As complex as they appear: Children's comprehension of conjunctive expressions in Georgian*

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Abstract

Mitrović and Sauerland [2014, 2016] claim that, across languages, DP-conjunction decomposes into [JP [MuP [XP$_1$ ⟲] MU] [J' J [MuP [XP$_2$ ⟲] MU]]]. The J-particle which occurs between conjuncts maps to set intersection, while the MU-particles map to the subset operator. Given that expressions which involve non-pronounced elements should be harder for children to comprehend than expressions which do not have such silent elements [Slobin, 1985, van Hout, 2008, Sauerland and Alexiadou, 2020, Guasti et al., 2022, a.o.], the account by Mitrović and Sauerland [2014, 2016] predicts that sentences where either J or MU are pronounced should be harder to comprehend relative to sentences where both J and MU are realized. We conduct an experiment testing this prediction by investigating children's comprehension of conjunctive expressions in Georgian. Our results constitute a challenge for the account by Mitrović and Sauerland [2014, 2016] and other existing accounts of conjunctive expressions [Brasoveanu and Szabolcsi, 2013, Szabolcsi, 2015, a.o.]

1 Introduction

One of the basic features of human language is the ability to create conjunctive expressions, that is, to build expressions through the joining of two (or more) phrases, as shown in (1).

(1) a. Mary and Susan love cars. DP
b. Mary loves cars and hates scooters. VP
c. Mary loves cars and Susan hates scooters. TP

Mitrović and Sauerland [2014, 2016] claim that languages share the same underlying structure for sentences involving DP-coordination like (1a). That is, across languages, DP-conjunction decomposes into [JP [MuP [XP$_1$ ⟲] MU] [J' J [MuP [XP$_2$ ⟲] MU]]]. The J-particle

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which occurs between conjuncts maps to set intersection, while the MU-particles which attach to each individual conjunct map to the subset operator. Before combining with the MU-particles, each conjunct combines with a type-shifter $\circlearrowleft$ which turns the individual into the characteristic property of that individual.

Languages are proposed to vary with regard to which of these particles they realize. While some languages pronounce J (e.g., English *and*), others pronounce MU (e.g., Japanese *mo mo*). Very few languages realize both J and MU in the same utterance. To our knowledge, the only languages reported so far are Hungarian, South-Macedonian, and Avar [Szabolcsi, 2015, Mitrović and Sauerland, 2016, a.o.].

This work focuses on Georgian, a language that seems to share this feature of having two conjunctive particles at its disposal: the particle *da* and the clitic particle *-c* which also has an additive use [Hewitt, 1995, Chutkerashvili, 2009]. Our investigations reveal that Georgian shows triadic exponence of J and MU, as shown in (2).

(2) *Georgian*

a. *k'ovz-i* **da** *saban-i* J
spoon-NOM J blanket-NOM

'the spoon and the blanket'

b. *k'ovz-i*-**c** *saban-i*-**c** MU
spoon-NOM-MU blanket-NOM-MU

'the spoon and the blanket'

c. *k'ovz-i*-**c** **da** *saban-i*-**c** J-MU
spoon-NOM-MU J blanket-NOM-MU

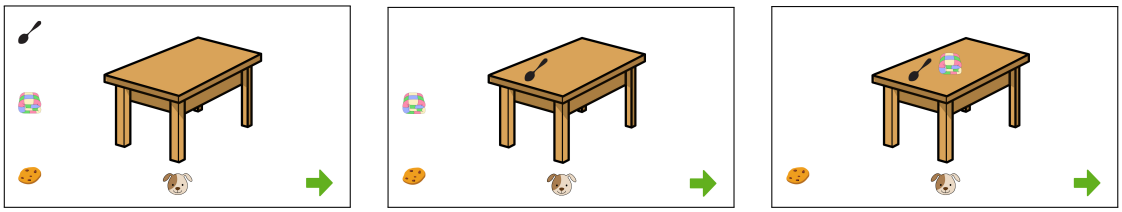
'the spoon and the blanket'

The aim of this work is to test Mitrović and Sauerland's (2014, 2016) account by investigating the comprehension of conjunctive expressions by Georgian-speaking children. Previous work in the acquisition literature indicates a preference from children for expressions that display more one-to-one mapping between form and meaning [Slobin, 1985, van Hout, 2008, Sauerland and Alexiadou, 2020, Guasti et al., 2022, a.o.]. This preference, combined with the account by Mitrović and Sauerland [2014, 2016], predicts that the expressions where both J and MU particles are articulated (i.e., (2c)) should be easier for children to comprehend relative to expressions where one of these particles is silent (i.e., (2a) and (2b)).

The remainder of the paper is organized as follows. Section 2 presents the experiment, the findings of which will be presented in Section 3. Section 4 discusses those findings and concludes.

2 Method

The goal of this experiment was to test the prediction that Georgian-speaking children would display better performance in comprehending conjunctive expressions containing both MU and J particles, relative to conjunctive expressions containing only MU or only J particles. We conducted an experiment with Georgian-speaking adults and children. Note that, before any data was collected, a preregistration of this experiment was published on the Open Science Foundation website and can be found here: https://osf.io/ve9n8.



(a) NONE (b) ONE (c) BOTH

Figure 1: Various starting layouts for the sentences in (3)

2.1 Participants

Thirty-one Georgian-speaking children (3;9-5;10, M = 4;9) and 41 Georgian-speaking adults participated in the experiment. Georgian-speaking children were recruited from daycare centers in Ozurgeti, whereas Georgian-speaking adults were students recruited at Ilia State University.

2.2 Paradigm

We used an act-out task. Each trial began with the participant being presented with one of the starting layouts in Figure 1. Participants then pressed the dog face and were played a pre-recorded version of one of the sentences in (3). Participants could replay the pre-recorded sentence as many times as they wished. After listening to the sentence, participants were instructed that they should change the scene to make the picture match the sentence, if it did not match already. They could do this by moving objects on and off the table.

There were three different *starting layouts* for the objects, which varied with regard to the number of conjuncts that were already satisfied. Specifically: NONE (Fig. 1a), ONE (Fig. 1b), and BOTH (Fig. 1c). We also presented three *sentence-types*: J (3a), MU (3b), and J-MU (3c).

(3) *Georgian*

a. *k'ovz-i* **da** *saban-i* *aris* *magida-ze.* J
spoon-NOM J blanket-NOM is table-on

'The spoon and the blanket are on the table.'

b. *k'ovz-i***-c** *saban-i***-c** *aris* *magida-ze.* MU
spoon-NOM-MU blanket-NOM-MU is table-on

'The spoon and the blanket are on the table.'

c. *k'ovz-i***-c** **da** *saban-i***-c** *aris* *magida-ze.* J-MU
spoon-NOM-MU J blanket-NOM-MU is table-on

'The spoon and the blanket are on the table.'

Crossing the 3 *starting layouts* in Figure 1 and the 3 *sentences-types* in (3) results in 9 conditions. We had 2 items per condition, resulting in a total of 18 items. The items were created as a joint effort between the local researcher based in Georgia and the remote researchers based in Germany and Italy. We included no fillers based on the worry that further items would extend the experimental session beyond children's abilities. Every participant was presented with every item. We measured response *accuracy*; specifically, whether the response was consistent

with an exhaustified interpretation of the sentence (e.g., the spoon and the blanket are on the table, and nothing else is on the table).

2.3 Procedure

Children were tested in a quiet room, at the institution where they were recruited, with an experimenter present. The experiment was displayed using a presentation software on a tablet. A warm-up phase consisting of 4 items, allowing the child to understand the task and get used to the tablet, was followed by the experimental phase consisting of 18 items in randomized order. The experimental sessions were conducted by the local researcher and their affiliates. Adult participants were presented with an on-line version of the experiment, with the instructions presented via text.

3 Results

We conducted two analyses of our data. The first corresponds to the planned analyses described in our preregistration (https://osf.io/ve9n8).

The second analysis is exploratory, and includes an analysis of a new measure variable, *sentence played*, which records how many times the target sentence was played for a given trial.

3.1 Planned analysis

As planned, we investigated the prediction that children's *accuracy* would be better when presented with J-MU sentences compared with MU or J sentences. Figure 2 plots the outcome of this measure variable. Following Barr et al. [2013], we generated a mixed-effects logistic regression analysis with the maximal random effect structure justified by the design. We then reduced this structure in order to achieve convergence by removing the elements with the least variance. This resulted in a model with an intercept for item and an intercept for subject. The fixed effect structure contained *group*, *sentence-type* and their interaction.[1] We then tested for the significance of the fixed effects by comparing this full model to a model that was equivalent except that it was missing one of the fixed effects. We found a significant effect of group ($\chi^2(1) = 12.27$, $p < 0.001$), with adults achieving higher rates of accuracy than children (see Figure 2). However, we did not find a significant effect of *sentence* ($\chi^2(2) = 2.24$, $p = 0.33$) nor the predicted significant interaction of *group* and *sentence* ($\chi^2(2) = 1.95$, $p = 0.38$).[2]

As mentioned in Section 2, participants could replay the pre-recorded sentence as many times as they liked. It is possible that allowing participants to do this generated a type of 'ceiling effect' whereby any difference in the comprehension *accuracy* of the different conjunctive expressions was cancelled.

If this explanation is on the right track, then we might expect the difference between these sentence to rather show up in the *sentence-played* measure; a measure identifying how many times a sentence was played in each trial. Specifically, we might expect that sentences that were more difficult to comprehend were played more times than those that were easier to comprehend. We investigated this possibility further in our exploratory analysis, which we turn to now.

[1] As presented in our preregistration (https://osf.io/ve9n8), we originally also included *sentence layout* in our fixed effect structure, however, we ultimately removed it because; i) with it, the model was too complex to achieve convergence, and ii) we did not make any specific predictions about it.

[2] Note, that we removed one of the items in the NONE.J-MU condition, due to a substantial number of participants expressing confusion about the nature of one of the objects presented in this item.

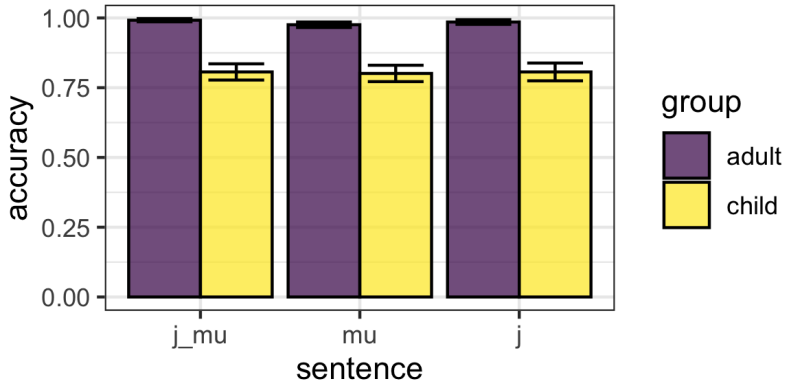


Figure 2: Mean accuracy of end-state. The vertical bars represent the standard error.

3.2 Exploratory analysis

The rates of *sentence played* across sentences and groups is presented in Figure 3.[3] Once again, following Barr et al. [2013], we constructed a linear mixed-effect model with a random intercept for subject. The model also had fixed effects for *group*, *sentence-type* and their interaction. We then determined the statistical significance of the fixed effects via model comparison. We found a significant effect for *group* ($\chi^2(1) = 36.82$, $p < 0.001$), *sentence-type* ($\chi^2(2) = 12.71$, $p < 0.01$), and their interaction ($\chi^2(2) = 20.52$, $p < 0.001$). Figure 3 shows that the main effect of *group* is driven by children playing the sentence more times than adults. Follow-up tests on the *sentence-type* effect indicated that, for children, there was a significant difference between J-MU sentences and MU sentences ($t = 3.68$, $p < 0.001$), as well as between J-MU sentences and J sentences ($t = 5.19$, $p < 0.001$). However, no difference was found between MU sentences and J sentences ($t = 1.67$, $p = 0.22$).[4] No differences were found for adults between the different *sentence-types*.

4 Discussion

Recall the prediction of the account by Mitrović and Sauerland [2014, 2016] we were testing in our study: J and MU sentences should be harder to comprehend for children relative to J-MU sentences. As expected, adults successfully completed the task, providing mainly accurate responses. Turning to the children's results, we found that they showed the same rate of accuracy for all types of sentences, i.e., J, MU and J-MU sentences. As mentioned in Section 3.1, we hypothesize that allowing children to replay the target sentence as many times as they liked may have cancelled any difference in the ease of comprehension of the different types of conjunctive expressions. In other words, we do not take this result as going against the account by Mitrović and Sauerland [2014, 2016]. This interpretation is corroborated by the fact that in the exploratory analysis on the *sentence played* measure, children were found to have played sentences with J-MU expressions more times than sentences with J or MU expressions. One may wonder whether these results relate to the frequency of these expressions in Georgian: children may have been prompted to replay a sentence more times when that sentence is less

[3] We excluded data points that were more than 3 standard deviations from the mean.
[4] P-values were adjusted for multiple comparisons via the Tukey method.

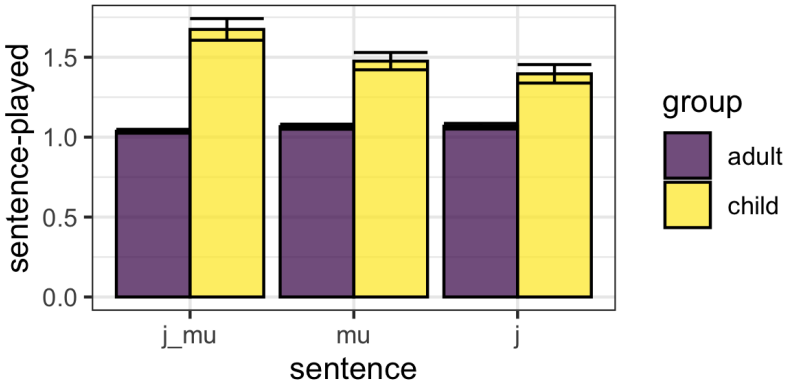


Figure 3: Mean number of times the sentence was played. The vertical bars represent the standard error.

frequently produced in the language generally. This, however, does not seem on the right track given that MU expressions are the less commonly used conjunctive expressions in Georgian.[5] Another potential explanation that can be ruled out on the basis of our results concerns the morphological complexity of these conjunctive expressions. If children were prompted to replay morphologically complex conjunctive expressions more often than the others, they should have played sentences with MU expressions more often than sentences with J expressions, contrary to our results.

Taking the *sentence played* variable as a measure of how easily sentences are understood by children, this study shows that (i) J-MU expressions are more difficult to comprehend than J expressions, (ii) J-MU expressions are more difficult to comprehend than MU expressions. These results constitute a challenge for the account by Mitrović and Sauerland [2014, 2016] which predicted the opposite. In contrast, (i) is in line with accounts in which J expressions and J-MU expressions do not share the same underlying structure. In particular, the underlying representation of J expressions only involves a J particle, unlike that of J-MU expressions which involves both J and MU-particles [Brasoveanu and Szabolcsi, 2013, Szabolcsi, 2015, a.o]. On such accounts, J-MU expressions are underlyingly more complex (i.e., involve more logical operators) than J expressions which would explain why J-MU expressions are harder to comprehend for children than J expressions. An additional complexity about J-MU expressions could come from the presuppositions they come with. Extending the account by Brasoveanu and Szabolcsi [2013] or Szabolcsi [2015] to Georgian would result in analyzing MU particles as (a special kind of) additive particles. As a result, J-MU expressions, unlike J expressions, would come with some additive presuppositions and in turn involve another level of complexity for children. Turning to the result in (ii), this finding constitutes to our knowledge a challenge for all current existing accounts of conjunctive expressions including Brasoveanu and Szabolcsi [2013] and Szabolcsi [2015], which posit a silent J-particle in MU expressions. On such accounts, MU expressions share the same underlying structure as J-MU expressions. Thus, we would expect J-MU expressions where both J and MU are articulated to be easier for children to comprehend than MU expressions where only MU is articulated, contrary to our results. Therefore, our study shows that an alternative account of conjunctive expressions in Georgian is required.

[5] Tamar Makharoblidze, p.c.

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