ABSTRACT

Down syndrome (DS), one of the most prevalent conditions of moderate and severe mental retardation of genetic origin, has been the object of intensive studies for a number of years. Regarding major aspects such as language, the greater lines of development can now be sketched according to a lifespan perspective, i.e., from beginning of life to the adult years. Of course many questions remain without a clear answer (for instance regarding communicative and prelinguistic development in the first year and later difficulties in the aging person), but a relatively comprehensive view of the acquisitions, stumbling blocks, plateaus, relative strengths and weaknesses in the speech and language abilities is emerging. Henceforth, it is increasingly possible to specify sounder remediation principles for improvement. Key aspects of language development in DS will be summarized (pointing out also the areas


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in which knowledge is insufficient) following a chronological perspective and dealing with the major language components (i.e., phonology and articulation, vocabulary, grammar, and pragmatics). For each component relevant remediation principles will be specified.

**PRELINGUISTIC DEVELOPMENT**

Typically developing (TD) preborn babies three months before birth already familiarize themselves with their mother’s voice in utero. Upon birth they recognize the voice of the mother and her language based on their prosodic properties. TD newborns also are able to make binarily distinctions between virtually all human consonants (in French, for example, contrasting b and p, t and d, f and v, etc.). In the course of the first year, TD babies specialize in the particular sounds of their community language (receptively, discriminating better the sounds — phonemes — of this language and gradually less well those of other languages; expressively, progressively saturating their babbling with phonemes of the community language to the exclusion of other sounds which were largely produced before).

Such prelinguistic developments are all the most relevant guiding the infant towards the phonemic properties of maternal language, therefore restricting the range of characteristics to pay attention to in the prospect of first language acquisition.

Our knowledge of the same aspects of development in DS children is still extremely reduced. Studies initiated in Brasil
(Tristao & Feitosa, 2002) suggest that babies with DS show patterns of attention and habituation to speech sounds that differ from TD babies. Research with event-related brain potentials and reaction times (e.g., Lincoln, Courchesne, Kilman, & Galambos, 1985) indicate that DS children process some type of auditory information (particularly complex auditory stimuli) more slowly than MA-or CA-matched TD children. Miezejewski, Hearney, Belser, and Sersen (1994) observed aberrant lateralization of auditory processing (using brainstem evoked responses) in some DS individuals (i.e., the patterns of left versus right ear responses differing from those in TD individuals). Bowler, Cuffin, and Kiernan (1985) have reported reversed ear advantages for the verbal material (but not the nonverbal one) in a proportion of children with DS compared with MA-matched TD preschool children; observations subsequently replicated in a series of studies by Elliot and associates (cf. Elliott, Weeks, & Elliott, 1987, for a review) and by Rondal (1995) with a sample of 24 DS adults aged 21 to 36 years (half of the subjects exhibited a clear right-ear advantage in a dichotic-listening task, but the other half a left-or no ear advantage at all — therefore with a substantial interindividual variability in cerebral lateralized of speech stimuli reception). Back to babies, we know nothing of a possible sensitivity or lack of it in the DS newborns to the prosodic and phonetic aspects of maternal language. We know that later their babbling is delayed but not deviant and that the same phonetic types and tokens may be recorded in their productions as in those of TD infants. A troublesome fact regarding prelinguistic development in DS babies is the marked delay in organizing babbling taking into
account the (pre) conversational partner (in most cases the mother). TD babies in the second half of the first year adapt their babbling to the responses of the human partner. For example, they shorten the last syllable of their two- or three-syllable sequences and space their productions apparently in order to signal and allow the interlocutor to insert a response. This behavior mark an important step in the development of dyadic communication.

If prelinguistic development, as now agreed, is a prerequisite for language acquisition, it is all the most important to study this stage in DS infants and perhaps try to intervene already at this time. Language is a highly complex function building on separate entities and subsystems that are mastered gradually and often prepared a long time before being fully operational. By working on the separate subsystems and boosting their development, we have the best opportunity to minimize delays and favor further acquisitions (e.g., vocabulary and syntax).

This being said, a word of caution is in order. If very early intervention (systematic stimulation, etc.) may seem desirable, it might not be without risk. In lower-level mammals, such as rats and mice, environmental enrichment does determine significant improvements in learning ability and memory accompanied by an increase in cortical volume, number of dendritic spines and synapses per neurone. However, the same experimentation with the corresponding animal model of trisomy 21 in humans, i.e., mouse Ts65Dn (with partial trisomy of chromosome 16 that contains a large sequence of genes equivalent to chromosome 21 in humans) yields different picture. Some animals actually show a decrease in learning
ability and signs of disorganization at the brain level. Florez (2005) analyzing these data cautions that trisomy 21 in humans being a major factor of neuroanatomical imbalance may interact negatively with too intensive attempts at early stimulation that could overwhelm the resources of the maturationally retarded organism with negative effect on development.

The moral of this to date, in my view, is as follows. There is no question to phase out early stimulation in DS. But we need more research to weight the pros and cons of VERY early stimulation. What we want to achieve is enhancing as much as possible brain and behavioral development of DS infants without exposing them to ill-calibrated practices that could run contrary to the educational objectives.

**OROPRAXIC DIFFICULTIES**

Many DS children have serious oro praxic and (hence) articulatory difficulties. Responsible factors include: (1) a buccal cavity too small for the tongue affecting sound resonance, a protruding tongue, a cleft or short hart palate, abnormal teeth disposal or deformities resulting in defective dental occlusion, larynx located high in the neck, hypotonia of speech muscles involving tongue, lips, soft palate, and breathing muscles; (2) auditory defects: mainly 25 to 55 decibel losses over the speech frequencies, impairment roughly half conductive and half sensorineural or mixed; (3) deficits in motor coordination; and (4) voice problems.
Motor development in DS is delayed from birth on. A possible contributor to this delay is subclinical hypothyroidism (which may be treated with levotiroxine, although the point is still disputed). In a recent work, Jordan, Arno, Santaliestra, Le Roux, Puig de Dou, and Perez (2004) have reported 7 months advance in psychomotor development in a cohort of DS babies following the administration of levotiroxine during 24 months following birth in comparison to an untreated sample.

Expectedly, the motor component of speech is problematic in DS. The generalized hypotonia affecting many DS infants negatively interacts with speech development. Several techniques have been proposed to reduce lingual hypotonia. One is the Castillo-Morales, Avalle, and Schmid (1984) technique, relying on a palatal plate equipped with mechanical stimulators. The average length of treatment is 18 months. Placement of the plate is advised from 2 or 3 months of age. Reported success varies from 50 to 80%. De Andrade, Tavares, Rebelo, Palha, and Tavares (1998) have designed a plate modelled after the Castillo-Morales one but with a pacifier tied to the plate, allowing longer and safer positioning in the baby’s mouth. Published results demonstrate reduced buccal hypotonia, lingual protrusion, labial hypotonia, and mouth opening, particularly when the technique is combined with orofacial stimulation.

A number of activities can be suggested with the potential of improving oral-motor praxis in the slightly older child. They include mobilizing the external speech organs (tongue, soft palate, lips, and jaws) and increasing muscular tone. Improvement of the expiratory
control (breathing out) is often needed given that many DS children have a poor control over this function.

In some (rare) cases of extreme macroglossia combined with a markedly reduced a buccal cavity, a surgical treatment consisting in removing a portion of the lingual mass may be advised. Various techniques exist. Correctly performed, they help improving the orolingual apparatus, setting a better ground for a (still necessary) more efficient speech training.

**PHONOLOGICAL DEVELOPMENT**

The setting of phonological contrasts is slow in many DS children, but overall the progression parallels that in TD children. Vowels, semivowels, and nasal and stop consonants are produced first. The fricatives, more delicate to articulate, take longer to be mastered (when they are).

Phonological intervention involves three steps: (1) assessing the child’s phonological system; (2) defining the intervention goals; and (3) selecting the appropriate method for achieving those goals. Some programmes focus on increasing the repertoire and reducing the errors relying on techniques similar to those used with non-DS children with phonological disorder (e.g., Cholmain (1994). The programmes are designed to encourage the child to recognize the basic structures of the phonological system, insisting on listening and production practices focused on particular phonemes and phonological processes. Other types of intervention directly address the word level (e.g., Dodd, McCormack, & Woodyatt, 1994). The target units of treatment are whole (therefore meaningful) words.
Parents can serve as agents of the therapy. They are instructed to accept only one pronunciation for a set of words selected for their child. Pronunciation errors are accepted as long they reflect developmental rather than deviant patterns. The idea to use parents as active partners in articulation therapy has a long history. It was already put to practice by Carrier (1970).

**LEXICAL TRAINING**

Lexical development proceeds in close relationship with mental age (MA). It is markedly delayed in DS, but there are many similarities with typical development. Intervention has three interrelated goals: (1) setting up patterns of adult-child interaction that are comfortable and effective; (2) the child should learn as many words as possible; (3) the child should be encouraged to use the words he or she knows spontaneously, both to express ideas and attempt to control the environment. Establishing and maintaining joint attention is crucial for vocabulary learning. An effective form of joint attention involves the adult following in on the focus of the child’s attention and labelling that focus multiple times within the same as well as across different interactive episodes. This strategy is particularly important with young DS children whose weaknesses in verbal memory increase the difficulty of encoding new labels, associating them with the referents, and remembering the associations.

The onset of expressive oral language is often markedly delayed in DS children and the rate of progress slow. To increase production rate, sign symbols can be introduced in conjunction with oral
language favoring a total communication strategy. Inputs composed of speech and simultaneous signing favor larger earlier expressive vocabularies in the children (Clibbens, 2001). Various systems of augmentative communication exist: for instance, forms borrowed from manual sign languages (such as the America or British Sign Language). Simplified versions of these systems (e.g., the Makaton repertoire; Walker, 1978) can be used with children experiencing language delays including DS children (Remington & Clarke, 1996; Forman & Crews, 1998). The rationale is twofold. Firstly, DS children exhibit particular productive delays (i.e., delays going beyond what can be expected on a MA basis). Their comprehension for vocabulary (also for syntax) usually exceeds production skill. Gesturing implying larger scale motricity is easier to perceive and produce than smaller, more delicate, and finely synchronized speech movements. Gesturing, therefore, may serve to drive out oral lexical production under the condition that both modalities be associated. Later on, signing is gradually faded out without difficulty. Secondly, visuo-spatial processing (including short-term memory) is better preserved than auditory-verbal one in DS children. Hence, relying on gestures as adjuncts for word learning should also facilitate memory storage.

It is important to carefully choose the labels to use and the exemplars to label. Objects may be labelled at different levels. Children learn basic-level names (e.g., dog, car, table, apple) more easily than superordinates (e.g., respectively, animal, automobile, furniture, fruit) or subordinates (e.g., Collie, Peugeot, chess-table, golden-apple). DS children need to hear a word several times, on
multiple occasions, in various contexts, with the referent clearly identified, before being able to map it reliably to the referent category and retain the association in semantic memory. The initial exemplars should refer to good examples (prototypes) of the categories (for example, for *bird*, a robin rather than a penguin or chicken) and be real objects or realistic replicas or pictures, rather than stylistic or more abstract representations.

Once the child has started to produce words, the range of referents to which he or she applies a given label will not necessarily be identical to that of the adults (over- or undergeneralization; for example, calling a cat *bow-wow* or *doggie*, or refusing to label a *car* any car but the family one, etc.). Such steps are normal ones in lexical acquisition and should be welcomed until the child becomes able to appreciate the attributes (semantic features) differentiating the referent-objects from members of close categories.

**MORPHOSYNTACTIC DEVELOPMENT AND TRAINING**

Morphosyntactic development is problematic in DS children and despite progresses in the teenage years, it often remains limited. Major difficulties and prolonged instability of use relate to:

(1) building up phrases using function words (articles, pronouns, auxiliaries, prepositions, and conjunctions) beside the usual content words (nouns, verbs, adjectives, and adverbs) in such a way as to express precise relational meanings;
(2) producing the proper inflections for nominal number concord as well as the markings for person, number, and tense or aspect on verbs;

(3) integrating phrases into basic sentences;

(4) producing various pragmatic types of sentences (declaratives, exclamatives, interrogatives, imperatives) according to the rules of the language.

DS children and adolescents also have difficulties in the comprehension of these structures and they lag behind MA-matched TD controls in this respect. Passive voice understanding is always problematic outside of contextual or pragmatic facilitation (e.g., the reversible passive The red car is followed by the blue car vs. the non-reversible one The car is driven by the young man).

Comprehension (receptive) training should always precede expressive (productive) training. The child should be encouraged to repeat short utterances, phrases, and sentences presented auditorily in appropriate situations. Once he or she has started producing multiword utterances, the expansion technique can be used systematically. Expansions can be produced at high rates quite naturally in interactive sessions with the DS child, exactly as they are by parents of TD children. Expansions consist in supplying the missing grammatical components in the utterances produced by the child (e.g., child: cat sleeping; adult: (Yes), the cat is sleeping). Semantic extensions can also be used profitably (i.e., elaborating on the meaning supplied by the child; e.g., child: Cat sleeping; adult: (Yes), the cat is sleeping on the mat). It is not necessary that the child repeats verbatim the expanded or extended forms. In the
middle term, expanding children’s utterances into more complex sentences improves their semantic-syntactic functioning.

More systematic training can also be supplied targeting the major structures in the language (cf. Rondal, 2003a).

**READING INSTRUCTION**

The opportunity to learn to read and be involved in reading (and writing) activities is important in itself to acquire a useful level of literacy skills in a world always more dependent on written and visual symbols; but also, and this is less known, in order to stabilize and improve spoken language. Studies demonstrate the feasibility and usefulness of teaching literacy skills to children, adolescents, and even adults with Down syndrome. The levels reached may be quite variable, however. Some subjects achieve functional levels of literacy (8 years and above), others a level of literacy skill allowing to record work in the classroom and read with assistance. Some may not achieve any useful level of independent reading skills but their speech and language may benefit from the literacy activities.

Buckley (2003) reports case studies showing that DS children introduced to reading activities designed to teach spoken language, as early as 3 years of age, demonstrate significantly advanced speech, language, literacy, and verbal short-term memory skills, in childhood and teenage years. They show more advanced skills as teenagers than children introduced to reading after 5 or 6 years of age. The explanation is threefold. First, as said, visuo-spatial processing is better preserved than auditory-verbal one in persons with Down syndrome. Second, duplicating the message (written and
spoken) favors storage in memory of the language structures involved. And third, the written medium by its very nature allows working on the morphosyntactic aspects of the sentences more easily than speech.

There is no evidence that DS children of school age learn to read any differently from other children, but they may rely longer on a logographic strategy. Eventually they reach a stage where they can use alphabetic strategies for reading and spelling (phonological awareness).

The following principles (retaken from Buckley, 2003, p. 148, with minor modifications) should inform the teaching of reading to DS children:

1. Start reading activities when child (a) comprehends 50 to 100 spoken words and says or signs some, so is ready to combine words, and (b) can match and select pictures (usually at around 2:6 to 3:6 years of chronological age);

2. Teach whole words first — ‘look and say’;

3. Select words as appropriate for the child's language comprehension level and interests, starting with words the child already understands;

4. Choose words to make sentences from the start — two word- and three word-sentences for children under 4 years but grammatically complete short, simple sentences for all children over 4 years;

5. Make books using pictures of the child’s own world and interests to illustrate the sentences;
(6) Always read the words and sentences with the child while he or she is learning — that is, use errorless learning techniques to prompt success;

(7) Once the child is enjoying the reading activities with familiar vocabulary, introduce new vocabulary into the reading;

(8) Always encourage the child to repeat the words and sentences with you;

(9) Practise writing alongside reading from the start as this will draw attention to letters and help handwriting;

(10) Teach phonics once the child has a sight vocabulary of 30 to 40 words; learning to write and spell rhyming sets of words helps.

Information technology can be useful to assist the training of speech and language skills (as well as other skills) in the education of DS individuals. Personal computers are optimally suited to organize reading schemes and “talking books”, illustrate and sustain activities targeting spelling, graphemic, and phonological awareness, word and picture matching, and grammatical sensitization and learning (cf. Black & Wood, 2003).

PRAGMATICS

Although formally reduced, the language of DS individuals is not devoid of communicative value. Conversational topics are dealt with in such a way as to allow for the necessary continuity in the exchange between interlocutors. Language contents are informative and new information is shared.

The conversational turn-taking functions correctly. DS persons are able to recognize those illocutionary acts requiring a response
on the interlocutor's part from those that do not. The exchange of information is active and correctly controlled. There are limitations, however. DS persons express fewer indirect speech acts. They formulate fewer clarification requests in uninformative extralinguistic contexts in comparison with MA-matched TD subjects.

Pragmatic and language-tied social skills can be improved though participation in adequately designed intervention programmes (cf. Abbeduto & Keller-Bell, 2003). Current interventions embody either a naturalistic approach or one making use of behavioral techniques to increase the frequency of correctly formulated speech acts.

Several principles underlie the naturalistic approaches. They require the crafting of an environment providing opportunities and motivations to communicate efficiently. The interaction style as controlled by the adult should be nondirective. Nondirectivity implies following the child's lead by providing him or her with a more developmentally advanced or pragmatically effective linguistic means of achieving the desired interpersonal goal he or she just attempted to address. The most well-suited naturalistic approach is the "milieu approach". Milieu intervention is typically conducted in a child's school or home and it involves responding to naturally occurring teaching opportunities created by the child's attempts at communication. Script-based language interventions have been successfully implemented with DS children (Rondal & Edwards, 1997). A script (i.e., an internalized routine of daily life) is the result of human cognitive functioning (Schank & Abelson, 1977). It can be
adapted to favoring language development (particularly from a pragmational point of view) in MR children. For example, Nagasaki, Yoshimura, and Tsuchiya (1991) and Nagasaki and Onazato (2005) were able this way to teach vocabulary items and particular types of sentence relevant to functional contexts (e.g., making toast; preparing and having a snack) to young DS children.

Behavioral approaches have also been used successfully to teaching particular communicative strategies to the intellectually disabled child; for example, increasing the number of verbal requests during a social episode (e.g., a meal), or improving topic initiation and maintenance in the child’s conversation. But their overall usefulness as well as generalization to nonexperimental contexts has still to be further investigated.

**LANGUAGE AGING**

Physically and biochemically some aging process is already at work in DS individuals in their forties and even before. This propensity towards earlier aging should not be confounded with a susceptibility in 55% of them between 50 and 59 years (8% between before, and up to 75% beyond these ages) to develop an Alzheimer type of dementia (Menendez, 2005; Rondal, Elbouz, Ylieff, & Docquier, 2003). Cognitively and linguistically, however, things are less clear. Some studies report a decline in mental age and memory abilities in older adults with DS.

Other research works suggest little to no change in nonverbal reasoning, memory, planning and attention, perceptual-motor and adaptive skills, until fifty or close to sixty years. DS persons over
sixty years may exhibit poorer performances on tasks requiring attention and planning but even that needs confirmation. We have conducted a four-year longitudinal study of 12 participants with Down syndrome (six women and six men), aged between 36 and 48 years at the beginning of the study (George, Thewis, Van der Linden, Salmon, & Rondal, 2001). The language functions (receptive as well as productive; with tasks concerning the lexical, morphosyntactic, and discursive aspects of language) were assessed at one year interval as well as a number of nonverbal cognitive abilities (short-term memory auditivo-verbal as well as visuo-spatial, episodic memory). None of the analyses yielded a significant result failing to corroborate the null hypothesis of a language change and/or a change in nonverbal cognitive functions over the four years. Comparing that part of the above language data obtained with the use of the receptive subtests of the Batterie pour l’Évaluation de la Morpho-Syntaxe (Rondal & Comblain, 2002) with corresponding data obtained from DS adolescents (mean CA: 16 years and 7 months) and younger DS adults (mean CA: 26 years and 9 months) [the three cohorts having comparable MA (4 years and 4 months, standard deviation: 8 months, for the adolescents; 4 years and 7 months, standard deviation: 9 months, for the younger adults; 4 years and 4 months, standard deviation: 6 months, for the older adults], it appears that no marked change takes place in the receptive morphosyntactic abilities of persons with DS in the interval of time between late adolescence and roughly fifty years of age.

Other longitudinal studies have contributed observations going in the same direction. Devenny, Hill, Patxot, Silverman, and
Wisniewski (1992), and Burt, Loveland, Chen, Chuang, Lewis, and Cherry (1995) did not observe significant changes in the cognitive functioning of DS individuals aged between 27 and 55 years, and 22 and 56 years, in the two studies respectively, over intervals of time going from 3 to 5 years. Devenny, Silverman, Hill, Jenkins, Sersen, and Wisniewski (1996) report only four cases of cognitive involution in 91 DS subjects followed for several years beyond the age of fifty years.

Turning to older non-disabled people, we know that the most frequent language problems encountered in later life include: (1) slower receptive and productive language processing; (2) less efficient respiratory support for speech; (3) aggravated hearing problems and reduced attention to auditory stimuli; difficulties in perceiving low-voiced and whispered speech, speech in noisy conditions, and in communicating on the phone; (4) difficulties in decoding less frequent and longer or more complex syntactic structures; (5) difficulties in planning and monitoring information in discourse; (6) augmented rates of dysfluencies (hesitation pauses, fillers, and interjections); (7) reduced word discrimination, less efficient retrieval from semantic memory, and reduced word fluency. Such and similar difficulties can be expected in aging DS persons particularly beyond 50 years.

Language maintenance with the nondisabled which has started in some places (see for example, Maxim and Bryan) can be adapted to aging people with DS. One can propose a series of activities with the objective of maintaining as far as possible the levels of language functioning attained in precedence (cf. Rondal, 2003b).
CONCLUSION

A great deal of relevant knowledge exists on language development in DS individuals and its difficulties that is of great help for guiding the work of therapists and teachers (cf. Rondal & Buckley, 2003, for a full review). A major theme in my presentation has been the need to adopt a lifespan perspective. This has clear implications. There is a need for language intervention to be age-appropriate and take account of the communication requirements of the individuals within their environment. It is important to stress that some aspects of language and communication skills may still improve into adult life and probably be maintained better with continued or renewed intervention in older ages. Also, current evidence lead to advocate that interventionists take seriously the importance of language learning in the first years, encouraging development as much as possible at these times. Regarding very early stimulation, although it is probably desirable, one should proceed with caution in the absence of more precise knowledge regarding its effects on the neurogenesis of DS babies.
REFERENCES


