

SHORT COMMUNICATIONS

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OFF-LINE SENTENCE COMPREHENSION IN POLISH MONOLINGUALS: DEVELOPMENTAL STUDY BASED ON THE COMPETITION MODEL*

This article reports on a study of sentence comprehension in Polish monolingual speakers. Children and young adults were presented with a sentence interpretation task in which they listened to a sentence comprised of two nouns and a verb, and had to decide which of these two referents was the agent. This task was used to examine semantic and morphosyntactic cues that are used to determine agent roles during sentence processing. Generally, children were able to decide with greater consistency when cues converged for canonical word order (SVO). In line with previous studies on languages with rich morphology, the results indicate an early reliance on strong morphological cues. However, the manipulation of these cues is automatized relatively late at about 12 years of age as shown by a decision time factor. The developmental patterns are considered within the framework of crosslinguistic work in previous sentence interpretation studies.

Introduction

Crosslinguistic studies have revealed enormous differences between languages. They are crucial for a full understanding of the mechanisms underlying child language acquisition and language processing (Slobin, 1985; Kail & Diakogiorgi, 1998; Kempe & MacWhinney, 1999). They also enable us to test hypotheses that cannot be examined in a single language.

The developmental studies of comprehension strategies in numerous languages have shown that agentivity assignment depends mainly on the structure of a given

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language. There are few systematic studies that could analyze the nature of these strategies in Polish. The main purpose of the present study was to establish the hierarchy of morphosyntactic and semantic cues (animacy, gender and case marking configurations) in Polish children and adults.

The paper reports data from off-line sentence processing experiments conducted on Polish with children from 6 to 12 years old and adults. The Competition Model (MacWhinney & Bates, 1989) has been proposed as a way of relating observed processing differences to variations in language structure. It is an integrative-activation framework that accounts for quantitative as well as qualitative differences in performance across a wide range of languages (Kail, 2004). The model does not characterize linguistic knowledge in terms of rules but in terms of a probabilistic complex set of weighted form-function mappings. The principle of direct mapping emphasizes, among others, that the different sources of information are processed via a common set of perceptual, representational and retrieval mechanisms.

In some cases, parallel activation of the formal and functional levels leads to competition between the different sources of information for role assignment (Kail, 2004). Each language provides linguistic cues (lexical, syntactic, morphological or prosodic) which indicate semantic functions, for example, the role of agent. The strength of the connections between forms and functions vary not only from one language to another but also within one language. The notion of *cue validity* represents the objective value of a given source of information (e.g. preverbal position) for the assignment of a particular function (e.g. agent). It can be measured directly in samples of language and is the basis of predictions about language processing. Cue validity depends on how often a source of information occurs as a cue for a certain underlying function (*cue availability*) and how reliably it marks this function (*cue reliability*). *Cue strength* is a subjective property tied to the weights that language users assign to different cues during processing. Previous off-line investigations on agentivity assignment within the Competition Model framework have examined processing in over 20 languages (Bates, McNew, MacWhinney, Devescovi & Smith, 1982; Kail, 1989; MacWhinney, Bates, & Kliegl, 1984; McDonald, 1986). It has been shown that in adults, cue strength and cue validity are isomorphic. In children, the order in which cues for sentence comprehension emerge in a language is largely a function of their relative validity in that language. One of the goals of the Competition Model is to provide an account why speakers of these and other languages attribute high cue strengths to certain grammatical forms and low ones to others.

Selective features of Polish

Polish has many interesting linguistic features including a rich system of case morphology and a variable word order. It is a fusional type of language in which single grammatical morphemes combine several functions, e.g. case, gender and number in noun forms. Polish has a unique configuration of structural cues for role assignment. The experimental design was confined to a systematic crossing of animacy, Accusative-Nominative configuration and gender. Due to the fusional character of Polish, these factors often strongly interact with each other. For example, the declension paradigm of masculine inanimate

nouns in singular contains Accusative-Nominative neutralization and masculine animate nouns are consistently marked in all the paradigm cells. On the other hand, feminine nouns are always marked regardless of whether they are animate or inanimate.

Purpose of the study

When children try to understand sentences, they have to figure out who did what to whom. This problem can be thought of as the role assignment problem (Sokolov, 1989). One part of it is deciding who is the actor. However, no one has yet provided an articulation of the Competition Model for Polish. The present study used a cross-modal paradigm to analyze the processing of morphosyntactic and semantic cues in an agent identification task in Polish. In a typical off-line study, subjects are presented with simple transitive sentences and are asked to decide which noun refers to the agent of the sentence. In previous studies it has been found that when subjects are given enough time for a deliberate consideration of all available and competing cues, they integrate cues in a way that maximizes the probable efficiency of their final interpretation. However, in our study subjects are asked to give the answer as rapidly as possible after the end of the sentence.

Method

Linguistic material

The present study focuses on the cues for agentivity in simple transitive sentences that take the form noun-verb-noun (NVN). A typical sentence of this type is “The boy kicked the ball”. This sentence was chosen because it is one used in many crosslinguistic studies that have been conducted in the past.

Using the factor gender, we planned on manipulating discrepancies between the two paradigms (one containing neutralizations and the other not).

Finally, 24 different NVN sentence types were constructed with:

- three levels of noun animacy (AA: animate, animate; AI: animate, inanimate; IA: inanimate, animate);
- four levels of gender (MM: masculine, masculine; FF: feminine, feminine; MF: masculine, feminine; FM: feminine, masculine);
- two levels of case marking position (Nominative-Accusative; Accusative-Nominative).

There were 4 versions of each sentence type.

EXAMPLE:

AA, NOM- ACC, MF *Pies podnosi dziewczynkę.* [The dog picks up the girl.]

AI, ACC-NOM, MF *Konia zabiera ciężarówka.* [The horse takes the truck.]

IA, ACC-NOM, FF *Pilkę uderza foka.* [The ball kicks the seal.]

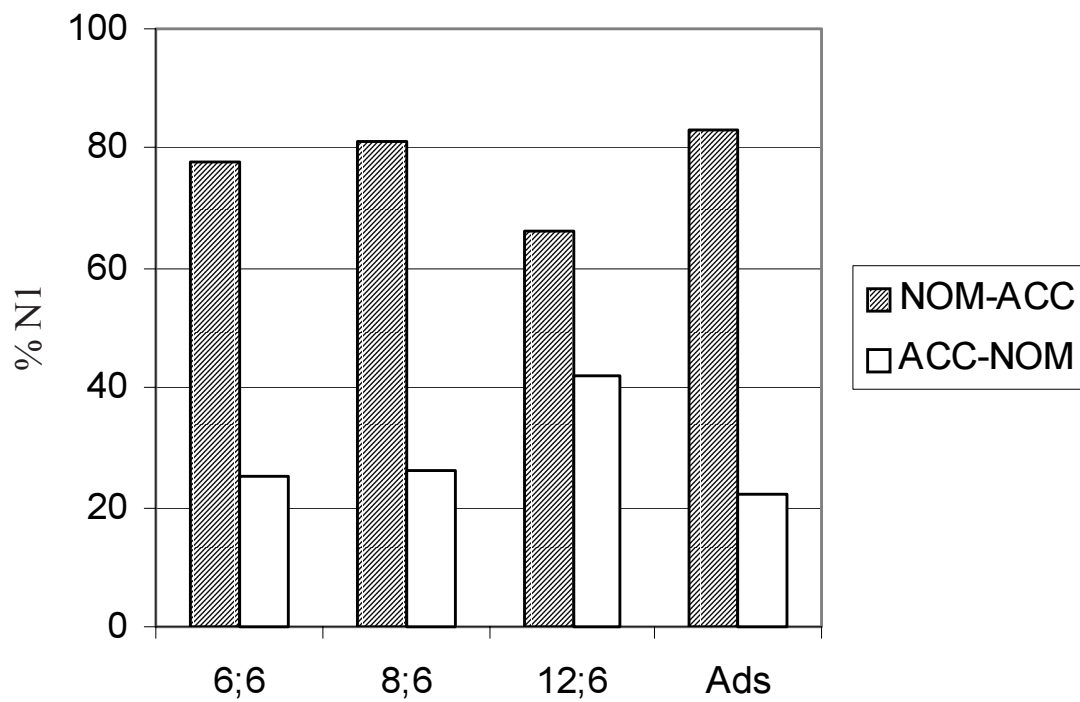
Subjects

60 monolingual Polish children (3 groups: 6;6, 8;6 and 12;6 years of age) and 16 adults (students of the University of Warsaw) took part in the experiment.

Figure 1. Percentages of N1 as agent as a function of animacy and age

% N1

Figure 2. Percentages of N1 as agent as a function of case marking position and age

7
6
6
5
5
4
4
3
3

Procedure

A cross-modal paradigm with a pointing screen was used to collect choices and decision times during the agent assignment task. Subjects heard a series of 96 simple transitive sentences with a simultaneous presentation of pictures corresponding to both nouns. Their task was: “After the sentence, as quickly as possible touch the picture that depicts who or what was carrying out the action”. Order of presentation was randomized. The E-Prime system was used to present stimuli and to collect data.

Results

Choice Responses

In line with the previous results obtained in other languages, the Polish data showed that when the animate noun was before the verb (and the inanimate after the verb) N1 was significantly more often chosen as an agent than when animacy cue was neutralized (AA) or when the first noun was animate and the second one inanimate (IA). The animacy effect was already observed in the youngest group (see Figure 1).

Case Marking Configurations had a strong impact on N1 as agent choice in all age groups: at 6;6 $F(1,20)=85.32$, $p<0.0001$; at 8;6 $F(1,18)=173.70$, $p<0.0001$; at 12;6 $F(1,18)=70.69$, $p<0.0001$; adults $F(1,14)=82.23$, $p<0.0001$. The contrast magnitude didn't change with age (see Figure 2).

As predicted by the Competition Model, cue convergence led to a higher percentage of N1 as agent choice in the groups of 6;6, 8;6, 12;6, and Adults.

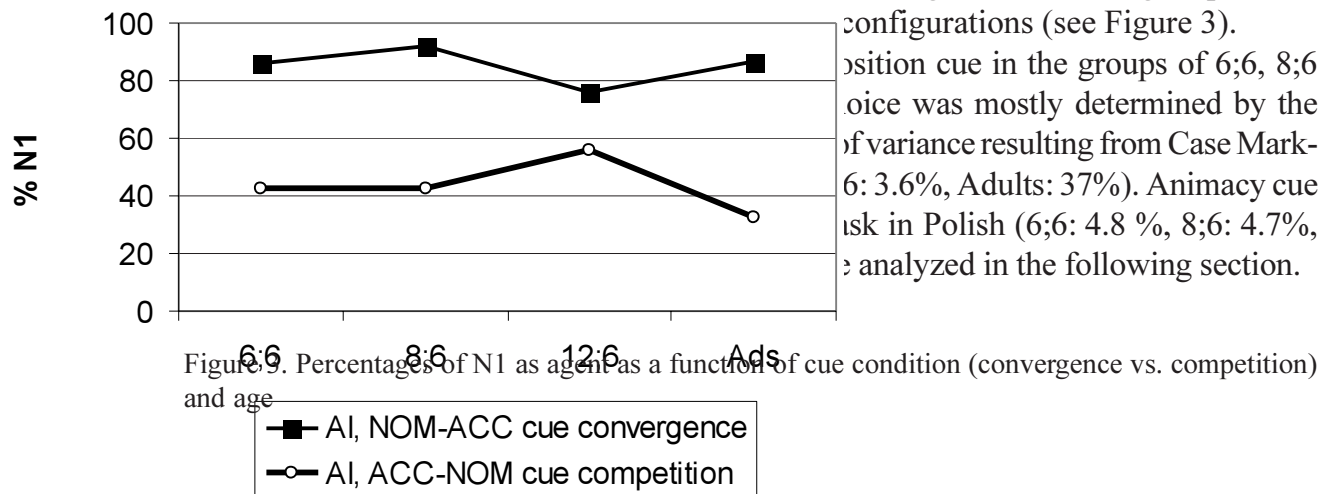


Figure 2. Percentages of N1 as agent as a function of cue condition (convergence vs. competition) and age

■ AI, NOM-ACC cue convergence
○ AI, ACC-NOM cue competition

Decision times

Decision times decreased significantly with age [$F(3,70)=12.04, p<0.0001$]. However, there were no differences between the younger groups.

Table 1. Decision times (ms)

	mean (ms)	s.d.
6;6	1230	495
8;6	1161	497
12;6	942	405
Ads.	737	318

Decision times for both Case Marking Configurations diminished with age. However, the contrast Nominative-Accusative/Accusative-Nominative was not significant except for the 8;6 age group (see Figure 4).

Figure 4. Decision times (ms) as a function of case marking position and age

Gender analyzed according to marking configurations (complete marking vs. partial marking) turned out to be significant only in the adult group [$F(1,32)=12.9, p<0.0001$]. As to partial marking configurations, when the marked noun was first in the sentence (m \emptyset), the decision times were significantly shorter than when the marked noun was in the second position (\emptyset m) [$F(1,322)=9.03, p<0.003$].

Figure 5. Decision times (ms) as a function of marking configurations

Discussion

The study revealed that morphological marking is the crucial factor in the NVN sentence comprehension process in Polish. In choice responses out of three factors manipulated: (case marking configuration, animacy and gender), case marking turned out to influence the most strongly the decisions of all the subjects, regardless of age. The semantic factor *animacy*, in contrast to such languages like German (Kempe & MacWhinney, 1999) and Italian (Bates et al., 1982), was much less important in the role assignment task in Polish. Gender, eventually decomposed to complete vs. partial marking contrast, was also in a way a morphological factor. However, the percentage of variance did not form any consistent profile across age groups.

Generally, most results from this study confirm the Competition Model predictions. Children were able to decide with greater consistency when cues converged for canonical word order (SVO). As in previously studied languages with rich case morphology: Hebrew, Greek, Hungarian, Russian (Sokolov, 1989; Diakogiorgi, 1995; Pleh, 1989; Kempe & MacWhinney, 1999) case marking was found to have strong impact on the interpretation process. However, there are enormous differences among rich morphology languages as well. Rich case morphology may refer to more and less reliable declension paradigms, containing more or less neutralizations, e.g. German vs. Russian (Kempe & MacWhinney, 1999). Polish case marking seems to be reliable because Polish monolinguals did not take into account the animacy contrast or the “first noun as agent” rule (as English monolinguals do) while interpreting the NVN sentences.

The case marking configuration proficiency is acquired early since it was equally efficiently manipulated by children in all age groups. However, it is automatized relatively late at about 12 years of age as shown by the decision time. A similar result was previously found in Greek children and adults. Kail and Diakogiorgi (1998) have shown that children as old as 10;6 years had not yet attained adult performance level. However, these results contrast with results obtained by Marslen-Wilson and Tyler (1981) suggesting that 5-year-olds are developing essentially the same types of analysis of the input as older children and adults, and that the time course of construction of syntactic and semantic representations does not differ across age.

All these results support the idea that more crosslinguistic comparisons are needed before decisive conclusions can be drawn on the respective role of grammatical and semantic constraints in sentence processing in children and adults. Undoubtedly, an on-line experiment of sentence interpretation in Polish is needed to get a deeper insight into the development of the comprehension process.

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