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Errors' analysis in a Portuguese version of the Token Test

Sara Leite Braga Coutada[1] e Cristina Petrucci Albuquerque[2]

Abstract

This study concerns a Portuguese version of the Token Test (TT), named Instructions Comprehension Test (ICT) that is part of the BANC (*Coimbra Battery of Neuropsychological Assessment*), and assesses receptive language. It carries out a quantitative and qualitative analysis of the errors made by children in this test, looking for the predominant errors, as well as specific difficulties in the comprehension of certain linguistic concepts. The ICT was applied to a sample of 295 children, of three age groups (7, 8 and 9 year-old), in which 149 are male and 146 are female. The errors made were categorized, quantified and object of a psycholinguistic analysis. The main errors found are related to some locatives, ordinal numbers and concepts of exclusion and temporal inversion, as well as to conjunctions. In this regard, there were difficulties in the interpretation of the coordinative conjunction *and*, when it connects two clauses with the same referent, and of the adversative conjunction *but*, when it introduces equality. The psycholinguistic analysis also drew attention to the role that working memory can have in this test. In sum, errors' analysis evidenced comprehension difficulties inaccessible through the simple scoring of children's answers as correct or incorrect.

Keywords: Instructions Comprehension Test; Errors' Analysis; Token Test

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Análise dos erros numa versão portuguesa do Token Test

Resumo

Este estudo reporta-se a uma versão portuguesa do *Token Test* (TT), o Teste de Compreensão de Instruções (TCI) da BANC (Bateria de Avaliação Neuropsicológica de Coimbra), que avalia a linguagem recetiva. Centra-se na análise quantitativa e qualitativa dos erros cometidos por crianças neste teste, a fim de identificar erros predominantes, bem como dificuldades específicas na compreensão de determinados conceitos linguísticos. A amostra é constituída por um total de 295 crianças, de três níveis etários (7, 8 e 9 anos), das quais 149 são do sexo masculino e 146 do sexo feminino. Os erros cometidos foram classificados, quantificados e objeto de uma análise psicolinguística. Os principais erros reportam-se a locativos, números ordinais e conceitos de exclusão e inversão temporal, bem como a conjunções. A este respeito, registaram-se dificuldades na interpretação da conjunção coordenativa *e*, quando liga duas orações com o mesmo referente, e da conjunção adversativa *mas*, quando introduz igualdade. A análise psicolinguística também chamou a atenção para o papel que a memória de trabalho pode desempenhar neste teste. Em conclusão, a análise dos erros evidenciou dificuldades de compreensão inacessíveis através da simples cotação das respostas infantis como corretas ou incorretas.

Palavras-chave: Teste de Compreensão de Instruções; análise dos erros; Token Test

ERRORS' ANALYSIS IN A PORTUGUESE VERSION OF THE TOKEN TEST

The Token Test (TT) is a receptive language assessment instrument, at the semantic and syntactical levels, that has been widely used in clinical practice and in research. Indeed, there are currently multiple versions of the TT, both for adults and children. Among the various TT versions created specifically for children, we may mention, as an example, the following: the Token Test for Children (DiSimoni, 1978); the Concepts and Directions Test of the Clinical Evaluation of Language Fundamentals-3 (CELF-3; Semel, Wiig, & Secord, 1995); and the Comprehension of Instructions Test of the *NEPSY-II* (Korkman, Kirk, & Kemp, 2007).

In Portugal, there is also a children's version of the TT, namely the Instructions Comprehension Test (ICT), which is part of the *Bateria de Avaliação Neuropsicológica de Coimbra* (BANC; Simões et al., 2016b). The ICT assesses, first of all, receptive language, both syntactically and semantically, and the processing of aural/verbal information. Similarly to other TT versions, the ICT assesses the understanding

of figurative attributes (colours, sizes, shapes) and basic relational concepts of identity, coordination, localization, exclusion and time/sequence. These basic relational concepts are an important aspect of linguistic and cognitive development. Additionally, the ICT also appeals to a variety of cognitive processes, including verbal and sequential reasoning, attention, working memory and the ability to create a visual image out of verbal information.

Regarding the reasons more likely to explain the wide diffusion of the TT and, particularly, the respective children's versions, it can be pointed out that their psychometric properties have shown to be satisfactory, especially concerning discriminant validity, illustrating their potential relevance in several clinical groups. In fact, in the studies carried out with children, the TT or other similar instruments have demonstrated the ability to differentiate children belonging to control groups from children belonging to various clinical groups, such as children with: High Functioning Autism (Minshew, Goldstein, & Siegel, 1995) or Autistic Disorder (Korkman et al., 2007); Dyslexia (Shiota, Koeda, & Takeshita, 2000; Whitehouse, 1983) and reading disabilities (Korkman et al., 2007); mathematical disabilities (Korkman et al., 2007); Attention Deficit and Hyperactivity Disorder (Korkman, Kirk, & Kemp, 1998; Pineda, Puerta, Aguirre, Garcia-Barrera, & Kamphaus, 2007); emotional disorders (Korkman et al., 2007); prematurity (Yhilerva, Olsén, & Järvelin, 2001); Traumatic Brain Injury (Korkman et al., 1998; Zetterqvist & Jennische, 2010); Fetal Alcohol Syndrome as well as both Expressive and Mixed Receptive/Expressive Language Disorders (Korkman et al., 1998, 2007).

In regard to the ICT, arguments similar to the previous ones justify its relevance. Thus, it has demonstrated a high internal consistency (Cronbach alpha of .89), as well as favourable evidence regarding concurrent validity (cf. Simões et al., 2016b). Nevertheless, evidence regarding discriminant validity stands out, since the ICT has differentiated control groups from groups with learning problems, intellectual disabilities, epilepsy, Traumatic Brain Injury and Oppositional Defiant Disorder (cf. Simões et al., 2016b).

Psycholinguistic analyses of the errors made in the TT have also been carried out, illustrating the relevance of this type of analysis, both in a clinical and in a developmental perspective. In this regard, we start by mentioning studies that examined the errors of groups of aphasic adults (Lezak, Howieson, & Loring, 2004; Noll & Randolph, 1978). As far as children are concerned, there are studies analyzing the errors of groups with and without dysphasia (Tallal, 1975), left hemisphere brain damage (Aram & Ekelman, 1987) and dyslexia (Whitehouse, 1983).

In a study carried out by Pinto (1988), a psycholinguistic analysis of the errors made by Portuguese children in the TT was also performed. In this study, it was shown that children had considerably higher percentages of errors in the lexical

units related to the shape, than with the size or with the colour, since the percentage of errors in the last two attributes was quite lower than in the first one. Moreover, the author concluded that the conjunction *and* is, in general, easily decoded, while the disjunction *or* was more difficult for the children.

Besides these studies concerning specifically the examination of errors made in different versions of the TT, it can be pointed out that, no matter what the adopted method of oral language assessment might be, the errors' analysis is an essential instrument to portray the trajectories of language development and of access to children's linguistic comprehension level (Boehm, 2004; Paul, 2001; Tallal, Stark, & Mellitz, 1985).

For these reasons, the present study carries out a quantitative and qualitative analysis of the errors made by Portuguese children in the ICT. It identifies the predominant errors and as the ICT assesses several important linguistic concepts (locatives, temporal terms, sequential terms, connectives, etc.), it recognizes the linguistic concepts of greater difficulty for the Portuguese children. The ICT administration (Simões et al., 2016a) indicates that the examiners should register the children's answers in a designated space of the record form, thus enabling errors analysis. The ICT is also normed in a large sample of Portuguese children. Notwithstanding, there is no information available concerning the errors committed by children or their qualitative analysis. These data will be essential for psychologists, as they will allow them to complement and enrich the test interpretation process.

It is also worth mentioning that the linguistic development of Portuguese children has rarely been studied and consequently it is unknown whether it is similar to the one of any other languages.

METHOD

Participants

The sample was taken from the BANC normative sample, comprising a total of 295 children, with ages from 7 to 9 years old (M = 7.98; SD = 0.82), distributed in terms of age and gender in the following way: 101 of them are 7 years old, 99 are 8 years old and 95 are 9 years old; 149 individuals are male and 146 are female. Concerning schooling, the children attended, mainly, the 2nd (n = 102), 3rd (n = 104), and 4th grade (n = 87), being the number regarding the attendance of the 1st grade very low (n = 2).

Regarding the geographic region and area of residence distribution, the majority of the participants (84.1%) lived on the coast and in a predominantly urban residence area (70.5%).

The ages selected correspond to the ones where the ICT has more adequate difficulty levels and is not too difficult or too easy (Simões et al., 2016b). Indeed, an item analysis revealed that the items are difficult for younger children and easy from age 10 onwards (Simões et al, 2016b). In addition, the analysis of ICT total scores as function of age indicated that they tended to remain stable after age 10 (Simões et al., 2016b). In addition, since errors' analysis is a detailed and time demanding process it could not be extended to the entire normative sample (1104 children from 5 to 15 years old).

The data collection process of the BANC is described elsewhere (Simões et al., 2016b). Approval was obtained from the Ministry of Education, the National Data Protection Commission and the schools' board of directors. Informed consent was also obtained from the parents of the children that participated in the study.

Instrument

The ICT is part of the BANC which is a comprehensive instrument that comprises 15 different tests in order to assess neurocognitive development in six theoretically derived domains: Memory, Language, Attention/Executive Functions, Motor Function, Laterality, and Orientation. The ICT is included in the language domain, together with rapid naming and phonological awareness tests.

The ICT is made up of 27 instructions or items, asked orally to children and youngsters (from 5 to 15 years old), and answered through pointing at figures. The 27 instructions are evenly distributed in three sections, which involve degrees of rising complexity, as well as different materials.

Thus, Section I has a total of 9 items and it is made up of a card which portrays a group of 8 small dogs, diverging in the following figurative attributes: colour (yellow and red); size (big and small) and expression (happy or sad). In this section, the instructions imply the comprehension of concepts of location, identity and coordination. Sections II and III are more complex than Section I and are made up of a group of 9 items each, requesting the identification of one or more geometric shapes – replacing the small dogs – from a total of 9. The 9 shapes concerning each section are represented in rows in distinct cards. On its whole, the two sections require the comprehension (individual or simultaneous) of several concepts: sequence, temporality, temporal inversion, coordination, location, identity and also exclusion.

The test has age-appropriate start points and thus children aged 5-6 start with Section I, while children aged 7-15 start with Section II. However, if a child aged

7-15 fails in either of the three two items of Section II, the reversal rule is applied (Section I is administered until the child obtains three correct answers).

The present study only analyses the results of the items in Sections II and III, as the children from the sample didn't make any errors in Section I. However, the reversal rule was applied in 21 children (7.11% of the sample): 11 aged 7, 8 aged 8 and 2 aged 9.

Table 1
Specific contents of the items in Sections II and III

	Number of Shapes	Number of Instructions	Attributes	
Section II			Number	Type
Item 10	3	1	2	Gs[a]-C[b]
Item 11	1	1	2	Gs-Gs-C
Item 12	3	2	2	C-Gs-C
Item 13	1	1	1	Gs-N[d]
Item 14	2	2	2	Gs-C-Gs-Gs-C
Item 15	2	2	2	Gs-C-Gs-C
Item 16	2	2	2	Gs-Gs-C-C
Item 17	2	2	2	N-N-Gs-C
Item 18	1	1	2	Gs-C
Section III				
Item 19	2	2	3	S[c]-Gs-C
Item 20	1	1	3	Gs-C-S
Item 21	1	1	1	Gs-Gs-Gs
Item 22	2	2	2	Gs-S-Gs-S
Item 23	2	2	3	C-S-Gs
Item 24	2	2	2	Gs-Gs-C-Gs-Gs-C
Item 25	2	2	2	Gs-Gs-S-Gs-Gs-S
Item 26	2	2	2	Gs-Gs-Gs-Gs-C
Item 27	1	1	3	N-S-Gs

[a]Gs – geometric shape; [b]C – colour; [c]S– size; [d]N – number.

Table 1 shows the contents of the instructions that correspond to each of the items of Sections II and III. This way, we intend to clarify the various characteristics that compose the ICT items, namely: the number of shapes to be identified in each item; the number of the instructions, that is, one instruction or two simultaneous or successive instructions; and also the attributes present in each item: S corresponding to size, C to colour, N to number and Gs to the geometric shape. For instance, in item 19 (Section III) "point at a large shape, but first point at a black triangle", we find the following characteristics: two shapes and three attributes (size, shape and colour), and it implies following two instructions which are, in this case, successive.

Table 2
Concepts distribution by the ICT items

Concepts	Items	Concepts	Items
Identity		Temporality	
Different	27	Then	16; 17
The same	27	At the same time	22
Conjunctions		Temporal Inversion	
And	14; 16; 17; 18; 22; 24; 25; 26	Before you have	12
		After you have	15; 23
But	27	But first	19
Location		Sequence	
Above	14; 24; 25	Last	13
Below	11; 18; 23; 25; 27	First	17
In the middle	26	Second	17
Next to	24; 26	Third	13
On the left	16	Exclusion	
On the right	21	All… but	10
Between	18	Not… nor…nor	20
		Instead of	21

Concerning the linguistic concepts demanded specifically by each item in Sections II and III, we may observe their distribution in Table 2. For instance, item 18 ("point at the shape that is between two squares and below a red shape") implies concepts of coordination (*and*) and location (*between; below*).

Adopted Procedures

Psychologists individually administered the ICT. The children's answers were registered in the record form, in a space specifically created for this purpose, where both the shapes pointed at by the children and the order in which this was done were registered. In relation to the errors' analysis, a number was attributed to each shape. Afterwards, the children's errors were distributed by 4 categories, along with an exceptional one on a specific item. The first category is the incorrect identification of one or more shapes, according to the correct number of requested shapes, i.e., this category contemplates the cases in which children made errors in the identification of one, two or three of the requested shapes, but in which the total number of pointed shapes corresponded to the request. The other three categories imply the identification of an incorrect number of shapes: for instance, the second category included the cases in which children pointed at two shapes when only one or three shapes were requested.

For item 22 ("point at a small circle and, at the same time, point at a big triangle") an additional category was created, for the situation in which the child,

instead of pointing at two shapes simultaneously, as requested in the instruction, pointed at one, first, and then at the other, i.e., this category was specifically created to register the error in the comprehension of *at the same time*.

Inter-rater agreement for the various errors' categories was calculated by dividing the number of agreements by the number of agreements plus disagreements. The average agreement was 90%.

RESULTS AND DISCUSSION

Quantitative Analysis

Table 3
Frequency (N) and percentage (%) of errors in the items of Groups 1 and 2 [N = 295]

Group 1	Sample	
Item	N	%
11	21	7.1
13	20	6.8
18	158	53.6
20	68	23.1
21	66	22.4
27	220	74.8
Group 2		
10	3	1
12	16	5.3
14	65	22
15	77	26.1
16	125	42.4
17	114	38.6
19	39	13.2
22	111	37.6
23	142	48.1
24	141	47.8
25	147	49.8
26	156	52.9

Firstly, the frequency of all types of errors made by the children in the ICT was analysed. This analysis took into account the characteristics of the items

themselves, since the items were divided into two groups, independently of the section they were part of, depending on if they requested an answer consisting of one (group 1) or two/three shapes (group 2). The errors in the two groups of items showed a moderate correlation (r =.43). Group 1 items presented a mean number of errors (M = 1.87; SD = 1.10) lower than group 2 items (M = 3.84; SD = 2.42) and the difference is statistically significant according to a paired samples t test (t (294) = -15.379; p <.001).

Concerning the first group of items – i.e., the items' group that requires only one shape as an answer – one may find in Table 3 the errors' frequency and respective percentages of the global sample, where it is possible to observe a considerable increase of the errors from the two first items (11 and 13) to the following ones, with items 18 (53.6%) and 27 (74.8%) presenting the highest number of errors. These two items differ from the others due to the complexity of the respective instructions: item 18 requires the comprehension of three concepts (coordination: *and*; location: *below* and *between*) and item 27 calls for the comprehension of four concepts (identity: *different* and *the same*; adversative conjunction: *but*; and location: *below*), while the other items in this group imply the comprehension of just one (items 11 and 20) or two (items 13 and 21) concepts. Joined together, items 18 and 27 have a higher mean of errors (M = 1.28; SD = 0.709) than items 11, 13, 20 and 21 (M =0.59; SD = 0.046) and a paired samples t test indicated that the difference is statistically significant (t (294) = 11.636; p <.001).

With respect to group 2 (group of the items that requires two or three shapes as an answer), relatively high errors frequencies may be seen in Table 3. Actually, in this group only items 10, 12, 14, 15 and 19 have a percentage of errors inferior to 30%. The percentage of errors in item 10 is so small, that it won't be further analysed.

In this group of items it is also possible to notice that the items that have the highest percentages of errors feature a wider conceptual diversity. Thus, items 10, 12, 15 and 19 require the comprehension of only one concept and are among the ones with fewer errors. On the other hand, items 16, 24, 25, 26 and 17 imply, respectively, the comprehension of three and four concepts, being the ones with the highest number of errors. Therefore, items were joined together in two subgroups, according to whether they require the comprehension of one/two concepts (items 10, 12, 14, 15, 19, 22 and 23) or three/four concepts (items 16, 17, 24, 25 and 26). A paired samples t test indicated a statistically significant difference (t (294) = - 7.68; p <.001) in the mean number of errors which is higher in the more conceptually demanding items (M = 2.32; SD = 1.5) than in the lesser ones (M = 1.53; SD = 1.5).

Table 4
Distribution of errors by the distractor stimuli (items of Group 1) [n=295]

	Errors (%)								
	Shapes (distractor stimuli)								
Item	1	2	3	4	5	6	7	8	9
11	3.4	0	0.7	0	1.7	0.7	_	0.3	0.3
13	0	0	0	0	0	5.1	0	1.7	_
18	1	15.3	1.4	_	2.7	7.5	0	0.7	3.4
20	_	1.7	_	2	2.7	4.4	0.7	6.8	3.1
21	0	5.1	9.5	1.7	0.7	2.7	1.4	_	0
27	2	2.7	0.7	4.7	15.3	3.7	_	14.9	7.5

Note. Dashes indicate the correct shape for each item. The values represent the errors' percentage. Bold values represent the most common error.

Table 5
Distribution of errors by the distractor stimuli (%) (Items of Group 2) [n=295]

	Type of Error (%)																
	First Instruction Shapes (distractor stimuli)									Second Instruction Shapes (distractor stimuli)								
Item	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
12[a]	0	0	0	0	0.3	0	0	_	0	0	0	0	0	_	0.3	0	0	_
14[b]	0	0	0	_	3.4	0	0.3	0	_	0	7.8	0.3	_	2.4	0.7	1.4	0	_
15	0.3	0	0	0.7	_	0.3	0	0	15.6	0	0	0	0.7	16.6	0.7	0.3	0	_
16	_	3.7	15.9	2	5.1	0.3	3.7	1.4	0.3	0	1	0	0	0.7	0.7	1.4	_	0.3
17	4.4	_	1	10.2	8.5	1.7	0	1.7	0	1.7	0.7	0	0.3	1	_	0.7	0	2
19[a]	1	0	0	0	_	0.7	_	0	4.7	_	0	_	0.3	_	0	1	0.3	_
22[a]	1	_	1.4	0.3	_	0.7	0	_	0.3	0.3	_	1	0	_	1.4	0.7	_	3.7
23[a]	3.4	0	7.5	1.7	2	1.4	0	8.8	_	_	0.7	_	_	3.1	_	0.7	_	7.5
24[b]	0.3	4.7	_	0.7	3.1	2.4	1	_	1.7	1.4	7.1	_	1.7	2.7	2.4	0.3	_	7.5
25[b]	_	1	1.4	10.2	0.3	2.7	0.7	_	1	_	3.4	3.1	4.1	5.4	3.7	2.4	_	2
26[b]	_	1	0.3	1	_	0.7	0.7	1.4	1.4	_	2.4	3.4	5.4	_	2.7	0.3	4.4	17.6

Note. Dashes indicate the correct shapes for each item. The values represent the errors' percentage. Bold values represent the most common error.
[a] In this item, there are several possible correct answers.
[b] In the errors' analysis, the order in which the figures were identified was not taken into consideration.

In order to analyse, in a more detailed way, the types of errors found, the percentages of errors in each item and in each distractor shape, in the items of group 1 and in the items of group 2, are presented in Tables 4 and 5. The distractor numbers correspond to the children's view of the cards. However, these tables only contain the errors that show the incorrect identification of one or more shapes, but that respect the number of requested shapes. In some specific items (14, 24, 25 and 26),

the authors did not considered as errors when the figures were correctly identified, but did not respected the order in which they were mentioned by the examiner.

Next, it will be performed a qualitative analysis of the most frequent errors, relating them with the assessed concepts.

Qualitative Analysis

Regarding the errors related to location concepts, it was curious to observe that these concepts influenced the children's answers in some of the items, namely in the items that implied the comprehension of *below*, *on the left*, *on the right* and *next to*.

Actually, in item 11 ("point at the square below the black circle") the most frequent error (shape 1, square *above* the black circle) demonstrates that children respected the attributes, switching the location to *above*. In the same way, difficulties with the locative *below* seem to arise in items 18 and 25, as in both of them the errors related to that instruction do not respect the location. In fact, in the second instruction of item 25, the errors that show difficulties in the locative under consideration stand out, since the most frequent error represents the shape that acts as the location reference (the instruction requests *the circle below the big triangle*, while the children identified the triangle itself - shape 5). In this item, two other errors must also be mentioned, in which the individuals either switched the locative to *above* (shape 2) or they ignored the location, only pointing at a circle (shape 3). Also in item 18 ("point at the shape that is between two squares and below a red shape"), the most frequent error was shape 2 (shape *between* two squares, that is *next to* a red shape and not *below* it).

Given these data, we point out that, although the locatives are concepts acquired in an early stage, the understanding research demonstrates that they are mastered initially with fronted objects, such as a doll, and only later on, with nonfronted objects such as the shapes of the ICT (Conner & Chapman, 1985; Corrigan, Halpern, Aviezer, & Goldblatt, 1981; Owens, 2012). These require a truly projective understanding of the locative, which is harder to achieve (Conner & Chapman, 1985).

In addition, Durkin, Crowther and Shire (1986) state that from the age of 5 onwards, the child initiates the process of learning more subtle meanings and relations of those concepts, in more complex structures. Therefore, as displayed in this study, when there is an increase of complexity, in terms of the concepts in the same instruction and/or in the sentence length (items 18 and 25), the difficulties in comprehension naturally increase.

Concerning the concepts of *on the left* and *on the right*, they are assessed, respectively, in items 16 and 21. In item 16 ("point at the square that is on the left

of the yellow circle and then point at the white shape") there is a high number of errors (42.4%), clearly due to difficulties with the concept of *left*, since the great majority of the registered errors are gathered in the first instruction (32.1%). As a matter of fact, the most frequent error represents a square *on the right* (and not *on the left* - shape 3 - 15.9%) of the yellow circle, which demonstrates that the children had trouble with the locative.

In item 21 ("instead of pointing at a square, point at a circle on the right of a triangle") there was also a considerable incidence of errors (22.4%), most of them being relative to the locative term *on the right*, as there was a notorious difficulty in understanding that the right side of a specific shape (triangle) was meant, and not the shapes that were on the right of the child. The most frequent error (shape 3, circle) demonstrates this difficulty, since it illustrates comprehension of the concept of exclusion *instead of a square*, attention to the requested attribute (circle), but disregard of the right side of the triangle, as the circle placed on the right of the child was pointed at.

This previous difficulty is explained given the fact that children acquire the right and left references firstly in relation to themselves – around the age of 7/8 – and only then do they transpose them to the position of the objects in relation to each other (Baron, 2004; Strauss et al., 2006; Vilar, 2007). Therefore, it is consensual that, at the age of 10, children can still make errors when this concept is assessed with relation to an external element (Baron, 2004; Strauss et al., 2006; Vilar, 2007).

Still in this set of difficulties regarding the concepts of location, the difficulty in the comprehension of the concept *next to* must also be pointed out. Actually, in item 24, for example, the majority of the errors are gathered in the second instruction, in which "point at the circle next to the black square" was requested. On the one hand, these results head towards the developmental progression in the acquisition of the locatives, since it has been observed a primacy of the front-back dimension over the side-to-side dimension (Boehm, 2004; Conner & Chapman, 1985).

On the other hand, it may be added that, concerning the acquisition of the term *next to*, Slobin (1982) refers specifically to this expression emphasising that the difficulties in its acquisition derive from lexical diversity, i.e., comparatively to the terms *above* and *below,* to express proximity, English has several equivalent expressions (*near*, *close to*, *next to*) (Slobin, 1982). The same happens in Portuguese and, therefore, lexical diversity might delay the acquisition of *next to (ao lado, a seguir, próximo).*

Also in item 26 ("point at the triangle in the middle of the circles and to the square next to the black circle") we can find errors related to locative terms that, as refers to *next to* (36.2% of errors), and by comparison with the second instruction of item 24 (23.1% of errors), seems more difficult to understand in the present

item. As a matter of fact, the comprehension of a locative depends on the phrasal context in which it is inserted (Baron, 2004) and even on the very disposal of the stimuli. In item 26, there are two shapes *next to* the black circle, while in item 24 there is only one next to the black square.

There were also errors in items that involve the comprehension of numeric concepts, namely in the first instruction of item 17 – "point at the second shape of the first row and then point at the red circle". In this item, the great majority of the errors were concentrated in the first instruction and the most frequent error demonstrates an inversion of the ordinals (10.2%), as the children pointed at the first shape of the second row (shape 4), or the retention of one of the ordinals (shape 5 = 8.5%; shape 1 = 4.4%; total = 12.9%). These errors might be explained by the two consecutive ordinal terms and by the sentence complexity and length. In this regard, it can be mentioned that although one might appeal to the same counting capacities to deal with cardinal and ordinal numbers, children demonstrate a considerable developmental difference concerning the use of such capacities, as ordinality is acquired after cardinality (Bruce & Threlfall, 2004).

Nevertheless, it is necessary to point out that working memory (WM) seems to have had influence on the individuals' answers to item 17, and also to several other items, among which we draw attention to the ones related to items 14, 16, and 22. In fact the limited capacity of the memory span (Baron, 2004; Gathercole, 2007) seems to have some effect on the items that, for different reasons, raise difficulties to children.

For instance, some of the errors found in item 16 ("point at the square that is on the left of the yellow circle and then point at the white shape") demonstrate a clear influence of the retention capacity, as, for example, two of the errors connected to the first instruction (shapes 5 and 7) are squares on the left of a circle, something which partly respects the instruction, but omits the attribute *colour*, relative to the circle. Another error found when dealing with this instruction was shape 2, which can also be related to memory, since it represents the yellow circle itself, meaning that the previous elements constitutive of the instruction have been forgotten.

The case of item 22 it is also worth mentioning ("point at a small circle and at the same time at a big triangle"), because it demonstrated that the children that pointed at two shapes simultaneously and made errors, did so because they omitted one of the attributes concerning the first (*circle* or *small*) and/or the second shape (*triangle* or *big*). It should be noticed that the examples referring to items 16 and 22, which we have just highlighted, do not intend to be exhaustive, since the restrictions concerning memory may have also influenced the errors made in other items.

As a matter of fact, one of the criticisms made to the TT and similar instruments, corroborated by some errors' analysis studies (Aram & Ekelman, 1987;

Noll & Randolph, 1978; Tallal, 1975), lies in the role that working memory plays in this test, which is once again evident in this study. The correlations of the ICT with memory tests of the BANC (e.g., Word List, Corsi Blocks, Narrative Memory), observed in the normative sample were also moderate or high (from .35 to .64), thus confirming the importance of working memory. As shown by Weighall and Altmann (2011), the development of verbal memory span is a crucial predictor of sentence processing skills in children between 6 and 8 years old.

One other aspect to be considered in the present qualitative analysis of the errors found in the ICT has to do with the connective *and*, as well as with the connective *but*, since both of them are present in some of the items in the test (*and* can be found in items 14; 16; 17; 18; 22; 24; 25; 26; *but* is present in item 27). Although these two connectives arise early in the spontaneous language of the child (Clark, 1995; Evers-Vermeul & Sanders, 2009; Owens, 2012), Peterson (1986) and Kail and Weissenborn (1980) verified that only older children used *but* to encode complex contrasts. This shows that children started using this conjunction long before they understood its semantic functions (Clark, 1985).

Based on the evidence presented in the literature, this study confirms also that most of the children decoded the additive semantic relationship of the connective *and* rather easily, as the errors found in items 14, 16, 17, 22, 24, 25 and 26 do not seem to arise from difficulties in this aspect. Regarding this conjunction, the analysis of the frequencies of errors shows that there are few children who make the error of pointing at only one shape, in those items in which the coordinative conjunction implied the identification of two shapes. Nevertheless, in item 18 ("point at the shape that is between two squares and below a red shape") in which the conjunction *and* connects two clauses with the same referent, the error of interpreting the clauses in a compartmented way stands out (18.9%). That is, in this item children interpreted the instructions similarly to the previous ones, assuming that *and* connected two instructions, each one involving its shape. This clearly demonstrates that when there is a higher syntactic complexity, children may not master completely the functions that the conjunction *and* can perform, neither the relations that it establishes between the two clauses (Evers-Vermeul & Sanders, 2009).

As for the connective *but*, included in item 27 ("point at the shape below two shapes with different sizes but with the same shape"), it seems to cause difficulty, as it, instead of introducing a difference or a contrast relation, which it usually does (Peterson, 1986), introduces an equality. Such difficulties are noticeable in the answers in which children only assume the equality (shape 5, shape between two circles [same shape] with the same size, 15.3%) or only assume the difference (shape 8 = 14.9% and shape 9 = 7.5%, different size and shape). In fact, this item presents more difficulties to children, as it introduces, simultaneously, concepts of equality

and of difference coordinated by a connective that qualifies or limits the content of the first clause, something that may explain the amount of errors found (74.8%).

As for temporal conjunctions, there is evidence that the term *before* is more easily acquired than *after* (Boehm, 2004; Clark, 1985). However, in comprehension tasks the child acts initially as if the order-of-mention, and not the conjunctions *before* or *after*, determined the interpretation. Therefore, the event, action or object mentioned first is understood and treated by the child as representing the first one in the sequence.

The temporal concepts *before* and a*fter* are present, respectively, in item 12 and in items 15 and 23. In item 12 ("before you point at the green shapes, point at the white circle") there was a low percentage of errors (5.3%), which right away demonstrates that children with ages between 7 and 9 already have some grasp of the concept *before*. The same did not happen in items 15 and 23, though, which might show greater ease and precociousness in the comprehension of the term *before* in relation to the expression *after*, confirming what was previously stated.

In items 15 ("point at the green circle, after you have pointed at the green square"), and 23 ("point at a white shape, after you have pointed at the big shape below a triangle"), the most frequent error was the inversion of the order requested in the instruction (14.9% and 5.4% for both instructions of items 15 and 23, respectively). For instance, the figure most chosen in the first instruction of item 15 was shape 9 (green circle = 15.6%), while in the second instruction of the same item it was shape 5 (green square = 16.6%). By carrying out the analysis of the errors made in these items, another type of error also became clear, consisting in the identification of only one shape, usually the green circle in item 15 (6.1%) and the white circle in item 23 (8.5%). Consequently, the children only performed the instruction that was given first. In that sense, the error patterns detected in items 15 and 23 demonstrate that the adoption of the strategy of comprehension based on order-of-mention is still used in instructions containing the concept *after*. In addition to this, in this process of decoding, the instruction's memory load (Stevenson & Pollitt, 1987) or the child's impulsiveness to answer may interfere, therefore limiting his/her capacity to interpret. As noticed by Trosborg (1982), when the child has to act according to a verbal instruction, it is a great advantage to get the signal for inversion of order at the beginning of the sentence (as in item 12). Otherwise, the child may not be capable of stopping an intended act from being carried out.

In addition to items 12, 15 and 23, item 19 ("point at a large shape, but first point at a black triangle") also assesses a concept of temporal inversion: *but first*. It was shown through the frequencies analysis that in this item, similarly to what happened in item 12, there was a low incidence of errors (13.2%), in comparison with the rest of the items that required the identification of two shapes. So, the

data obtained in item 19 converge with the ones obtained in item 12, as they demonstrate the relative easiness in the comprehension of *but first* and *before you have*.

The ICT also assesses concepts of exclusion, such as: "point at the shape that is *not* a triangle and that is *nor* black, *nor* small" (item 20); "*instead of* pointing at a square, point at a circle on the right of a triangle" (item 21). Regarding these items, both of them present a considerable percentage of errors (23.2% and 22.4%, respectively). This is justifiable due to the complexity and extent of these items, since they require not only operations of denial, but also the retention of a group of attributes. Indeed, the sentences that imply the concept of negation require considerably more time to be understood, and the children's mastery of them takes time, given the complexity of the respective syntactic structures (Carroll, 1999; Dimroth, 2010), thus increasing the probability of incorrect interpretations. It also seems plausible that discordant connectives, which express antithetical meanings and introduce exceptions to events, take longer to master (Nippold, Schwarz, & Undlin, 1992). These difficulties with negative sentences and discordant connectives are also due to the fact that it is easier to deal, cognitively, with positive information than with negative information, since denial implies the exclusion of characteristics (or attributes) present in the sentence (Lahey, 1988). Denial or truth-functional negation require that children can simultaneously represent two mental models, one representing a true state and other representing its false counterpart (Dimroth, 2010). Consequently, when, in a sentence, more than one denial appears – such as in item 20 –, the difficulties of processing increase evenly (Sim-Sim, 1998), thus justifying the amount of errors found.

CONCLUSIONS

This study carried out the quantitative and qualitative analysis of the errors made by Portuguese children in the ICT, of the BANC, aiming to scrutinise difficulties in the comprehension of a group of linguistic concepts.

The qualitative analysis, along with the quantitative one, made it possible to verify that the items in which more errors were found correspond, to a point, to the concepts that are acquired at a later stage. Even so, the errors' analysis enabled us to put into evidence a broad group of elements, inaccessible through the mere analysis of the correctness or incorrectness of the answers. Thus, and firstly, it confirmed available research in what concerns the developmental progression in the acquisition of the locatives, the relative ease in the decoding of the coordinative conjunction *and*, the greater ease in the comprehension of the term *before* in relation to the term *after*

and the difficulties in the processing of denial. Secondly, it drew attention to the role that working memory can have in this test. Thirdly, it revealed several comprehension difficulties, such as those concerning: some locatives (*below*, *left* and *right,* and particularly *left)*; the coordinative conjunction *and*, when it connects two clauses with the same referent; the connective *but*, when it introduces equality; the adoption of the order-of-mention strategy, in instructions containing after.

Nonetheless, we consider that it would have been useful to include other age groups in the errors' analysis, namely the age group of the 6-year-olds, as well as to compare different age levels. Although this last option has been carried out for 7, 8 and 9 years old, it was not possible to include it in the present work.

In another perspective, it should be mentioned that, in the qualitative analysis it was difficult, in some cases, to identify the most important reasons that could explain the errors, among the various available ones. In other words, it became clear that – given the complexity and diversity of the concepts and attributes present in the items – it is not always clear or unequivocal which factors interfere in the comprehension process and that, therefore, condition the children's answer, leading them to make the type of errors found. In sum, errors' analysis deepens, but it does not deplete the possibilities of detailed examination of the concepts assessed in the ICT.

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