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Analysis of population recognition of pictures from the sentence production program for aphasia

Análise do reconhecimento populacional das figuras do sentence production program for aphasia

Keywords

Aphasia
Rehabilitation
Language
Language Disorders
Translation

ABSTRACT

Purpose: To analyze the recognition of the pictures and contexts familiarity from the Sentence Production Program for Aphasia (SPPA) to acquire data determining its potential use in Portuguese and/or need for adaption. **Methods:** The stimuli for English speakers were first translated, back-translated and adjusted without changing the syntactic structures of the phrases. The material was then tested in 39 highly literate individuals. In the first stage of the study, the adults had to produce a phrase corresponding to each picture. In the second stage, participants were exposed to the original phrases associated with their respective contexts. Participants were given an answer sheet containing numbered responses for each picture and rated the familiarity of the contexts on an analogic scale ranging from 0 to 10. **Results:** Based on the sentences produced by the participants, the overall mean agreement of stimuli with responses for the pictures from the SPPA was 35.5%. Familiarity of the contexts with pictures was greater in scenes involving sentences with a syntactic structure similar to that of Portuguese. **Conclusion:** Given most stimuli had a low level of recognition, adaptations are required for use of the program in the Brazilian population. The study allowed identification of those pictures which need adapting before use in the rehabilitation of agrammatic patients in Brazil.

Descritores

Afasia
Reabilitação
Linguagem
Transtornos de Linguagem
Tradução

RESUMO

Objetivo: Analisar o reconhecimento das figuras e a familiaridade dos contextos do *Sentence Production Program for Aphasia (SPPA)*, para obter dados sobre a possibilidade de uso para a língua portuguesa e/ou da necessidade de sua adaptação. **Método:** Inicialmente, foi realizada a tradução dos estímulos por falantes do inglês e, em seguida, a retrotradução para ajustes sem a alteração das estruturas sintáticas das frases. O material foi então submetido para a análise de 39 indivíduos adultos de alta escolaridade. Na primeira fase do estudo, os adultos deveriam criar uma frase de acordo com cada figura apresentada. Na fase seguinte do estudo, os participantes foram expostos às frases originais associadas aos seus respectivos contextos. Os participantes receberam uma folha de registro das respostas com numeração segundo as figuras e julgaram a familiaridade dos contextos a partir de uma escala analógica de 0 a 10. **Resultados:** Observou-se que a média geral de concordância dos estímulos com as respostas para as figuras do SPPA foi de 35,5%. Em relação à familiaridade dos contextos com as figuras, essa foi maior para as cenas relativas às frases com estrutura sintática mais usadas em português. **Conclusão:** Pelo fato de os estímulos terem apresentado baixo grau de reconhecimento, adaptações serão necessárias para que o programa possa vir a ser utilizado na população brasileira. O estudo também permitiu identificar quais as figuras que necessitam de adaptação antes de serem usadas para a reabilitação de pacientes agramáticos no Brasil.

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INTRODUCTION

Aphasia is defined as an acquired language disorder that results from damage to the Central Nervous System (CNS), characterized by impairments in auditory comprehension and oral-expressive language and/or writing. Difficulty with comprehension, reading, speaking and/or writing can occur⁽¹⁾. Aphasia is caused by lesions to the left hemisphere, an area associated with language functions⁽²⁾.

Aphasia manifests in different forms in each individual, depending on the site and severity of the brain injury and language ability prior to lesion⁽³⁾. Lesions can have different etiologies such as stroke, traumatic brain injury (TBI), infectious diseases, or tumors involving the CNS⁽⁴⁾.

The goal of speech-language therapy for aphasia-related deficits is to remediate patient communication abilities.

The therapy approaches available are designed to improve some of the more common language symptoms arising in this patient group. Therapy focused on language processing deficits allows control, at least in part, of the effectiveness of treatment⁽⁵⁾. No published Brazilian literature or commercial material exists reporting therapy methods for the specific language symptoms of aphasia. Therefore, a study of the methods published in other languages for rehabilitation of some of the problems classically found in aphasic patients can be of great use.

One of the most common symptoms of aphasia is agrammatism, a change in syntactic structure evidenced by the omission of sentence components⁽⁶⁾. Grammatical words tend to be dropped in speech while lexical words are retained. In severe cases, utterances can be restricted to single words; sentence structure can be made up of only simplified forms. The core feature of grammatical production in aphasia is that utterances consist of words strung together in an ungrammatical sequence or, at best, simple canonical sentences (e.g., subject-verb-object)⁽⁷⁻⁹⁾. In agrammatism, sentences are often shorter and low grammatical complexity contributes to reduced fluency⁽¹⁰⁾. The speech of individuals with agrammatism is paused and characterized by omission and/or substitution of morphemes and verbs. Besides affecting spontaneous speech, agrammatism can be observed in repetition, reading and writing^(11,12).

There is a lack of specific protocols for the treatment of agrammatism. In addition, the existence of syntactic differences across languages can hamper adaptation of available protocols. Three key therapeutic intervention protocols for agrammatism in the literature include: *Linguistic Specific Treatment* (LST), whose aim is to increase knowledge on the lexical representation of verbs and access of lexical and syntactical elements of sentences⁽¹³⁾; *Reduced syntax therapy* (REST), whose objective is to enable patients to produce more fluent speech and ensure that the formulation of everyday phrases takes place in an easier and simpler manner⁽¹⁴⁾; and the *Sentence Production Program for Aphasia* (SPPA)⁽¹⁵⁾.

The SPPA consists of 120 sentences grouped into 8 Blocks of 15 sentences according to 8 different types of grammatical structures. The sentences are presented together with a picture

and introduced within a context read out by the therapist. The 8 types of grammatical structure have different inherent levels of complexity. Because the program was originally developed for use in the United States, some of the images reflect North-American culture, with references to baseball, to American football, and so forth. Moreover, it is believed that the complexity of the grammatical structures in English does not match that of the corresponding Portuguese sentences.

Before the SPPA can be used in Brazil, it is important to analyze whether recognition of the pictures and familiarity of the contexts in which the sentences appear in the program are similar to those of Brazilian culture or whether these require prior adaptation.

Therefore, the objective of the present study was to analyze the recognition of pictures and the familiarity of the contexts from the Sentence Production Program for Aphasia (SPPA) to acquire data determining its potential use in Portuguese and/or the need for adaptation.

METHODS

This study was approved by the Research Ethics Committee of the institution (Permit 1475/2016). All participants were given information on the study and signed the Free and Informed Consent Form.

The present study was based on the SPPA program containing 120-pictorial stimuli and 120 sentences whose context was everyday situations of three families. The sentences are grouped into 8 blocks according to their syntactic structure: Imperative Intransitive; Imperative Transitive; Wh- Interrogative (What & Who); Wh- Interrogative (Where & When); Declarative Transitive; Declarative Intransitive; Comparative; and Yes-No Questions.

The study method is described in two sections: 1 and 2, with the latter is divided into subsections 2.1 and 2.2.

Part 1 Translation

The first step was to translate the SPPA sentences from their original English into Brazilian Portuguese. Two fluent speakers of both languages translated the instructions and stimuli into Portuguese. Another translator then performed the back-translation of this version. After translation and back-translation, minor changes were made to the stimuli in order to ensure equivalence of the structures at word and sentence level. In the event of doubts over items that differed between the translation and back-translation, a third expert judge fluent in Brazilian Portuguese and English was consulted to reach a consensus on the best way to translate the stimuli.

Part 1 of this study entailed translation of the instrument while part 2 involved the analysis of recognition of the pictures alone, and of the pictures together with their respective contexts.

Part 2: Analysis of pictures and of familiarity of contexts

Analysis of recognition of pictures from the SPPA

This step consisted of determining how well the pictures represented the context of the SPPA sentences, based on the recognition analysis performed by the non-expert judges.

In order to analyze the recognition of the context elicited by the pictures, group data collection was performed for 39 young adults with a high educational level. High-educated subjects were chosen because low educational level may have led to poor agreement of answers^(2,16).

The SPPA pictures were first scanned and then organized by sentence group. The pictures associated with the sentences were presented to participants using the Microsoft Office Power Point application in a quiet room with appropriate lighting. The images were displayed by a projector connected to a microcomputer.

The participants were given an answer sheet numbered according to the slides. The following instruction was then given:

You are going to see a series of pictures depicting everyday scenes. You must imagine that a sentence is said in the context of each picture. The sentences may vary in terms of grammatical structure (imperatives, imperatives with complement, interrogatives, declaratives and comparatives). You must create a sentence that you believe best applies to the context shown by the picture and that obeys the predetermined grammatical structure.

The maximum display time for each picture was 20 seconds.

After writing the sentences for the pictures displayed on the slides, each participant handed in their answer sheet for analysis. The agreement between participants' answers and the original stimuli for the SPPA was then analyzed. One of the researchers was responsible for assessing participants' answers and checking whether participants had failed to provide an answer or had answered the questions differently to that requested. Answers which used a different grammatical structure to that requested were considered wrong.

The data were subjected to statistical analysis. The mean overall recognition of the pictures was calculated together with mean recognition per sentence block. Blocks were compared using the Kruskal-Wallis test. Tukey's multiple comparison (pairwise) test was applied in cases exhibiting 5% significance to determine which sentence blocks were more recognized than others.

Analysis of rating of context familiarity together with picture recognition

For this stage, participants were shown all the material, i.e.: the original translated sentences of the SPPA were presented together with their respective contexts. The 39 volunteers from phase 2.1 took part in this step. This group only received the complete context after finishing the first step. The participants listened to the context read out loud, while reading the sentence. They then had to answer the following question: "How familiar is this context/scene to you?". The participants were given an answer sheet containing numbered responses according to the

slides/contexts and rated the familiarity of the contexts on an analogue scale from 0 to 10, where 0 indicated no familiarity and 10 indicated 100% familiarity. After collection of answers, the familiarity of the stimuli was analyzed statistically.

A separate statistical analysis was performed for the analysis of the familiarity of the pictures together with their respective context.

The result of the comparison between the two variables (pictures and context) was obtained using Friedman's test with Sidak's multiple comparisons (pairwise) for instances of > 5% significance. All of the items that reached the level of significance were submitted to multiple comparisons.

RESULTS

Phase 1: Translation

Phase 1 of the study involved the process of translating the original sentences into Portuguese. The Portuguese translation by the two translators and the back-translation were analyzed and found to agree. The stimuli from the SPPA essentially comprise simple sentences and thus the resultant translation obtained in this step proved consistent. Consequently, the 3rd judge only checked whether the final translation of the stimuli reflected the same syntactic structure as their corresponding stimuli in English.

Two participants discontinued during the group data collection process. The final analysis was thus performed for the answers of 37 individuals.

Phase 2: Analysis of pictures and of familiarity of contexts

Analysis of Recognition of pictures from SPPA

In phase 2.1 of the study, the extent to which pictures represented the context of the SPPA sentences was determined based on the overall mean agreement with expected answers, i.e. SPPA sentences versus sentences produced by the participants. This comparison revealed the degree of similarity between the two sets of sentences. The overall mean for expected answers for all program pictures is given in Table 1.

The mean recognition rate for each Block of Pictures was calculated to ascertain whether the low recognition was due to specific types of grammatical sentences distributed in the 8 blocks and which may have reduced the overall mean recognition of the picture contexts by the volunteers. The results are shown in Table 2. For improved readability of the answers, the data

Table 1. Overall Mean recognition of SPPA pictures

	Expected answer for picture
Mean	35.6%
Median	24.0%
Minimum	0.0%
Maximum	100.0%
Standard deviation	33.0%
n	120

Table 2. Mean recognition of each sentence block for SPPA pictures

		BLOCK								Total
		1	8	4	5	3	2	7	6	
Expected answer for picture	Mean	19.7%	27.6%	30.4%	31.5%	35.4%	36.1%	40.2%	63.5%	35.6%
	Medium	16.0%	5.0%	19.0%	24.0%	30.0%	32.0%	32.0%	76.0%	24.0%
	Standard deviation	26.2%	36.0%	32.1%	29.3%	27.7%	29.6%	35.7%	35.2%	33.0%
	n	15	15	15	15	15	15	15	15	120

Chart 1. Comparison of recognition of sentences from the SPPA for each Block

BLOCK	COMPARISONS
1	(S4=S15=S7=S5) < (S6=S10=S3=S1)
2	(S23=S16=S28=S29=S18=S20) < (S30=S22=S27=S25=S17=S24=S19)
3	S32 < (S42=S37=S41=S40=S43=S35=S33=S45=S31)
4	(S48=S51=S54=S58=S56=S46) < (S47=S53=S49=S57=S60=S50=S55)
5	(S66=S74=S63=S61) < (S75=S71=S70=S64=S72=S67=S65=S62=S68)
6	(S88<S87=S86) < (S80=S77=S84=S81=S89=S82=S85=S76=S90=S78=S79=S83)
7	(96=S98=S97) < (S103=S92=S101=S102=S95=S99=S91=S100)
8	(S115=S109=S110=S113=S119=S11)<(S118=S108=S120=S116=S114=S112=Ss07=S117)

S = Sentences Sidak Comparisons

are presented in increasing order for the Blocks of sentences (from lowest to highest mean recognition rate).

All sentence blocks were then statistically compared to determine whether the blocks differed significantly for picture recognition. The Kruskal-Wallis test was applied followed by Tukey's multiple comparisons test to check where the differences occurred.

The results showed that the pictures for sentences from Blocks 1 and 8 had lower recognition than those for sentences from Block 6, where this difference was statistically significant. The other blocks were similar to one another in terms of recognition, with no statistically significant differences.

Analysis of rating of context familiarity together with picture recognition

The familiarity of the contexts together with pictures presented was assessed. To this end, mean recognition of each sentence in each of the blocks was checked. Subsequently, comparative analysis of sentences from each block was performed in a pairwise fashion. The results of these analyses are provided in the Appendix A for reference.

The analysis of all the tables revealed which sentences had lower recognition rates. These sentences are shown in Chart 1.

DISCUSSION

The aim of the present study was to analyze recognition of pictures and familiarity of contexts of a North American program for rehabilitation of agrammatism for potential use in Brazil. The key finding of this study was that recognition of the pictures was low, even when used together with their respective contexts. These findings will be discussed in the ensuing text.

With regard to the translation of the stimuli, a consensus on the versions produced between the translators and researcher was reached, where the professionals involved were versed in the English language. Some adaptations were made to maintain the original syntactic structure of the sentences, and the names of the characters of the three families were changed so as not to sound strange to the Brazilian volunteers. These changes were minor and agreed by the 3 judges.

It is widely acknowledged that visual elements do not have pre-established meanings. These elements only take on meaning when associated with a formal context⁽¹⁵⁾. In order for an image to be understood and duly processed, there is a hierarchy of recognition that ensures the image can be recognized accurately. The types of signs featured in the image are first identified: icon signs (drawing), plastic signs (characteristics such as color, shape and texture) and language sign (related to verbal language)⁽¹⁶⁾. The image is then processed using inferences, which are mental representations the individual has based on their world knowledge⁽¹⁷⁾. We believe that the group data collection process with the volunteers elicited this processing: the image was presented to the individuals who then had to interpret it. This interpretation was possible (or not) based on the world knowledge held by the group of young high-educated adults. A high rate or percentage of image recognition was expected.

This world knowledge is directly related with the culture and experiences of the individual. If the representation of the image is compromised during any of these processes, particularly with regard to the mental representation of the stimulus, this inference is likely to be incomplete. This can lead to problems understanding the image, given that familiarity is an important predictor of this recognition^(18,19). The generally low recognition of the pictures seen in Table 1 can be explained by 3 different hypotheses: the existence of cultural differences between the

Brazilian and North-American populations; the fact that volunteers recognized the image, but this did not generate the expected context in the program; and difficulty interpreting pictures that represent actions, which are semantically more complex than nouns⁽²⁰⁾. Regarding the overall mean recognition of pictures for each of the blocks, the statistical analysis showed that overall mean recognition of pictures from Blocks 1 and 8 was lower than that of pictures from Block 6. Comparisons among the other Blocks showed similar recognition rates. This finding might be explained by the type of syntactic structure used when participants have to write a sentence for the picture, allied with the cultural difference between the volunteers and North-American population. The first Block contains intransitive imperative sentences constituting commands with only one (intransitive) verb that does not require a complement. The use of intransitive imperative sentences is uncommon in Portuguese because, unlike in English, most verbs used for requests or commands require a complement. The pictures from Block 8 involve producing interrogative sentences which should be answered with a Yes or a No. Thus, from a picture, the individual should devise a sentence, e.g. "Do you eat meat?" This block had the lowest rates of answers matching those originally devised in the SPPA since, as outlined previously, the absence of a context widens the range of interpretations, especially if a picture is unclear. The pictures representing questions have broader and more open contexts that are harder to represent in a specific way. As a consequence, the range of answers increases and the recognition rate decreases. In this case, participants' answers varied more when they had to devise questions, and the fact that questions are involved likely broadened interpretation and led to vaguer answers.

Block 6, whose pictures had higher recognition by the volunteers, correspond to declarative intransitive sentences (subject + verb without complement). The pictures in this block were clear and objective, i.e., elicited the target sentence. Also, the simplicity of the syntactic structure of this block was a facilitating factor.

In phase 2.1 of the study, in which pictures were presented to participants without their respective contexts (Table 2), removal of context increased the number of different interpretations of the images. The pictures tended to be identified based on participants' world knowledge and most interpretations failed to match the target phrases from the SPPA. This result confirmed that the pictures alone proved insufficient to elicit the target sentence of the program.

These images depict everyday scenes of three North-American families, but some activities performed by this population differ to those found in Brazil⁽²¹⁾.

In phase 2.2 of the study, pictures together with their contexts were presented to the participants, who rated how familiar these were on an analog scale.

The statistical analysis revealed, in increasing order of recognition, which images plus contexts were least familiar to the participants for each of the Blocks of sentences. The results of comparisons showed that for all blocks, certain pictures when

presented together with their respective sentences, were rated as having low familiarity by study participants. Individual analysis of each Block revealed that in Block 3, for example, only one stimuli differed in familiarity to the rest. By contrast, eight stimuli in Block 8 showed a statistically significant difference for familiarity. On average, at least 4 stimuli (sentences+pictures) per block were rated as less familiar relative to the other stimuli. This result indicates that, even when the pictures were combined with sentences, there were cultural barriers to identifying the stimuli. This finding strongly suggests that the SPPA requires extensive reformulation of some situations depicted in the pictures and others in the sentences, so that they may better reflect Brazilian culture. Chart 1 shows which images with low recognition need reformulating for use in Brazil.

A message conveyed by an image predicts the textual message because the image is a form of universal understandable information for populations with different languages and cultures. The processing of these images is reliant on language inferences, defined as mental representations that allow the construction of new knowledge drawing on data previously held by the interlocutor (world knowledge). This memory is activated and applied to language information explicit in a message. The frequency and familiarity of the semantic representations aid recognition of what they infer⁽²²⁾.

However, the degree of imageability and concreteness⁽²³⁾ of the SPPA images failed to promote the recognition of the contexts these images are supposed to depict. Major cultural differences and comprehension difficulties for the stimuli presented were evident, where lower than expected ratings were given even for pictures representing everyday scenes of Brazilian culture. Images incorporated world knowledge of the population and were therefore expected to have a high level of recognition, but this was not the case for many of the stimuli. A number of pictures were poorly recognized when presented alone, but subsequently interpreted correctly when presented together with their contexts. This shows low recognition for pictures alone and highlights the importance of presenting images within a context to facilitate their comprehension, as occurs in the SPPA. However, determining the degree of recognition of the pictures and the familiarity of the situation produced by the contexts allows estimation of their role in processing the stimuli from the program. Not all pictures with low recognition rates proved easier to recognize when presented together with the context.

This study had some limitations including a difficulty inherent to group data collection of excluding participants and the large number of pictures presented, which may have led to participants losing interest in providing the best possible answer during the course of the procedure.

CONCLUSION

The pictures from the SPPA had a low degree of recognition and familiarity for the contexts, where adaptations are required for use of the program in the Brazilian population. The study also allowed identification of those pictures which need adapting before use in the rehabilitation of agrammatic patients in Brazil.

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Author contributions

BRPR collected, analyzed and interpreted the data, and drafted the paper. R. SSS helped to design the study. KZO supervised the data collection, performed the analysis and interpretation of the data, drafted and performed critical.

Appendix A. Analysis of the recognition of each one of the SSPA sentences

Table A1. Mean recognition of figures of Block 1

Block 1	S4	S15	S7	S5	S12	S8	S2	S13	S11	S9	S14	S6	S10	S3	S1
Mean	3.0	4.4	5.2	5.5	6.1	6.2	6.3	6.9	7.1	7.8	7.9	8.2	9.1	9.1	9.4
Median	3.0	5.0	6.0	6.0	7.0	6.0	7.0	7.0	8.0	9.0	8.0	9.0	10.0	10.0	10.0
Standard deviation	3.1	3.4	4.0	3.8	3.1	3.1	3.0	2.6	3.1	2.9	2.2	2.0	1.6	2.0	.9
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A1. Multiple comparison of mean recognition of block 1

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
S2	.000													
S3	1.000	.002												
S4	.000	.001	.000											
S5	.000	1.000	.007	.140										
S6	.073	.044	.999	.000	.050									
S7	.000	1.000	.002	.175	1.000	.004								
S8	.000	1.000	.003	.003	1.000	.083	1.000							
S9	.142	.793	.954	.000	.438	1.000	.05	.502						
S10	1.000	.000	1.000	.000	.003	.750	.000	.000	.888					
S11	.015	1.000	.312	.000	.859	1.000	.716	1.000	1.000	.248				
S12	.000	1.000	.003	.001	1.000	.023	1.000	1.000	.782	.000	.999			
S13	.000	1.000	.021	.000	.977	.453	.522	1.000	1.000	.014	1.000	1.000		
S14	.025	.173	.920	.000	.063	1.000	.006	.737	1.000	.860	1.000	.034	.500	
S15	.000	.691	.000	.983	1.000	.000	1.000	.925	.004	.000	.020	.443	.009	.000

Then: (S4=S15=S7=S5) < (S6=S10=S3=S1)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow

Table A2. Mean recognition of figures of Block 2

Block 2	S23	S16	S28	S29	S18	S20	S26	S21	S30	S22	S27	S25	S17	S24	S19
Mean	3.7	4.4	4.4	4.7	5.5	6.2	6.6	7.0	8.1	8.3	8.3	8.4	8.6	9.1	9.5
Median	4.0	5.0	4.0	5.0	5.0	7.0	7.0	8.0	10.0	10.0	10.0	9.0	10.0	10.0	10.0
Standard deviation	3.4	3.4	3.9	3.2	3.1	3.8	3.2	3.3	3.3	2.9	2.8	1.7	2.5	1.9	1.4
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A2. Multiple comparison of mean recognition of block 2

	16	17	18	19	20	21	22	23	24	25	26	27	28	29
17	.000													
18	1.000	.005												
19	.000	.999	.000											
20	.833	.368	1.000	.002										
21	.041	.615	.999	.026	1.000									
22	.000	1.000	.073	.924	.785	.988								
23	1.000	.000	.300	.000	.096	.001	.000							
24	.000	1.000	.001	1.000	.021	.042	1.000	.000						
25	.000	1.000	.001	.102	.118	.876	1.000	.000	1.000					
26	.318	.236	1.000	.001	1.000	1.000	.397	.021	.014	.303				
27	.000	1.000	.012	.754	.631	1.000	1.000	.000	1.000	1.000	.559			
28	1.000	.000	1.000	.000	.962	.108	.000	1.000	.000	.000	.287	.000		
29	1.000	.000	1.000	.000	.999	.133	.001	.998	.000	.000	.437	.000	1.000	
30	.000	1.000	.064	.917	.935	1.000	1.000	.000	1.000	1.000	.971	1.000	.000	.001

Then: (S23=S16=S28=S29=S18=S20) < (S30=S22=S27=S25=S17=S24=S19)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow

Table A3. Mean recognition of figures of Block 3

Block 3	S32	S44	S36	S39	S34	S38	S42	S37	S41	S40	S43	S35	S33	S45	S31
Mean	1.0	6.5	6.6	6.7	6.8	7.3	7.7	7.8	8.0	8.0	8.5	9.0	9.2	9.5	9.5
Median	.0	7.0	7.0	7.0	7.0	8.0	9.0	9.0	10.0	9.0	10.0	10.0	10.0	10.0	10.0
Standard deviation	2.0	2.9	3.3	2.3	3.0	2.5	3.0	2.7	2.8	2.2	2.3	2.4	1.3	1.0	1.2
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A3. Multiple comparison of mean recognition of block 3

	31	32	33	34	35	36	37	38	39	40	41	42	43	44
32	.000													
33	1.000	.000												
34	.000	.000	.002											
35	1.000	.000	1.000	.222										
36	.000	.000	.003	1.000	.003									
37	.079	.000	.561	1.000	.936	.943								
38	.000	.000	.010	1.000	.499	1.000	1.000							
39	.000	.000	.000	1.000	.004	1.000	.976	1.000						
40	.038	.000	.507	.926	.999	.819	1.000	1.000	.404					
41	.080	.000	.730	1.000	.884	.551	1.000	1.000	.252	1.000				
42	.194	.000	.584	1.000	.898	1.000	1.000	1.000	1.000	1.000	1.000			
43	.868	.000	1.000	.601	1.000	.419	1.000	.979	.100	1.000	1.000	1.000		
44	.000	.000	.000	1.000	.003	1.000	.382	1.000	1.000	.753	.243	.991	.040	
45	1.000	.000	1.000	.001	1.000	.000	.031	.003	.000	.109	.207	.035	.547	.000

Then: S32 < (S42=S37=S41=S40=S43=S35=S33=S45=S31)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow

Table A4. Mean recognition of figures of Block 4

Block 4	S48	S51	S54	S58	S56	S46	S52	S59	S47	S53	S49	S57	S60	S50	S55
Mean	2.8	3.3	4.1	5.3	5.6	5.6	5.9	6.3	7.7	7.8	7.9	8.1	8.4	8.7	8.8
Median	2.0	3.0	4.0	5.0	6.0	7.0	7.0	6.0	9.0	10.0	9.0	10.0	10.0	9.0	10.0
Standard deviation	2.6	3.2	3.6	3.6	3.9	3.8	3.7	3.3	2.4	3.5	3.1	3.6	3.0	2.1	2.8
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A4. Multiple comparison of mean recognition of block 4

	46	47	48	49	50	51	52	53	54	55	56	57	58	59
47	.408													
48	.215	.000												
49	.677	1.000	.000											
50	.001	.998	.000	1.000										
51	.328	.000	1.000	.000	.000									
52	1.000	.571	.001	.190	.007	.035								
53	.571	1.000	.000	1.000	1.000	.000	.885							
54	.980	.001	1.000	.014	.000	1.000	.935	.000						
55	.020	1.000	.000	1.000	1.000	.000	.012	1.000	.000					
56	1.000	.383	.053	.458	.005	.191	1.000	.527	.975	.019				
57	.463	1.000	.000	1.000	1.000	.000	.518	1.000	.000	1.000	.477			
58	1.000	.142	.104	.658	.000	.302	1.000	.234	.999	.007	1.000	.056		
59	1.000	.991	.001	.995	.008	.004	1.000	.896	.054	.014	1.000	.228	1.000	
60	.166	1.000	.000	1.000	1.000	.000	.050	1.000	.000	1.000	.063	1.000	.025	.113

Then: (S48=S51=S54=S58=S56=S46) < (S47=S53=S49=S57=S60=S50=S55)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow

Table A5. Mean recognition of figures of Block 5

Block 5	S66	S74	S63	S61	S73	S69	S75	S71	S70	S64	S72	S67	S65	S62	S68
Mean	5.5	6.1	7.3	7.5	7.5	8.0	8.1	8.2	8.5	9.1	9.1	9.3	9.4	9.6	9.7
Median	5.0	6.0	8.0	9.0	8.0	8.0	9.0	9.0	9.0	10.0	10.0	10.0	10.0	10.0	10.0
Standard deviation	3.4	3.2	3.1	3.1	2.8	2.1	2.8	2.2	2.2	1.7	2.0	1.5	1.3	.7	.9
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A5. Multiple comparison of mean recognition of block 5

	61	62	63	64	65	66	67	68	69	70	71	72	73	74
62	.027													
63	1.000	.006												
64	.791	.999	.089											
65	.127	1.000	.021	.996										
66	.657	.000	.333	.000	.000									
67	.195	1.000	.113	1.000	1.000	.000								
68	.024	1.000	.005	.824	1.000	.000	1.000							
69	1.000	.007	1.000	.875	.177	.022	.385	.007						
70	1.000	.312	.921	1.000	.823	.000	.997	.250	1.000					
71	1.000	.141	.997	.997	.575	.000	.949	.104	1.000	1.000				
72	.784	1.000	.179	1.000	1.000	.000	1.000	1.000	.850	1.000	.995			
73	1.000	.013	1.000	.103	.033	.032	.247	.015	1.000	.917	.999	.021		
74	.801	.000	.995	.000	.000	1.000	.000	.000	.122	.004	.101	.000	.516	
75	1.000	.122	1.000	.992	.650	.095	.646	.172	1.000	1.000	1.000	.968	1.000	.600

Then: (S66=S74=S63=S61) < (S75=S71=S70=S64=S72=S67=S65=S62=S68)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow

Table A6. Mean recognition of figures of Block 6

Block 6	S88	S87	S86	S80	S77	S84	S81	S89	S82	S85	S76	S90	S78	S79	S83
Mean	6.0	7.7	7.9	8.0	8.1	8.5	8.6	8.8	9.3	9.4	9.6	9.6	9.6	9.6	9.6
Median	7.0	8.0	8.0	9.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Standard deviation	3.8	2.6	2.0	2.8	3.4	2.3	2.3	2.4	1.7	1.8	1.7	1.0	.7	.8	.9
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A6. Multiple comparison of mean recognition of block 6

	76	77	78	79	80	81	82	83	84	85	86	87	88	89
77	.957													
78	1.000	.633												
79	1.000	.702	1.000											
80	.500	1.000	.146	.111										
81	.130	1.000	.711	.655	1.000									
82	1.000	.947	1.000	1.000	.909	1.000								
83	1.000	.805	1.000	1.000	.163	.711	1.000							
84	.970	1.000	.571	.454	1.000	1.000	1.000	.583						
85	1.000	.922	1.000	1.000	.282	1.000	1.000	1.000	1.000					
86	.068	1.000	.003	.002	1.000	1.000	.352	.003	1.000	.247				
87	.116	1.000	.010	.014	1.000	1.000	.396	.014	.982	.397	1.000			
88	.002	.242	.000	.000	.729	.091	.000	.000	.200	.003	.753	.988		
89	.902	1.000	.995	.998	1.000	1.000	1.000	.992	1.000	1.000	1.000	1.000	.113	
90	1.000	.890	1.000	1.000	.238	.571	1.000	1.000	.753	1.000	.003	.021	.001	.995

Then: (S88<S87=S86) < (S80=S77=S84=S81=S89=S82=S85=S76=S90=S78=S79=S83)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow

Table A7. Mean recognition of figures of Block 7

Block 7	S96	S98	S97	S94	S93	S104	S105	S103	S92	S101	S102	S95	S99	S91	S100
Mean	4.0	5.3	5.8	6.5	7.1	7.1	7.5	7.8	8.4	8.6	8.8	9.3	9.3	9.6	9.6
Median	5.0	5.0	6.0	7.0	8.0	8.0	7.0	9.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Standard deviation	3.4	3.4	3.8	3.1	3.3	3.5	2.1	2.9	2.7	2.5	2.3	1.6	1.8	1.7	.8
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A7. Multiple comparison of mean recognition of block 7

	91	92	93	94	95	96	97	98	99	100	101	102	103	104
92	.399													
93	.039	.865												
94	.000	.433	1.000											
95	1.000	1.000	.048	.001										
96	.000	.000	.001	.006	.000									
97	.000	.065	.999	1.000	.001	.793								
98	.000	.009	.283	1.000	.000	.972	1.000							
99	1.000	1.000	.176	.012	1.000	.000	.001	.000						
100	1.000	.438	.009	.000	1.000	.000	.000	.000	1.000					
101	.999	1.000	.942	.067	1.000	.000	.086	.000	1.000	.886				
102	.966	1.000	.654	.019	1.000	.000	.001	.000	1.000	.907	1.000			
103	.285	1.000	1.000	.975	.678	.000	.618	.013	.488	.058	1.000	.979		
104	.004	.675	1.000	1.000	.226	.000	1.000	.449	.267	.007	.880	.200	1.000	
105	.005	1.000	1.000	1.000	.069	.000	.986	.030	.040	.000	.958	.833	1.000	1.000

Then: (96=S98=S97) < (S103=S92=S101=S102=S95=S99=S91=S100)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow

Table A8. Mean recognition of figures of Block 8

Block 8	S115	S109	S110	S113	S119	S111	S106	S118	S108	S120	S116	S114	S112	S107	S117
Mean	3.9	5.0	5.2	5.4	5.7	6.6	6.9	7.6	7.8	8.2	8.6	8.6	9.1	9.1	9.5
Median	5.0	5.0	5.0	6.0	7.0	6.0	7.0	8.0	9.0	9.0	10.0	10.0	10.0	10.0	10.0
Standard deviation	3.4	3.2	3.4	3.5	3.7	2.5	2.7	2.5	2.9	2.2	2.6	2.6	2.1	2.0	1.7
individuals	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37

Chart A8. Multiple comparison of mean recognition of block 8

	106	107	108	109	110	111	112	113	114	115	116	117	118	119
107	.001													
108	1.000	.992												
109	.479	.000	.000											
110	.982	.001	.003	1.000										
111	1.000	.004	.999	.738	.938									
112	.030	1.000	.933	.000	.000	.006								
113	.998	.001	.003	1.000	1.000	.996	.000							
114	.747	1.000	1.000	.000	.006	.118	1.000	.001						
115	.045	.000	.000	.999	.997	.075	.000	.518	.000					
116	.685	1.000	1.000	.000	.003	.144	1.000	.005	1.000	.000				
117	.001	1.000	.480	.000	.000	.000	1.000	.000	.982	.000	.930			
118	1.000	.758	1.000	.000	.021	.997	.301	.028	1.000	.000	.999	.077		
119	1.000	.004	.533	1.000	1.000	1.000	.001	1.000	.037	.904	.005	.000	.443	
120	.955	1.000	1.000	.000	.004	.851	1.000	.003	1.000	.000	1.000	.629	1.000	.127

Then: (S115=S109=S110=S113=S119=S111) < (S118=S108=S120=S116=S114=S112=Ss07=S117)

Other comparisons showed similar recognition rates

The differences in recognition between sentences are highlighted in yellow