On-line Comprehension of Russian Case Cues in Monolingual Russian and Bilingual Russian-Dutch and Russian-Hebrew Children

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1. Introduction

For a correct interpretation of the thematic roles of constituents of a sentence, the relation between those constituents has to be understood. For each language, a combination of specific interpretation cues leads to a correct understanding of a sentence, and one of the comprehension cues is most reliable. The speed and success rate of children in acquiring those cues most relevant for their language depends on the cue reliability, cue availability and the cue strength. The case cue is the most powerful cue in interpreting thematic roles and pragmatic functions in inflecting languages like Russian (MacWhinney, 2005).

There are relatively few studies on the processing of case cues and comprehension strategies: by monolinguals in German (e.g. Dittmar, Abbot-Smith, Lieven, Tomasello, 2008; Roesch & Chondrogianni, 2014; Schipke, Knoll, Friederici, Oberecker, 2012), and by bilinguals in Lajamanu Walpiri and Light Walpiri (O'Shannessy, 2010). In Russian, most of the available studies focus on case production, so that little is known about case comprehension and case processing. Our study aims to close this gap by investigating case cue processing in monolingual Russian and bilingual Russian-Dutch and Russian-Hebrew children. Dutch and Hebrew are both languages with a sparse case morphology. Further, we aim to explore the effects of age of L2 onset (AoO), length of exposure to the language of society (LoE) and home language use.

2. Case-marking and word order in Russian, Dutch and Hebrew

Russian is a rich case language that realizes case features morphologically; all Russian nouns, adjectives, numerals, and demonstratives must have a case
Case marking in Russian is a fully grammatical cue that indicates the role of each noun in an utterance. For the interpretation of a simple transitive sentence, case-markings on the subject and the object ensure that the agents and patients are identified.

In contrast, Dutch and Hebrew have no morphological case inflections on nouns. Hebrew marks case only by the prepositions et (for accusative definite nouns) and shel for the genitive (Berman, 1978). The contrast between the three languages is presented in (1) for accusative and (2) for dative:

(1) ‘The boy loves the girl.’
RU Mal’čik ljubit devočk-u.
   Boy.NOM.M love.SG.3P girl.ACC.F
DU De jongen houdt van het meisje.
   DEF boy love.SG.3P+of DEF girl
HE ha- yeled ohev et ha- yalda.
   DEF boy love.M.SG.3P ACC DEF girl

(2) ‘The boy phones the girl.’
RU Mal’čik zvonit devočk-e.
   Boy.NOM.M phone.SG.3P girl.DAT.F
DU De jongen belt het meisje.
   DEF boy phone.SG.3P DEF girl
HE ha- yeled mitkašer la- yalda.
   DEF boy phone.M.SG.3P to+DEF girl

In Russian, the rich inflectional case morphology establishes the relationship between the different constituents in a sentence and thus allows for word order flexibility (Timberlake, 2004). In a simple transitive sentence, Russian permits all six basic word orders (SVO, SOV, VSO, VOS, OVS, and OSV). In discourse neutral contexts, Russian has a clear preference for SVO (Dyakonova, 2009; Timberlake, 2004). Kallestinova (2007) reports that three-year-old monolingual children produce all six word orders in transitive thetic sentences but that SVO is predominant. Of non-canonical word orders, adult L1 speakers consider OVS and SOV to be the most acceptable word orders (Kallestinova, 2007).

Dutch and Hebrew have much stricter word orders than Russian. Dutch has a mostly SVO word order in main clauses, and SOV in subordinate clauses (Wijnen & Verrips, 1998). Modern Hebrew uses mostly SVO word order, with

\(^1\) Russian has six cases (nominative, genitive, accusative, dative, instrumental and prepositional. There are three more case values, which do not apply to all nouns: locative, partitive and vocative. Russian has a three-gender system (masculine, feminine and neuter). Russian has three declensional patterns (that do not overlap with the genders). Not all case endings are unique between the genders/declensional patterns: therefore, it is important to know to which declensional pattern a word belongs to in order to correctly interpret and produce case-markings.
VSO only in highly restricted contexts (Doron, 2000).

3. Acquisition of case in Russian in monolingual and bilingual children

There is robust evidence that typically developing\(^2\) monolingual Russian-speaking children consistently and appropriately use case-markings from the onset of acquisition (Babylonyshev, 1993). By the age of 4;0, Russian monolingual children know a variety of case endings, meanings and contexts, and the regular inflectional patterns for the three genders. However, the acquisition of irregular and infrequent inflectional forms lasts until age 6-7 (Cejtlin, 2009; Gvozdev, 1961).

In contrast bilingual children aged 5-7 acquiring Russian as a minority language are reported to have severe problems resulting in incomplete acquisition or attrition of case cf. Gagarina (2011) for Russian-German; Peeters-Podgavskaja (2008) and Janssen (to appear) for Russian-Dutch; Meir & Armon-Lotem (to appear), Schwartz and Minkov (2014) for Russian-Hebrew; Turian and Alterberg (1991) for Russian-English; Ringblom (2014) for Russian-Swedish. All these studies were on bilingual children acquiring Russian in the context of a majority language with a sparse case morphology. Unbalanced bilinguals with Russian as their weaker language have the most severe problems.

Age of onset (AoO), length of exposure to the target language (LoE), the quantity and quality of input, and the home language use have been reported to affect the linguistic abilities of bilingual children (e.g. Anderson, 2004; Guiberson, Jancosek, & Yoshinaga-Itano, 2006). Specifically, Meir and Armon-Lotem (to appear) and Schwartz and Minkov (2014) demonstrated that children with early AoO to Hebrew exhibit more profound difficulties with Russian case morphology. The present study aims to explore the role of AoO, LoE and home language use on children’s ability to comprehend and process case morphology.

4. Processing of case

Case processing has been discussed within the Competition Model (MacWhinney, 2002, 2005). This model elaborates on language specific processing strategies and links these strategies to the cue availability (how frequent does a child encounter that particular cue in the input?), the cue reliability of the cue (does the cue always signals the same relation?), cue cost (how difficult is that cue?), and cue conflict resolution (which cue can or cannot be overridden?). Cue strength determines the speed of processing: strong cues lead to faster responses and competing cues lead to slower reaction times as they require conflict resolution. Empirically, processing costs (= slower reaction

\(^2\) When discussing acquisition, this paper refers exclusively to typically developing children. Language development in children that are at risk of having a specific or non-specific language impairment, general developmental problems, impaired hearing or attention deficit disorders is not taken into consideration here.
times) have not been found for simple sentences with conflicting cues (German adults), but processing time is longer for more complex sentences with conflicting cues (Dittmar et al., 2008).

MacWhinney’s model accounts for different processing strategies in different languages. For example, word order is the most reliable cue for non-case-marking languages like English so that noun-verb-noun strings will be processed as an SVO sentence. In languages with rich nominal morphology case marking is the predominant cue. However, there are differences in processing strategies depending on the cue strength in a specific language.

Children have been reported to use non-adult like processing strategies by adhering to ‘incorrect’ cues. For Dutch speaking adults, the strongest cue is the case on pronouns, followed by SV order and by animacy (McDonald, 1986). However, Dutch monolingual children take a long time to develop these strategies: when parsing sentences with conflicting cues similar strategies to adults appear only around age 15-16. SV word order is reported to be the predominant cue. Similarly, in Hebrew Frankel et al. (1980) showed that word order is the strongest cue. Young monolingual Hebrew speaking children with age they learn to assign subject-object roles using other linguistic information (e.g. the direct object marker ‘ha-’ for definite nouns and gender agreement).

Changes in cue preferences have been shown also for second language learners. L2 learners heavily rely on their L1 cue strength hierarchy (MacWhinney, 2002). However, this transfer decreases with growing L2 competence leading to cue preference patterns similar to monolinguals.

In contrast to transfer, VanPatten (2004) proposes a set of principles for L2 language processing based on the learner’s knowledge of the lexicon and the world. According to the first noun principle a learner will always interpret the first noun in a sentence as its subject (VanPatten, 2007). For some languages, like English, adhering to this strategy results in native like processing, while for languages with a more flexible word order, like Russian, it may lead to misinterpretation.

There is only one study on case comprehension in monolingual Russian and bilingual Dutch-Russian children (Janssen & Peeters-Podgaevskaja, 2012). Janssen and Peeters-Podgaevskaja (2012) showed that Dutch-dominant Russian-Dutch bilinguals aged 6-9 had a strong preference for word order and showed very little case sensitivity. They did not use case in Russian when case and word order cues compete. They had non-native processing strategies regarding word order as a stronger cue as predicted by MacWhinney’s and VanPatten’s models for L2 learners.

5. The current study
5.1 Research Questions & Predictions

The current study aims to provide evidence for the processing strategies used by bilingual children acquiring Russian as a minority language in The Netherlands and Israel.
There are two main research questions. Firstly, we wish to establish to what extent monolingual Russian children and bilingual Russian-Dutch and Russian-Hebrew children are sensitive to case cues in Russian. According to MacWhinney (2004), monolingual children will be expected to process and correctly interpret the case cue in sentences with converging and conflicting cues. In terms of accuracy, monolingual children should perform above chance level on both word order conditions (SVO and OVS). In contrast, we expect bilingual children to have problems with case cue processing in sentences where the case cue and word order are in conflict. Following VanPatten’s principles (2005) and MacWhinney’s Competition Model for L2 learners, bilingual children should exhibit a stronger bias for the word order cue, which will be reflected in lower accuracies on the OVS sentences. Although monolingual Russian speaking children should be sensitive to case cues and thus perform accurately, processing costs for the sentences with conflicting cues (OVS sentences) are expected to be higher resulting in slower reaction times. For bilinguals, since no case cue sensitivity is expected, no differences in reaction times are predicted.

Secondly, our goal is to determine the effects of factors such as AoO, LoE to the sparse case language (Dutch or Hebrew), and home language use on case cue processing in the bilingual children? Based on the findings of previous studies discussed earlier, AoO is expected to be a factor: children with earlier AoO to L2 with sparse case morphology are expected to show more profound problems than children with a later AoO.

5.2 Method

Subjects

Seventy-two healthy, typically developing children, equally divided into four groups, participated in the study: Russian-Dutch (biDU) and Russian-Hebrew bilingual children (biHE), monolingual age-matched Russian speaking children (RU-AgeM) and younger Russian monolinguals (RU-Young). Parental questionnaires were used to obtain data on language background (see Table 1).

A one-way ANOVA indicated GROUP difference on age (F=54.107, p<.001, η² = .705), The Turkey HSD post hoc analysis showed no significant differences between biDU, biHE and RU-AgeM. The two bilingual groups differed on AoO (t(34)=5.013, p<.001) and on LoE to the majority language (t(34)=4.776, p<.001): the children in Israel had far later onset to Hebrew and hence less exposure. AoO and LoE were highly correlated (r(36)=.975, p<.001). The two bilingual groups differed significantly in home language use: in the biHE group 61.1% of the families reported Russian to be the language of communication, while in the biDU group this was only 16.7% (χ²(1) = 7.481, p=.006). The background differences between the two bilingual groups reflect the nature of Russian-speaking populations in the Netherlands and in Israel, the parents in the Netherlands being less inclined to use Russian.
Table 1. Background information on the participants per group

<table>
<thead>
<tr>
<th></th>
<th>biDU (n=18)</th>
<th>biHE (n=18)</th>
<th>RU-AgeM (n=18)</th>
<th>RU-Young (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (months)</strong></td>
<td>M: 67.06 (SD: 5.23)</td>
<td>M: 64.50 (SD: 3.17)</td>
<td>M: 63.67 (SD: 4.01)</td>
<td>M: 63.67 (SD: 4.01)</td>
</tr>
<tr>
<td><strong>AoO (months)</strong></td>
<td>M: 10.67 (SD: 13.16)</td>
<td>M: 35.73 (SD: 16.40)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>LoE (months)</strong></td>
<td>M: 54.61 (SD: 14.28)</td>
<td>M: 28.77 (SD: 17.56)</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

| Language Spoken at Home | Only Russian: 3/18 (16.7%) | Only Russian: 11/18 (61.1%) |

Experimental Task

A forced-choice online sentence comprehension task (Janssen, to appear) was used to test comprehension and processing of case cues in Russian. The task consisted of 40 reversible transitive sentences, both in canonical (SVO) and non-canonical (OVS) word order, and was administered in E-prime. For each item, two pictures were presented on the screen; one match and one mismatch (see Figure 1). The only difference between the pictures was the roles assigned to the nouns: in one of the pictures the noun A was the subject, and in the other the object. The location (left – right) of the correct picture on the screen was randomized. All pictures were child-friendly and most of the nouns are in the Russian adaptation of the MacArthur-Bates Communicative Development Inventory (Vershinina, Eliseeva, Lavrova, Ryskina, & Cejtlin, 2011). All audio-stimuli were pre-recorded in a soundproof studio by a native speaker from Saint-Petersburg, Russia. Gender, animacy and item-frequency were balanced across the items.

Conditions

First, in order to establish a baseline for comprehension canonical sentences were used in which the case cue and the word order cue converge (Condition 1). Secondly, in order to test cue strength in sentences with two competing cues (word order and case), non-canonical sentences were used (Condition 2). It is predicted that adherence to the case cue strategy, would result in better comprehension of the sentences with the conflicting cues and higher scores on this task. In Russian, objects in canonical and non-canonical reversible transitive sentences are only possible in the accusative and the dative case. Therefore, accusative and dative were alternated in the object position (see Conditions 1 and 2).
Condition 1. Converging cues (SVO)

ACC Petux trogaet zme-ju.
Rooster.NOM.M touches snake.ACC.F
‘The rooster touches the snake.’

DAT Kukl-a zvonit zmej-e.
Doll.NOM.F calls snake.DAT.F
‘The doll calls the snake.’

Condition 2. Conflicting cues (OVS)

ACC Petux-a ljubit zhiraf.
Rooster.ACC.M loves giraffe.NOM.M
‘The giraffe loves the rooster.’

DAT Zmej-e ulibaetsa zhiraf.
Snake.DAT.F smiles+at giraffe.NOM.M
‘The giraffe smiles at the snake.’

Figure 1. Pictures for the item ‘the rooster touches the snake’ (in SVO) as it appeared on the screen. Left: match, right: mismatch.

Procedure

Informed parental consent was obtained prior to participation. A notebook with a touchscreen was used. Each child was tested individually: all monolingual children and all Russian-Dutch bilinguals were tested by the first author, the second author tested all Russian-Hebrew children. The experimenter gave oral instructions. Four warm-up items were administered to familiarize the children with the task and the electronic equipment. Including instructions, warm up items and positive feedback, the task took approximately six minutes to administer. All coding for accuracy and measuring of reaction times was done automatically in e-prime. Accuracy scores were used as a measure of children’s ability to correctly interpret sentences and response times were used as a processing measure.

\[^{3}\text{In the Netherlands, this study was approved by the Ethics Committee of the Faculty of Humanities of the University of Amsterdam. In Israel, it was approved by the review board of Bar-Ilan University as well as by the Israeli Ministry of Education.}\]
6. Results

6.1 Accuracy

To identify differences between the groups and the conditions, a mixed repeated measures analysis of variance ANOVA was conducted with factors GROUP (biDU, biHE, RU-AgeM, RU-Young), CUE (converging vs. conflicting) and CASE (ACC vs. DAT). Interactions were followed by using a post-hoc Sidak test with adjustments for multiple comparisons. The analysis showed a main effect of GROUP ($F(3,68)=7.202$, $p<.001$, $\eta^2 = .241$), a main effect of CUE ($F(1,68)=119.670$, $p<.001$, $\eta^2 = .638$), and an interaction between GROUP and CUE ($F(3,68)=18.678$, $p<.001$, $\eta^2 = .452$). No main effect of CASE was observed ($p=.442$).

We separately analyzed the CUE effect in each group using a series of paired t-tests. Monolingual age-matched ($t(17)=4.415$, $p<.001$), bilingual Dutch ($t(17)=7.496$, $p<.001$) and bilingual Hebrew speaking children ($t(17)=5.726$, $p<.001$) performed significantly better on converging cue sentences (SVO) as compared to sentences with conflicting cues (OVS). For the younger monolingual children the CUE effect was not significant using the corrected critical alpha level ($t(17)=3.299$, $p=.004$).

![Figure 2. Accuracy on converging and conflicting sentences per group](image)

To investigate group differences on each condition, we administered a one-way ANOVA separately on sentences with converging and conflicting cues. The results indicated group difference on both conditions: for converging cues ($F(3,68)=5.241$, $p=.003$, $\eta^2 = .188$) and for conflicting cues ($F(3,68)=14.653$, $p<.001$, $\eta^2 = .393$). On sentences with converging cues biDU ($M=0.87$, $t(17)=4.415$, $p<.001$, $\eta^2 = .638$) performed significantly better than biHE ($M=0.50$, $t(17)=7.496$, $p<.001$, $\eta^2 = .452$).
SD=0.09) scored significantly higher than RU-Young (M=0.71, SD=0.16) (p=.003). On the sentences with conflicting cues (OVS), a post-hoc Sidak test indicated that the two monolingual groups outperformed both bilingual groups (p<.002). No differences were observed between the two bilingual groups.

To explore cue strength, we checked whether or not all groups scored significantly above or below chance level.

The distribution of answers on sentences with converging and conflicting cues can be seen in Figure 2. The analysis of answers on SVO and OVS in relation to chance level (50%) was done using a one-sample t-test. All four groups of children performed above chance in the SVO condition (RU-AgeM: t(17)=11.996, p<.001; RU-Young: t(17)=5.742, p<.001; biDU: t(17)=16.900, p<.001; biHE: t(17)=8.878, p<.001). In the OVS condition, both monolingual groups also performed significantly above chance (RU-AgeM: t(17)=8.456, p<.001; RU-Young: t(17)=3.999, p<.002). In contrast, the Dutch bilingual children performed significantly below chance (t(17)=−2.538, p=.021) and the Hebrew bilingual children at chance level (t(17)=−.058, p=.954). A total of 100% of RU-AgeM, 83% of RU-Young, 27.3% of biDU and 50% of biHE scored above the chance level. In sum, approximately a quarter of the Russian-Dutch children and about half of the Russian-Hebrew children adhered to a case processing strategy.

### 6.2 Reaction Times

To investigate if there were processing costs for any of the conditions, reaction times (RTs) were analyzed only on correct responses. We identified extreme values by using the boxplot procedure in SPSS and removed and replaced those by mean RTs per condition. Based on children’s off-line scores on the comprehension of sentences with conflicting cues (OVS), all children were divided into two strategy groups: children with case cue preference were participants performing above chance level (n=25); children with a word order cue preference performed below chance level (n=47).

A mixed repeated measures analysis of variance ANOVA was conducted on reaction times with CUE (converging vs. conflicting) and CASE (ACC vs. DAT) and STRATEGY_GROUP (case cue strategy vs. word order strategy) with GROUP as a covariate to control for exposure differences in technology in different countries. The analysis showed no significant effect of CUE, no significant effect of CASE and no significant effect of STRATEGY_GROUP. However, there was a significant interaction between CASE and STRATEGY_GROUP (F(1,69)=13.990, p<.001, η² = .169).

We further investigated processing of case in each group separately using paired t-tests. In those children using a word order strategy, no difference in RTs were observed between accusative and dative, whereas in those using the case cue strategy, the dative case in the sentences with conflicting cues (OVS) resulted in longer RTs in comparison to the accusative case in the same condition (t(46) =2.311, p=.025).
6.3 The impact of AoO, LoE and home language

To investigate the impact of AoO and LoE on the comprehension of case cues, we conducted a Pearson correlational analysis. AoO ($r^2=.487$, $p<.01$) and LoE ($r^2=.474$, $p<.01$) are associated with children’s ability to process case cue in sentences with conflicting cues. Children with earlier AoO in the language with sparse inflectional case morphology and rigid word order have more profound problems with understanding case cues in their Russian, the language to which they have been exposed from birth.

Subsequently, we evaluated the effect of language spoken at home on the case cue processing in bilingual children. The Spearman's correlational analysis revealed that children with more input at home (children who mainly hear Russian at home) have higher scores on case cue sensitivity ($r^2=.449$, $p<.01$). This emphasizes the importance of the amount of input for processing of case inflections.

A step-wise regression was conducted to see whether AoO, LoE and language spoken at home were predictors of bilingual children’s off-line scores for sentences containing conflicting cues (OVS). It was found that AoO explains a significant amount of the variance in the scores on the OVS condition ($F(1, 34) = 10.587, p < .002, R^2 = .237, R^2\text{Adjusted} = .215$).

The three factors had no influence on reaction times. No significant correlations were observed between RTs on SVO and OVS sentences and LoE, AoO and the language spoken home.

7. Discussion

The current study investigated to what extent monolingual Russian children and bilingual Russian-Dutch and Russian-Hebrew children are sensitive to case cues in Russian. We analyzed whether children adhere to case cues or follow a word order strategy to parse simple sentences in Russian. Moreover, we examined whether higher processing costs can be observed for sentences with conflicting cues. Finally, for the bilingual children, we explored the effects of LoE, AoO and language use on their processing of case cues.

The off-line results in terms of accuracy showed that the children’s ability to comprehend case cue was not linked to a particular case: Accusative was not better than Dative. There were clear effects of cue strength across all groups. All children in all four groups scored above chance level on the SVO sentences. However, a large variation was observed for the condition in which cues were in conflict and where case cue sensitivity was vital for correct interpretation. Monolingual Russian speaking aged as early as 4 demonstrated adult-like processing strategies and showed high case sensitivity as production results from earlier research suggested. The results for the two monolingual groups are in line with the Competition Model confirming that case is the strongest cue for monolingual Russian speaking and even children as young as 4.2.
The picture was different for the bilingual children. Only a quarter of the Russian-Dutch children and about half of the Russian-Hebrew bilinguals showed case sensitivity. In fact, the majority of bilingual children exposed to both Russian from birth and the majority language from an early age show non-native like processing strategies. Individual differences in bilingual children can be largely explained by LoE, AoO, and the amount of input in Russian at home. These findings for bilingual children extend MacWhinney’s Competition Model (2005) and VanPatten’s First-Noun Principle (2004) originally formulated for second language learners to early bilinguals who acquire Russian together with a sparse case language. For Dutch and Hebrew word order have been reported to be the most predominant cue in children, until they reach adult processing (Frankel et al., 1980; McDonald, 1986).

Since very few bilingual children showed case sensitivity, we re-assigned children into two groups according to their strategy: case cues or word order. As expected, the children who had problems with processing case cues did not show difference in RTs across conditions as a result of failing to notice conflicting cues. However, children sensitive to case cues showed processing costs in interpreting sentences with conflicting cues, although only for datives.

It is not clear from this study whether these results are due to bilingualism in itself, to the fact that Russian was being learned as the minority language, or to the fact that the other language provided no support for case cues. Both Dutch and Hebrew are languages with sparse case morphology and word order is the predominant cue for children in the two languages until late age. For future studies, it would be insightful to compare processing strategies of bilingual children acquiring two rich case languages (i.e. Russian in a combination with Turkish, Hungarian, Finnish, Lithuanian, or Azeri).

Overall, the current study confirmed that monolingual children achieve an adult-like processing mastery and adhere to the case cue strategy as early as age 4. Bilingual children on the other hand show a non-native processing pattern and follow a word order strategy, which is the predominant cue in the majority language they are acquiring. Processing strategies in bilingual children are associated with AoO of the other language and home language use: children with an earlier AoO and children with more input in the majority language show less case sensitivity.

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