The linguistic profile of Down’s syndrome subjects: evidence from wh-movement construction*
Marina Tsakiridou
129173@soas.ac.uk

Abstract
This study investigates the performance of Greek adolescents with Down’s syndrome (DS) on the production of referential and non-referential wh-questions and compares it to the performance of typically developing children (TDC). DS individuals showed low level of correct performance on all tested structures whereas TDC performed at ceiling. Error analysis indicated that DS adolescents and typically developing children produced different types of errors. Based on the above results, I suggest that Down’s syndrome subjects show a very deviant pattern of performance compared to typical development and therefore the findings support the difference hypothesis of language development.

1 Introduction
During the past two decades, rigorous research activity can be observed among psycholinguists, neuropsychologists, linguists and scholars of related disciplines (cognitive psychologists, neurobiologists, speech-pathologists) on developmental disorders. Developmental disorders are often considered to be those that show no evidence that a skill was previously mastered and has been lost (Temple, 1997). In particular, a number of studies focuses on the linguistic performance of atypical populations that exhibit asymmetries between linguistic and other cognitive abilities such as Specific Language Impairment (Leonard, 2000; Levy & Schaeffer, 2003; Stavrakaki, 2002a,b, 2001; van der Lely, 2003), Williams syndrome and Down’s syndrome (Chapman et al., 1991, 1998; Clahsen & Temple 2003; Ring & Clahsen, 2003; Laws & Bishop, 2003; Perovic, 2001; Rondal, 1993; Stavrakaki, 2004a, b). This paper focuses on the linguistic abilities of adolescents with Down’s syndrome and in particular on the production of wh-questions.

2 Characterising Down’s syndrome
Down’s Syndrome is a congenital disorder caused by an extra copy of a segment of Chromosome 21 that is associated with specific physical features and cognitive delay (Rondal, 1993: 165). There are three subtypes of chromosome anomaly in Down’s syndrome. First type is the ‘standard trisomy 21’ that is the presence of three chromosomes 21 instead of two in all body cells. This type accounts for approximately 95% of cases. Second type is the ‘translocations’. This type is identical to regular trisomy 21 in terms of the spread of extra chromosomal material in the body cells but not in terms of the casual mechanisms involved and accounts for 4% of cases. The third type is ‘mosaicisms’ in which certain types of cells contain the extra chromosome but the remainder have the normal number of chromosomes. This type accounts for 1% of cases (Rondal, 1993: 166). Mosaic form is known to give rise to less severe cognitive and possibly linguistic impairments (Perovic, 2001: 432).

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The severity of the deficit varies considerably across individuals. Research evidence indicates (Chapman, 1995; Fowler, 1990; Perovic, 2001; Rondal, 1993) that Down’s syndrome individuals exhibit different degrees of cognitive and linguistic abilities. However, there is a consensus among researchers (ibid.) that although Down’s syndrome individuals experience many difficulties with both language and cognition, linguistic development falls significantly behind cognitive development.

2.1 The cognitive and linguistic profile of Down’s syndrome individuals

Despite, the heterogeneity observed in Down’s syndrome population, research evidence indicates (Chapman, 1995; Chapman et al., 1991; Chapman et al., 1998; Facon, et. al. 1998; Fowler, 1990, 1998; Perovic, 2001; Rondal, 1993) that Down’s Syndrome individuals experience common difficulties in the cognitive domain. Their cognitive profile is characterised by short attention span, slow reaction time; deficiency in auditory-vocal processing, limitation of short-term memory, reduced perceptual discrimination and generalisation capability; deficiency of symbolisation facility; inherent inability to adopt an abstract attitude (Marcell & Weeks 1998; Rondal, 1993)

Special attention has been given to the linguistic abilities of Down’s syndrome individuals. Again, given the heterogeneity of this population, the linguistic limitations that Down’s syndrome individuals encounter can be grouped into five categories: phonetics and phonology, lexicon, semantic structures, morhpo-syntax and pragmatics (Rondal, 1993: 168).

In phonetics and phonology individuals with Down’s syndrome encounter problems with speech production and in particular with the production of specific sounds such as fricatives. Also, they make errors with phonological features, phonological feature changes, cluster reductions and phoneme assimilation. The lexicon is reduced but correctly used and understood. With regards to semantic structures, children with Down’s syndrome appear to express a wide range of relational meanings as those reported in studies of typical language acquisition. Examples of semantic relations expressed are ‘notice or existence’, ‘disappearance’, ‘recurrence’, ‘attribution’, ‘possession’, ‘location’, ‘agent-action’, ‘action-patient’, ‘agent-action-patient’.

With regards to morpho-syntax, the population with Down’s syndrome use short telegraphic utterances with limited morpho-syntactical elaboration. The utterances are characterised by inconsistent use and widespread omission of grammatical morphemes such as articles, auxiliaries, copulas, pronouns, conjunctions, prepositions, verbal and nominal inflection (Chapman et al. 1998; Fowler, 1990; Rondal, 1993). Finally, pragmatics has been reported to be relatively less impaired. Down’s syndrome language is informative and they use the major illocutionary types of sentences such as declaratives, imperatives, questions (Rondal, 1993:171).

3 Theoretical background: The nature of the linguistic deficit in Down’s Syndrome (DS)

A pertinent question in developmental language disorders and in particular in the Down’s Syndrome literature is whether language development is delayed but normal or whether it is truly different from language development in intact individuals. There are two major theoretical approaches in current literature on Down’s syndrome; the delay hypothesis (Quantitative Variation) (Bridges & Smith, 1984; Brophy et al., 2003) and the difference hypothesis (Qualitative Variation) (Chapman,1995; Fowler,
The linguistic profile of Down’s syndrome subjects

The delay hypothesis posulates that language development in individuals with DS passes through the same stages as those observed in Typically Developing children, the only difference being that it takes more time, thus pointing out that the differences observed in the two populations are a matter of quantitative variation. According to the difference hypothesis, language development in individuals with DS does not go through the same stages as those observed in Typically Developing children, thus concluding that the differences observed between the two populations are a matter of qualitative variation. Linguistic research on Down’s syndrome indicates that there is no consensus on the nature of the linguistic deficit.

3.1 The delay hypothesis

Bridges and Smith (1984), conducted a series of experiments with children with DS to investigate their syntactic comprehension. In particular, they run tests on comprehension of active and passive sentences in 24 children with DS using act-out tasks. The subjects were required to act out all the events described by 16 test sentences. The sentences comprised eight active/passive pairs (e.g. the girl washed the boy/the girl gets washed by the boy; the man kicks the cow; the man gets kicked by the cow). They compared the findings with that of 24 typically developing children. Bridges and Smith (ibid.) reported no differences with Typically Developing Children (TDC). The results were taken as support for the proposition that the processes underlying language comprehension in children with DS are fundamentally the same as those of TDC.

Brophy et al. (2003), conducted experiments of comprehension of active and passive constructions in 8 high-functioning individuals with DS using act-out tasks and true-value judgement tasks. They also tested the comprehension of wh-questions and in particular the sensitivity to A- and A’- dependencies of subjects with DS, using a story comprehension task. In particular, Brophy et al. (ibid.) based on the analysis that island constraints characterise movement to A’-position (Complimentizer Phrase), they tested the block on movement of a question word from within a temporal adjunct clause as shown in the example below:

*Who did Sue ask Bill before he met?*

According to Brophy et al. (2003) the results of both tests support the delayed-but-normal view of language development for subjects with DS.

3.2 The difference hypothesis

Perovic (2001) tested the comprehension of reflexives and pronouns in 4 English-speaking subjects with DS. Perovic (ibid.433) included four experimental conditions: a) name-reflexive, for example ‘Is Snow White washing herself?’ b) name-pronoun, for example ‘Is Snow White washing her?’ c) quantifier-reflexive, for example ‘Is every bear washing himself?’ and d) quantifier-pronoun, for example ‘Is every bear washing him?’. The subjects with Down’s syndrome performed at ceiling on all conditions involving pronouns (100%) and below chance on at least one condition involving reflexives, revealing a systematic misinterpretation of the later constructions. According to Perovic (ibid.) subjects had specific difficulties assigning appropriate interpretation to reflexives, that according to standard Binding Theory reflexives are governed by Principle A. On the contrary, subjects with Down’s syndrome had no difficulties in sentences with pronouns that are governed by...
Principle B in the same framework. Those findings led her to propose a specific syntactic deficit in the language of DS, related to the inability to establish a certain syntactic dependency, meaning the binding relation between an anaphor and its antecedent. Hence, her findings support the difference hypothesis.

Ring and Clahsen (2003), conducted a series of experiments on the comprehension of pronouns and reflexives and the comprehension of active and passive sentences in 8 subjects with DS and 10 subjects with William’s syndrome (WS). In particular, they used the sentence-picture matching task TAPS (van der Lely, 1996) and examined four conditions a) active transitive (The girl mends the teddy), b) full verbal passive (The teddy is mended by the girl), c) short progressive passive (The teddy is being mended), d) ambiguous (stative or eventive ) passive (The teddy is mended) (Ring and Clahsen, 2003: 6). Also, Ring and Clahsen (ibid. :7) tested syntactic binding using the sentence-picture judgment task STOP (van der Lely & Stollwerck, 1997), and presented the subjects with four kinds of experimental sentences in a match and a mismatch condition: a) Name-pronoun (Is Mowgli tickling him?), b) Quantifier-pronoun (Is every monkey tickling him?), c) Name-reflexive (Is Mowgli tickling himself?), Quantifier-reflexive (Is every monkey tickling himself?).

Ring and Clahsen (2003) reported that subjects with DS encountered difficulties in interpreting passives and sentences with reflexive pronouns, whereas subjects with WS did not. Also, they reported that subjects with DS gave more accurate interpretations in active sentences and sentences with non-reflexive pronouns (principle B). Based on those findings, Ring and Clahsen (ibid.) proposed that subjects with DS have a difficulty in the formation of local syntactic dependencies. In particular they proposed an impairment in A-chain formation. Also, they suggested that according to their findings, the linguistic difficulties with syntactic binding and passivisation that individuals with DS encountered, do not appear to result from their low levels of cognitive development because they were different from subjects with WS. Should the above linguistic difficulties with binding and passivisation in DS be attributed to low levels of cognitive development then subjects with WS would encounter the same difficulties and this is not the case.

Given the preceding research evidence that has examined the DS subjects performance on the formation of A-chains the research question of this study poses the question of what is the linguistic performance of DS subjects in the formation of A’-chains. This study investigates the performance of 4 Greek speaking adolescents with DS on the production of referential and non-referential wh-questions and compares it to the performance of typically developing children (TDC). Before moving on the analysis of the experimental design, I present the syntactic properties of the test constructions; the structure of Greek Wh-questions.

4 The structure of Wh-questions in Greek
Subject & Object Wh-questions are complex syntactic structures that require two kinds of movement. First we have a Wh-operator movement. This entails an overt raising of a Wh-operator to a clause initial position, thus creating an A’-chain with the wh-operator in Spec-CP binding a variable in the base position (Browning 1987; Chomsky, 1986). Second we have a V-to-C movement. This movement is obligatory in Greek and follows from the assumption that interrogatives have an abstract Q morpheme, which occupies the C position (Chomsky, 1991) and has the effect of attracting the verb to C obligatorily (Tsimpili, 1990).
Following are two examples of the formation of subject and object wh-questions in Greek:

- **Subject questions**

  *Pios filise ti Mary?*
  Who-nom kiss-3s-past the-Mary-acc
  Who kissed Mary?

- **Object questions**

  *Pion filise I Mary?*
  Who-acc kiss-3s-past the-Mary-nom
  Who did Mary kiss?

Although in both subject and object questions the lexical verbs move to C only in object wh-questions this movement results in OVS word order whereas the word order in subject questions remains SVO, as shown in the examples above. Furthermore, it should be pointed out that in Greek wh-pronouns and NPs are case marked overtly (Holton et al. 1997; Philippaki-Warburton 1985, 1989; Philippaki-Warburton & Spyropoulos 1999).

5 The experiment

5.1 The Subjects

4 Greek speaking adolescents with Down’s syndrome participated in this study. Table 1 shows their chronological age and mental age. DS adolescent’s mental age was calculated on the basis of the Greek version of WISC-III test (Georgas et al. 1997).

*Table 1: The profile of subjects with Down syndrome*

<table>
<thead>
<tr>
<th></th>
<th>Chronological Age</th>
<th>Mental Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>DS2</td>
<td>28</td>
<td>7</td>
</tr>
<tr>
<td>DS3</td>
<td>27</td>
<td>7.5</td>
</tr>
<tr>
<td>DS4</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>25.7 (3.86)</td>
<td>7.3 (0.47)</td>
</tr>
</tbody>
</table>

5.2 The experimental material

**Test structures**

4 types of wh-questions were tested: referential subject questions, referential object questions, non-referential subject and non-referential object questions. Examples of the test material are presented below:

- **Referential Subject Question**

  *Pios gorilas hitipise ton elefanta?*
  who-gorila-nom hit-3s the-elephant-acc
Which gorilla hit the elephant?

♦ Referential Object Question
   
   *Pion gorila kinigise o rinokeros?*
   
   who-gorila-acc chased-3s the-rhino-nom
   Which gorilla did the rhino chase?

♦ Non-Referential Subject Questions

   *Pios kinigise ton elefanta?*
   
   who-nom chased-3s the-elephant-acc
   Who chased the elephant?

♦ Non-Referential Object Questions

   *Pion filise o ipopotamos?*
   
   who-acc-kissed-3s-the-hippo-nom
   Who did the hippo kiss?

Procedure

To elicit wh-questions, games were designed in which the adolescent asked a puppet a question about a scenario acted out with toys (Thornton, 1990, 1996; Crain & Thornton, 1998). Six exemplars for each question type were tested giving a total of 24 responses per subject. Each subject was tested individually at a table or sitting on the floor (depending on the preference of the adolescent) in a quiet room in the adolescent’s school. Before the task began, a collection of animal toys representing the 11 referents (dog, tiger lion, giraffe, rhino, gorilla, elephant, bear, hippo, zebra, dear) was placed in front of the subject with DS and the subject was asked to point to the animal toys as the experimenter named them. The ones that were confusing for the subject were not included in the experiment (e.g. a panda that was mixed up with a bear, a Dalmatian dog that was mixed up with the zebra). The subject was then told that there is a puppet (which was shown to the adolescent) that comes from another country and does not understand Greek very well. The subject was asked to name the puppet as s/he wished. The subject was told that the experimenter was going to act out a story with the animals and the subject had to ask a question to the puppet to assess the puppet’s understanding. To test whether the subject understood the task, a practice story was acted out, and the subject was encouraged to ask a wh-question to the puppet. Most of the subjects grasped the requirements of the task. Two of the subjects failed to meet this criterion and subsequently were excluded from this study. After the introductory part of the experiment was completed, the 24 stories were acted out in front of each subject. The entire testing session took approximately 45 to 60 minutes to administer per adolescent. All testing sessions have been tape-recorded.

For which-NP questions there were three animals, of which two were identical. In what follows there is a sample story of which-NP question. The experimenter proceeds as follows:

Se aftin tin istoria einai dio skiloi ki ena liontari. Paizoun ena paihnidi kai o enas apo tous skilous kinigai to liontari pou prospathei na kriftei pisw apo ena thamno. Se aftin tin istoria, o enas apo tous skilous kinigise to liontari. Rwtise tin koukla pios?

   • Target response: Pios skilos kinigise to liontari?
In this story there are two dogs and a lion. They are playing a game and one of the dogs is chasing the lion that is trying to hide behind a bush. In this story one of the dogs chased the lion. Ask the puppet which one?

- Target response: Which dog chased the lion?

For the elicitation of who-questions, three different animals were used in each story. Consider the who-question sample story below.

Se aftin tin istoria einai enas rinokeros, enas elefantas kai mia kamilopardali. Oloi kanoun diakopes se ena para poli zesto meros. O elefantas zostenete poli kai zitai apo tin kamilopardali na tou ferei ena potiri nero. I kamilopardali fernei nero ston elefantas, o opoios einai toso haroumenos mou agializei tin kamilopardali. Se aftin tin istoria o elefantas agialiase tin kamilopardali. Rwtise tin koukla pion?

- Target response: Pion agialiase o elefantas?

In this story there is a rhino, an elephant and a giraffe. They are all having holidays in a very hot place. The elephant feels very hot and asks the giraffe to bring him a glass of water. The giraffe brings the water to the elephant that is so happy he hugs the giraffe. In this story the elephant hugged the giraffe. Ask the puppet whom?

- Target response: Who did the elephant hug?

### Results

The individual and overall correct performance (%) of subjects with Down’s syndrome on all types of wh-questions is presented in Table 1 and illustrated in chart 1 and chart 2 below:

#### Table 1: Overall and Individual correct performance on the production of wh-questions (N=6)

<table>
<thead>
<tr>
<th>Subjects</th>
<th>MA</th>
<th>Subject wh-questions</th>
<th>Object wh-questions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Which-S</td>
<td>Who-S</td>
</tr>
<tr>
<td>DS1</td>
<td>7</td>
<td>2 (33.33%)</td>
<td>0</td>
</tr>
<tr>
<td>DS2</td>
<td>7</td>
<td>3 (50%)</td>
<td>1 (16.66%)</td>
</tr>
<tr>
<td>DS3</td>
<td>7.5</td>
<td>5 (83.33%)</td>
<td>2 (33.33%)</td>
</tr>
<tr>
<td>DS4</td>
<td>8</td>
<td>5 (83.33%)</td>
<td>4 (66.66%)</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>7 (29.16%)</td>
<td>5 (20.83%)</td>
</tr>
</tbody>
</table>
As can be seen in the chart 1, DS subjects performed significantly low in all four structures tested. The correct performance on which-S questions were 62.5%, on who-S questions 29.16%, on which-O questions 20.83% and on Who-O questions 16.66%. As can be seen the DS subjects performance drops significantly on who-subject, which and who-object questions. This pattern of performance indicates severe problems with producing wh-questions. The individual correct performance of subjects with DS can be seen in chart 2.

In chart 2, it can be seen that DS1 performed 33.33% correct in which-S questions and 16.66% in which-O questions and failed to produce any correct responses in who-S and who-O questions. DS2 produced 50% correct responses on which-S questions and 16.66% on who-S questions and failed to produce any correct responses on which-O and who-O questions. DS3 produced 83.33% correct responses on which-S questions, 33.33% correct responses on who-S questions and failed to produce any correct responses on which-O and who-O questions. DS4 produced 83.33% correct responses.
on which-S questions and 66.66% on who-S, which-O and who-O questions respectively. Of all four subjects only DS4 managed to produce correct responses on who-O questions. Referring to table 1, DS4 is the subject with the highest mental age (8).

Error Analysis
A detailed error analysis was performed in the data. It should be noted that DS subjects produced many and different error types in the same utterance. For example observe the following response:

- Case error, Gap filling (resumptive NP), gender error
  1a. *Pion xtipise to kamilopardali ton elefanta?
     Who-acc hit-3s the-giraffe-acc-neuter the-elephant-acc (DS response)

  1b. Pion elefanta htipise I kamilopardali?
     Who-acc elephant-acc kicked-3s the-giraffe-nom (Target Gr)
     Which elephant did the giraffe kick? (Target En)

In 1a, a case error, a gap filling error (resumptive NP) and a gender error can be observed in the same utterance.

Being more specific the main error types produced across the structures are classified in three categories: 1) A’-chain errors, problems with binding an empty category; 2) case errors, problems with checking operations and 3) various morphological errors. Down’s syndrome subjects produced semantic errors as well that were insignificant.

A’-chain errors
It has been already mentioned that the formation of wh-questions requires two kinds of movement. First requires a wh-operator movement and second requires a V-to-C movement. The wh-operator movement involves the overt raising of a wh-operator to a clause initial position, thus creating an A’-chain with the wh-operator in Spec-CP binding a variable in the base position (Chomsky, 1986; Radford, 2003). The clause initial position where the wh-operator lands is a non-argument position. Structural case must be assigned to the extraction-site and then transmitted by the trace along the chain to the wh-phrase. The moved wh-operator leaves behind a trace at its extraction site and it binds its trace from the A’-position. Although the extraction site on the surface is empty, on the under face it is not, because it is occupied by the trace left behind by the moved wh-operator. Therefore, if this Gap is filled the sentence is ungrammatical.

Down’s syndrome subjects produced A’-chain errors revealing problems with binding an empty category. To overcome this difficulty and finally form a wh-question, DS subjects used two strategies. First, they filled the Gap by inserting an NP and second they filled the Gap by not moving the NP in which-O questions. In any case, it is evident from the data that Down’s syndrome subjects could not tolerate the Gaps. Examples 2 and 3 show the A’-chain errors.
**Example 2: DS subjects’ strategy: Gap filling by NP insertion:**

2a. *Pios klotsise o skilos to gorilla?*
    Who-nom kicked-3s the-dog-nom the-gorilla-acc (DS response)

2b. *Pios klotsise [ ] to gorila?*
    Who-nom kicked-3s the-gorilla-acc (Target Gr)
    Who kicked the gorilla? (Target En)

As can be seen in 2a, DS subjects are inserting the NP the-dog-nom, where it should have been empty as in 2b. The NP the-dog-nom, is in fact the answer to the question the experimenter asks the subject.

**Example 3: DS subjects’ strategy: Gap filling by not moving the NP in which-object questions**

3a. *Pion htipise to kamilopardali ton elefanta?*
    Who-acc hit-3s the-giraffe-acc-neuter the-elephant-acc (DS response)

3b. *Pion elefanta htipise I kamilopardali?*
    Who-acc elephant-acc kicked-3s the-giraffe-nom (Target Gr)
    Which elephant did the giraffe kick? (Target En)

In 3a DS subjects are not moving the NP the-elephant-acc, thus again filling the Gap. The error in 3a indicates problem with operator movement, as shown by the split between the wh-pronoun and the NP.

**Case errors, problems with checking operations**

In Chomsky’s *checking theory*, words carry grammatical features, which have to be checked in the course of a derivation. For example, a nominative pronoun like *I* must have its nominative case checked, which means that it must occupy a nominative position (as the subject of the kind of constituent which allows a nominative subject, e.g. a finite auxiliary) at some point in the derivation. When a feature has been checked, it is erased if it is uninterpretable (i.e. if it is a purely formal feature with no semantic content). Any uninterpretable features which remain unchecked (and hence which have not been erased) at the level of logical form will cause the derivation to crash (i.e. to be ungrammatical) (Radford 2003: 497).

Example 4 and 5 below, show Case errors and the difficulties DS subjects had with checking operations.

4a. *Pion gorilla filise ton rinokero?*
    Who-acc gorilla-acc kissed-3s the-rhino-acc (DS response)

4b. *Pion gorilla filise o rinokeros?*
    Who-gorilla-acc kissed-3s the-rhino-nom (Target Gr)
    Which gorilla did the rhino kiss? (Target En)

5a. *Pion agaliase ton elefanta?*
    Who-acc hugged-3s the-elephant-acc (DS response)
5b. *Pion agaliase o elefantas?  
Who-acc hugged-3s the-elephant-nom (Target Gr)  
Who did the elephant hug? (Target En)

In 4a it is observed that DS subjects used the-rhino-accusative instead of the-rhino-nominative. In 5a DS subjects used the-elephant-accusative instead of the-elephant-nominative.

Morphological Errors (omission of determiners, tense errors, gender errors, case errors)  
DS subjects produced various Morphological Errors such as omission of determiners, tense errors, gender errors and case errors. An example is shown in 6 below:

Example 6: Morphological Case error + omission of determiners

6a. *Pio htipise elefanta?  
Who-unspec hit-3s-past [ ] elephant-unspec (DS response)

6b. *Pion htipise o elefantas?  
Who-acc hit-3s-past the-elephant-nom (Target Gr)  
Who did the elephant hit? (Target En)

In 6a both who and elephant are unspecified, rendering the sentence ungrammatical. Also, in 6a. the determiner has been omitted. In 6b it is observed that who is accusative and elephant is nominative case. These morphological case errors should be clearly differentiated from the case errors observed in the course of the derivation, and caused by problems in checking operations. In the morphological case errors the DS subjects leave the noun phrase and the wh-operator unspecified. Given the fact that in Greek case is overtly marked, this results in the morphological case errors.

Example 7: Tense error

7a. *Pios htipai to gorilla?  
Who-kick-3s-the-gorilla-acc (DS Response)

7b. Pios htipise to gorilla?  
Who-kick-3s-past the-gorilla-acc (Target Gr)  
Who kicked the gorilla? (Target En)

It can be observed that in 7a the Down’s syndrome subject used present tense, instead of past tense.

Other error types that were produced with a lower frequency
1. Non-referential instead of referential subject question. The DS subjects produced a who-subject question instead of a which-subject question as shown in example 8.

8a. *Pios kinigise to liontari?  
Who-nom chased the-lion-acc? (DS response)
2. Referential instead of non-referential subject question. The DS subjects produced a which-subject question instead of a who-subject question as shown in example 9.

9a. *Pios elefantas esprokse to rinokero?
   Which-elephant-nom pushed-3s the-rhino-acc? (DS response)

9b. Pios esprokse to rinilero?
   Who-nom pushed-3s the-rhino-acc? (Target Gr)
   Who pushed the rhino? (Target En)

3. Who-Subject question instead of which-Object question. The DS subjects turned a target which-object question into a who-subject question. In other words, apart from turning an object-question into a subject-question they converted a referential question into a non-referential one as shown in example 10.

10a. *Pios gorillas filise ton rhinokero?
   Who-gorillas-nom kissed-3s the-rhino-acc? (DS response)

10b. Pion gorilla filise o rhinoceros?
   Which-gorillas-acc kissed-3s the-rhino-nom? (Target Gr)
   Which monkey did the rhino kiss? (Target En)

Table 2: The main error types across the structures.

<table>
<thead>
<tr>
<th></th>
<th>Which-S</th>
<th>Who-S</th>
<th>Which-O</th>
<th>Who-O</th>
</tr>
</thead>
<tbody>
<tr>
<td>A’-chain errors</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Case errors</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Morphological Errors</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Table 2 above shows the main error types across the structures. It can be observed that case errors and morphological errors were produced in all four test structures. A’-chain errors are the main error type in who-subject, which-object, and who-object questions but not in which-subject questions. A possible explanation can be that in which-subject questions there is a referential noun phrase that gives semantic cues to the Down’s syndrome subjects.
Chart 3: Main error type (%) in Which-S questions out of total number of errors (N=9)

Chart 3 shows that the main error type produced by DS subjects in which-subject questions was the morphological errors that accounts for 88.88% (8) of all the errors produced (9) in which-subject questions. The remaining 11.12% (1) is the error of producing a non-referential instead of a referential subject question (see section other error types example 8).

A’-chain errors   Case errors

Chart 4: Main error types (%) in Who-S questions out of total number of errors (N=17)

Chart 4 shows that the main error types produced by DS subjects in Who-subject questions are A’-chain errors and Case errors. A’-chain errors account for 35.29% (6) and case errors account for 23.52% (4) out of the total number of errors (17) made in this test structure. The remaining type errors are tense errors that account for 5.8% (1), morphological errors (omission of determiner) that account for 17.64% (3), wrong
argument that accounts for 5.8% (1), and the production of referential wh-question instead of a non-referential one that accounts for 11.76% (2).

Chart 5: Main error types (%) in which-O questions out of total number of errors (N=19)

Case errors

Chart 5 shows that the main error type produced by DS subjects in Which-object questions is Case errors. Case errors account for 63.15% (12) of the total number of errors (19) produced in which-object questions. The remaining are the production of who-subject questions instead of which-object ones that accounts for 26.31% (5) and mixed errors that account for 10.52% (2).

Chart 6: Main error types (%) in Who-O questions out of total number of errors (N=20)

Case errors  Morphological Errors  A’-chain errors

Chart 6 shows that the main error types produced by DS subjects in Who-object questions are case errors, morphological errors and A’-chain errors. Case errors account for 30% (6) out of the total number of errors (20) produced in who-object
Conclusions on the Down’s syndrome performance

Given the preceding analysis, it is evident that Down’s syndrome performance is characterised by severe deficits in the production of wh-questions. Down’s syndrome subjects showed low level of correct performance on the production of all four tested structures, which-subject (62.5%), who-subject (29.16%), which-object (20.83%), and who-object (16.66%) questions.

The error analysis revealed first a complicated linguistic profile for subjects with DS. Down’s syndrome subjects produced many and different types of errors. Several times, multiple errors were found in the same utterance. The main error types produced were A’-chain errors (problems with binding an empty category), case errors (problems with checking operations) and morphological errors (omission of determiners, tense errors, gender errors, morphological care errors). Those errors accounted for most of the errors produced across all four structures apart from A’-chain errors which were not a main error in which-subject questions. Apart from those three main categories, other error types were produced with a lower frequency. Those were: a) Non-referential instead of referential subject question, b) Referential instead of non-referential subject question, c) Who-subject question instead of which-object question.

Second, the error analysis revealed high uniformity across subjects. The main errors produced were observed in the performance of all four DS subjects.

Third, the error types produced reflect the severe deficits that DS subjects have with their linguistic development.

6.1 Comparison of Down’s syndrome subjects and Normally Developing Greek Children

Down’s syndrome performance was compared to the typical pattern of development using data available in the literature. Stavrakaki (2001; 2004b) ran similar experiments on the production of wh-questions with 16 Typically Developing Children (TDC). Stavrakaki’s (ibid.: 302) results show that Greek children at the age of 4:4 (SD:0.73) have acquired wh-questions. Chart 7 below shows the correct performance (%) of TDC:
It is observed in the above chart that TDC performed on all four structures at ceiling. TDC children performed 100% (SD: 0) on the production of Who-S questions, 92.71% (SD: 12.13) on the production of Who-O questions, 91.67% (SD: 12.17%) on the production of Which-S questions, and 81.25% (SD: 19.13) on the production of Which-O questions. According to Stavrakaki (2004b:302), even the youngest children of the group aged 3;6 and 3;7 showed a high level of performance on the production of wh-questions, especially on the production of who-object ones.

Chart 8: presents the error types (%) produced by TDC out of the total number of responses (96 responses for each question type) (Stavrakaki, 2004b: 303).

As observed in the above chart Typically Developing Children (TDC) produced four error types. First, they omitted the NP in the wh-phrase. This error was observed in Which-S questions and accounted for 8.33% (8) of the errors and in Which-O questions where accounted for 15.626% (15) of the errors. Second TDC produced a Yes/No question instead of wh-question. This error was found in Which-O and Who-O questions and accounted for 3.125% (3) respectively. Third, TDC produced a Who-
S question, instead of Who-O questions. This error type was found only in Who-O questions and accounts for 2.083% (2) of the total errors. Finally, there were 2 TDC that gave no response when they were asked to produce a Who-O question. This accounts for 2.083% (2) of the total errors. Stavrakaki (2004b:303) reports that those two children when asked to produce a Who-O question answered ‘I do not know’ and ‘I do not remember’.

Having presented the correct performance of subjects with Down’s syndrome and typically developing children above, a comparative chart (9) is produced to better highlight the performances of the two populations.

Chart 9: Down’s syndrome Versus Typical Development: Correct performance (%).

Chart 9 presents the overall correct performance of typically developing children and Down’s syndrome subjects. In which-subject questions TDC’s correct performance was 91.67%, whereas DS subjects performance was 62.5%. In who-subject questions TDC’s correct performance was 100%, whereas DS subjects performance was 29.16%. In which-object questions, TDC’s correct performance was 81.25%, whereas DS subjects performance was 20.83%. Finally, in who-object questions TDC’s correct performance was 92.71%, whereas DS subjects performance was 16.66%.

The above results clearly indicate that subjects with Down’s syndrome performed significantly low compared to their typically developing counterparts. Typically developing children performed at ceiling on all tested structures whereas subjects with Down’s syndrome failed to do so.

7 General discussion

In this study I investigated the linguistic ability of Greek subjects with Down’s syndrome in producing wh-questions and compared the findings with those of typical development (Stavrakaki, 2001; 2004b). The aim was to shed light on the nature of the linguistic deficit in Down’s syndrome and to determine whether the performance of subjects with Down’s syndrome can be best described in terms of the delay or difference hypothesis.
The findings are striking. First, Down’s syndrome subjects encountered problems with the production of both subject and object wh-questions. This performance is highly atypical and has not been evidenced in the literature of neurodevelopmental disorders before. Research evidence (cf. SLI van der Lely & Batell 2003; Stavrakaki 2001, 2002a, 2004a, b) has confirmed asymmetries in the production of subject and object wh-questions in impaired populations. In particular, van der Lely & Batell (2003) conducted a study with fifteen Grammatical Specific Language Impaired (G-SLI) children and twenty-four younger children matched on language abilities. They investigated wh-movement by eliciting 36 questions balanced for subject and object questions and wh-words (who, which, what). The G-SLI subjects were significantly impaired in producing wh-questions, showing particular difficulties with object questions than subject questions in relation to the control children. Stavrakaki (2001, 2002a, 2004a, b) conducted a study with 8 Specific Language Impaired children and 16 normally developing children on the production of referential and non-referential wh-questions. Stavrakaki’s (ibid.) results also confirm that SLI children’s performance dropped significantly especially on object-wh questions compared to subject-wh questions. Therefore, the results of this study are of great significance as they point out to a deviant pattern of performance since subjects with Down’s syndrome performed significantly low in the production of both subject and object wh-questions.

Second, the detailed error analysis revealed quantitative and qualitative differences between the subjects with Down’s syndrome and the typically developing children. In other words, first typically developing children produced far more less errors than their Down’s syndrome counterparts (quantitative difference) and second the error types produced by Down’s syndrome subjects have not been attested in typical development (qualitative difference). In particular, the main error types produced by Down’s syndrome subjects were case errors (problems with checking operations), A’-chain errors (problems with binding an empty category) and many morphological errors (omission of determiners, tense errors, gender errors, case errors). These error types, as it has already been mentioned previously, indicate that the Down’s syndrome subjects have severe deficits with the production of wh-questions per se. Those error types reveal a particular deficit with the formation of wh-questions. On the contrary, the main error types produced by typically developing children were the omission of NP phrase in which-questions, the production of yes/no questions instead of wh-questions, and the production of who-subject questions instead of who-object questions. The few incorrect responses (see chart 8) that TDC children gave are mainly due to non-grammatical rather than to grammatical errors (Stavrakaki, 2004b: 305). Thus, the performance of TDC indicates that Greek children aged 4 have already acquired the syntactic processes required for the formation of wh-questions. Comparing the two sets of errors the data indicates that Down’s syndrome subjects performance shows a deviant pattern of development compared to their typically developing counterpart’s performance.

Third, I would like to discuss further the A’-chain errors (problems with binding an empty category), that was one of the main error types produced by subjects with Down’s syndrome. This type of error has major theoretical implications for determining the nature of the linguistic deficit of individuals with Down’s syndrome. As it has been analysed in detail before, the formation of wh-questions according to standard linguistic theory (Chomsky, 1986; Radford, 2003) requires the movement of the wh-operator to an initial SpecCP position. The moved wh-operator leaves behind a trace at its extraction site and it binds its trace from the A’-position. Although the
extraction site on the surface is empty, on the under face it is not, because it is occupied by the trace left behind by the moved wh-operator. Therefore, if this Gap is filled the sentence is ungrammatical. The error analysis revealed that Down’s syndrome subjects could not tolerate the Gap’s left behind by the wh-operator movement. It is therefore proposed that the wh-question is formed by inserting the wh-operator at the clause initial position and by not moving it from the extraction site. Consider the example 6 below:

**Example 6: A’-chain error**

6a. *Pios [klotsise o skilos to gorilla]?*
   Who-nom [kicked-3s the-dog-nom the-gorilla-acc] (DS response)

6b. **Pios klotsise to gorila?**
   Who-nom kicked-3s the-gorilla-acc (Target Gr)
   Who kicked the gorilla? (Target En)

In 6a it is observed in the Down’s syndrome response that in the brackets there is a V-S-O order, which is the basic word order for Greek (Alexiadou, 1999). This response (excluding the wh-operator) could be the correct answer to the target question ‘Who kicked the gorilla?’ In this vain, there is a base generated sentence and the wh-operator is being inserted at the clause initial position. Therefore, it could be argued that Down’s syndrome subjects formed the wh-question by insertion and not movement of the wh-operator.

Overall, given the preceding analysis, I have argued that the findings of this study suggest that subjects with Down’s syndrome show a very deviant pattern of performance compared to typical development. First the Down’s syndrome subjects performed significantly low in all test structures compared to typically developing children. Second, the errors attested in Down’s syndrome subjects performance are quantitatively and qualitatively different compared to the errors attested in their typically developing counterparts. Third, the detailed error analysis revealed that Down’s Syndrome subjects have severe deficits with the syntactic operations required for the formation of wh-questions. Fourth, it appears that Down’s syndrome subjects have developed their own strategies in the formation of wh-questions. Finally, all this evidence presented in this study is taken to support the ‘Difference hypothesis’ (cf. Ring & Clahsen 2003) according to which language development in individuals with Down’s syndrome does not go through the same stages as those observed in typically developing children.

**References**


