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Spoken Language in Persons with Down Syndrome: A Life-Span Perspective

Abstract

Language development, training, and maintenance in Down syndrome are a life-long endeavour. Present-day knowledge of the typical profile of the condition with its relative points of strength and weakness can be set in a life-span perspective from the first days of life until the common propensity to earlier physical and cognitive ageing.

Keywords: Spoken language, Down syndrome, life-span.

Introduction

Language development and functioning in congenital intellectual disabilities, and particularly Down syndrome, is best understood according to a life-span developmental perspective. It must be considered as a delayed and eventually incomplete but corresponding version of standard development (Cichetti & Beeghly, 1990; Rondal & Edwards, 1997). The sequence of steps as well as the stages arrived at and the underlying mechanisms and processes are similar limited only by the brain shortcomings and the cognitive deficiencies that are the mark of the various conditions conducive to intellectual disability (Rondal & Perera, 2006).

In what follows, I review current data and theoretical positions regarding speech and language development in persons with Down syndrome from birth (and before) until the ageing years. Although the present text is not conceived as an intervention manual, it contains important implications for the conduct of cognitive interventions with these persons across the life span.

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Down Syndrome

Down syndrome (DS) or trisomy 21 corresponds to three etiological subcategories: (1) standard trisomy 21, (2) translocation, and (3) mosaicism. In 93% of the cases (standard trisomy 21), the genetic error (nondisjunction in the pair 21 at the meiotic stage) takes place in the ovula or the spermatozoid before syngamy or during the first cell division. All the living cells of the embryo receive three chromosomes 21. In 2% of the cases, the genetic error takes place during the second or the third cell division. In those cases, the embryo develops with a mosaic of cells containing the regular number of 46 chromosomes and cells with three chromosomes 21. In the remaining 5% of the cases, the additional genetic material is not a triplicate of chromosome 21 but a part or the totality of another chromosome, often chromosome 13, 14, 15, 21 itself, or 22 (cases of translocations reciprocal or not; the translocations 21/21 are labelled Robertsonian). In about 66% of the translocation cases, the genetic error takes place during the formation of the ovula or the spermatozoid, or during the first division of the embryo cell. In 34% of the cases, one of the parents, although phenotypically normal in all respects, carries the translocation (said to be equilibrated) in his genotype. In cases of a Robertsonian translocation in one of the parents, the probability to have it passed to the offspring and causing Down syndrome is 100%.

A natural question is whether karyotypic variation makes a difference in the psychological outcomes of persons with Down syndrome? The issue was first raised by Clarke et al. (1961), who described a case of mosaic trisomy in a typically developing girl presenting some features of Down syndrome. Other reports have explored the frequency of trisomic cells in relationship with IQ (intelligence quotient) level. Overall findings (Gibson, 1981) suggest that: (1) persons with Down syndrome of the mosaic subtype are less severely retarded than those with translocation or standard trisomy 21 and (2) persons with Down syndrome of the translocation subtype display less intellectual disability on the whole than persons with Down syndrome of the standard trisomy 21 subtype.

Fewer data have been published on the corresponding issue regarding language abilities. Fishler and Koch (1991) reported a mean IQ difference of 12 points between a group of 30 persons with standard trisomy 21 (mean IQ 52, standard deviation - SD - 14.6) and a group of subjects with mosaic Down syndrome (mean IQ 64, SD 13.8). The two groups were matched for chronological age (CA) - between 2 and 18 years, sex, and parental socioeconomic background. Most subjects with Down syndrome of the mosaic subtype (but none with standard trisomy 21) showed better receptive lexical abilities at the Peabody Picture Vocabulary Test.

As the most common noninherited chromosomal cause of intellectual disability, Down syndrome affects about one in 800 live births. A markedly increased risk of bearing a child with trisomy 21 exists in women advancing in age (particularly over 30 years). Benda's classical curve of mental growth for individuals with Down syndrome (Benda, 1949) culminates around 40 months mental age (MA) reached between 10 and 15 years

CA. Modal IQ in standard trisomy 21 is between 45 and 50 points (Gibson, 1981). The literature on psychological development sees mental evolution in persons with Down syndrome in three "stages" (Gibson, 1981). Mental growth is steady during the first 18 months MA, developed over 4 or 5 years CA. This phase witnesses the evolution of the child through Piaget's stages of sensorimotor intellectual development. A beginning of conceptual-symbolic development is also evident. The second and third periods of mental growth take place between 5 and approximately 15 years CA. They cover a MA range from 2 to 5 years. Five or six years MA seems to be a realistic upper limit of mental growth for many (but not all) individuals with Down syndrome. However, mental development may continue well in the third decade of life for some individuals with Down syndrome, albeit at a slower rate (for example, Berry et al., 1984). Hodapp et al. (1999) have contributed a reanalysis of previous data (e.g., Carr, 1994) as well as data of their own regarding rate of intellectual development in children and adolescents with Down syndrome. They confirm a slowing of developmental rates with age (from global IQs above 70 points before 3 years CA to close to 40 beyond 15 years). It is worth noting, however, that there is no indication of actual losses of acquired skills. No clear explanation has been proposed for the decline in rate of intellectual development in adolescents and young adults with Down syndrome. It could be a precocious manifestation of the tendency to earlier ageing as documented in many of these persons beyond 35 years or so (see below).

Prelinguistic Development

Language development in typically developing children begins three months before birth. By that time, the auditory system of the fetus-baby is functional and tuned to the speech frequencies (basically 400 to 4000 cycles per second). This is a unique feature of the human ontogenesis (suggesting a strong species predisposition for speech). During the waking periods, every acoustical stimulus exceeding 60 decibels is normally received by the auditory apparatus and treated by the baby's brain. The loss in intensity is due to the aquatic milieu surrounding the baby and the fact that the middle ear is filled with amniotic liquid. As a likely consequence of this exposure, the typically developing baby, at birth, demonstrates an ability to recognize the mother's voice and individuate it from other voices. The discriminative ability is purely prosodic. It relies on the unique tonal and rhythmic characteristics of the mother's voice. This can be demonstrated relying on the techniques of cognitive-behavioural investigation in neonates (Boysson-Bardies, 1996). Beyond the particular mother's voice (and through it, to say so), typically developing neonates and young babies demonstrate an ability to recognize the maternal language (always through its prosodic characteristics). They are able to differentiate the one language that they have been exposed to in utero from other languages (Nazzi et al., 1998; 2000).

Young typically developing babies can also differentiate accentuated syllables from non-accentuated ones (Jusczyk et al., 1993). They do recognize varying sequences of syllables (Safran et al., 1996; Marcus et al., 1999). Typically developing neonates can also differentiate between functions words in English (i.e., prepositions, articles, auxiliaries, pronouns, conjunctions) and content words (verbs, nouns, adjectives,

adverbs); the former class is less accentuated and tends to be shorter in length as well as poorer in mean number of vowels (Shi et al., 1999).

Lastly, typically developing neonates have an inborn ability to discriminate between virtually all possible pairs of sounds in human speech; an ability which retrocedes in the course of the first year in correlation with a progressive specialization in the sounds (future phonemes) of the community language (Eimas, 1996). For instance, Japanese babies are able to distinguish r and l sounds, whereas older Japanese children and adults no longer can, as these phonemes do not exist in Japanese. The loss of phonic sensitivity is cognitive or attentional but not neurosensorial. Research shows that only those sounds that share one or several dimensions with maternal phonemes and therefore are potential competitors for the maternal ones, are "faded away" on a statistical basis. Less frequent sounds not being primed disappear from the activated attentional/memory register. These abilities and prelanguage knowledge supply a valid point of departure for cracking the language code.

We know virtually nothing on the corresponding abilities in Infants and children with Down syndrome. This prevents figuring out when and how prelanguage development starts in these babies rendering uncertain the definition of very early intervention programmes which on several grounds (e.g., brain plasticity, efficiency) may be highly desirable. The kind of research needed to answer the above question should figure high on our agendas for there are reasons to suspect that infants with Down syndrome may not come to birth with the same beginning knowledge base as typically developing newborns regarding prosodic language properties.

Several observations suggests that babies with Down syndrome exhibit patterns of attention and habituation to speech sounds that differ from typically developing babies (for example, longer responses to complex auditory stimuli) and that they are more easily distracted from such stimuli (Pueschel & Sustrova, 1996; Tristao & Feitosa, 2002). Research with event-related brain potentials and reaction times indicate that children with Down syndrome process complex auditory information more slowly than CA- and even MA- matched typically developing children (Eilers et al., 1985).

Aberrant lateralization of auditory processing (using brainstem evoked responses) is observed in some individuals with Down syndrome (Miezejewsky et al., 1994). Reversed ear advantage for the verbal material in at least a proportion of children and adults with Down syndrome has been reported (Bowler et al., 1985; Elliott et al., 1987; Rondal, 1995). These indications add to the well known auditory deficit in at least 25 % of the children with Down syndrome.

Judging from these indications, pending more specific data gathering, early prelanguage intervention may already be in order in babies with Down syndrome. It should consist in intensifying the natural verbal and vocal interaction with the baby, quantitatively (at least half an hour a day) and qualitatively (slowing down the pace of speech addressed to the baby but without altering the normal prosody except for a slightly higher pitch which plays as an attention getter). More on the vanguard side pending appropriate research, it

could prove useful to manage increasing the intensity level of the mother's voice in the lasts three months of pregnancy in a plausible attempt to help the fetus attending and memorizing the prosodic parameters of maternal speech and language.

Prelinguistic development covers the first 18 months of life in typically developing infants. It may be quite extended in Down syndrome. Neurological examination reveals hypotonia and abnormalities in the early reflexes and automatisms of neonates with Down syndrome (including palmar and plantar reflexes, ventral suspension, Moro response, and automatic stepping). Early motor development is delayed largely due to congenital hypotonia. Four periods can be identified in babbling development:
  • Stage 1 (0-2 months in TD babies): reflex or quasi-reflex vocalizations (crying and vegetative sounds).
  • Stage 2 (2-4 months): cooing sounds tied to smiles and prevocalic sounds.
  • Stage 3 (4-8 months): quasi-vowels, clicks, palatalized or pharyngealized consonants, affricates, etc.
  • Stage 4 (8-10 months): canonical babbling (production of well formed syllables; e.g., *ba, pa, da, ta, ga, ka*), often reduplicated (e.g., *bababa*, *mamama*, *tatata*, etc), then variegated (consisting of differing consonants and vowels). Before approximately 6 month, infants' babbling appears to be only minimally influenced by the community language. Sounds that do not belong to maternal tongue are readily produced. Between 6 and 12 months, a clear influence of the linguistic environment can be demonstrated. In some way, the older infant babbles in her (his) mother tongue.

Babbling sounds are mostly similar in types and tokens in typically developing and infants with Down syndrome (Smith & Oller, 1981). However, there is a three-month delay on average regarding the onset of reduplicated babbling in the latter. This is all the more important as reduplicated babbling is a distinct precursor to meaningful speech. Significant positive correlations have been found between the age of onset of reduplicated babbling in infants with Down syndrome and their scores at 27 months on the early Social-Communication Scales (Mundy et al., 1984) that are predictive of subsequent development in verbal communication.

Speech Development

A majority of children with Down syndrome demonstrate slowness of articulatory development and persisting (sometimes lifelong) difficulties which may reduce the intelligibility of their speech.
The causes include:
  • Peripheral anatomical factors: an oral 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 mouth occlusion, the larynx located high in the neck, an hypotonia of speech muscles involving tongue, lips, soft palate, and breathing muscles (Spitzer et al., 1961);
  • Auditory defects : mainly 25 to 55 decibel losses over the frequencies 500, 1000, and 2000 Hertz; impairment being roughly half conductive and half sensorineural or mixed;

• Deficits in motor coordination and timing (Rosin et al., 1987);
• Voice problems, including hoarseness; higher or lower fundamental frequencies than normal (Montague & Hollien, 1973).

Phonological development (the setting of phonological contrasts in production and their discrimination in speech perception) is slow and difficult in many children with Down syndrome but the overall progression appears to parallel development in typically developing children (Smith & Oller, 1981; Stoel-Gammon, 1980, 1981, 2003; Menn, 1983). Vowels, semivowels, and nasal and stop consonants are produced first. The fricatives [f],[θ],[s],[ʃ], [v], [z],[ð], and [z] are more delicate to articulate. They take longer to be mastered (when they are). Intelligibility of speech remains low in many individuals with Down syndrome (Ryan, 1975; Rondal, 1978). The articulatory simplifications are of the same type, albeit more inconsistent and variable from trial to trial in the same persons and from person to person, even at comparable IQ and MA levels, as those observed in the speech of typically developing children (mainly: feature changes, cluster reductions, and assimilations; Dodd, 1976; Rosin et al., 1988; Dodd & Leahy, 1989; Van Borsel, 1993). Most adolescents and adults with Down syndrome show a pattern of phonological performance similar to that of older children with Down syndrome (Rondal & Lambert, 1983; Van Borsel, 1988).

Nonsegmental phonology (prosody, intonation, accents, pauses in speech), has been little studied in persons with Down syndrome. A few limited indications suggest that it may be slightly in advance of other linguistic skills. Contrastive intonation patterns are used to support the emerging conversational skills but with some inconsistency (Rondal & Edwards, 1997).

Within the first year, typically developing infants learn to recognise the sounds of their native language and segment the flow of speech heard into conventional units. Little is known about early speech perception abilities in infants with Down syndrome and how these relate to later language development. The bulk of the literature on phonological development in Down syndrome has concentrated on the production of phonology. It has been suggested that difficulties originate mainly in the assembly and rhythmic ordering of speech sounds which likely is an incomplete account. Eilers et al. (1985) tested perception of phonemes by CA 14-25 month old infants with Down syndrome using a behavioural technique (the head turn paradigm). Once infants with Down syndrome reached a MA level of 7 months, they demonstrate typical discriminatory orientation. However, Tristao & Feitosa (2002) in a similar experiment but with younger infants with Down syndrome (CA 3-12 months) demonstrated that not all infants with Down syndrome gave evidence of phonemic discrimination. The CAs differ in the two experiments and it is possible therefore that some of the subjects tested by Tristao and Feitosa were still in a transitory stage regarding phonemic discrimination.

Lexical Development

From comparative studies of typically developing individuals and individuals with Down syndrome, MA appears to be a valid predictor of receptive lexical level. In both

populations, early word understanding begins at the same MA and there are many similarities in the respective progressions (Cunnigham & Sloper, 1984). In children with Down syndrome, lexical development proceeds according to mental growth which follows CA with increasing delays (Rondal, 1985). The relationship between MA and expressive lexical development (not to be confounded with lexical definitions — a metalinguistic task at which persons with intellectual disabilities are little apt for obvious cognitive reasons) is more variable because additional variables come into play (prominently the problems associated with articulatory development and motor programming). Hence the dissociations observed between lexical understanding and expression in these people. The onset of expressive language is markedly delayed in Down syndrome. In some studies, cohorts of CA 4 year-olds have expressive vocabularies of 50 words on average which is about the median value of 16-18 month old typically developing infants (Smith & Stoel-Gammon, 1983).

Lexical learning is a complex task involving:
1. Segmenting the input speech flow into candidate lexical units;
2. Establishing relevant (i.e., conventional denotative) associations between forms, meaning, and categories of referents;
3. Maintaining the information in short-term memory the time needed to allow registration in longer-term stores;
4. Organizing the lexical units in semantic memory to insure permanent storage and efficient retrieval.
   Let us consider these operations in more detail.

Segmenting speech
Except for the fact that globally the language input to children with Down syndrome is comparable formally and as to its contents to the one addressed to children in typical development at comparative levels of language development (Rondal & Edwards, 1997; Rondal & Docquier, 2006), virtually nothing is known on the way the former come to segmenting the input speech they are exposed to in relevant lexical units. It is known that the first lexical acquisitions of typically developing children correspond to the words most often produced by the parents when addressing the children and even more to those words produced in isolation (Otomo, 2001; Brent & Siskind, 2001). No systematic study has been conducted on the same aspects regarding infants with Down syndrome.

Constraints on lexical learning
Several strategies bearing on the acquisition of the early lexical repertoires, particularly nouns at the basic level, have been proposed for typically developing children (e.g., Mervis, 1987; Markman, 1990; Golinkoff et al., 1994; Waxman & Booth, 2001). They are instrumental in meeting the challenge created by the important number of logically plausible alternatives regarding the relationships between lexical forms and plausible referents. Some of the most important lexical strategies are:

1. *Reference (words refer to objects, persons, events in the environment)*

2. *Whole object* (a new name refers to a whole referent and not to one of its properties, qualities, parts, substance, etc.).

3. *Mutual exclusivity* (to each object corresponds a different name).

4. *Taxonomy* (lexical categories are constituted of similar objects and not, for example, of objects that can be associated thematically).

5. *Form*

6. *Function*

7. *Contrast* (each formal difference codes for a difference in meaning and/or formal class status; e.g., noun/verb).

8. *Conventionality and stablity* (words have conventional meaning that are stable over time).

9. *New name — category without a name* (new words refer to categories for which one does not have a name yet).

Research reveals that the strategy "new name — category without a name" is not available at the beginning of lexical development (CA 2-3 years) in children with Down syndrome. It is also the case for typically developing infants earlier which suggest a close relationship between lexical strategies and MA. Interestingly, the children with Down syndrome who subsequently have access to this principle proceed more rapidly in lexical acquisitions (Mervis & Bertrand, 1994, 1995; Mervis & Becerra, 2003).

Short-term memory

It has been suggested that auditory-vocal short-term memory (AV-STM) plays an important role in lexical learning (Baddeley, 1980). Correlative data supporting this hypothesis have been gathered by Gathercole and Baddeley (1993) and confirmed in following works. A mechanism that may account for the relationship between AV-STM and lexical development is that the longer a new word is kept in STM, the better the odds that it will be learned, i.e., passed onto long-term memory. DS subjects typically have shorter and more unstable AV-STM (but better visuo-spatial STM; Marcell & Armstrong, 1982; Marcell & Weeks, 1988) which may account, at least partially, for the slowness and limitations of their lexical learning (MacKenzie & Hulme, 1987; Jarrold & Baddeley, 1997; Jarrold, et al., 1999). Although the exact relationship between AV-STM development and language acquisition still needs to be further specified, it is clear that increasing STM span must be part of any language and cognitive intervention program in children with Down syndrome. Particular techniques to this aim have been devised and tested successfully in recent years (see Conners, 2003, for a review).

Lexical organization in long-term memory

A fast and reliable retrieval is needed to produce and understand a linguistic utterance in real time (several words produced/a second in usual conversations). Such ability also depends on the quality of the organization in long-term memory. Although this aspect of lexical functioning is not fully explained in typically developed people, a few organizing principles and dimensions have been studied, prominently among which lexical prototypicality and the hierarchical dimensions of semantic fields.

Prototypicality (or "best category example") means that in a number of lexical categories, one can readily identify individual referents presenting at the same time most if not all the typical characteristics of the category and few or none of the characteristics of neighbouring classes (for example, among *birds*, *eagle*, *sparrows*, and *crows* are most often considered prototypes of the general category, whereas *ducks*, *swans*, and *hens* are not (Rosch, 1978).

By hierarchical dimension, one means a structuration based on two types of relations, i.e., a hierarchy of subsets and a series of attributions. Consider, for instance, the three-level hierarchy composed of superordinate, basic, and subordinate levels, holding in the case of the categories: *animal*, *dog*, *German shepard* (Rosch, 1978).

Studies (Barrett & Diniz, 1989, for a review) show that individuals with Down syndrome tend to represent the meaning of a number of noun categories relying on lexical prototypes. They gradually extend their lexical categories to include other items on the basis of similarity with the prototypes. The closer the new item with the prototype, the faster it can be identified as belonging to the same category (Tager-Flusberg, 1986). Individuals with Down syndrome do develop the notions of superordinate and subordinate relationships but with important delays (Barrett & Diniz, 1989). The basic level is always dominant. Items at this level are learnt, memorized, recognized, and recalled more reliably and more rapidly. The knowledge of items at nonbasic levels is less advanced and remains unstable (Tager-Flusberg, 1986).

Grammar

Relational or thematic semantic structures are the building blocks for grammatical development (Rondal, 2006). Children with Down syndrome are delayed in semantic development in proportion to their cognitive delay, as approached by MA measures.

Semantic Structural Development
When combining two and three words in the same utterance, children with Down syndrome appear to understand and express the same range of relational meanings or thematic roles and relations as reported in typical combinatorial language (Duchan & Erickson, 1976; Rondal, 1978; Coggins, 1979; Layton & Sharifi, 1979). Examples of early thematic relations are: notice or existence; denial or disappearance; recurrence, attribution (qualitative or quantitative); possession; location; agent; patient; instrument; source; agent—action; action—patient; agent—action—patient.

In spite of noticeable delays, children with Down syndrome develop the typical semantic basis for combinatorial language functioning. Further delays in grammatical development are due to particular difficulties with the morphosyntactical dimensions of the language.

Morphosyntactic Development
Morphosyntactic development is difficult and rarely complete in persons with Down syndrome. Progress is obvious, however, with increased CA. It is reflected in the

progressive lengthening of the utterances as indexed by mean length of utterance (MLU). MLU data in spontaneous speech (free conversation) reveal an increase in group mean values from MLU slightly beyond 1.00 around 4 years CA to close to 3.00 around 9 years, 3.50 around 11 years, and close to 6 in early adulthood. The slowness and limitation of MLU development correspond to shortcomings in basic morphosyntax. However, word order in those languages that rely on sequential devices to express basic semantic structuring is usually correct.

Phrases are the building blocks of sentences. They are formed of particular lexemes disposed around a phrase head. The major phrases in the English language are nominal, verbal, and prepositional. Noun phrases have a noun or a pronoun as syntactic head. Preceding or following the head noun, one may have one or several modifiers (articles, qualifiers, quantifiers, classifiers, deictics, or one or even entire propositions; for example, in *the little house that the doggie inhabits*). Verb phrases are formed by a conjugated verb, as head of phrase, followed by one or several noun phrases (*Mummy cooks the meal*). Prepositional phrases are composed of a preposition (head) followed by a noun phrase. Reductions in the composition of the phrases in children with Down syndrome is due to a restriction in combinatorial ability, itself attributable to limitation in short-term memory and mental working spaces, and difficulties in mastering grammatical classes (articles, prepositions, pronouns, modals, auxiliaries, copula, and conjunctions).

Morphological inflexions in verbs and auxiliaries are slow to learn and tend to remain unstable in persons with Down syndrome. These markings are concerned with number and person of the grammatical subject of the verb and the temporal (present, past, future) and aspectual dimension of the action/event related (in process, finished with no bearing on the present situation or not, imaginary or real). These forms are less salient in the speech flow and they carry less semantic weight than content words. Persons with Down syndrome have difficulties in planning and controlling the execution of multidimensional tasks such as complex language production (dealing simultaneously with communication intent, semantic content, pragmatic realities, lexical selection, morphosyntactic marking, and speech regulations). As a consequence, they regularly leave out those components judged to be less important for concentrating on more important content ones.

Sentences are formed by combining phrases sequentially. Delays in phrase development will automatically impinge on sentence formation. Basic types of monopropositional simple declarative affirmative actives sentences are as follows:
- Simple transitives (for example, *The dog chases the cat*);
- Simple intransitives (*The dog barks*);
- More complex transitive structures (*The dog chases the cat in the yard*);
- More complex intransitive structures (*The dog barks in the yard*);
- Simple attributives (*The dog is big*);
- Transitive or intransitive structures modified by an adverb (*The man drives his car fast*).

Children and adolescents with Down syndrome experiment limitations in the comprehension and even more in the production of the more advanced sentential structures. They lag behind MA-matched controls. Younger typically developing children tend to decode reversible passive sentences as actives *(The blue car is followed by the red car* means *The blue car follows the red car)*. The same trend is observed in children and adolescents with Down syndrome (Rondal, 1995). Actional passives (i.e., passive sentences constructed around action verbs, e.g. *push, carry)* as opposed to mental or experience verbs *(imagine, like, see,* etc.), which are facilitative for typically developing children (Rondal et al., 1990), have no such an effect in children with Down syndrome for whom formal complexity blocks the otherwise facilitating semantic effect.

Pragmatics

Although formally reduced, the language of individuals with Down syndrome is not devoid of communicative value. Conversational topics are dealt with to allow for the necessary continuity in the exchange between interlocutors. Language content is informative and new information is exchanged. Owings et al. (1981) illustrate the capacity of adults with moderate and severe intellectual disability (including persons with Down syndrome) to take part in conversation with other persons in dyadic or triadic contexts. In experimental settings, young adults with Down syndrome prove able to judge topic maintenance correctly. They exhibit similar types of conversational controls as typically developed adults. Abbeduto and Rosenberg (1992) and Rosenberg and Abbeduto (1993) have examined the communicative competence of moderately to mildly adults with intellectual disability, including adults with Down syndrome. Their conversational turn-taking is functional. They are able to recognize the illocutionary acts requiring a response from the interlocutor from those that do not. The exchange of information is active. Children with Down syndrome already make use of a variety of illocutionary devices in relating verbally to their mothers, as shown in the data gathered by Rondal (1978) in free-play interactions. Research by Leifer and Lewis (1984) and Scherer and Owings (1984) also demonstrate nontrivial conversational capacities in responding to verbal requests by children with Down syndrome around 5 years CA. A number of studies (Abbeduto & Keller-Bell, 2003, for a review) have found that children with Down syndrome use language to express the same speech acts and at the same relative rates as do younger typically developing children at corresponding levels of cognitive development. There are some limitations, however. Persons with intellectual disability tend to express fewer indirect speech acts (Abbeduto & Rosenberg, 1992). They formulate fewer clarification requests in comparison with typically developed MA-matched subjects (Abbeduto et al., 1991). Abilities such as understanding or guessing the interlocutor's communication intent, requesting information, clarification, confirmation, or a specific action, establishing, maintaining and/or switching the referent of talk, evaluating self- and other-understanding of language, are related to the conceptual side of language implying a close relationship with cognitive development. This means that there will be difficulties in developing the more advanced pragmatic functions on the top of the formal limitations mentioned before. Additionally, there may be some shortcomings in "reading" other people's minds (as an advanced component of

a "theory of mind"; Rondal & Quiros Ramirez, 2007) that have not been systematically studied in persons with Down syndrome.

Discourse

Reilly et al. (1991) have compared MA-matched adolescents with Williams syndrome (a congenital condition of moderate and mild intellectual disability etiologically linked to the hemizygotic absence of a dozen of genes on chromosome 7) and Down syndrome in a story-telling task. The subjects were introduced to a wordless picture book and asked to construct a story from the pictures as they progressed page by page through the book. In contrast with adolescents with Down syndrome, the adolescents with Williams syndrome told coherent and complex narratives making extensive use of affective prosody. They enriched the referential contents of their stories with narrative, affective and social cognitive devices (e.g., mental verbs, emphatic and intensifier forms, negative markers, causal connectors as well as onomatopoeic forms).

A study by Chapman et al. (1991) confirms the particular difficulty of children and adolescents with Down syndrome in online story processing. In such contexts, these subjects no longer demonstrate the fast-mapping ability with novel words which they currently exhibit in simpler event contexts. In story contexts, subjects with Down syndrome encounter additional difficulties in processing the narrative structure and in memory for story gist generally. These difficulties interfere with inferring the likely referent of the novel words preventing the fast-mapping production forms observed in event contexts to occur.

More generally, however, Chapman et al. (1992) report significant increases in the narratives of older adolescents with Down syndrome (CAs between 16 and 20 years) in comparison with children with Down syndrome and younger adolescents aged 5 to 16 years. Chapman (1995) suggests that these data contradict the hypothesis of a critical period in language development of MR children which would terminate around puberty or before. As discussed below, contemporary views of the critical period hypothesis are modular and restrict the temporal constraints to the computational aspects of language development. The discursive dimension is not specifically concerned with the grammatical structure of language (Halliday, 1985). It relates to the network of relationships between clauses and/or paragraphs allowing for textual cohesion. It may be expected that at least some adolescents and adults with Down syndrome can continue progressing on this aspect as well as on other cognitive aspects of the language system given correct opportunities and stimulation.

The Critical Period Problem

The question whether there exists a critical or a sensible period for first language acquisition has practical relevance for children with intellectual disability and Down syndrome given that they usually fail to complete the typical developmental course by the end of childhood. The notion of a critical period for first language development was initially proposed by Lenneberg (1967). Outside the field of intellectual disability, series

of data (Curtis, 1989; Mayberry et al., 1983; Ploog, 1984; Newport, 1992) support a milder and slightly diverse form of critical period hypothesis. It is limited to two language components, phonology and morphosyntax, with different temporal definitions (the phonological critical period being shorter than the morphosyntactic one). These periods relate to temporal evolution in the optimal brain ability to implicitly extract regularities regarding distributional features of language.

Lenneberg et al. (1964) reported data supporting the hypothesis of a 'freeze' in language acquisition in Down syndrome after roughly 14 years. Sixty-one individuals with Down syndrome aged CA 3-22 years at the beginning of their study were followed over a three-year period. Those who had attained puberty failed to make further progress in language structures. This was in contrast to younger subjects for whom some growth was observed. However, judging from the unclear report of Lenneberg et al. (1964) on this point, it seems that only 4 subjects were beyond CA 14 years when tested, too limited a sample for allowing a safe generalization.

We have recorded the spontaneous speech of 24 French-speaking adolescents with intellectual disability of mixed aetiologies in dyadic conversational interaction with a an adult without disability (Rondal et al., 1980). Mean MLU for the 16 subjects whose ages were between 14 and 18 years was 5.52. Mean MLU for the subjects aged 12-14 years was 5.15, not significantly different from the older group. None of the other language measures yielded a significant difference between younger and older subjects (type-token ratio; proportion of correct articles; proportion of correct verbal inflections; proportion of sentence; sentence complexity; proportion of information; or proportion of new information).

Fowler (1988) has supplied conversational MLU data from a group of adolescents with Down syndrome (aged 12-19 years). She split her group between subjects with lower Stanford- Binet IQs (38-48) and higher IQs (55-64). Mean MLU in words plus grammatical morphemes reached 3.58 in the lower and 3.78 in the higher IQ group (with marked individual differences in the two groups). These MLU figures may be compared to the middle age group (7-12 years) also studied by Fowler (1988). Corresponding MLU data for this group were 2.56 in the lower IQ and 4.03 in the higher group. Corresponding results were obtained by Fowler (1988) with a second measure, the Index of Productive Syntax, awarding points for the occurrence in the speech sample of 56 kinds of morphological and syntactic forms. In another study, Fowler et al. (1994) reported no further modification in MLU over a 2 to 4 years following initial measurement in four adolescents with Down syndrome (mean CA 12 years and 7 months at the beginning of the study). MLU remained in the range 3-3.50 words plus grammatical morphemes.

Regarding speech, Buckley and Sacks (1987) have reported that over half of the adolescent girls and about 80 per cent of the adolescent boys in their survey were rated by their parents as unintelligible to strangers. Intelligibility in adolescents with Down syndrome does not seem to have changed much from the reports of Lenneberg (1967), Ryan (1975) and Rondal (1978). Bray and Woolnough (1988) confirm that intelligibility

of speech is a serious problem in many children and adolescents with Down syndrome, even for those displaying a more advanced syntax.

Van Borsel (1988) undertook a comprehensive analysis of the elicited speech of five Dutch-speaking girls with Down syndrome (CAs from 16 to 20 years), including a phonetic, a substitution, and a phonological process inventory. All Dutch phonemes occurred in the corpus of each subject, except the low-frequency loan-phonemes /ß/ and /Ω/. Results indicate that the speech errors of the adolescents with Down syndrome are for the greater part identical to the error patterns observed in younger typically developing children.

Observations regarding several aspects of the language of French-speaking children, adolescents, and adults with Down syndrome can be found in Comblain's doctoral work (1994) at the Laboratory for Psycholinguistics of the University of Liège. (see also Rondal & Comblain, 1996). She proposed a series of randomized language tasks to 11 children with Down syndrome (8 girls and 3 boys), aged 7 to 13 years, 16 adolescents (9 girls and 7 boys), aged 14 to 21 years, and 15 adults (9 females and 6 males), aged 24 to 42 years. All subjects had standard trisomy 21. The MLU values reported for the children and adolescents groups are consistent with those of Rondal et al. (1980), Fowler (1988), and Fowler et al. (1994), suggesting no change in productive morphosyntactic ability from late adolescence to early adult ages.

Chapman et al. (1998) have reported contradictory results from cohorts of individuals with Down syndrome aged between 5 and 20 years. MLU increased with CA throughout the age range in both conversational and narrative language samples. MLU increases were larger in narrative than in conversational context, most notably after age 16, although the individual variability became also larger at this point. Chapman et al.'s data may be particular in the sense that their 12-16 aged-group scored relatively low with comparison to the younger one (as well as to comparable age-group samples in Fowler's 1988 study, mentioned before, and even with regard to the MLU data reported by Rondal, 1978, for his English-speaking children around 12 years of age), which made appears the MLU difference between the older group (16-20 years) and the younger one in Chapman et al.'s data more important than it might have been otherwise.

Thordadottir et al. (2002) also claim that syntactic development in individuals with Down syndrome continues in late adolescence. They report that in narrative languages samples, both older children and adolescents with Down syndrome and a group of typically developing children matched on MLU, use conjoined and subordinate sentence forms (ten percent of the time). It is interesting to observe that some subjects with Down syndrome sometimes use complex syntactic forms to a limited extent. However, it is hard to see why the authors have interpreted their data as contradicting previous conclusions regarding the critical period question given that these data concern solely the adolescent years.

There is no clear indication of a continued progress in phonological and morphosyntactic aspects of language beyond mid-adolescence (earlier for the

phonological aspects) in Down syndrome. There may be some continued progress, at least in some individuals, regarding other aspects of language, for example, lexical, pragmatical, and communicative abilities (Zetlin & Sabsay, 1980; Owings et al., 1981; Berry et al., 1984; Abbeduto et al., 1991), yet to be investigated more thoroughly.

Interindividual Variability

Many, but not all, individuals with a given syndrome demonstrate the characteristic behaviours of the syndrome. Nor will each individual show the typical behaviours to the same extent. Some within-syndrome variability exists in every syndrome of intellectual disability studied so far (Hodapp & Dykens, 2004). Regarding physical outcomes, for example, although many professionals consider epicanthal folds as the hallmark facial characteristics of persons with Down syndrome, at least during infancy, only around 60 per cent of infants with Down syndrome exhibit those characteristics (Pueschel, 1995). The same is true regarding the domains of behavioural and cognitive development.

The reasons behind within-syndrome variability are undoubtedly complex. Some have to do with the probabilistic nature of the genetic effects. Genetics is better conceptualized as predisposing a person to have one or another aetiology-related neurobehavioural trait expressed to a certain extent in her/his phenotype. Essentially, genes provide the starting point of complex multidirectional epigenetic pathways. The interactions between genotype and environmental events from the time of conception on determine the spans of individual variation. Behavioural phenotypes can also change at different chronological age. Often relative strengths become stronger with age and weaknesses weaker. Cascade effects may be operating in such ways that early propensities lead to greater personal and other people's interest; greater interest and time spent performing these activities lead to increased skills. In this perspective, family background variables have not been studied sufficiently, although they are considered customarily to have a role in the individual differences between people with Down syndrome and other syndromes of intellectual disability.

Some individual differences in language development may be particularly striking. Studies have been published of individuals with Down syndrome demonstrating atypical language abilities, i.e, abilities beyond those currently observed in the syndrome (Rondal, 1995; Rondal & Edwards, 1997). As discussed in Rondal (2003, 2009), the major determinants of morphosyntactic and phonological differences between atypical and typical individuals with Down syndrome operate at brain level. There may exist significant within syndrome variability in some brain areas of the persons with Down syndrome devoted to language, consequent upon genetic variations. Of importance, is the observation that language-exceptional individuals with Down syndrome are atypical only with respect to the phonological and morphosyntactic aspects of language, which is consistent with a modular conception of basic language organization (Rondal, 2006, 2009).

Language Ageing

Physically and biochemically some earlier aging processes appear to be at work in persons with Down syndrome (Franceschi, 1998; Van Buggenhout et al., 2001). This is independent of the susceptibility in roughly 20 percent of these persons to develop an Alzheimer-like degenerative brain pathology (Rondal et al., 2003). Fenner et al. (1987) have reported a decline in mental age in less than one-third of their total sample (n=39) of persons with Down syndrome between 20 and 49 years and in just over one-third of the subjects older than 35 years. Ribes and Sanny (2000) have documented a lowering in short-term and longer-term memory capacity, vocabulary of use, and expressive as well receptive language abilities, in adults with Down syndrome. According to their data, there is already a slight decline in the cognitive and language aspects evaluated between 20 and 40 years. However, a more marked decline takes place beyond 40 years. Along a similar line, Moss et al. (2000) have reported an inverse relation between age increase and several aspects of auditory linguistic comprehension in a cohort of participants with Down syndrome aged between 32 and 65 years. Correspondingly, Prasher (1996) has documented an age-associated decline in short-term memory, speech, practical skills, general level of activity and interest, in 20% of the persons with Down syndrome aged 50 to 71 years.

Other research works are less definitive. Little to no change in nonverbal reasoning, memory, language (receptive and expressive vocabulary), planning and attention, perceptual-motor and adaptive skills, until close to sixty years, is suggested in a study by Das et al. (1995). The same authors remark, however, that their older persons with Down syndrome (those over sixty years) showed a poorer performance than those in younger groups, on tasks requiring attention and planning. George et al. (2001) 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. 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 (using an adaptation of the Child Rivermead Behavioral Memory Test; Wilson et al., 1991); visual perception, visuo-spatial functions, executive functions, reasoning (evaluated with the K-ABC, Kaufman & Kaufman, 1993), and attention]. 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 of study. Comparing that part of the above language data obtained with the use of the receptive subtests of the Batterie pour l'Evaluation de la Morpho-Syntaxe (Comblain, 1995) with corresponding data reported by Comblain (1994, 1996) from her study of adolescents (mean CA: 16 years and 7 months) and younger 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], Rondal and Comblain (2002) argued that no marked change takes place in the receptive

morphosyntactic abilities of persons with Down syndrome in the interval of time between late adolescence and roughly fifty years of age.

Other longitudinal studies have contributed observations allowing the same conclusion. Devenny et al. (1992) and Burt et al. (1995) did not observe significant changes in the cognitive functioning of individuals with Down syndrome 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 et al. (1996) reported only four cases of cognitive involution in 91 subjects with Down syndrome followed for several years beyond the age of fifty years.

Bilingual Ability

A question asked more and more often by parents and other people concerned with individuals with Down syndrome, is whether it is reasonable, or advisable and effective to expose children with Down syndrome to developmental contexts and learning situations involving two languages. There is anecdotal evidence (Buckley, 1999, and Rondal, 2003b, for reviews) suggesting that a number of children and adults with Down syndrome may exhibit some degree of bilingual competence. Some of these children and adults are able to understand and to speak two, sometimes three languages. The usual problem with anecdotal data is that their validity and reliability are difficult to establish. One case of language-exceptional individual with Down syndrome has been documented by Vallar and Papagno (1993). FF, an Italian girl of 23 years at the time of the study, with standard trisomy 21, exhibited a good acquisition of Italian (her maternal tongue) and to a lesser degree of English and French vocabularies and expressive morphosyntax. She showed correct articulation in the three languages. It would seem then that learning foreign languages are within the capacities of at least some children with Down syndrome.

Recent group data and analyses by Kay-Raining Bird and associates (Kay-Raining Bird, 2006; Kay-Raining Bird et al., 2005; Feltmate & Kay-Raining Bird, 2008) confirm this indication with contrasted group data and systematic psycholinguistic analyses of children with Down syndrome raised bilingually (English and one other language either French or Cree - a native American language). The results provide evidence of a similar profile of language abilities in bilingual as has been documented for monolingual children with Down syndrome. There appears to be no evidence of a detrimental effect of bilingualism on the competence in English on any of the language components, including syntax and inflexional morphology. Nonetheless there is considerable diversity in the second-language abilities demonstrated by individual children with Down syndrome. It would appear that these children have the same (but unfortunately limited ability) to develop second-language competence as typically developing children. The clinical implications therefore are the same as for first – and only – language acquisition.

Conclusions

Thanks to the large number of research work conducted over the last fifty years or so, we now dispose of a rich data base regarding the language of persons with Down syndrome across the lifespan. Specific information is still needed regarding prelinguistic development, particularly the first weeks and months of life, if only to establish whether the sensitivity usually exhibited by typically developing babies towards the prosodic and distributional aspects of their language input is also be found in infants with Down syndrome. Data are partially insufficient concerning the later adult and aging years. On the whole, nowhere do we find indications of deviant patterns and mechanisms. Wherever analyzed in sufficient detail, the language of persons with Down syndrome demonstrates quantitative differences, significant delays, and incompleteness, particularly regarding more the complex aspects, but no qualitative difference in the sense of developmental steps or processes unknown in so-called normal development.
This basic normality of language development in Down syndrome, leaving aside the purely temporal and quantitative characteristics, has important consequences which have not been analyzed in depth in this paper but are worthwhile acknowledging such as the validity of using developmental data from language acquisition in typically developing children in order to evaluate progress and assess the efficiency of the remediation procedures used with individuals with Down syndrome.

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