Is DP conjunction always complex?: The view from child Georgian and Hungarian *

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Abstract Mitrović & Sauerland (2014, 2016) claim that, across languages, DP-conjunction decomposes into $[_{JP}\ [_{MuP}\ [DP_1 \circlearrowright]\ \textsc{mu}]\ [_{J'}\ \textsc{j}\ [_{MuP}\ [DP_2 \circlearrowright]\ \textsc{mu}]]]$. Their account, when combined with the independently motivated assumption that children better comprehend utterances which display a greater degree of 1-to-1 mapping between form and meaning (van Hout 2008, Guasti et al. 2023: a.o.), predicts that sentences where only J or MU are pronounced should be harder to comprehend relative to sentences where both J and MU are realized. We conducted an experiment testing this prediction by investigating children's comprehension of conjunctive expressions in Georgian and Hungarian. While, for Hungarian, we did not find any differences between the types of conjunctive expressions, for Georgian, we found evidence that J-MU expressions were harder for children to comprehend than J or MU expressions. Our results challenge the account by Mitrović & Sauerland (2014, 2016) and cannot be captured by other existing accounts of conjunctive expressions either (Szabolcsi 2015, Haslinger et al. 2019).

Keywords: conjunction, Georgian, Hungarian, child language acquisition, one-to-one mapping, comprehension

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1 Introduction

There is cross-linguistic variation in the complexity of conjunctive expressions. Specifically, in some languages conjunctive expressions involve one particle occurring between conjuncts (e.g., English *and*) whereas in others they involve a particle attaching to each individual conjunct (e.g., Japanese *mo...mo*). Throughout this paper, we adopt Mitrović & Sauerland's (2014) terminology and call these particles J and MU particles respectively. Hungarian allows both types of conjunctive expressions, as shown in (1a) and (1b). In addition, it is one of the few languages that can realize both J and the two instances of MU as yet another way of expressing conjunction, as in (1c) (Szabolcsi 2015: a.o.).[1] For a detailed investigation of the crosslinguistic variation found not only within conjunctive expressions but also in other uses of these particles, we refer the reader to Mitrović (2021).

(1) *Hungarian*

a. Az alma **és** a banán az asztal-on van. — J
the apple J the banana the table-LOC is

b. Az alma **is**, a banán **is** az asztal-on van. — MU
the apple MU the banana MU the table-LOC is

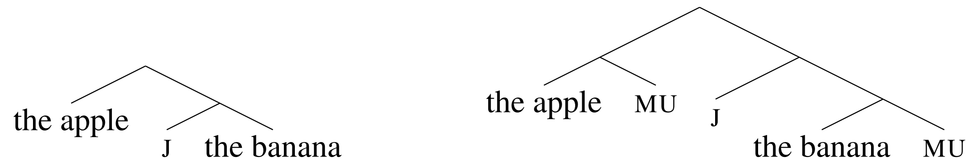
c. Az alma **is** **és** a banán **is** az asztal-on van. — J-MU
the apple MU J the banana MU the table-LOC is

'The apple and the banana are on the table.'

Theoretical accounts of these conjunctive expressions vary along two main dimensions: (i) whether they are derived from the same underlying structure or not, and (ii) the semantic contribution of the J and MU particles that make them up.[2] As far as (i) is concerned, Szabolcsi (2015) and Haslinger et al. (2019) assume that J expressions on the one hand and MU and J-MU expressions on the other hand do not share the same underlying structure: namely, J expressions only involve a J particle underlyingly, unlike MU and J-MU expressions which involve both a J particle, which may be realized or not, and two MU-particles, as illustrated in the simplified structures in Fig. 1a and 1b respectively. In contrast, Mitrović & Sauerland (2014, 2016) and Mitrović (2021) claim that these three types of conjunctive expressions share the same underlying structure simplified in Fig. 1b. What varies among them is which pieces are realized.

1 We call here J-MU expressions conjunctive expressions made up of J and the two instances of MU, and do not take into consideration expressions which involve only one of the MU particles.

2 For the sake of simplicity, we ignore collective interpretations of conjunction which J expressions can yield, and focus on distributive uses of these conjunctive expressions.



(a) Structure with J particle (b) Structure with J and MU particles

Figure 1: Structures for J, MU and J-MU expressions

As for (ii), we will not detail all the accounts here for the sake of space, and focus on Mitrović & Sauerland (2014, 2016) which we investigate in this paper. According to Mitrović & Sauerland (2014, 2016), across languages DP-conjunction decomposes into a J particle which maps to set intersection, and two MU particles which map to subset operators (see Fig. 2). Before combining with the MU-particles, each conjunct combines with a type-shifter ↻ which turns the individual into the singleton set that contains that individual. Once all the pieces are combined together, we obtain that the singleton sets {Mary} and {Susan} both be a subset of the verbal predicate. A conjunctive meaning is thus derived.

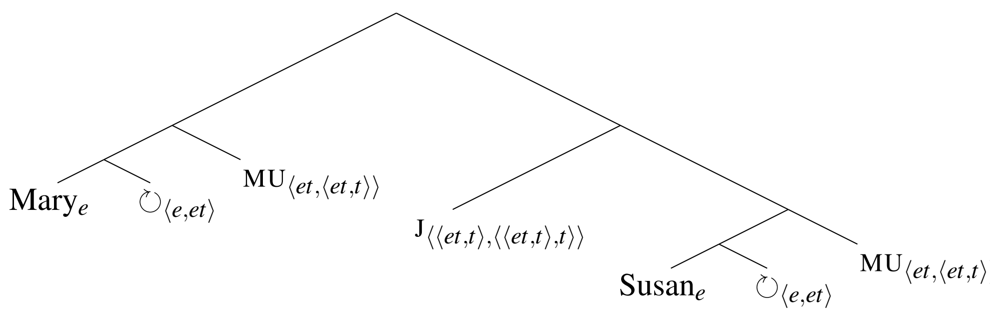


Figure 2: Universal structure for DP-coordination

Like Hungarian, Georgian seems to have two conjunctive particles at its disposal: *da* and the clitic *-c* (Hewitt 1995, Chutkerashvili 2009, Makharoblidze 2024), and also allows the same three types of conjunctive expressions, as shown in (2) (see also Koopman et al. 2021).

(2) *Georgian*

a.

vashl-i	**da**	banan-i	aris	magida-ze.	J
apple-NOM	J	banana-NOM	is	table-on	

b.

vashl-i-**c**,	banan-i-**c**	aris	magida-ze.	MU
apple-NOM-MU	banana-NOM-MU	is	table-on	

c. vashl-i-**c** **da** banan-i-**c** aris magida-ze. J-MU
apple-NOM-MU J banana-NOM-MU is table-on

'The apple and the banana are on the table.'

The fact that it is possible in both Georgian and Hungarian to generate this range of conjunctive expressions provides a unique opportunity to test Mitrović & Sauerland's (2016) account. The validity of this investigation as a test of Mitrović & Sauerland's (2016) account is predicated on the assumption that children better comprehend utterances when they display a greater degree of 1-to-1 mapping between form and meaning (Slobin 1985, van Hout 1998, 2008, Sauerland & Alexiadou 2020, Guasti et al. 2023). This idea was nicely articulated in van Hout (1998) as the 'Transparency Principle':

(3) **Transparency Principle:** If acquisition involves finding the mappings between particular concepts and their linguistic encodings, [: : :], then learning should be easier for overt and unambiguous mappings (one-to-one) than for covert and/or conflated ones (many-to-one) (van Hout 1998: p. 399).

Once this independently motivated assumption is taken on board, a consequence of the account by Mitrović & Sauerland (2016) with regard to children's comprehension is given in (4). No further prediction is made regarding the kind of errors that children will make.

(4) Children will perform better in comprehending the more transparent J-MU expressions compared to the less transparent J or MU expressions.

One might wonder whether such an investigation could be undermined by children's performance across conditions being so high that it is not possible to distinguish between them. While we cannot rule it out, many previous studies have found that children's performance in comprehending AND was not at ceiling (Chierchia et al. 2001, Singh et al. 2016: a.o.). For example, Tsakali & Mastrokosta (2023) found that 3-5-year-old Greek-speaking children make errors approximately 22% of the time with sentences involving two conjuncts.

We turn now to our experiment testing Mitrović & Sauerland (2016)'s prediction that J-MU expressions will be better understood than J or MU expressions.

2 Method

The aim of our experiment was to test whether children's performance would track with the proposed transparency of the expressions (see (4)). Before the collection of any data, both versions of these experiments were preregistered on the Open Science Foundation website.[3]

2.1 Participants

For Georgian, we included 31 children (3;9-5;10, M = 4;9), recruited from daycare centers in Ozurgeti, Georgia, and 41 adults, recruited from Ilia State University, Tbilisi, Georgia.

For Hungarian, we included 25 children (3;0-5;0, M = 4;2), recruited from daycare centers in Budapest, Hungary, and 30 adults, recruited from the Prolific participant recruitment website.[4]

Participants were excluded if they had any language or hearing impairments.

2.2 Procedure

We used an act out task.[5] Initially, participants were presented with a screen showing a set of 3 objects (e.g., a spoon, a blanket, and a cookie), a table, and a cartoon dog face. Participants then pressed the dog face in order to hear a sentence stating that two of the objects ‘are on the table’. They could replay the 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 by moving objects onto the table, if it did not match already.

Before the experiment started, participants were presented with a series of 6 training items designed to familiarize the participants with the paradigm. In one of these training items, participants were not required to move any objects to accurately satisfy the truth conditions of the relevant sentence.

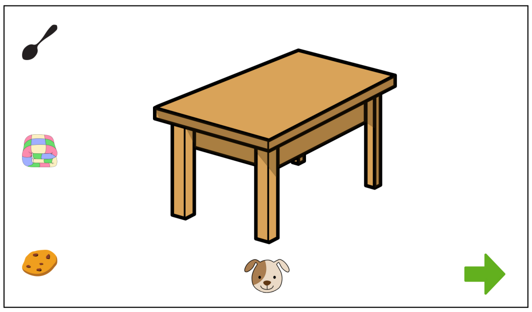
3 Georgian: https://doi.org/10.17605/OSF.IO/VE9N8;
Hungarian: https://doi.org/10.17605/OSF.IO/29UFG.

4 While we made some attempt to achieve a similar age-distribution in each language, it is worth noting that our research question does not depend on these distributions being parallel. This is because the predictions are language-internal, so, they relate to children’s behavior between the different sentence-types within each language, not to a comparison between languages.Nevertheless, to the extent that there was a difference between the languages, it went in the direction of Hungarian-speaking children being more adult-like than Georgian-speaking children (see Section 3), despite the former being younger. That is to say, it would not be explainable by a difference in the ages of the children.

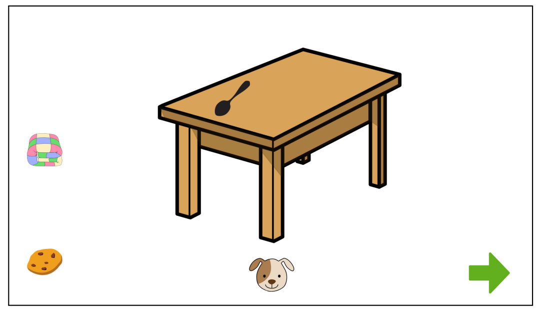
5 While this paradigm is often used to identify preferred interpretations, we selected this task primarily because we were concerned about the possibility of a ceiling effect masking any differences in the target sentences’ processing complexity. As mentioned above, an act out task was used in recent work by Tsakali & Mastrokosta (2023), and found 3-5-year-old children’s performance comprehending similar sentences was well below ceiling.

2.3 Materials

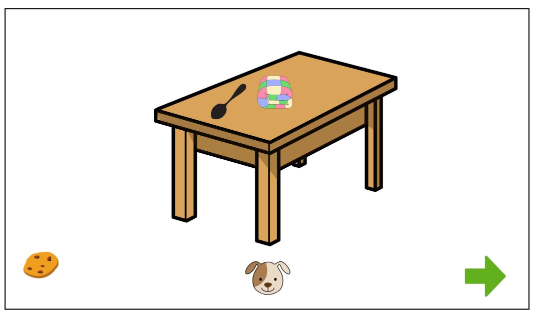
There were three different starting pictures: *none* (see Fig. 3a), which had no objects on the table, *one* (see Fig. 3b), which had one of the mentioned objects already on the table, and *both* (see Fig. 3c), which had both of the mentioned objects already on the table.



(a) NONE



(b) ONE



(c) BOTH

Figure 3: Starting layouts for the sentences in (5) and (6).

Moreover, as shown in (5) and (6), there were three types of conjunctive expressions: J, which contained only a J particle, MU, which containted only MU particles, and J-MU, which contained both J and MU particles.

(5) 3 *sentences-types* (Georgian):

a.

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

b.

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

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.'

(6) 3 *sentences-types* (Hungarian):

a.

A	kanál	**és**	a	takaró	az	asztal-on	van.	J
the	spoon	J	the	blanket	the	table-LOC	is	

b.

A	kanál	**is**,	a	takaró	**is**	az	asztal-on	van.	MU
the	spoon	MU	the	blanket	MU	the	table-LOC	is	

c.

A	kanál	**is**	**és**	a	takaró	**is**	az	asztal-on	van.	J-MU
the	spoon	MU	J	the	blanket	MU	the	table-LOC	is	

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

There were two versions of each *starting picture* for each *type of conjunctive sentence*, resulting in 6 items per *sentence-type* and a total of 18 experimental items. Comprehension was measured using two variables: *accuracy* (i.e., whether the end state was consistent with an exhaustified interpretation of the sentence, e.g., the spoon and the blanket, and nothing else, are on the table), and *sentence-played-n* (i.e., the number of times the test sentence was played).[6] It is standard when designing experiments investigating child language acquisition to include filler or control items in order to determine whether children understand certain aspects of the target sentences and/or have achieved an appropriate understanding of the task (Crain & Thornton 1998, Ambridge & Rowland 2013). In this experiment, we did not follow this practice because: i) we were concerned that their inclusion could create problems of fatigue for child participants, ii) given the simplicity of the task, we did not feel that applying any filler-based exclusion criterion was necessary, and iii) previous studies (e.g., Tieu et al. 2017) suggest that children perform at ceiling (> 90%) with the kinds of fillers we might have included (e.g., *The spoon is on the table*). Having said that, we acknowledge that the decision not to include any fillers/controls is not straightforward or without drawbacks. Therefore, we think

6 The Georgian preregistration does not mention the *sentence-played-n* response variable, because this variable was identified in the course of conducting exploratory analyses on the Georgian data.

that future work in this area should not necessarily follow our example, especially as such items can often help to shed light on children's behavior in critical conditions.

Study materials can be accessed here: https://doi.org/10.5281/zenodo.15225998

3 Results

3.1 Georgian

During initial explorations of the Georgian data, we discovered that many of the participants were confused by one of the items in the *none-j* condition. Specifically, several participants commented that they were unable to determine the reference of 'cake' in the sentence, as there were two objects that looked like 'cakes' to them in this item. As a result, we removed this item (i.e. 'item 2') from the dataset for all participants.

3.1.1 Planned analysis

We generated an initial mixed-effects logistic regression model with *response accuracy* as the measure variable and with *group* (adult/child), *sentence-type* (J/MU/J-MU), and their interaction as fixed effects. Figure 4 shows the distribution of the data based on these predictors.[7] We then generated the random effect structure following Barr et al. (2013)'s "Best Path" algorithm, resulting in a model containing a random intercept for subject and a random intercept for item.

This model was compared, using a Likelihood Ratio Test, with models that were equivalent, except that they lacked one of the fixed effects. The results of these comparisons are shown in Table 1, with only the *group* fixed effect being found to significantly improve the model fit. As shown in Figure 4, this effect is driven by the response accuracy of children being lower than that of adults.[8]

3.1.2 Exploratory analysis

It is possible that we did not find the predicted *sentence-type* effect in *response accuracy* because participants could re-play the recorded sentence as many times as they wanted, cancelling out any variation in accuracy between sentences. Such a possibility is made more plausible by the fact that previous research has found that children of this age are more likely to replay or ask for a repetition of sentences that

7 Note that this is slightly different from our preregistration in the sense that we did not include a context (aka starting picture) fixed effect. This was because: i) any model including this effect would not converge, and ii) we didn't make any specific predictions about this variable in the first place.

8 We conducted a point-biserial correlation on the child group to investigate the relationship between age and accuracy and found a medium-strength, positive correlation ($r(525) = 0.31$, $p < 0.001$).

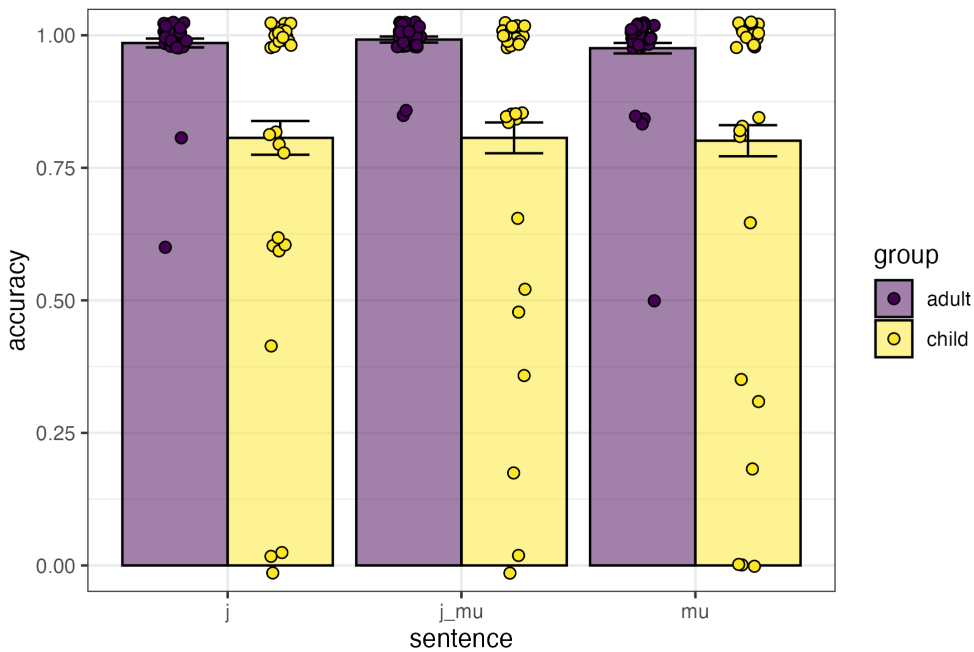


Figure 4: Response accuracy in Georgian for both groups across sentence types. Vertical bars = standard error. Dots = individual participants means.

Effect	df	χ^2	p.value
group	1	12.27	<.001*
sentence	2	2.24	.327
group:sentence	2	1.95	.377

Table 1: Results of model comparison via Likelihood Ratio Tests for *response accuracy* measure variable in Georgian.

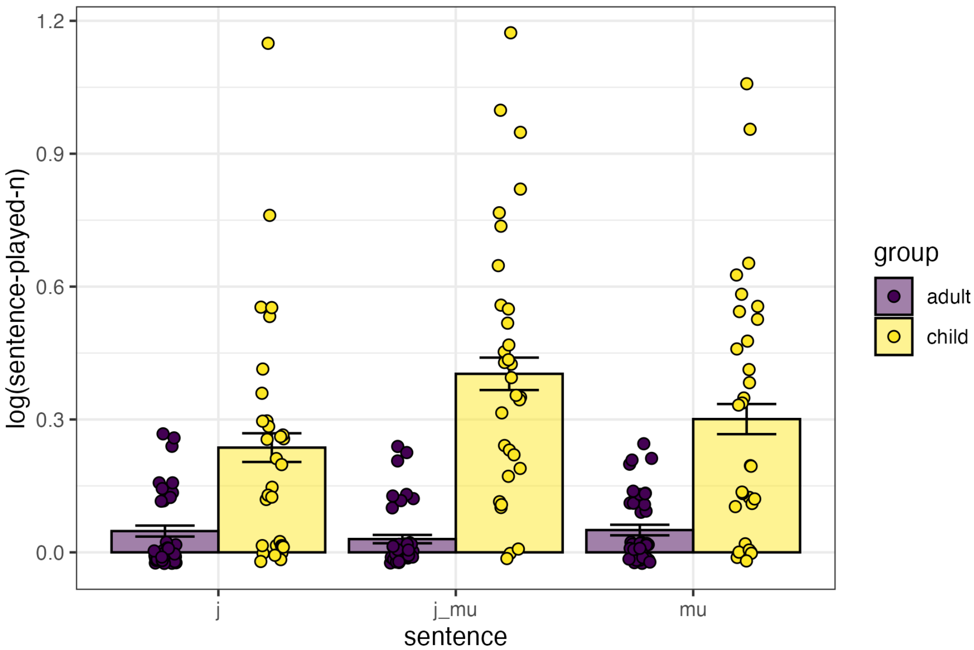


Figure 5: Logarithmically transformed sentence-played-n in Georgian across both groups and sentence types. Vertical bars = standard error. Dots = individual participants means.

they find difficult to comprehend (Flavell et al. 1981, Wang 1999, Saywitz et al. 2010).

To explore if such an explanation is on the right track, we looked at the number of times the sentence was played. We first excluded data points associated with a response that did not satisfy the basic truth conditions of the relevant sentence, leaving us with 689 adult data points and 499 for children. To reduce the effect of outliers, we applied a logarithmic transformation to this data. The resulting data is shown in Figure 5.

We created a mixed-effect linear regression model including *group* (child/adult), *sentence-type* (J/MU/J-MU), and their interaction as fixed effects. We then generated the random effect structure following Barr et al. (2013)'s "Best Path" algorithm, resulting in a model which only contained a random intercept for subject.

Model comparison using Likelihood Ratio Tests generated the results in Table 2, with all the fixed effects significantly improving the model fit.[9]

9 We also conducted a Pearson (product-moment) correlation test on the child group to investigate the relationship between age and the *sentence-played-n* measure. This test found a small, negative correlation ($r(497) = -0.18$, $p < 0.001$).

Effect	df	χ^2	p.value
group	1	35.88	<.001*
sentence	2	14.95	<.001*
group:sentence	2	23.89	<.001*

Table 2: Results of model comparison via Likelihood Ratio Tests for *sentence-played-n* measure variable in Georgian.

Group	Contrast	Estimate	SE	df	t.ratio	p.value
Adult	J VS. J-MU	0.019	0.026	1120	0.708	.759
	J VS. MU	-0.003	0.027	1120	-0.102	.994
	J-MU VS. MU	-0.021	0.025	1120	-0.850	.672
Child	J VS. J-MU	-0.176	0.031	1121	-5.681	<.0001*
	J VS. MU	-0.069	0.031	1121	-2.230	.067
	J-MU VS. MU	0.106	0.03	1121	3.555	<.01*

Table 3: Results of follow-up tests. P-values were adjusted for multiple comparisons using the Tukey method (Tukey 1949). Results are given on the log (not the response) scale.

Effect	df	χ^2	p.value
group	1	0.75	.385
sentence	2	2.93	.231
group:sentence	2	1.82	.402

Table 4: Results of model comparison via Likelihood Ratio Tests for *response accuracy* measure variable in Hungarian.

The results of follow-up tests on the *sentence-type* factor reveal that, for children, there was a significant difference in the number of times the sentences were played between J and J-MU sentences, as well as between MU and J-MU sentences (see Table 3). No difference was found between MU and J sentences.

3.2 Hungarian

For consistency, we also removed the item with the confusing ‘cake’ image from the Hungarian data (i.e., item ‘2’).

3.2.1 Planned analysis

We generated an initial mixed-effects logistic regression model with *response accuracy* as the measure variable and with *group* (adult/child), *sentence-type* (J/MU/J-MU), and their interaction as fixed effects.[10] Figure 6 shows the distribution of the data based on these predictors. Next, we generated the random effect structure following Barr et al. (2013)’s “Best Path" algorithm, resulting in a model containing only an intercept for subject.

Model comparison using Likelihood Ratio Tests generated the results in Table 4: none of the predictors were significant.

As in Georgian, we conducted an analysis based on the *sentence-played-n* response variable (see Fig. 7). We included *group* (child/adult), *sentence-type* (J/MU/J-MU), and their interaction as fixed effects. We generated the random effect structure following Barr et al. (2013)’s “Best Path” algorithm, resulting in a model containing a random intercept for subject and a random intercept for item. Model comparison

10 As with the Georgian data, this model is slightly different from that which we preregistered in the sense that we did not include a context (aka starting picture) fixed effect.

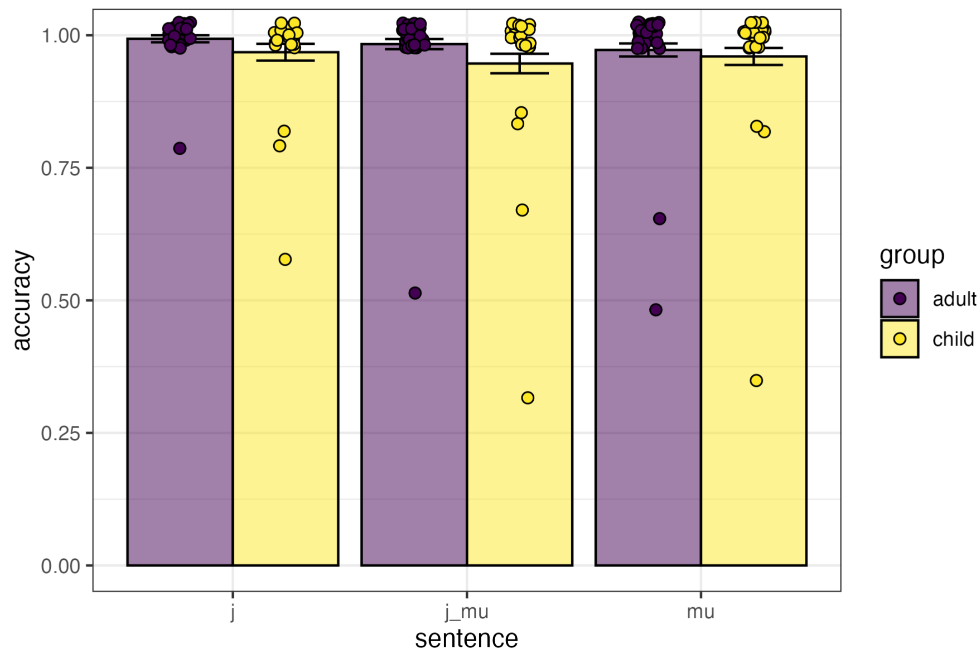


Figure 6: Response accuracy in Hungarian for both groups across sentence types. Vertical bars = standard error. Dots = individual participants means.

Effect	df	χ^2	p.value
group	1	6.54	$< .05$
sentence	2	2.19	.334
group:sentence	2	0.55	.761

Table 5: Results of model comparison via Likelihood Ratio Tests for *sentence-played-n* measure variable in Hungarian.

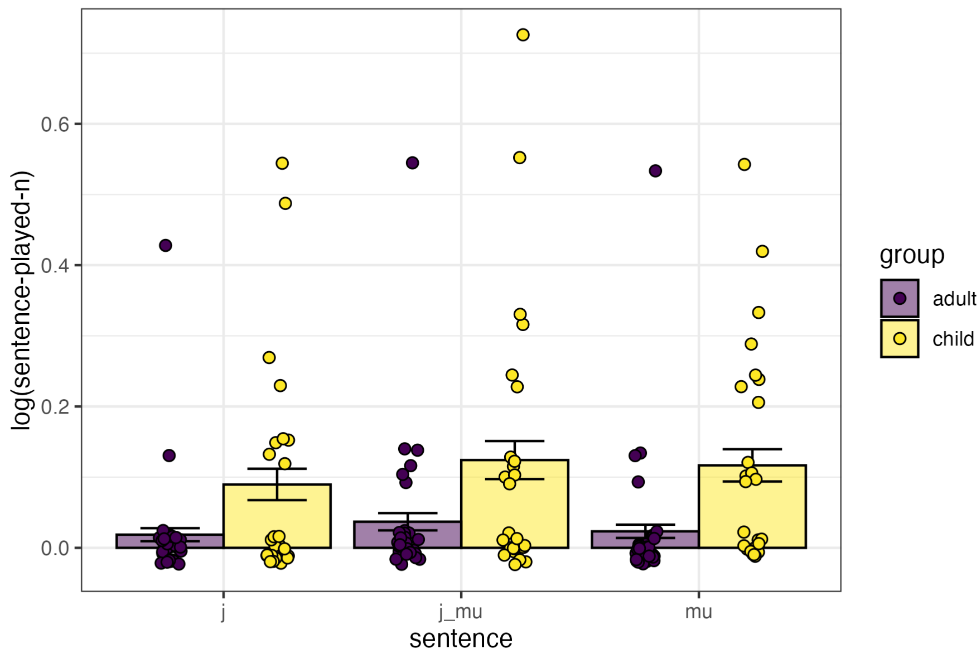


Figure 7: Logarithmically transformed sentence-played-n data in Hungarian across both groups and sentence types. Vertical bars = standard error. Dots = individual participants means.

using Likelihood Ratio Tests generated the results in Table 5: only *group* was significant. [11]

4 Discussion

Our experiment was designed to test Mitrović & Sauerland's (2016) account which, when combined with the independently motivated assumption that children have a preference for transparent expressions, predicts that J and MU conjunctive expressions would be harder for children to comprehend than J-MU expressions. This prediction was not borne out in either of the languages we investigated. In Hungarian, there was no difference between the sentence-types when it came to either response measure. For Georgian, we found a difference between *sentence-types* when it came

11 We also conducted a point-biserial and Pearson (product moment) correlations to investigate the relationship between age and our response measures. We found a small positive relationship correlation for age ($r(423) = 0.19$, $p < 0.001$) and a small negative correlation for *sentence-played-n* ($r(405) = -0.28$, $p < 0.001$).

to the *sentence-played-n* measure.[12] However, the direction of this difference was unexpected: J-MU sentences were harder for Georgian-speaking children to comprehend than either J or MU sentences. And no difference was found between J and MU sentences.

As for other accounts of conjunctive expressions such as Szabolcsi (2015) and Haslinger et al. (2019), if we assume that the more morphologically and semantically complex an utterance is, the harder it is to comprehend, then these accounts would predict that children would perform better in understanding J expressions than J-MU expressions.[13] However, this is not what we found, with no difference being found between these expressions in Hungarian. This result presents a challenge, then, to these accounts. Interestingly, such a difference was found in Georgian, perhaps indicating that one of these analyses could be extended to Georgian. However, the fact that Georgian-speaking children performed better in comprehending MU expressions than J-MU expressions would be puzzling as, according to these accounts, they are semantically equivalent, and in fact, MU expressions are the more opaque of the two. In sum, our results cannot be straightforwardly captured by any of these accounts of conjunctive expressions.

A successful account – which would capture both our Georgian results (namely, that J-MU expressions are harder to comprehend for children than J and MU expressions) and the difference between our Georgian and Hungarian results – should include (i) that J-MU expressions are semantically more complex than J and MU expressions, (ii) that J and MU expressions do not differ from each other in terms of semantic complexity and (iii) that MU particles in Hungarian are morphologically or semantically less complex than MU particles in Georgian. As far as (iii) is concerned, two distinct lines of research will be explored in future work.[14] On the semantic side, a thorough investigation of the uses and interpretations of MU particles in these two languages will be pursued to understand whether one is semantically more complex than the other (see e.g. Mitrović (2021) for a recent discussion of the various uses of MU particles across languages). On the morphological side, one would need to understand whether free morphemes in Hungarian are acquired more readily than bound morphemes in Georgian, as suggested by previous litera-

12 There was also a difference in *accuracy* between *groups*. Out of the 103 errors produced by children, 75 (73%) involved placing unmentioned objects on the table, 21 (20%) involved placing only one of the mentioned objects on the table, and 7 (7%) involved placing neither of the mentioned objects on the table. Errors of the first kind could be a result of these children not deriving the so-called ‘ad-hoc’ implicature that ‘nothing else is on the table’. Previous research has found that, while children derive such implicatures at a higher rate than other kinds of implicatures, it is still often not adult-like at this age (Stiller et al. 2015, Yoon & Frank 2019, Franchin et al. 2023, Rees et al. 2023).

13 Even though Szabolcsi’s (2015) account focuses on Hungarian and thus makes predictions for this language only, we discuss here whether these predications are borne out for either language.

14 We thank our reviewers for suggesting these.

ture (e.g., Clark 2017), which could explain why conjunctive expressions involving MU particles were easier for Hungarian children to comprehend than for Georgian children.

5 Conclusion

In this paper, we investigated Mitrović & Sauerland's (2016) account by looking at children's interpretations of DP conjunctive expressions in Georgian and Hungarian. In Hungarian, we generated a null result, with no difference being found between the different expressions. In Georgian, we found a difference between the sentences, with J-MU expressions being harder for children to comprehend than J or MU expressions. This pattern was the opposite of that predicted by Mitrović & Sauerland (2016) when combined with the independently motivated assumption that children have a preference for transparent expressions, and so challenge this account. Our results in Georgian are also unable to be straightforwardly captured by any existing account of DP conjunction (e.g., Szabolcsi 2015, Haslinger et al. 2019). Moreover, the lack of convergence between the results from Georgian and Hungarian could indicate that, despite the noted similarities, different analyses for DP conjunction in these languages are required.

Author contributions

CB and AG conceived the experimental question, designed the experiment, conducted statistical analyses, and drafted the manuscript. ID conceived the experimental question, designed the experiment, and conducted typological analyses. TM designed the experiment, created experimental material, provided language descriptions and glosses, as well as collected the data for Georgian. LP designed the experiment, created experimental material, provided language descriptions and glosses, as well as collected the data for Hungarian. All authors revised and accepted the final version of the paper.

Ethics and Consent

The research on Georgian was approved by the Ilia State University Research Ethics Committee (R/173-22). The research on Hungarian was approved by the Scientific Committee of the Pázmány Péter Catholic University (B/1177/2021).

Data availability

All experimental materials, data and statistical analysis scripts are available at Zenodo: https://doi.org/10.5281/zenodo.15225998

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