

Grammatical dissociation during acquired childhood aphasia

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AIM We report the case of a 6-year-old female who suffered a left hemisphere stroke attributed to a genetically determined prothrombotic state. She presented a fluent speech pattern with selective difficulty in retrieving names but not verbs. An evaluation was designed to clarify whether her symptoms represented a specific impairment of name retrieval.

METHOD The child undertook an experimental battery of visual naming tasks requiring the production of 52 nouns (belonging to nine different semantic categories) and 44 verbs. Her performance was compared with that of 12 healthy children, matched for age and IQ, attending a local kindergarten.

RESULTS The child retrieved significantly more verbs than nouns ($\chi^2=16.27$, $p<0.01$) and had a significantly lower score in noun ($t=-7.2$, $p<0.005$), but not in verb retrieval than the comparison group. This pattern persisted when verbs and nouns were matched for oral word frequency, showing that the results could not be explained by stimuli difficulty.

INTERPRETATION To our knowledge, this is the first report of a grammatical dissociation in a child. It suggests that nouns and verbs are subject to different processing early in development, at least before the formal acquisition of grammar. It contradicts theories that postulate a common processing of different grammatical categories early in life.

A 6-year-old, right-handed, preschool female, developed a language disorder and right hemiplegia after a left hemisphere infarct due to occlusion of the middle cerebral artery (Fig. 1). An extensive investigation to elucidate the cause revealed only a genetic predisposition to thrombosis. She was a homozygotic carrier of the mutation PAI-1-675 G>A (5G/4G), which is rather non-specific (occurring in 42% of the normal population), and a heterozygotic carrier of the mutation MTHFR (677c>TF).

Performance on standardized tests

A formal language assessment was performed 3 weeks later (Table I). At that time the child's speech was fluent with normal syntax and prosody, but with word-finding difficulties, verbal paraphasias, and circumlocutions consisting of the description of the use of objects she could not name (e.g. 'this is to drink' instead of 'a glass'). She understood conversational speech and had a normal score for her age

on tests of lexical comprehension (recognition of named objects or line drawings among foils).^{1,2} She had significant difficulty naming real objects (50% correct) or line drawings of objects (50% correct), but could name actions.² On developmental language scales³ she performed within the normal range for her age in the comprehension scale ($z=0.4$) but had a low score ($z=-1.5$) on the expressive scales assessing vocabulary ($z<-2$) and syntax ($z=-2$). Her performance in all these measures was compared with age-adjusted normative data. Cut-off scores (1SD below mean) are presented in Table I.

Performance on experimental measures

Given the child's apparent difficulty in name retrieval, she was evaluated by an experimental naming battery requiring the production of nouns or verbs through the presentation of objects, line drawings, or pictures. Her performance on these experimental measures was compared with that of 12

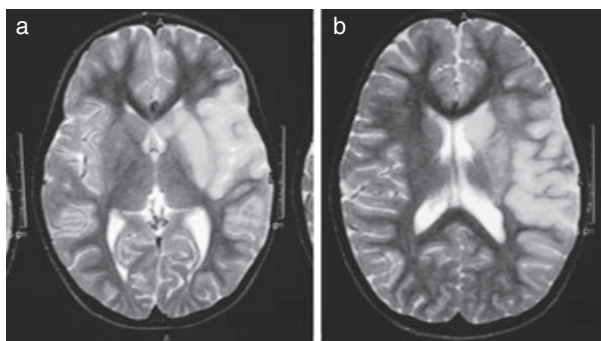


Figure 1: Brain magnetic resonance image (second day after onset) demonstrating a left hemisphere infarct in the territory of the anterior branches of the middle cerebral artery, involving the inferior frontal gyrus (pars opercularis and triangularis), transverse and superior temporal gyrus, insula, and the striatum, visible in both slices (a, b).

Table I: Performance on standardized tests

	Time after onset		Normal score ^a
	21d	8mo	
Non-verbal IQ (RCM) ⁴	NP	16	≥12.5
Language (maximum score)			
Naming			
Objects of daily use ¹ (16)	8		≥11.56
Line drawings ² (41)	23	32	≥33.76
Nouns (36)	18	27	≥29.30
Action verbs (5)	5	5	≥3.13
Verbal comprehension			
Object recognition ¹ (16)	16	16	≥15.77
Lexical comprehension ²	21	21	≥15
Comprehension of commands ¹ (8)	7	8	≥7.75
Token Test ¹ (22)	NP	16.5	≥11.77
Repetition			
Word repetition ² (15)	14		≥14.7
Pseudoword repetition ² (15)	10		≥13.3
Verbal fluency			
Animals ²	0	3	≥13.3
Objects ²	1	1	≥7.9
Reynell Developmental Scales			
Expressive language ³	50		≥51
Language comprehension ³	64		≥57

^aNormal score corresponds to age-adjusted average score minus 1SD. NP, not performed; RCM, Raven's Coloured Matrices.

healthy children of identical age, IQ,⁴ and education. These participants were selected from a local kindergarten on the basis of their age and school grade (6-year-old pre-

schoolers, without knowledge of reading or writing) and their willingness to participate. Children were tested in the school individually, after the aim and procedures of the testing had been explained to their parents and consent had been obtained.

The experimental naming battery was designed according to other published studies on verb–noun dissociation performed in adults.⁵ Material used in this battery was selected from children's books and from material used in language testing/rehabilitation on the basis of its appropriateness for the child's age group and interests. There were 44 line drawings or pictures representing people performing specific actions that required the production of transitive or intransitive verbs and 52 items representing concrete living or nonliving entities. The latter were distributed across the following nine semantic categories: clothes, furniture, household or daily-use manipulable objects (i.e. objects that can elicit learned actions), animals, body parts, fruits, vegetables, cartoon heroes (classified as proper names), and colours. Name agreement in the comparison group was 90.4% for nouns and 88.6% for verbs respectively. Cronbach's alpha of the experimental naming battery was 0.77. Statistical comparison between the study participant and the comparison group was made using SINGLIMS software.⁶

The child named verbs (39 out of 44) significantly better than nouns (26 out of 52; $\chi^2=16.27$, $p<0.01$). Her naming ability was identical across semantic categories of nouns, particularly when living entities (3 out of 8) were compared with non-living entities (10 out of 16; Fisher's exact test), moving (6 out of 12) were compared with non-moving (7 out of 16) entities ($\chi^2=0.11$, *ns*), or when manipulable objects (4 out of 13) were compared with those not associated with specific actions (12 out of 19; Yates' corrected $\chi^2=2.07$, *ns*). Her performance was low for both common names and proper names. Compared with the comparison group, the child scored within the normal range on verb retrieval but significantly below average on noun retrieval (Table II). This difference persisted when words were matched for oral word frequency.

Follow-up

Eight months later the child was quite recovered. Her performance was normal on the aphasia battery, except on noun retrieval (picture naming and verbal fluency tasks), which remained significantly worse (75%) than verbs (97.7%; $\chi^2=9.35$, $p<0.01$; Table I). She could walk unaided but had a right spastic hemiparesis with no use of the right hand and became left-handed.

The child's mother gave written consent to publish these results.

Table II: Naming tasks: patient vs comparison group

Naming tasks (maximum score)	Comparison group (<i>n</i> =12), mean (SD), range	Patient's (raw score)	<i>t</i>	Comparison group below or equal to patient's score (%)	95% CI
Action verbs (44)	38.75 (1.54), 35–41	39	0.16	56.06	34.05–76.68
Nouns (52)	45.08 (1.97), 42–50	26	−9.31 ^b	0	0–0
Proper names (cartoon heroes)	2.0 (0.85), 1–3	0	−2.26 ^a	2.25	0.03–11.17
Frequency-matched					
Low-frequency					
Nouns (11)	8.92 (1.24), 7–11	3	−4.59 ^b	0.04	0–0.32
Verbs (11)	10.08 (1.16), 7–11	10	−0.07	47.42	26.31–69.11
Medium-/high-frequency					
Nouns (16)	15.42 (0.90), 13–16	10	−5.79 ^b	0.01	0–0.03
Verbs (16)	15.58 (0.66), 14–16	16	0.61	72.33	50.03–89.41

^a*p*<0.05; ^b*p*<0.005. CI, confidence interval. Statistics performed with SINGLIMS software.

DISCUSSION

Studies of normal language development have revealed some universal tendencies. There is continuity between lexical and grammar acquisition, and nouns precede and outnumber verbs early in development,⁷ suggesting that the initial processing of nouns and verbs may share a common network. The present case challenged this view for it demonstrated that early in life, at least by the age of 6 years, there were already two independent networks for the production of nouns and verbs that might dissociate after brain lesions.

The fact that verbs were selectively spared in this case indicated that the dissociation could not be explained by a difficulty gradient in word processing. Because verbs are more abstract than nouns, are acquired and produced later during development, and have a more complex morphology and semantics (introducing the concept of time in discourse), this makes them more vulnerable to brain lesion. Indeed, studies of aphasia in adults have shown that verbs are generally more affected than nouns.⁸ Moreover, the difference persisted when items were matched for word frequency and compared with the comparison group.

The selective difficulty in the production of nouns affected all semantic categories of nouns tested and was associated with a correct description of the presented items, showing that the child had an adequate knowledge and recognition of them. She also had normal lexical comprehension for her age. This pattern of performance suggested that her difficulty lay in the phonological output lexicon or its access, and was not a semantic impairment.

The anatomical basis of this impairment is somehow atypical. In adults, verb production depends upon the left prefrontal and parietal cortices, whereas nouns are supported by the left middle temporal and fusiform gyrus. Other cortical areas are activated by both grammatical types of words with some overlap between those networks.^{9,10} In this case, verb sparing, in association with an anterior lesion, suggested that verb production may not require such participation of the frontal lobe. This is in accordance with a functional magnetic resonance imaging study of healthy participants, ranging from 7 to 32 years of age, demonstrating an age-related increase in the recruitment of the posterior frontal cortex during word retrieval (including verbs), i.e. an additive phenomenon, as well as decreased activation of the posterior temporo-parietal regions with age.¹¹

CONCLUSION

This case showed that grammatical dissociations can be found in young children before the formal acquisition of grammar; and that, despite their complex nature and late acquisition, verbs can be specifically spared after a focal lesion. These findings support the hypothesis that distinct neural networks process nouns and verbs early in development and that the frontal cortex may be progressively more involved in verb and syntactic processing with age.

Detailed analysis of acquired aphasia in childhood may contribute to the understanding of the early stages of lexical organization and its interaction with conceptual knowledge and grammatical proficiency. It may unveil the timing and factors associated with the architecture of the cognitive system, as it is known in adults.

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Book Review: WHO Child Growth Standards

Growth velocity based on weight, length and head circumference
Methods and development
World Health Organization, 2009, CHF/\$US 50.00
(In developing countries: CHF/\$US 35.00), 261 pp.
ISBN 978 92 4 154763 5

In 1993 the World Health Organization (WHO) undertook a comprehensive review of growth data and concluded that the WHO growth references recommended since the 1970s was no longer reliable. New growth curves were needed. The WHO Multicentre Growth Reference study (MCGRS) was implemented and tasked with generating new growth curves.

The MCGRS collected primary growth data from 8440 breastfed infants and young children from diverse backgrounds and cultural settings. The first WHO child growth standards based on height/length, weight, and age that described the growth of healthy children was released in April 2006.

The data presented in this book are collected from a longitudinal study of these children examined over 21 visits

for the first 24 months of age. Proponents of the use of growth velocity consider it to be a superior qualitative measurement of growth compared with measurements of size for age. The argument being that using growth velocity leads to earlier identification of growth problems if examining growth alone.

The book tabulates predicted centiles for male and female weight velocity, length velocity, and head circumference between birth and 24 months at 1, 2, 3, 4, and 6-month intervals.

The velocity standards presented in this report provide a tool for monitoring the rapid and changing rate of growth in early childhood and can be used to assess children everywhere, regardless of ethnicity, socio-economic status, and type of feeding.

For those that want to be familiar with anthropometric velocity standards for height, weight, and head circumference from birth to 24 months of age this is the book. It is not bedtime reading but it is worthwhile knowledge!

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