence was broken into three parts: the initiating request, the response and the coda.

Initiating request. The initiating request was broken into two subcategories:

- request for label;
- request for name of colour (only one DS parent and two TD parents did this, thus categories one and two were collapsed).

Response. The responses were broken in to seven categories:
• no answer;
• 'I don't know';
• answer as a good description or correct, 'It's a spinning magnet', 'A purple doll', 'Blocks';
• answer fantastical or made up, 'It's a twirlie', 'It's a thingamagig';
• another question, 'What do you think it is?';
• unintelligible;
• other – examples include when a response is acknowledging and on task, but not technically an answer, 'I want to see', 'Let's find out.' In addition, there were responses that merely conveyed emotion, 'Yucky'.

Coda. The codas were broken into six categories:
• nothing more in the request act, conversation continues;
• initiator requests again and gets no answer;
• initiator requests again and gets an answer;
• initiator repeats the responder's answer;
• initiator replies, 'I don't know';
• initiator answers own question (supplies label).
The coding was implemented by the first author. Because some categories contained sparse data (e.g. codas where the initiator then replied, 'I don't know'), requests, responses and codas were aggregated and Pearson's correlation was used. Inter-rater reliability was obtained using a senior from the Communicative Disorders department. The raters' correlation was statistically significant, $r = 0.87$, $P < 0.01$. All disagreements were discussed until consensus.

Labels – results and conclusions

Requests for labels. Both parents and children could initiate requests for labels. Table 3 lists the mean counts and proportions for the six groups. The three groups of parents did not request labels differently (F-value less than 1.00). Approximately every 20th utterance from the parents was a request for a label. The parents of the older children with DS requested labels as frequently as parents of TD children. However, the DS children requested labels themselves significantly less than the TD children, mental age-match, $t(63) = 3.95$; $P < 0.05$; MLU-match, $t(63) = 4.15$, $P < 0.001$. Proportionally, the children with DS still differed significantly; approximately every 200th utterance was a request for a label for the children with DS. MA-matched children requested labels at four times that frequency; MLU-matched children at six times. Thus, the children with DS elicited labels far fewer times in the conversational transactions than TD children, even though at least two of the toys were most certainly novel to all of the groups.

Level of scaffolding. We wanted to get inside the speech act to see how parents might differentially respond when their children did not reply to a request with an answer. This could happen in two ways: either the children would reply, 'I don't know', or they would give no answer (a pause of 5 s or longer, or a change of topic). Participants in all three groups gave no answer 30 times, and said, 'I don't know' 10 times. The following analyses allow a window onto how the parents probe for, and subsequently might supply, lexical knowledge. We had two specific questions that address the scaffolding issue:
1 When a child replies 'I don't know' to a parent's request, will different groups of parents respond differently? Will DS parents more frequently supply the answer (modelling vocabulary, informative scaffolding) or will they ask the question again (prompting for knowledge, facilitative scaffolding) more often when compared to TD parents?

Table 3 Requests for labels: mean counts, utterances and proportions with standard deviations

Requests for labels	Parent DS	Parent MLU-match	Parent MA-match	Child DS	Child MLU-match	Child MA-match
Mean count	2.55 (1.62)	2.63 (1.87)	3.18 (2.13)	0.10 (0.31)	0.83 (0.95)	0.68 (0.77)
Utterances	50	50	50	19.17 (9.85)	25.23 (16.54)	33.96 (15.00)
Proportion (RFL/utterances)	0.05	0.05	0.06	0.005	0.033	0.020

DS, Down syndrome; MA, mental age; MLU, mean length of utterance; NDW, number of different words; RFL, requests for labels.

Table 4 Raw counts: informative vs. facilitative contingency tables of discourse turns 2 and 3 (after parent has requested label)

Child	Parent coda repeat question	Parent coda supply answer
Down syndrome group		
No answer	2	10
Don't know	1	2
MLU-match group		
No answer	2	10
Don't know	1	3
MA-match group		
No answer	0	6
Don't know	1	2

MA, mental age; MLU, mean length of utterance.

2 When a child does not respond to the question (transcripts reveal a change of topic, either immediately or after a delay), will the DS parents more frequently supply the answer (informative) compared to the TD parents who might ask the question again (facilitative)?

Table 4 shows the informative vs. facilitative contingency raw counts for turns 2 and 3. For example, in turn 1 the parent requests the label, in turn 2 the child responds (the rows), and in turn 3 the parent responds to the child's response (codas in the columns).

For these analyses codas scored as category two (request again, no answer) or three (request again, answer) were collapsed. Using parents' coda as the dependent variable, two logistic regressions were analysed, one with group and child's response, and one with group, child's response and the interaction of group and child's response. The interaction asks the question of whether the groups are different. Both regressions yielded probability values greater than 0.90, revealing that there is no statistically significant difference between the three groups in the manner in which parents deal with their children's lack of knowledge or failure to reply.

Because the incidences of 'I don't know' were so small, we collapsed children's responses within group, this new category can be thought of as insufficient or contentless response to a request. We can now use the chi-square statistic to ascertain if parents differentially respond by either repeating the request or supplying the answer. The following are the ratios for both types of coda, for DS = 3:12, for MLU-match = 3:13, for MA-match = 1:8. If using a 0.5 probability, the parents supplied the answer significantly more often than they repeated the question, DS: $\chi^2(1) = 5.4$, $P < 0.05$; MLU-match: $\chi^2(1) = 6.3$, $P < 0.05$; MA-match: $\chi^2(1) = 5.4$, $P < 0.05$. The expected cell count for the MA-match group is 4.5; this is small but not problematic because we are essentially failing to reject the null hypothesis. Thus, the three groups of parents responded similarly to one another; they all used more informative scaffolding. We contend that the groups of different parents were equally interested in supporting their children's lexical development regardless of age and developmental category by supplying the answer. The parents of the children with DS were not supplying more informative scaffolding than the TD parents, they were similar to both sets of parents with TD children at the same productive and cognitive levels as the children with DS.

Correlation of requests with child variables. Our last question returns to the tuning hypothesis. Our initial premise was that parents who were requesting labels from their children were attempting to assess and perhaps enhance the child's lexicon. Although the requests are not numerous in this sample, we hypothesized that we might still see evidence of parental requests correlating with the child's language and cognitive variables. We predicted that the highest parental requesters would have children with the highest NDW; that is, that parents might tune the frequency of their questions to their children's lexicons. We analysed by group and discovered no significant Pearson or Spearman correlations between parental requests and the child's NDW, nor between parental requests and the child's non-verbal cognition, and parental requests and the child's MLU-morphemes. This lack of significant correlation may be because of the small number of requests in our sample (per parent range 0–9) as only 5% of the parents' first 50 utterances were requests for labels. If the exploration task had gone on for a longer amount of time and participants had been supplied with more novel toys, then perhaps raw counts would have increased and more power would have been obtained.

Discussion

We would like to highlight four results of particular interest, one that relates to MLU, one that relates to NDW, and two that relate to requests for labels.

Mean length of utterance. Mean length of utterance measures syntactic complexity. The DS population offers us an opportunity where linguistic and syntactic output is de-coupled from a child's cognitive and linguistic comprehension skills. The parents of children with DS do not speak to their children with the same level of syntactic complexity as the parents of the MLU-matched children do. We found that the parents of children with DS speak to their children in a manner more similar to the parents with older children who are matched for non-verbal cognition. This suggests that parents of children with DS are still modelling a more sophisticated syntax than is produced by their children. We did not, however, find evidence for tuning, or significant correlations between parent MLU and child variables in the DS group. In this regard, the DS group more resembled the MLU-match group than the other two TD-match groups. The parents of children with DS do not appear to adjust the syntactic complexity of their sentences in accordance with their children's complexity.

Number of different words. Again, there were significant differences between the MLU-match group and the DS group in NDW that the parents used. A multiple regression revealed that when holding NonVerbCog and ReceptSyn constant at an average level, as the DS children increased their NDW, the DS parents significantly increased their NDW when compared than the MLU-match dyad. This finding suggests that parents of those with DS are moderately tuning their NDW to their children's NDW, and that they may be modelling an expanded lexicon for their children. It is impossible to say with cross-sectional data if the parents or the children are the causal force behind NDW correlations. A statistical trend suggests that over all levels of NDW, the parents of the children with DS are using more different words in a more accelerated manner than the parents of the MLU-matched children. This is an important finding because it may help to explain why children with DS (in this study they are chronologically adolescents and young adults) have vocabulary comprehension skills greater than one would predict from measures of their production and non-verbal cognition (Chapman *et al.* 1991).

Requests for labels. Parents of children with DS request labels for novel objects with the same frequency as the parents of the TD children. This suggests, once again that parents of those with DS are training their children as 'life long learners', they may still be trying to enhance their children's lexicons and are probing in a manner consistent with parents of TD children who are in very active stages of language learning. The DS children, in contrast, requested labels from their parents significantly less frequently than the TD children did. The reduced DS request rate for verbal labels, in the context of novel toy exploration, is consistent with other work reporting reduced non-verbal requesting in early communicative interaction (Mundy *et al.* 1995), despite equivalent frequencies of other speech acts. Whether requests and directives, as a class, are less frequent in other language contexts in adolescents with DS has not been assessed (to our knowledge). It may also be the case that those with DS are more focused on the social interaction uses of language and not on how language refers to inanimate objects.

The three sets of parents also reacted to no answer or an 'I don't know' from their children in the same manner, that is, more often supplying the name of the item rather than requesting again. We interpret these findings as evidence of active lexicon building on the part of both DS and TD parents, with fewer contributions to the reciprocal process from DS children than the TD children. Although the children with DS are chronologically far removed from what would traditionally be considered an active stage of lexicon building, the parents still ask their children what the items are called, and the parents of those with DS still aid their children by using informative scaffolding and supplying the labels when the children do not know the answer. Finally, our prediction that parents who requested more labels would have children with larger vocabularies was not borne out. No correlation was above 0.10. This might be because of the paucity of the requests for labels in the parents' first 50 utterances (the average across the groups was 2.8). It may also be the case that parents of all children with relatively larger vocabularies do not feel the

need to press their children for labels, so variability is reduced.

Future research

Future studies of the language of children with Down syndrome should look at more inter-utterance level relationships in a variety of communicative contexts. These studies should also address parents' expansions and re-castings of children's utterances. If parents were expanding their children's utterances during this play task, the percentage of utterances expanded was apparently too small to affect overall the MLU of the parent; conversational coding of frequencies would be necessary to reveal continued tuning. The play situation we used revealed interactive vocabulary modelling and may also be particularly suited to analyses of parent encouragement of exploratory play – future studies might utilize content analyses. It might also be the case that parents adjust their MLU to match their perceptions of their children's comprehension and this may explain why there was no fine-tuning to MLU. These perceptions might be set and no longer variable by a certain age. Future research should also analyse other types of questions. Finally, it would be highly beneficial to have a comparison group for the DS children of children/young adults matched for chronological age (CA) and IQ from another syndrome associated with cognitive disability, one associated with asynchronies in language and cognitive development (e.g. fragile X syndrome), or relative strengths in language production (e.g. Williams syndrome).

Although the task was one of play, all the older DS children were extremely engaged and the parents were equally as enmeshed. It would, nonetheless, be valuable to compare how often parents of CA-matched TD children/young adults, and parents of other types of children with delays would request labels for the novel objects when comprehension and production skills did not diverge, or where there were strengths compared to non-verbal cognition.

Implications

The majority of evidence for MLU tuning can be seen in the older TD groups; however, the correlations were never more than moderate. This is a reminder that when a context challenges non-verbal aspects of cognition, a sensitive parent may support explorative non-verbal behaviour with means that are not linguistic. The TD parents tuned their MLU mainly to the older children's non-verbal cognition. Although there was no evidence of macrolevel MLU tuning for the DS group, there was some evidence for an active role in lexical acquisition. The DS parents may be continuing to support their children's NDW or lexicon in a positive, linear manner when their children are at the average levels of receptive syntax and non-verbal cognition. This may be a factor in explaining why most individuals with DS continue to grow in vocabulary over time (Chapman *et al.* 1991). Parents of those with DS are encouraged to continue using lexically challenging language with their children. In addition, intervention could usefully focus on encouraging children with DS to request labels when they are uncertain of them, as this would increase the children's language learning opportunities.

Acknowledgements

The authors wish to acknowledge and thank the participants in this study and their parents, Sally Miles, Gary McClelland, Leonard Abbeduto, project assistants Heidi Sindberg and Hye-Kyeung Seung, and the staff of the transcription lab. This research was supported by Grant No. R01-HD23353 to R. Chapman from the National Institutes of Health and Grant No. (T32HD07489) supporting M. Johnson-Glenberg as a fellow in the Postdoctoral Training Program in Mental Retardation Research at the Waisman Center.

References

Bates E. (1979) *The emergence of symbols: Cognition and communication in infancy*. Academic Press, New York, NY.

Bornstein M. H. & Haynes M. O. (1998) Vocabulary competence in early childhood: measurement, latent construct, and predictive validity. *Child Development* **69,** 654–71.

Bornstein M. H., Haynes M. O. & Painter K. M. (1998) Sources of child vocabulary competence: a multivariate model. *Journal of Child Language* **25,** 367–93.

Bruner J. (1974–5) From cognition to language: a psychological perspective. *Cognition* **3,** 255–87.

Burch M. C. M. (2001) Maternal narratives and children's language development: a longitudinal examination of 1- to 3-year-olds. *Dissertation Abstracts International: Section B The Sciences and Engineering* **61(**12-B), 135.

Carrow-Woolfolk E. (1985) *Test for Auditory Comprehension of Language-Revised*. DLM Teaching Resources, Allen, TX.

Chapman R. S. (1981) Mother-child interaction in the second year of life: its role in language development. In: *Early language: Acquisition and intervention* (eds R. Schiefelbusch & D. Bricker), pp. 201–50. University Park Press, Baltimore, MD.

Chapman R. S. (1995) Language development in children and adolescents with Down syndrome. In: *Handbook of child language* (eds P. Fletcher & B. MacWhinney), pp. 651–63. Blackwell, Oxford.

Chapman R. S. (1997a) Language development in adolescents with Down syndrome. In: *Adolescents with Down syndrome* (eds S. Pueschel & M. Sustrova), pp. 99–110. Brookes Publishing Co., Baltimore, MD.

Chapman R. S. (1997b) Language development in children and adolescents with Down syndrome. *Mental Retardation and Developmental Disabilities Research Review* **3,** 307–12.

Chapman R. S. (1999) Language and cognitive development in children and adolescents with Down syndrome. In: *Improving communication development in persons with Down syndrome* (eds J. F. Miller, L. A. Leavitt & M. Leddy), pp. 41–60. Brookes Publishing Co., Baltimore, MD.

Chapman R. S. (2000) Children's language learning: an interactionist perspective. *Journal of Child Psychology and Psychiatry: Annual Research Reviews* **41,** 33–54.

Chapman R. S. & Hesketh L. (2000) The behavioral phenotype of Down syndrome. *Mental Retardation and Developmental Disabilities Research Review* **6,** 84–95.

Chapman R. S., Kay-Raining Bird E. & Schwartz S. E. (1990) Fast mapping of novel words in event contexts by children with Down syndrome. *Journal of Speech and Hearing Disorders* **55,** 761–70.

Chapman R. S., Schwartz S. E. & Kay-Raining Bird E. (1991) Language skills of children and adolescents with Down syndrome. I. Comprehension. *Journal of Speech and Hearing Research* **34,** 1106–20.

Chapman R. S., Seung H.-K., Schwartz S. E. & Kay-Raining Bird E. (1998) Language skills of children and adolescents with Down syndrome. II. Production deficits. *Journal of Speech, Language, and Hearing Research* **41,** 861–73.

Clarke-Stewart K. A. (1973) Interactions between mothers and their young children: characteristics and consequences. *Monographs of the Society for Research in Child Development*, Serial no. 187.

Clarke-Stewart K. A., Gruber C. P. & Fitzgerald L. M. (1994) *Children at Home and in Day Care*. Lawrence Erlbaum Associates, Hillsdale, NJ.

Davidson R. G. & Snow C. E. (1996) Five-year-olds' interactions with fathers versus mothers. *First Language* **16,** 223–42.

Gallaway C. & Richards B., eds (1994) *Input and Interaction in Language Acquisition*. Cambridge University Press, Cambridge.

Hampson J. & Nelson K. (1993) The relation of maternal language to variation in rate and style of language acquisition. *Journal of Child Language* **20,** 313–42.

Harris M. (1992) *Language experience and early language development: From input to uptake*. Lawrence Erlbaum Associates, Hillsdale, NJ.

Hart B. & Risley T. (1995) *Meaningful differences in the everyday experience of young American children*. Paul H. Brookes Publishing Co., Baltimore, MD

Hesketh L. J. & Chapman R. S. (1998) Verb use by individuals with Down syndrome. *American Journal of Mental Retardation* **103,** 288–304.

Mayer M. (1969) *Frog, Where Are You?* Dial Press, New York, NY.

Messer D. J. (1994) *The development of communication: from social interaction to language*. John Wiley & Sons, Chichester.

Miller J. F. & Chapman R. S. (1990) *Systematic Analysis of Language Transcripts*. Language Analysis Laboratory,. Waisman Center, Madison, WI.

Mundy P., Kasari C., Sigman M. *et al.* (1995) Nonverbal communication and early language acquisition in children with Down syndrome and in normally developing children. *Journal of Speech and Hearing Research* **38,** 157–67.

Newport E., Gleitman H. & Gleitman L. (1977) Mother, I'd rather do it myself: some effects and noneffects of maternal speech style. In: *Talking to children: Language input and acquisition* (eds C. Snow & C. Ferguson), pp. 109–49. Cambridge University Press, Cambridge, UK.

Ninio A. & Bruner J. (1978) The achievements and antecedents of labeling. *Journal of Child Language* **5,** 1–16.

Pan B., Feldman H. & Snow C. (1993) Parental speech to low-risk and at-risk children. Manuscript, Harvard Graduate School of Education.

Rescorla L. A. (1984) Individual differences in early language development and their predictive significance. *Acta Paedologica* **1,** 97–116.

Retherford K. S., Schwartz B. C. & Chapman R. S. (1981) Semantic roles and residual grammatical categories in mother and child speech: who tunes into whom? *Journal of Child Language* **8,** 583–608.

Richards B. (1994) Child-directed speech and influences on language acquisition: methodology and interpretation. In: *Input and interaction in language acquisition* (eds C. Gallaway & B. Richards), pp. 74–106. Cambridge University Press, Cambridge, England.

Sachs J. (1979) Topic selection in parent-child discourse. *Discourse Processes* **2,** 145–53.

Searle J. (1976) A classification of speech acts. *Language and Society* **5,** 1–23.

Snow C. E. (1995) Issues in the study of input: fine tuning, universality, individual and developmental differences, and necessary causes. In: *Handbook of child language* (eds P. Fletcher & B. MacWhinney), pp. 180–93. Blackwell Reference, Oxford, UK.

Sokolov J. L. (1993) A local contingency analysis of the fine-tuning hypothesis. *Developmental Psychology* **29,** 8–23.

Stein N. & Glenn C. (1982) Children's concept of time: the development of a story schema. In: *The developmental psychology of time* (ed. W. J. Friedman), pp. 255–82. Academic Press, New York.

Thorndike R. L., Hagen E. P. & Sattler J. M. (1986). *Stanford-Binet Intelligence Scale*, 4th edn. The Riverside Publishing Co., Chicago, IL.

Yoder P. J., Hooshyar N., Klee T. & Schaffer M. (1996) Comparison of the types of child utterances mothers expand in children with language delays and with Down's syndrome. *Journal of Intellectual Disability Research* **40,** 557–67.

Yoder P. & Warren S. (1998) Maternal responsivity predicts the prelinguistic communication intervention that facilitates generalized intentional communication. *Journal of Speech, Language, and Hearing Research* **41,** 1207–19.

Received 13 January 2002; accepted 14 February 2003