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Testing procedures to assess language competence among individuals with cerebral palsy

Tina Magnuson

Abstract

Many persons with congenital brain damage, such as cerebral palsy, do not suffer from mental retardation or other cognitive dysfunction. Nevertheless, in this group we find more individuals with reading and writing difficulties than average. These difficulties may or may not be related to poor underlying basic linguistic knowledge or be a consequence of the very handicap. In order to get a better understanding of these relationships the exploration and investigation of basic linguistic competence in individuals with cerebral palsy and reading and writing difficulties is of great importance. The aim of this study is to develop relevant testing procedures for this purpose. Standard test of language function together with material developed in the project will be used and their relevance will be evaluated.

Introduction

Many individuals with congenital brain damage, for example, cerebral palsy, have physical impairment accompanied by cognitive dysfunction. However, there is also a large group of individuals with cerebral palsy who do not show any evidence of a decreased cognitive level. Nevertheless, adult individuals with cerebral palsy show a higher incidence of reading and writing difficulties than do the rest of the population.

The reason for this can be discussed in many aspects. It may be due to fewer years of education or lower expectations from the environment and themselves. Reading and writing difficulties may also either be a specific consequence of the brain damage per se or a symptom among others caused by the brain damage. It is also possible to think of these reading and writing difficulties as not necessarily being related to any cognitive or intellectual disorders, in analogy with dyslexia (Høien & Lundberg, 1992). Thus may reading and writing difficulties among individuals with cerebral palsy sometimes be considered as an additional handicap.

Reading and writing difficulties may also be related to poor basic linguistic knowledge. We know that other stages of disturbances of brain functions give rise to linguistic dysfunctions (e.g. aphasia after stroke) and this may also be the case in persons with cerebral palsy. In that case, the linguistic problem would be a problem on its own and a separate impairment, a parallel disability due to the brain damage. Individuals with brain damage may have a specific language impairment, just like the children with specific language impairment (SLI). Language impairment may in other cases be a consequence of the dysfunction. Poor basic linguistic knowledge may be due to abnormal development during the phase in life when linguistic skills normally are developed. Depending on the presence and degree of dysarthria it may also be related to different language acquisition strategies due to inability to produce oral language during the prewriting stage (Bishop et al., 1990). Another plausible reason for poor basic linguistic knowledge may also, just like reading and writing difficulties later on, be related to low expectations from school and family. Consequently, just like the reasoning with reading and writing difficulties, linguistic dysfunction may be considered as an additional handicap, besides the more obvious physical dysfunction. Regardless of the reasons for this possible language deficiency, it must imply another additional handicap in being part of the “normal” society with “normal” expectations, including aspects like education and employment, if one does not fully master the linguistic code.

Reading and writing difficulties may be a consequence of the handicap or a consequence of the linguistic impairment or, like the linguistic impairment just discussed, a specific, parallel impairment due to the same brain damage. It is also possible that dyslexia is an additional, completely separate problem, i.e., that we find individuals with “pure” dyslexia in the group with motor dysfunction. Most individuals with dyslexia do not have other dysfunctions. The point we want to make here is that there are individuals with cerebral palsy
who are cognitively and intellectually normally functioning and at the same time have basic linguistic knowledge and/or literacy skills that do not meet with society’s demands and expectations for a cognitively non-disabled person. There are also individuals who may have an intellectual impairment but whose linguistic and/or literacy skills are still below their cognitive level. There is a gap between social and cognitive level on the one hand and linguistic and literacy skills on the other.

This paper has two purposes: To discuss very briefly the differences and relationship between the separate abilities mentioned above and to present the task of establishing a list of relevant methods to measure the aspects that are to be studied. Results from the pilot testing of linguistic abilities of two subjects will also be presented.

**Project background**

The testing of linguistic abilities in persons with language impairment is a part of a larger Swedish project where the main purpose is development and evaluation of writing support for persons with 1) motor dysfunction 2) dyslexia 3) a combination of both. The questions we asked in the evaluation part of this larger project were: Is it possible for individuals with motor dysfunction and reading and writing difficulties to benefit from writing support software in their text construction and spelling? Can we find evidence for improvement in the linguistic expression with aided writing and eventually even in unaided writing? Can writing support narrow the gap between social and cognitive level and linguistic and literacy skills?

This part of the study includes investigation of linguistic skills in persons with cp and no, or hardly any cognitive impairment The reason for testing and establishing a linguistic profile is at least threefold: to explore the relationship between linguistic ability and cognition; to explore the relationship between linguistic ability and literacy development; and to see how these conditions relate to a broader handicap, such as motor impairment as a consequence of cerebral palsy. Furthermore, thorough knowledge about the individuals’ linguistic competence and strategies may work as a base for aid selection, and a linguistic baseline is necessary in order to establish a point of reference for possible generalised improvement. This reason would be the primary rationale for testing in the evaluation part of the project.

**Method**

The first step in the process of establishing a reference point for improvement was to define the linguistic abilities that can be considered basic linguistic skills and relevant to reading and writing development, and to define parameters to investigate reading and writing skills. The next step was to put together a test battery that would correspond to the defined linguistic parameters and aspects. Two subjects with cp, moderate to severe motor dysfunction, moderate to severe speech impairment and no, or small, cognitive impairment, have participated in this pilot phase of the project to judge the relevance and adequacy of the tests.

The work resulted in an operational definition of linguistic abilities that can be considered basic linguistic skills but also relevant to reading and writing development, parameters for investigation of reading and writing skills, and tentative results from the pilot testing procedure.

**Definition of basic linguistic abilities**

**Linguistic awareness**

- phonology
  - rhyming skills
  - blending sounds into words
  - segmenting words into sounds
  - phoneme substitution and omission
- morphology
  - combining morphemes into words
  - operations with endings

**Linguistic competence**

- phonemic identification
  - congruence
  - verb and noun inflection
  - receptive and expressive
- phonemic discrimination
  - vocabulary
  - word order in subclauses and questions
- morphology
  - syntax
  - conjunctions
Definition of parameters for inventory of reading and writing skills

**Reading**
- Decoding
- Comprehension

**Writing**
- Copying
- Spelling: error analysis that illuminates different stages of spelling development
- Morphology: error analysis that includes omitted, incorrect, misspelled or extra morpheme
- Syntax
  - Clauses: presence and variation of subclauses, word order in negated subclauses
  - Phrases: phrase length
  - Words: presence and variation of word classes, variation within a certain word class, presence of function words, length of information words

Establishing a list of investigation methods and tests

The following list is what we originally decided to use, but the list has been constantly changing. Tests that do not seem appropriate have been taken out and new material has been added.

**Phonological awareness**
- Magnusson E. & Nauclér K: “Bedömning av språklig medvetenhet” (Assessment of linguistic awareness)
- Elbro C: “Bo skriver ord” (Bo writes words), “Lis skriver ord” (Lis writes words)

**Morphology**
- Material developed within the project
- Ege B: “Ringsted-materialet” (The Ringsted material)
- Hellquist B: “Språkligt Impressivt Test” (Receptive Test of Linguistic Abilities)
- Holmberg E & Stenkvist H: “Nya Lunda-materialet”

**Vocabulary**
- Dunn LM & Dunn L: “Peabody Picture Vocabulary Test”
- Boston Naming Test
- Material developed within the project

**Syntax**
- Ege B: “Ringsted-materialet”
- Hellquist B: “Språkligt Impressivt Test” “ (Receptive Test of Linguistic Abilities)
- Holmberg E & Stenkvist H: “Nya Lunda-materialet”
- Ege B: “Ringsted-materialet” (The Ringsted material)
- Ståsa: Logiska, grammatiska konstruktioner

**Reading**
- Material developed within the project
  - SL60, SL40, OS64, OS120
  - Johansson M-G: “Klassdiagnoser i läsning och skrivning”
  - Jacobson C: “Word Chain Test”, “Letter Chain Test”

**Short term memory**
- Material from Holmberg E & Sahlén B, “NELLI”

**Cognition**
- Raven’s coloured progressive matrices
Results from the pilot testing procedure: Subject A

Background information
Subject A is a 24-year-old male with spastic quadriplegia. He moves independently from one chair to another, but is unable to walk unaided. He lives in his own apartment with help from personal assistants. He does not have a permanent job but is quite eager to get one. He attends various courses and special, adapted educational programs.

Communication
Speech is his primary means for direct communication. He has no speech aids (VOCAs). His speech is barely intelligible, and he has difficulty making himself understood on the telephone. He does not have a text telephone.

Reading habits
He browses through the newspaper sometimes, but does not actually read it. He cannot follow the subtitles on foreign TV programs, but manages somehow to understand the content. Sometimes he tries to read books, but reports that the letters all blend together and that it is difficult to distinguish anything at all when there is much text.

Writing habits
He does some writing almost every day and tries to manage his daily correspondence without help, even though he is aware of his severe difficulties. He benefits from computer-based writing support. Unaided, his written text is barely understandable. He is able to write a couple of words with pen and paper.

Results from the linguistic testing procedure

Linguistic awareness
Phonological: He has no problems in identifying sounds in a spoken word. He is able to segment words into sounds and has knowledge about rhyming, but makes mistakes when attempting to rhyme. He has difficulties with phoneme deletion.

Morphological: He does not know how to segment words into syllables.

Linguistic knowledge and skills
Morphology: Due to his severe dysarthria it is not always easy to decide whether his speech contains any morphological errors. Discrimination, in which the task is to select a target picture out of four, corresponding to a spoken phrase (T.R.O.G.) is considerably better than written production of sentences with shifted grammatical content or operations with inflections in an inflection paradigm. In selecting a correct, target phrase containing inflected noun phrases among written phrases where only one paradigm is correct, the number of mistakes he makes is greater than the number of correct answers (material developed in the project). When his own erroneous phrases are included in the set of eligible phrases, he does not necessarily choose those that are his own, which means that his mistakes do not reflect his knowledge about the morphological inflection system, but happen by coincidence and are not consistent. The difference between this test, which includes both reading and writing, and T.R.O.G is that he needs both to decode and spell in the former, which is not the case with T.R.O.G. He is most often able to tell which phrase is correct of two spoken ones. Due to dysarthria it is difficult to distinguish inflections and endings in his oral production, but on an analogy spoken test (Ringsted) he sometimes simplifies the grammatical burden instead of applying the same grammatical structure as in the target sentence. There is a seemingly large discrepancy of test results in the expressive and receptive morphological tasks. Both types of skills were tested with tasks that involved some reading and writing, but receptive morphology was mainly tested with spoken sentence choices and expressive morphology was tested in a written task and, therefore, it would be incorrect to draw any conclusions about the subject’s general morphological knowledge with certainty. In order to be able to say anything about the plausible difference between his receptive and expressive morphological knowledge, it is necessary to administrate tests that are modality specific, i.e., written or spoken input and output. Morphological knowledge needs thus to be retested through both input and output across different modalities (The subject will be taken up in more detail under the heading “augmentation suggestions”).

Syntax: He scored 46 out of 46 correct answers on the SIT which probably indicates a ceiling effect. This is presumably an effect of age and general experience because there are other tests, standardised for the same age group as SIT, that cause him much more difficulty. He has good knowledge about basic syntax, but makes mistakes with inverted logical structures such as topicalised phrases or phrases linked together by a chronology-inverting conjunction (a temporal
subjunction such as “following” [NP]). His syntactic knowledge is sufficient for everyday use in a spoken context, but when the syntax task is taken out of its context or becomes more complicated, such as with inverted constructions, he runs into great difficulties.

**Vocabulary:** His vocabulary is sufficient for everyday needs but he showed unexpected poor performance on a receptive vocabulary test (PPVT). He has an approximate knowledge about a relatively large vocabulary, but the PPVT demands exact knowledge. A test, developed in this project, showed similar results, i.e., he placed the words in the right semantic sphere but without knowledge of the exact meaning. This finding is supported by the result from an expressive vocabulary test (Boston Naming) where many words are nearly correct e.g., bench - sofa, octopus - centipede, rhinoceros - hippopotamus, etc. His performance improves considerably when prompting for lexical memory (access) is added. He seems to have a combination of two problems; a limited vocabulary knowledge combined with a word finding difficulty. A very small amount of prompting during picture naming makes a large difference in the result. This is in line with the idea of deficient access to the phonological representation of lexical units (Elbro et al., 1994.) A finding that is related to his relatively poor vocabulary knowledge is his insufficient understanding of idiomatic expressions such as “stiff upper lip”, “go the distance” or “sitting pretty”. Although vocabulary and a more abstract use of words are linguistically related in some way they differ in some aspects, such as degree of concreteness and “hidden” meaning of words. As is discussed earlier, vocabulary expansion may be related to the ability of memorizing non-words (new words) and the usage of idiomatic expressions is more the result of an expanded, subtle handling of known words. On a test where the task was to match a word with an explanation (a vocabulary test for high school), the test was aborted halfway due to lack of results.

**Results from investigation of reading and writing skills**

**Spelling**

**Dictation:** One way to classify the subject’s spelling errors is to place them in four categories: 1) phonetic resemblance “allmänhet” - /amenet/, “bråttom” - /brotom/ 2) partial knowledge of letters that should be included (not phonetic) “information” - /ifomion/, “noggrann” - /norgan/, “djurvän” - /dujrvänd/, 3) pure guesswork “bubblorna” - /brande/, “precis” - /pindf/ and 4) words memorised correctly /handikapp/, /människa/ och /kommun/. This last category includes words with irregular spelling. With little help from the test administrator in sounding the words out, he gets them all correct. When comparing his ability to spell real words vs. non-words he scores 10/12 correct answers on dictation of real words and 4/12 correct answers on non-words, which indicates that most of his spelling involves remembering the spelling rules or knowing the words by sight. With a small amount of sound prompting the difference in the result on the dictation test is considerable, from sometimes unintelligible to correct. Why is it that he cannot produce this seemingly small difference himself? The role of pronunciation and ability to sound correctly and the role of dysarthria in the spelling development has been discussed in Bishop (1990).

**Reading**

**Word decoding:** There is a large discrepancy depending on the presence or absence of picture clues. On a test of decoding of isolated words without any picture clues his score is equivalent with a low stanine 1 for grade seven (age 13-14), which means he is not considered literate. When he has to rely solely on decoding he runs into great difficulty. In a more normal situation than a decoding test, his reading is supported to a great extent by context and redundancy. In a way this finding supports the theory discussed earlier that reading is a parallel process involving decoding and comprehension simultaneously. When presented with picture clues (OS64) he gets a relatively high score. With the seemingly small difference caused by adding a picture, the image of him as a reader changes from almost illiterate (decoding of isolated words) to a relatively competent reader (text supported with picture clues). There are not enough distractors, though, to draw any real conclusions from OS64. He did not even want to try the reading comprehension test for grades seven to nine (age 13-16) (Johansson, 1992). The results from the Word Chain Test and the Letter Chain Test gave a very low WRI (12). The task is to rapidly sort out words from a letter string in the Word Chain Test and to detect double letters in the Letter Chain Test. A difference in performance would indicate a word finding deficit rather than a pure decoding difficulty. It is argued that a low WRI is an indication of a word retrieval deficit (lexical access) (Jacobson), but it seems more likely to
be a deficit of storage of lexical units. For subject A, the understanding of written text seems to be close, but still beyond reach.

**Working memory**

On auditory sequencing he made mistakes on 4 and 5 digits but managed with 6 digits once. He always fails in the first task after the number of digits is augmented. He succeeds on the second task on both 4 and 5 digits. In repetition of unrelated words, he gets all tasks with three words correct and most often with four words. In repetition of sentences, he manages 9 words. In the eleven-word sentence he managed 9 words correctly. The complexity does not increase with the number of words in the sentence, so it is difficult to draw any conclusions about his sentence memory span with this test as a source of information.

**Cognition**

He scored equivalent to the 50th percentile for a eleven-year-olds on Raven’s coloured matrixes.

**Comments**

This is a young man who manages to handle his daily life reasonably well in spite of his disability, which includes both dysfunction of linguistic basic skills combined with reading and writing difficulties. He has very large difficulties with written text, but with some help he can figure out the context when it does not get too abstract. I believe he has more potential than he gets the opportunity to prove and that he has linguistic skills that he still cannot take fully advantage of.

Aspects that needs to be checked to complement subject A’s linguistic profile:
- listening comprehension vs. reading comprehension
- receptive and expressive morphological skills without involvement of reading and writing
- SIT with decoding involved
- identical material tested through different modalities
- spelling of nonwords vs. real words, with and without sound prompting.

**Results from the pilot testing procedure: Subject B**

**Background information**

Subject B is a woman between 25-30 years of age. She sits in a wheelchair and is not able to move independently. She lives in an apartment together with her husband but is heavily dependent on a personal assistant. She has a permanent job at a closed workshop.

**Communication**

She uses only her speech for communication. She has mild dysarthria with some tension but is very verbal and easy to understand.

**Reading habits**

During leisure time subject B reads very little and cannot follow the subtitle on TV.

**Writing habits**

As she does not have a computer at home she never writes outside her workplace. She wants to buy a computer for personal needs at home. She has twice applied for money at a center for communication aids and from three funds, but has been refused all five times.

**Linguistic awareness**

**Phonological**: She knows the principle for rhyming, but is very unsure and makes mistakes on a rhyming task. She is able to identify phonemes in a given word. She knows how to segment a word into sounds but makes mistakes. She does not know how to segment a word into syllables. She fails the phoneme deletion task.

**Linguistic knowledge and skills**

**Morphology**: She does not make any morphological errors when speaking. She is able to tell whether a sentence containing inflected words is correct or not. In selecting a target phrase among written phrases (only one sentence out of four is correct) she often says the correct inflections spontaneously, but then thinks she has made a mistake, and alters the correct answer into an erroneous one. This test involves both reading and writing, thus it does not reflect her exact knowledge of verbal inflections with certainty. She immediately says the right alternative, but nevertheless does not know how to write it. She sometimes has problems in using forms such as subjunctive and the conditional.

**Syntax**: She does not make any syntactic mistakes in her speech nor in the standard, receptive tests for children. When the syntax becomes more complex, however, such as with inverted constructions or double negations, she gives both correct and incorrect answers. This type of syntax is rarely used in spoken language.
Vocabulary: It is not possible to tell her exact score on either receptive (PPVT) nor expressive (BNT) tests as these are not standardised for Swedish, but she performs very well on the PPVT and gets almost all answers correct with precision on the BNT.

In a test where the task was to explain certain (difficult) words (MG Ordförståelse /word comprehension/), she scored a stanine 4 for grade 7. This result is somewhat lower than for the pure naming and pointing tests, but this test included verbal and exact explanation of rather complicated and unusual words. Her own explanation for her good vocabulary is that she loves words.

Results from investigation of reading and writing skills

Spelling

We can distinguish three categories based on spelling strategies. 1) a phonetic spelling strategy, like “noggrann” - /nogran/, “landsbygd” - /lansbygd/, “allmänhet” - /almenhet/, “snabbt” - /snapt/, “regnskyddet” - /räng-skydets/; 2) knowledge (not phonetic) of letters that should be included, but sometimes occur in the wrong order or are omitted, “uppgrävt” - /pupgräfft/, “badhandduk” - /baddhanduk/, “innetemperaturen” - /intpraturen/, “diskuterat” - /disuterat/; 3) correctly learned or remembered words (not so many) /köttfärs/, /aktuellt/. She does not benefit very much from sound prompting.

Reading

The picture of subject B is similar to that of subject A, i.e., there is a large discrepancy depending on the presence or absence of picture clues; when decoding isolated words without any picture clues her score falls into a low stanine 1 for grade seven. The difference between A and B in this respect is that subject B manages to get more correct answers on the decoding test, but that her slow speed worsens the result. The WRI taken from the Word Chain Test and the Letter Chain Test was three times the WRI for subject A. According to the rationale for the WRI, this finding may be related to her good linguistic knowledge at the word level.

Working memory

On auditory sequencing she managed 4 digits without any difficulties; on 5 and 6 digits the first item had to be repeated once; at seven digits there was one reversal.

In repetition of sentences, she managed 8 words. At 9 words she added one functional word. At 10 words she reversed two attributive adjectives. At 11 words she lost place adverb. At twelve words she managed but exchanged one word semantically. At 13 words she reversed parts of speech.

Cognition

She scored equivalent to the 25th percentile for nine-year-olds on Raven’s coloured matrixes. The only measure of non-verbal intelligence that is used in this study is Raven’s coloured matrixes. This test contains visual tasks of a spatial character and it is questionable if tests including spatial tasks are the best measure of non-verbal intelligence in individuals with motor dysfunction, as development of spatial relations are claimed to be at risk in children with severe movement limitations. Her score on this test equivalences the 25th percentile for nine-year-olds. In one of the receptive linguistic tests (SIT), where some of the tasks were more related to cognitive development than to linguistic, the only mistake she made was a cognitive one.

Comments

The linguistic profile for this subject is considerably more even than for subject A. There is no reason to suspect any specific linguistic impairment. The occasions when she does make mistakes is when reading and writing is involved in the task or when attempting to disentangle complex syntactic structures. These situations rarely occur in spoken language. Although there is no evidence for specific linguistic impairment, there is a large discrepancy between her linguistic knowledge and literacy skills, with severe reading and writing difficulties but no apparent dysfunction of basic linguistic skills. Her handling of linguistic forms is in general better than what can be noticed in her written output or when asked to read. She has made good progress in adulthood and, according to her own statement, did not receive much literacy training during her school years.

Discussion

The process of establishing an adequate test battery caused some difficulties due to the fact that there are few standardised or normalised tests in Swedish. Tests often address the “wrong” group i.e., tests for children when adults are the subjects, or aphasics when you want to test individuals with congenital brain damage. Tests do not always focus on the aspect of interest and it is necessary to use something close to what is intended. This shift
in task focus can make a considerable difference to the expected result, due to involvement of alternative problem solving strategies. There are also aspects that emerge during the process and are not represented in any of the existing, traditional tests. This testing procedure has taken place with a mixture of traditional, revised, translated or newly devised tests. A consequence of this problem with standards and norms is that we do not really know what the specific results mean. Under these circumstances there are difficulties establishing linguistic profiles and difficulties in sharing the results with colleagues and others. The results from the pilot testing procedure show that the compilation of methods and tests has to be further completed and revised. There are still some of the linguistic aspects that we have not been able to investigate with the methods above.

The test battery has to be flexible and individually adapted. (Another possibility, communicated by experienced test administrators, is to use traditional tests in a very flexible manner. In that case, the tests seem to serve more as a check list than as a proper test.) When a specific difficulty is discovered it is necessary to procede and have the possibility of finer or a more qualitative analysis. On the other hand, it is desirable to give “broad,” extensive tests to allow for alternative problem solving strategies. At the same time it is not effective, either to the subject or to the investigator to test abilities that do not cause any problems. The starting level of the testing procedure has to be set at the highest level and then go backwards in complexity. On the other hand, it has been evident in this pilot phase that seemingly small changes to the character of the task has had large consequences in the result. We can then draw the conclusion that seemingly similar tests can complement each other to give a more complete picture of the dysfunctions.

In general it can be claimed that most of the tests have too few distractors, such as phonological or semantic distractors, and most of the tests investigate too many abilities at the same time, i.e., decoding and word comprehension or word retrieval difficulties and knowledge of receptive vocabulary. This is often necessary for the general applicability of the tests and, in addition, more general tests give opportunity to alternative task solving procedures, as mentioned above. These tests must, however, be complemented with qualitative judgements and individually adapted tasks that concentrate on the specific ability that is to be studied. The only solution is often to develop testing material as the inventory proceeds. These qualitative investigation methods can obviously not be standardised and may consequently cause difficulties in communicating with researchers and colleagues.

SIT (Hellquist, 1982) is a good, screening method but is meant for children. It is too simple, and most adults, even with severe difficulties, reach a ceiling effect. There is not a Swedish version of PPVT (Dunn & Dunn, 1981) that has an increasing level of complexity that is standardised. The score can only serve the purpose of comparing the subject with other subjects and to give a hint of the person’s vocabulary knowledge. The case is the same with the Boston Naming Test and T.R.O.G. (Swedish versions of these tests are under development.) In the sentence repetition task in the test for working memory, complexity does not follow an increasing number of words. A sentence with eleven words may not necessarily be more complex than one with nine. Compare “First of all she took on one sock, than the other” (11 words) with “He got a big, ruddy, new, semiplump and cherublike doll” (10 words). The complexity of the sentence is a combination of the word order, the reciprocal relationship of the words, the rhythm, the expected words, etc. Raven’s coloured matrices test only one cognitive ability and is a measure of cognition that is far too narrow. Even cognitively “normally developing” individuals are likely to show very different scores due to personal preferences. It may also be misleading to use a spatial test with individuals with motor impairment as one prevailing theory is that precisely spatial abilities and concepts are affected by the motor impairment per se.

In the investigation of reading skills, we look separately at decoding and comprehension. This dual view is probably not only oversimplified but probably not even correct. The reading process seems to be more of an interacting, multimodal activity with support from “external” clues, rather than a serial process from decoding to understanding (Liberg, 1996).

When we have the results, there are questions we must then ask ourselves. What do the results mean to the individual’s ability to cope with daily life? What does it mean to his/her literacy development? How can we use this information as a base for selection of personal equipment?

**Augmentation suggestions**

Even though it is not feasible to obtain a list of tests complete enough to cover all linguistic
aspects of interest, we want to mention some suggestions to improve the material.

In order to investigate morphological awareness, the list may be complemented with the work on morphological awareness by E Arnbak.

A method to test phoneme discrimination would be a test, in which the task is to decide whether a pair of nonsense words are identical. This type of task has proved valid to distinguish individuals with a speech impairment (anarthria) from dysarthric controls (Bishop, 1990).

As a complement to the phoneme discrimination test, a word judgement test can be used. The task in this test is to look at a picture and listen to an accompanying word pronounced aloud by the test administrator, and then judge whether the word is pronounced correctly or whether a sound has been changed. A similar test has been conducted by Bishop (1990), in which speech impaired individuals did not score lower than controls.

The receptive vocabulary test needs to be improved. Vocabulary tests distinguish the severely speech impaired group from a control group, while the two groups did not differ in e.g., understanding of grammatical structures. One plausible explanation is that the ability to memorise novel sound strings is facilitated by overt or covert articulation. From this it follows that individuals who lack fluent speech have difficulties in memorising nonwords and therefore fail to carry out tasks such as identifying identical or non-identical pairs of nonwords and show the specific (selective) difficulty of learning new vocabulary (Bishop, 1990). In line with this reasoning, we need a method to compare the ability to memorise nonwords vs. real words.

To be able to pinpoint specific difficulties, it is necessary to sort out basic linguistic knowledge from modality-specific skills (Smith, 1996). We therefore need a discrimination test to investigate and compare input and output for different modalities, that is, speech, writing and pictures. The need is to have similar testing material (pictures), and to have the different modalities as the independent variable. A plausible testing material may include the following parameters:

- The sentences that accompany the pictures are to be read aloud by the test administrator and the subject discriminates the target picture.
- The sentences are to be read silently by the subject who then discriminates the target picture.
- The subject looks at an additional picture with the same content but different form and then discriminates the target picture.
- The subject describes the target picture orally to the test administrator.
- The subject writes a description of the target picture for the test administrator.
- The subject uses only pictures (or symbols) to “tell” the test administrator which one is the target picture (Fig. 1).

Apart from the technical problem, there is also a theoretical problem with testing. Even if we were given all the results and profiles, standardised and normed, we still would not really know their significance as long as we do not fully understand the relationship between cognition, linguistic knowledge and literacy skills and consequently do not exactly know what is measured in a specific test. Abilities, by definition, are often the outcome of a test which makes the whole argument circular, e.g., “IQ is what you measure in an intelligence test.” It is also important to remember that all tests are based on the specific scientific theory of the test constructor. The tests can only be instrumental in measuring certain skills of the subject, but the interpretation of the results is then left to the test administrator or investigator with his/her personal theory and view.

<table>
<thead>
<tr>
<th>Spoken language</th>
<th>Input</th>
<th>Output</th>
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<tbody>
<tr>
<td>Sentences read aloud to the subject (A)</td>
<td>A describes the picture orally to the test administrator</td>
<td></td>
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<table>
<thead>
<tr>
<th>Written language</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>A reads the picture sentences silently</td>
<td>A writes about a picture</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Images</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>A looks at pictures</td>
<td>A “tells” the target picture by arranging pictures</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1. A planned procedure to test input/output through different modalities.**
Comments on the discrepancies/similarities between the two subjects

These two subjects may represent an indication of the possibility that even within the group of individuals with brain damage the relation between cognition - linguistic ability - literacy skills can be very differently manifested. Their profiles look different and there are probably different reasons for their reading and writing difficulties even though their functional reading and writing skills are at the same level.

References


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