Abstract

To investigate the relationship between language acquisition and cognition, we evaluated linguistic abilities in 12 Italian-speaking children with Williams syndrome (WS) and 12 with Down syndrome (DS) of comparable global cognitive level. Another control group included 12 typically developing (TD) children, matched for mental age. Linguistic measures included a parent questionnaire to assess vocabulary, a verbal comprehension test, a sentence repetition test and MLU calculated on spontaneous production. No dissociation was evident between lexical and cognitive abilities, but specific morphosyntactic difficulties emerged both in comprehension and production in children with DS. Individuals with WS, albeit less compromised than DS, also had difficulty in the phrase repetition task and, particularly, using content words. Our results demonstrate that the linguistic abilities of infants with WS are not above their cognitive level and that language development in these special populations is not only delayed, but follows a different developmental trajectory.

Keywords: Infancy; Linguistic development; Cognition; Mental retardation

1. Introduction

A key issue in developmental neuropsychology concerns the relationship between language acquisition and cognition. Namely, it is still an open question whether language development proceeds together with other cognitive capacities or whether language is an “independent” function, unrelated to other cognitive domains. New insights on this topic have been provided by studies of language acquisition in special populations and, particularly, in those populations with uneven cognitive-linguistic profiles. This is one of the reasons why cognitive neuroscientists have recently shown a great deal of interest in a genetic developmental disorder—Williams syndrome (WS). This is a rare syndrome (the incidence is estimated to be 1 in 25,000 live births) as[7,18,20]. Children with WS usually present a number of severe medical anomalies including mental retardation with a specific cognitive profile. Indeed, some aspects of language and face recognition seem relatively spared, whereas visual-spatial processing, but not all visual processing, numbering, planning, and procedural learning are more severely impaired[1,4,43]. Many researchers have considered this uneven pattern of cognitive and linguistic abilities as empirical evidence for the existence of specialised and separate cognitive modules (e.g.[33]), some of which are impaired and others preserved. Unfortunately, despite early reports which claimed that WS language is relatively normal, a series of more recent studies have demonstrated that children with WS have a complex neuropsychological profile with atypical development not only in the cognitive but also in the linguistic domain[22,23,46–49]. Indeed, although adolescents and young adults with WS exhibit good lexical and phonological abilities, their performance is usually at their mental age level and below what would be predicted on the basis of their chronological age[46]. Furthermore, difficulties in semantic processing[37,47] and slight impairment in the use of morphosyntactic rules[22,23] have been extensively documented.

Clahsen and Almazen[12,13] presented evidence for a modular account of the linguistic skills of individuals with WS. In particular, they argued that children and adolescents...
with WS perform excellently on regular past tense and regular plural inflection, but their scores on the irregular forms are lower than those of unimpaired mental age matched controls. More interestingly, as Clahsen and Temple claimed [14], children with WS appear “to use regular rules of inflection excessively, even in circumstances in which unimpaired children (and adults) would not use them”.

The hypothesised dissociation between language and non-verbal cognition seems to emerge most clearly when the performance of children with WS is compared with that of children with Down syndrome (DS) on the same verbal and non-verbal tasks. Comparative studies of adolescents with these two syndromes showed that children with WS are significantly more competent in terms of lexical abilities and semantic fluency, morphological abilities, and also narrative abilities [3,5,34,50]. However, more recent studies reported partially different results. A study by Klein and Mervis [25] showed that receptive lexical abilities are equivalent for 9- to 10-year-old children when the two syndromes are matched for chronological and mental age. Another study involving a large number of children with WS and DS in the early stages of language development [39] found that both syndrome groups are substantially and equally delayed in the onset of language. However, children with WS displayed a significant advantage over children with DS in the early stages of grammar. Finally, a study by Mervis and Robinson [28] on groups of very young children with DS and WS, carefully matched for chronological age, confirmed that both syndromes evidence a language delay. But, in contrast with some of the results reported by Singer Harris et al. [39], an expressive advantage in children with WS relative to children with DS was apparent even at 2 years and 2 months of age.

All these findings seem to suggest that the neuropsychological characteristics of the two syndromes develop differently along distinct trajectories. As Paterson, Brown, Goodl, Johnson and Karmiloff-Smith argued, linguistic and cognitive skills in adolescents are not predictable on the basis of the pattern exhibited at younger ages and, consequently, researchers “…cannot rely on phenotypic outcomes to make generalisations about impaired or intact modules in the initial state” [32]. The language development of children with DS appears consistent with this theoretical framework. Despite rare exceptions [31,35,41], adolescents and young adults with DS usually exhibit very poor linguistic capacities. Their spontaneous language is telegraphic with a greatly reduced use of function words such as articles, prepositions, pronouns, etc. [10,19,36]. Verbal comprehension, also, usually lags behind their level of cognitive development even though it appears better preserved than their language production [29,30]. In contrast with this generalised and catastrophic pattern in older children, the early linguistic development of infants with DS presents some surprises, with a much less even pattern. In a recent paper, Vicari, Caselli and Tonucci [44] explored the acquisition of language in children with DS in comparison with typically developing (TD) infants of the same mental age (around 30 months). At this developmental stage, no differences were found between the two groups in lexical production and no dissociation was evident between lexical and cognitive abilities in either group; however, specific morphosyntactic difficulties emerged both in comprehension and production for DS.

Data on language acquisition in DS suggest the presence of a developmental trajectory that cannot be predicted on the basis of the final phenotypic outcome, raising questions about the innateness and/or autonomy of cognitive and linguistic modules. Thus, knowing more about cognitive and linguistic profiles in infancy is crucial from a theoretical perspective, and it is also important for clinical practice and the design of adequate rehabilitative programs.

It must still be determined whether the linguistic pattern exhibited by children with DS is specific to this population, or a non-specific effect of cognitive delay. Data from other special populations, such as WS, and the direct comparison of these two syndromes in the early stages of development may help to answer this question.

The goal of the present study was to gather more detailed data on language acquisition in Italian-speaking children with WS, in children with DS of comparable global cognitive level, i.e. matched for chronological and mental age, and in TD children matched for mental age. Particularly, we wished to investigate whether infants with WS are as proficient in language processing during infancy as they are reported to be in adolescent and adult life. Another aim of this study was to compare language acquisition in infants with DS and infants with WS at comparable cognitive levels, to replicate and extend our previous results [44]. We attempted to demonstrate that the contrasting linguistic profiles of these two syndromes (assuming that contrasts are found) are not a straightforward by-product of mental retardation. Finally, we considered the performances of TD children to determine whether the linguistic abilities of infants with WS are above their cognitive level and whether language development in special populations is delayed, but follows the same stages and modes generally observed in TD children, or whether it is deviant, that is, follows different developmental trajectories.

2. Materials and methods

2.1. Participants

The sample consisted of 12 children with WS, matched on the basis of mental age to a group of 12 children with DS and to a group of 12 TD children. Mental age was established using the non-verbal Leiter intelligence performance scale [26]. Since four children with DS were unable to solve the items of the Leiter scale, their global cognitive level was established using the Brunet and Lézine scale [8]. As a consequence, their control subjects, both WS and TD children, were administered the same developmental scale.
The questionnaire was completed by the parents while the child was being tested in the laboratory or, for the purposes of assessing their child's language production and a section on grammar production. The three groups of children were given the same tests. For evaluation purposes, the children with WS and DS were examined in the hospital on two occasions within approximately a 1-week period. The TD controls were examined individually at school. All the observations were videotaped and subsequently transcribed and analysed after informed consent was obtained from the families. The chronological and mental age in months for all children (including means and S.E. within each group) are reported in Table 1.

### Table 1

<table>
<thead>
<tr>
<th>Groups</th>
<th>Chronological age</th>
<th>Mental age</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS children (N = 12)</td>
<td>58.2 (22.4)</td>
<td>34 (14.8)</td>
<td>7</td>
</tr>
<tr>
<td>DS children (N = 12)</td>
<td>67.2 (9.9)</td>
<td>52.2 (5.4)</td>
<td>6</td>
</tr>
<tr>
<td>TD children (N = 12)</td>
<td>29.7 (5.5)</td>
<td>30 (4.9)</td>
<td>7</td>
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2.2. Instruments

A short description of the instruments used to determine linguistic development is reported below. The linguistic tasks and measures were already used in a previous study and are available elsewhere [44].

#### 2.2.1. *Il Primo Vocabolario del Bambino (PVB)*

The Italian version of the MacArthur Communicative Development Inventory [9] was used. The words and phrases form used for this study consists of a section on vocabulary production and a section on grammar production. The parents of the children included in the sample were asked to fill out the questionnaire and were told that the aim was to collect detailed information about their child's language development. Particularly, on the vocabulary list the parents were asked to cross off the words their child produced in spontaneous conversation. On the sub-scale referring to grammatical complexity, for each pair of phrases the parents were asked to choose the one closest to the kinds of expressions spontaneously used by their child.

The questionnaire was completed by the parents while their children were being tested in the laboratory or, for the TD controls, at school. They were asked to examine how the questionnaire was organised and to begin filling it out. Any questions or clarifications could be addressed to the person collecting the completed questionnaire. All parents willingly participated in the data collection, showing interest in the instrument that, as they often said, made them observe their child more carefully and become more aware of his/her real abilities. All questionnaires were checked to make sure the parents had filled them out correctly and completely, and were then coded to determine the lexical abilities of the children examined.

For the purpose of scoring, the total number of words marked by the parents as produced by the child were summed. In addition the types of sentences produced were scored.

#### 2.2.2. **Verbal comprehension test (VCT)**

This test was adapted from Miller by Chilosi, Pfanner and Cipriani [11]. It explores children’s ability to understand increasingly complex phrases. Namely, the child was asked to perform a requested action correctly. The requests included the following: performing motor and verbal routines, pointing to some parts of the body, performing the requested actions by choosing the correct toy lying on the table in front of them.

Children were given one point for each item they answered correctly by performing the requested action.

#### 2.2.3. **Phrase repetition test (PRT)**

A phrase repetition test [16] is designed to ascertain children’s ability to imitate verbal stimuli, particularly their morphological and syntactic aspects. All the words used in the test are high frequency words, based on the data reported by Caselli and Casadio [9]. The test includes a set of 51 cards plus 3 training cards. Each card depicts the meaning of each noun and the overall meaning of each utterance. The test was presented to each child individually as a game, introduced as follows: “Now let’s play a game together: I will say something and you say the same thing”. If the child did not respond to the first presentation of the stimulus phrase, it was repeated a second time, with the figure in view.

The evaluation consisted of the total number of phrases repeated correctly out of the total number of phrases repeated.

#### 2.2.4. **Mean length of utterance in words (MLU-w)**

Samples of spontaneous production (about 20 min per child) were collected and videotaped. In order to compute the mean length of the utterance in words (MLU-w), the spontaneous conversation of each child, corresponding to 50 utterances, was orthographically transcribed. Whenever production was insufficient to provide such a large number of utterances, all of the utterances actually produced were transcribed.

An utterance was defined as a sequence of words preceded or followed by silence (pause) or by a conversational turn [15,38]. In many studies on children’s speech, characterised by poor fluency, a quantitative criterion is also introduced,
that is, elements separated by pauses of less than 2s are considered part of the same utterance [17,42]. For each child, all the elements present in the utterances produced were summed and the mean length of the utterances was calculated (that is, the ratio between the sum of all the elements and the number of utterances produced).

3. Results

3.1. Primo Vocabolario del Bambino

The mean number of word types reported by children with WS, DS and TD controls is presented in Fig. 1. Normal children produced an average of 488 different words (S.D. = 116.4), while children with WS and DS produced an average of 452 (S.D. = 157.3) and 457 (S.D. = 125.4) different words, respectively. An ANOVA was performed treating group as the independent variable and the number of different words produced as the dependent variable. There was no significant difference between the three groups of children (F(2, 33) = 0.25). It is worth noting the range of individual variability in the groups. This is typical in the early stages of language development. Therefore, since there were no differences in lexical abilities among children with WS, DS and their TD controls, we have no evidence here for a dissociation between lexical development and non-linguistic cognition.

Differences emerged when the performances of the three groups were considered in the part of the questionnaire referring to grammatical complexity (Fig. 2a and b). This part consists of 37 pairs of phrases. Each phrase is presented in two versions: the first without any function words (telegraphic style) and/or lacking any predicate and/or necessary argument (incomplete phrase), the second is morphosyntactically complete (for example: (a) Medicine no! (b) I don’t want any medicine).

The three groups of children, with equivalent vocabularies, differed in the type of sentences used. An ANOVA performed with group as the independent variable and the number of simple/telegraphic sentences produced as the dependent variable showed a significant difference between the three groups of children (F(2, 31) = 4.7). Planned comparisons revealed that, on average, children with DS used more simple and telegraphic sentences (M = 14.9, S.D. = 11.8) than TD controls (M = 3.2, S.D. = 3.5). Children with WS used a smaller number of telegraphic sentences than children with DS but a higher number than TD controls (M = 7.6, S.D. = 9.7). Although no statistical difference emerged between WS and TD control groups (F(2, 31) = 1.36), a comparison between WS and DS children approached significance (F(2, 31) = 3.7, P = 0.06). Similar results were obtained by analysing the number of complete sentences produced by the three groups (F(2, 33) = 5.37, P < 0.05) (Fig. 2b). TD children produced more complete sentences (M = 28.8, S.D. = 8.1) than children with WS (M = 21.9, S.D. = 13.4) and with DS (M = 13.1, S.D. = 10.4). Once again, the comparison between DS children and TD controls was statistically significant (F(1, 30) = 10.6, P < 0.01), while the DS versus WS comparison only approached significance (F(1, 30) = 3.7, P = 0.06) and the WS versus TD controls’ comparison was not significant (F(1, 30) = 2.1).

3.2. Verbal comprehension test

Each group’s performance on this test is shown in Fig. 3. They were analysed by an ANOVA in which group was treated as the independent variable and the number of correct responses and actions as the dependent variable (F(2, 33)=14, P < 0.05).

Children with DS scored lower (M = 29.9, S.D. = 4.7) than TD controls (M = 33.7, S.D. = 1.6) and children with WS (M = 31.9, S.D. = 2.4). Nevertheless, planned comparisons revealed that only the comparison between DS
Fig. 2. (a) Mean number of simple sentences produced by children with WS and DS and TD controls. (b) Mean number of complex sentences produced by children with WS, DS and TD controls.

Fig. 3. Mean number of words comprehended by children with WS, DS and TD controls.
and TD controls groups was significant ($F(1,33) = 8.3, P < 0.01$), while comparisons between DS and WS groups ($F(1,33) = 2.35$) and between WS and TD controls groups ($F(1,33) = 1.8$) failed to reach significance.

### 3.3. Phrase repetition test

In Fig. 4 we report the mean number of correctly repeated sentences expressed as percentage of the total number of repeated sentences by each group. An ANOVA on the phrase repetition results showed a significant difference among groups ($F(2,33) = 6.7, P < 0.01$). Children with DS repeated a smaller number of phrases more accurately ($M = 23.6, S.D. = 18.6$) than the TD controls group ($M = 57.1, S.D. = 19.9$), and a planned comparison revealed this difference to be statistically significant ($F(1,33) = 11.05, P < 0.01$). Also, children with DS repeated a significantly smaller number of phrases than children with WS ($M = 54.01, S.D. = 32.8$) ($F(1,33) = 9.1, P < 0.01$). Finally, no significant difference was found when WS and TD controls groups ($F(1,33) = 0.9$) were compared.

We then analysed the sentence production data in more detail. Namely, we looked at the percentage of articles, nouns, verbs, modifiers and prepositions present in the test and correctly reproduced by the three groups (Fig. 5).

An ANOVA with group as the independent variable and the percentage of lexical items reproduced as the dependent variable indicated that group was a significant factor ($F(1,33) = 6, P < 0.01$). Post-hoc comparison (least significant difference —LSD test) confirmed the significant difference between DS and TD controls ($P < 0.01$) and between DS and WS ($P < 0.05$). No differences were found between WS and TD controls groups. Item type was also significant ($F(1,33) = 12.3, P < 0.0001$), suggesting that some lexical items are reproduced more often than others. In fact, post-hoc comparison (LSD test) showed that, in general, articles and prepositions were more frequently omitted than nouns, verbs and modifiers.
Finally, the groups × items interaction was also significant \( F(1, 33) = 2.6, P < 0.05 \), indicating the three groups had different performance profiles in reproducing the different lexical items. To qualify this interaction, a post-hoc comparison (LSD test) was performed. Results showed that for all five categories considered, the children with DS always reproduced fewer lexical items than the TD controls and fewer lexical items than children with WS \((P \text{ always } <0.001)\). In contrast, a different profile was observed in the WS group compared with the TD controls: although children with WS reproduced a lower percentage of nouns \((P < 0.01)\), verbs \((P < 0.001)\) and modifiers \((P < 0.001)\), no difference was detected between the two groups in reproducing articles and prepositions.

### 3.4. Mean length of utterance in words

Computation of the mean length of utterances in the three groups showed that children with WS have a significantly longer length in their spontaneous production \((M = 3.1, \text{S.D.} = 0.8)\) than children with DS \((M = 2.4, \text{S.D.} = 0.5)\) \((F(1, 31) = 6.4, P < 0.05)\). TD controls \((M = 2.9, \text{S.D.} = 0.7)\) did not differ statistically from WS \((F(1, 31) = 0.7)\) or from DS individuals \((F(1, 31) = 2.5)\).

### 3.5. Relations between grammar and vocabulary size

In this study, children with WS and DS and the TD controls did not differ significantly in lexical measures. However, the three groups have different performance profiles on measures of grammar, with DS children obtaining the lowest scores. The grammar measures that revealed group differences included the following: the complexity section of the PVB, a measure of mean length of utterance based on laboratory observations, and a measure of correctly repeated sentences on the repetition test, TRF. These findings suggest there may be a dissociation between lexical and grammatical development in WS and DS populations.

On the other hand, several studies of TD children showed a strong correlation between grammar and lexical growth (see [2] for a review). Vicari et al. [44] observed a significant correlation in children with DS between vocabulary size and sentence complexity on the PVB \((r = 0.75, P < 0.001)\), the laboratory measure of mean length of utterance in words \((r = 0.51, P < 0.05)\), and the percentage of correctly repeated sentences on the TRF \((r = 0.62, P < 0.01)\). To verify this result and to extend this observation also to the Italian WS population, we performed the same type of analyses. Significant correlations were observed between vocabulary size and sentence complexity on the PVB both in children with DS \((r = 0.80, P < 0.01)\) and with WS \((r = 0.92, P < 0.001)\). Significant correlations were also found between vocabulary size and the laboratory measure of mean length of utterance in words \((DS, r = 0.49, P < 0.05; WS, r = 0.85, P < 0.001)\), and the percentage of correctly repeated sentences on the TRF \((DS, r = 0.72, P < 0.01; WS, r = 0.84, P < 0.001)\).

In other words, grammar and vocabulary are still correlated in the DS and WS populations, even though DS children have a significant disadvantage in grammar compared with WS children and TD controls, matched for mental age. This result suggests that grammar is not independent from lexical development even in special populations.

### 4. Discussion

In the present study, we investigated linguistic abilities in young Italian children with WS and DS matched for chronological and mental age. Language in these two groups was also compared with that of TD children matched for mental age. The aims were to determine whether individuals with WS are as proficient in language processing during infancy as they are reported to be at later stages of development, and also to compare language acquisition in infants with DS and WS at comparable cognitive levels. Furthermore, we were interested in determining whether language development in special populations is merely delayed, in comparison with the developmental stages followed by TD children, or whether it follows a different trajectory.

The results of our study can be summarised as follows: the expressive vocabulary size of the three groups, as reported in the PVB, is very similar and corresponds to the mean number of words reported for the Italian normative sample on the PVB for 30-month-old toddlers \((M = 446, \text{S.D.} = 168)\) [9]. This finding contrasts with a recent report by Mervis and Robinson [28]. These authors used the English version of the CDI words and sentences for 24 children with WS and 28 children with DS (mean chronological age of both groups was 30 months). In that study, children with WS exhibited a significantly larger vocabulary than children with DS. The discrepancy between their findings and ours may be explained by differences in the age range examined and in the methodology used for recruitment. Our children were more than 2 years older than the children examined by Mervis and Robinson. Also, these authors matched their participants only on the basis of chronological age, while ours were matched for both mental and chronological age. This is an important methodological difference. Indeed, looking only at chronological age, IQ differences among individuals can be missed and an advantage in lexical production may simply reflect higher global cognitive capacities.

Considering the mean chronological age of the participants, our results seem more comparable to those reported by Singer Harris et al. [39]. In their study, no significant differences were found in vocabulary size for children with DS and WS when it was corrected for a ceiling effect, that is, when children who produced more than 600 words (considered the ceiling for the CDI) were excluded.

Data on sentence production from parental reports also revealed interesting findings: children with DS were reported...
to produce a significantly higher proportion of telegraphic and incomplete sentences than children with typical development. Similar findings were reported in Singer Harris et al. [39], and confirmed in a recent Italian study of 15 children with DS using the PVB [44]. Children with DS were also reported to produce more telegraphic sentences than individuals with WS, although this comparison only approached significance ($P = 0.06$). In contrast, no difference was found comparing the children with WS and the TD controls.

Examination of the phrase repetition test as well as mean length of utterance further confirmed the difficulties of children with DS in the morphosyntactic aspects of language. Indeed, data on the phrase repetition test showed that children with DS produced far fewer complete sentences (proportionally) than WS children with the same mental age and vocabulary size. In turn, WS individuals did not differ from TD children in the number or proportion of complete repetitions. Similarly, in spontaneous production, children with DS used significantly shorter utterances than children with WS.

It is worth noting that in the phrase repetition test the performance profile of children with WS and DS is quite different. Indeed, individuals with DS reproduced fewer items than TD controls in all lexical categories considered: articles, nouns, verbs, modifiers and prepositions. In contrast, WS and TD children differed only in the percentage of nouns, verbs and modifiers correctly reproduced but not in the percentage of articles and prepositions. In other words, the children with DS displayed a generalised problem in reproducing all of the lexical items considered, including function words, reflecting both semantic and morphological impairment. This feature is more evident in the repetition task, which requires more memory and attentional resources, than in the PVB which, in turn, is based on observations in spontaneous interaction [9]. On the other hand, in the phrase repetition task the children with WS had difficulty only with the “content words” but not with the free morphological elements. We interpret this result as a consequence of the lexical-semantic difficulty often exhibited by individuals with WS [45,46]. The relatively preserved ability to reproduce aspects of free-standing morphology may be related to the good competencies of these subjects in processing auditory stimuli. Indeed, it is well known that auditory processing capacities are highly involved in the mastery of function words, as reflected in the performance of neurologically intact individuals with normal intelligence but serious auditory deficits [47].

There seems to be a partial discrepancy between the present results and those reported by other studies on Italian children and on English-speaking children with WS [37,47]. These studies reported that children with WS have particular difficulty with prepositions. The present analysis was made only on correctly repeated elements. Thus, a more qualitative analysis is needed to investigate whether other differences emerge in the type of errors produced in sentences with prepositions. The TD control children, as well as the children with DS, tended to omit free-standing morphemes (e.g. articles and prepositions), while the children with WS tended to produce substitutions of these elements rarely observed in other groups of children. A qualitative analysis of the errors produced in repetition data by a subgroup of the children with WS described here seems to reveal such a trend [48].

In addition to the grammatical deficit already described for production in children with DS, morphosyntactic problems in comprehension were also observed at a very early age. In fact, the verbal comprehension test showed that the children with DS had greater problems in understanding simple sentences than the TD and WS children. Once again, no difference emerged between WS and TD controls.

Our results may be compatible with the modular account provided by Clahsen and Almazen [12,13], who argued that the computational, rules based system for language is selectively spared in WS while lexical representations and/or their access procedures are impaired. However, Clahsen and Almazen’s theoretical interpretation assumes a clear dissociation between lexical and morphosyntactic performance also at an early age.

In order to explore this hypothesis, we investigated whether grammatical development and lexical ability were or were not dissociated in our special populations by examining the correlations among morphosyntactic capacities, sentences and vocabulary size in the DS and WS groups, respectively. Consistent with a previous report [46], we found a robust correlation between grammatical and lexical performance in the DS sample. A similar correlation also appeared in the WS group, confirming findings reported by Stojanovik, Perkins and Howard [40]. Although children with intellectual disabilities, especially those with DS, may have a grammatical disadvantage compared with TD children at the same mental age and vocabulary size, we cannot conclude that grammar is dissociated from other aspects of language in these special populations.

To summarise so far, the results reported in the present study confirm and extend previous findings with older children and adolescents with DS and with WS [21–23,27,29,37,46,47]. Particularly, in children with DS they confirm an apparent dissociation between mental age and morphosyntactic abilities and, in the area of linguistic skills, a different developmental relationship between morphosyntactic and lexical capacities [44]. Our results also documented that language is not ahead of mental age in the Williams population in this early age range, in line with a revised view of WS already suggested by previous studies [21,27,46]. The apparently spared linguistic abilities of children with WS may be, at least in part, an artefact of comparisons made with individuals with DS, whose morphosyntactic production abilities are usually very poor, below their non-verbal mental age. Children with WS do not speak like their normally developing peers at the same chronological age and they have an expressive lexical repertoire and use sentences like younger normally developing children with a comparable level of non-verbal abilities [21,23,46,49]. The pattern of results we reported here underscores the value of direct
comparisons of linguistic production in matched samples of children with WS and DS, as well as younger normally developing children.

The theoretical importance of prospective studies on genetic disorders, tracing language development from its earliest manifestations, may lie in what they reveal about how different cognitive and perceptual capacities affect the process of language development, which is a different issue than the independence of different domains of the brain [6,24,32]. Language problems and the relationships among linguistic subdomains seem to vary over time as a function of subjects’ developmental level, the characteristics of the language they are learning and individual differences in the rate and nature of this learning process. For example, in children with DS the discrepancy between lexical and morphosyntactic abilities, evident in the early stages of development, may gradually decrease with age, leading to a pattern of residual deficits in both domains [29]. Similarly, the linguistic skills of individuals with WS are usually reported to be particularly sophisticated in adolescence, while the linguistic capacities of very young children are described as poor and consistently delayed [28].

Such findings argue for a dynamic approach to intellectual disorders and for change in cognitive and linguistic profiles over time. In other words, dissociation in linguistic and cognitive functioning in children with intellectual disabilities does not necessarily support the hypothesis that cognitive modules are innately specified in infancy. On the contrary, cognitive and linguistic modular organisation may be, as Paterson et al. [32] claimed, “...the product of a development trajectory (in both normal and atypical cases), not its starting point”.

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