

Moving Beyond Forced-Choice: A Fresh Perspective on Children's Disjunction Comprehension

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1. Introduction

Research on children's comprehension of the disjunctive word 'or' has consistently found that children differ from adults in their interpretations (e.g., Bleotu, Tieu, et al., 2025; Chierchia et al., 2001; Jasbi & Frank, 2021; Nicolae et al., 2024; Paris, 1973; Singh et al., 2016; Skordos et al., 2020; Tieu et al., 2017). Specifically, children predominantly interpret disjunction either inclusively—allowing for both disjuncts to be true ($\vee$)—or conjunctively—requiring both disjuncts to be true ($\wedge$) (Bleotu, Nicolae, et al., 2025; Chierchia et al., 2001; Huang & Crain, 2020; Sauerland & Yatsushiro, 2018; Singh et al., 2016; Skordos et al., 2020; Tieu et al., 2017). For instance, when presented with sentence (1), children may understand it to mean that the rabbit has a carrot or a tomato, or possibly both, or even that the rabbit has both a carrot and a tomato. Adults, by contrast, more frequently adopt an exclusive interpretation, understanding the sentence to mean that the rabbit has either a carrot or a tomato, but not both ($\oplus$) (Chierchia et al., 2001; Sauerland & Yatsushiro, 2018; Tieu et al., 2017), though inclusive interpretations can also arise in certain contexts (Huang & Crain, 2020).

(1) The rabbit has a carrot or a tomato.

While children's inclusive interpretation of disjunction is generally argued to result from a failure to generate scalar implicatures (Chierchia et al., 2001; Gotzner et al., 2020; Tieu et al., 2016), their conjunctive interpretations have been more difficult to account for. Four different hypotheses have been proposed to explain why some children interpret a disjunction word like conjunction in some experimental tasks:

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1. Non-adult-like exhaustification of non-adult-like alternatives
2. Experimental task artifacts
3. Ambiguity of the disjunction word
4. Default interpretation of unknown or hard-to-interpret utterances

The first account proposes that children's conjunctive interpretation of disjunction results from a *pragmatic strengthening* of the disjunctive meaning, where the set of alternatives includes only the individual disjuncts and lacks the conjunctive alternative (Singh et al., 2016; Tieu et al., 2017). While the set of alternatives for disjunction in adults is S , for children it is $\bar{S}$.

- (2) a. $S = \{A, B, A \wedge B\}$
 b. $\bar{S} = \{A, B\}$

Adults easily negate the conjunctive alternative using the EXH¹ operator and reach an exclusive interpretation (see 3). In contrast, for children, in the absence of the conjunctive alternative, the outcome of EXH operation on the disjunctive sentence leads to a contradiction (see 4). Therefore, children apply a recursive exhaustification mechanism (see 5) analogous to the process by which adults derive free-choice inferences (Fox, 2007), and reach a conjunctive interpretation of disjunction.

- (3) EXH(The rabbit has a carrot or a tomato) = The rabbit has a carrot or a tomato, and not both carrot and a tomato
- (4) a. EXH(The rabbit has a carrot or a tomato) = The rabbit has a carrot or a tomato, and the rabbit does not have a carrot, and the rabbit does not have a tomato

¹The EXH is a covert exhaustive operator that is an unrealized version of *only*. The EXH strengthens the meaning of a sentence, p , by negating all the 'innocently excludable' relevant alternatives ($ALT(p)$) of p .

- (5) a. EXH(The rabbit has a carrot) = The rabbit has only a carrot
- b. EXH(The rabbit has a tomato) = The rabbit has only a tomato
- c. NOT(EXH(The rabbit has a carrot) and EXH(The rabbit has a tomato))
= The rabbit doesn't have only a carrot and the rabbit doesn't have only a tomato
- d. EXH(EXH(The rabbit has a carrot or a tomato)) = The rabbit has a carrot or a tomato, and it doesn't have only a carrot and it doesn't have only a tomato
= The rabbit has a carrot and a tomato

In the second hypothesis, the advocates of the *task artifacts account* (Huang & Crain, 2020; Skordos et al., 2020) argue that the conjunctive interpretation of disjunction in children is due to experimental artifacts. They observed that experiments where disjunction was interpreted conjunctively, the context typically involved only two objects that were the disjuncts (Singh et al., 2016; Tieu et al., 2017). In the study of Skordos et al. (2020), children preferred to accept the sentence, “*The chicken pushed the bus or the airplane*” as a true sentence in scenarios where the chicken pushed both the objects, but rejected the sentence where the chicken pushed only one of the objects. The authors argued that in such a situation where the two disjuncts were the only relevant objects, the disjunctive sentence was not *informative* if understood inclusively, because the sentence would always be true. The sentence became informative only under a conjunctive or exclusive interpretation, the latter being the interpretation adults tend to adopt. However, in their third experimental condition, children preferred to accept the sentence in both scenarios when a third object (a bicycle) was introduced in the experimental scenario. It was because, in the presence of an additional object, the disjunctive sentence became informative in its inclusive reading. However, some argue that children's inclusive interpretation in the case of the additional third object situation does not necessarily suggest that children generally derive an inclusive meaning of disjunction. Rather, the introduction of a third object may simply have reduced the likelihood of a conjunctive interpretation, since children can also derive ad-hoc implicatures (*not the bicycle*) (Bleotu, Tieu, et al., 2025).

The third hypothesis suggests that children may not always know the meaning of the connective, and in that case, the meaning is ambiguous between the disjunctive and conjunctive interpretations (Sauerland & Yatsushiro, 2018). This is called the *ambiguity account* of children's conjunctive interpretation of disjunction. This account argues that when a connective is ambiguous between the two meanings, the stronger meaning (conjunctive meaning) prevails. The fourth hypothesis, *the default interpretation account*, is somewhat similar to the ambiguity account. It suggests that when the connective is unknown or it is not processed due to noise or task demands, children and sometimes adults assign a default conjunctive interpretation to the utterance by default (Bleotu, Nicolae, et al., 2025; Jasbi & Frank, 2021). It is a common observation that a simple list of items with no connective

often receives a conjunctive interpretation by default. For example: “He followed many soccer teams; Manchester United, Real Madrid, Barcelona ... you name it.”

While the pragmatic strengthening account, the ambiguity account, and the default interpretation account differ in their assumptions about the source of children’s conjunctive interpretations of disjunction, they share the prediction that such interpretations may persist even in the absence of task artifacts present in previous experiments. By contrast, the task artifacts account makes the claim that conjunctive interpretations arise primarily as a consequence of experimental design. Therefore, conjunctive interpretations should disappear when disjunction is tested in an experimental paradigm that removes the previously discussed experimental artifacts. In the present study, we employ a “give-item” task that avoids previously discussed experimental artifacts. We tested children with a set of six picture cards that made a disjunctive statement always informative under either the inclusive or exclusive interpretation. Shifting away from the truth-value judgement task, which restrict children’s responses to binary true/false choices, our task allowed children to freely choose how to respond, thus providing a very different measure of their interpretation than previous studies. At the same time, the set of picture cards shown to the children in each trial represented possible truth-conditions of the connectives, allowing us to capture children’s interpretations as inclusive, exclusive, and conjunctive. The cards shown to the children had any of the following four types of pictures: (a) A is true; B is true ($A \wedge B$), (b) A is true; B is false ($A \wedge \neg B$); (c) A is false; B is true ($\neg A \wedge B$) and; (d) A is false; B is false ($\neg A \wedge \neg B$). Thus, the possible alternatives were restricted within the experimental set-up. Section 2 discusses the study in detail.

2. Methods

2.1. Participants

Forty one 4-to5-year-old children (age range = 4;1-5;11; mean age = 5;1; $SD = 0.56$) and twenty two adults participated in the study. The children were recruited from two different preschools in Dharmanagar, Tripura, India, and the adult participants were recruited from the Government Degree College, Dharmanagar. All participants were native speakers of Tripura Bengali. Each child was tested individually in a test session that lasted for about ten to fifteen minutes. Adult participants completed the study in approximately eight to ten minutes.

2.2. Materials and procedure

In each trial, the items were six same-sized picture cards depicting some animals (Figure 1). The six cards were categorized into three types: 1-animal picture card, 2-animal picture card, and 0-animal picture card. There were two 1-animal picture cards, each depicting two different animals; two 2-animal picture cards, each depicting both animals; and two 0-animal picture cards, which depicted nothing on them. In each trial, the experimenter asked the child to hand over cards

depicting certain animals. Participants were tested in a series of 8 trials. The 8 trials were of three types: disjunctive trials, conjunctive trials, and simple trials.

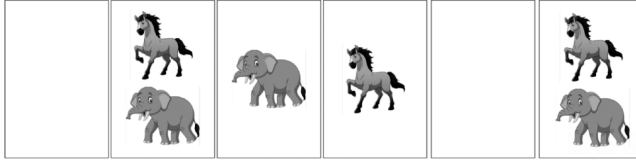


Figure 1: Sample of picture cards used in disjunctive and conjunctive trials.

In the disjunctive trials, the experimenter placed in front of the participants cards similar to those shown in Figure 1, and commanded:

- (6) tumi āmā-re oi card-ti de-o je-ti-r moddhe ghora
 You I-DAT those card-PL give-2P that-PL-GEN center-LOC horse
 nāile hāti ase
 or elephant be-PRES
 ‘Give me the cards that have a horse or an elephant on them.’

The prediction was that if participants accessed the exclusive meaning of disjunction, they would hand over only the two 1-animal cards. However, if they accessed the inclusive meaning of disjunction, they would hand over both the two 1-animal cards and two 2-animal cards. And if they accessed a conjunctive interpretation of disjunction, they would hand over only the two 2-animal cards.

In the conjunctive trials, the cards shown to participants were the same as in the disjunctive trials (Figure 1). However, the experimenter’s command to participants was as follows:

- (7) tumi āmā-re oi card-ti de-o je-ti-r moddhe ghora ār
 You I-DAT those card-PL give-2P that-PL-GEN center-LOC horse and
 hāti ase
 elephant be-PRES
 ‘Give me the cards that have a horse and an elephant on them.’

In conjunctive trials, participants were expected to hand over the two 2-animal cards to the experimenter.

One could inquire why not use four cards (Figure 2) instead of six cards to create the contrast between connectives. The answer is that in such a case, we could not use the same template for the experimenter’s question across trial types. While in disjunctive trials, the experimenter would command, “Give me the cards that have a horse or an elephant on them,” in conjunctive trials, she would have

to command, “Give me the card that has a horse and an elephant on it.” To avoid such irregularities, more than one card was used for each card type.

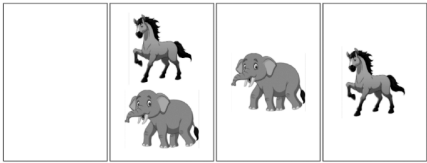


Figure 2: Sample of card combination not used in the Experiment.

In the simple trials, the experimenter’s command was as follows:

- (8) tumi āmā-re oi card-ti de-o je-ti-r moddhe ghora
You I-DAT those card-PL give-2P that-PL-GEN center-LOC horse
ase
be-PRES
‘Give me the cards that have a horse on them.’

In the case of simple trials, one empty card was replaced with the picture of the animal experimenter mentioned (Figure 3). This manipulation was necessary to ensure that the plural noun in the experimenter’s utterance appropriately matched the visual context. Otherwise, the experimenter’s utterance did not align with the scenario; the sentence “Give me the cards that have a horse on them,” is not suitable in a situation where only one card has a horse on it. In this trial type, participants were expected to hand over the two cards depicting the same animal.

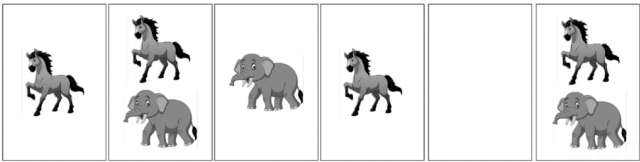


Figure 3: Sample of picture cards used in simple trials.

There were a total of 8 trials: 4 trials in the disjunctive trial type, 2 trials in the conjunctive trial type, and 2 trials in the simple trial type. Each trial featured different animals. The positions of the cards were randomized in each trial.

Children (and adults) had considerable introduction and training before the test phase for this study. There were 8 training trials where children had to perform similar tasks as described in the test trials above. The training session involved pictures similar to those in the disjunctive and conjunctive trial type. However, the experimenter’s commands in the training session did not involve any connective. Instead, the following four types of sentences were used during the training session:

- (9) tumi āmā-re oi card-ti de-o je-ti-r moddhe ektā
 You I-DAT those card-PL give-2P that-PL-GEN center-LOC one
 poshu āse
 animal be-PRES
 ‘Give me the cards that have one animal on them.’
- (10) tumi āmā-re oi card-ti de-o je-ti-r moddhe duitā
 You I-DAT those card-PL give-2P that-PL-GEN center-LOC two
 poshu āse
 animal be-PRES
 ‘Give me the cards that have two animals on them.’
- (11) tumi āmā-re oi card-ti de-o je-ti-r moddhe kuno
 You I-DAT those card-PL give-2P that-PL-GEN center-LOC any
 poshu nāi
 animal NEG
 ‘Give me the cards that have no animal on them.’
- (12) tumi āmā-re oi card-ti de-o je-ti-r moddhe poshu
 You I-DAT those card-PL give-2P that-PL-GEN center-LOC animal
 āse
 be-PRES
 ‘Give me the cards that have animals on them.’

In the case of ‘one animal’ sentences, children were supposed to hand over the 1-animal cards. In the case of ‘two animals’ sentences, children were supposed to hand over the 2-animal cards. In the case of ‘no animal’ sentences, children were supposed to hand over the 0-animal cards. Finally, in the case of ‘animals’ sentences, children were supposed to hand over all the non-empty cards. There were 2 training trials for each type. If it was observed that children had trouble picking up the right cards in any particular training trial type, the training cards were repeated for that specific training trial type until children got the right responses. The purpose of the training session was to train the children how to pick up different numbers of cards that match the experimenter’s utterance.

There were three phases in the experiment: instruction, training, and test. The test phase and the training phase have been described above. The instruction phase was like the following:

“[Child’s name!] We will play a game today. Let me explain the rules of the game to you. In this game, I will place pictures of some animals in front of you. Then I will ask you to hand me over some of the pictures. You will have to give me the pictures I ask you to give me. Can you do that? Children generally nod here. If they do not nod, the

instruction was repeated. *Okay, let us start the game then.* (Here the experimenter picks up the stack of picture cards (kept upside-down in front of her) and places the first six picture cards (cards for training) in front of the children.”

The entire study was video-recorded. All the participants were aware of the recordings. Data was documented manually by looking at the recorded videos.

2.3. Coding

For analysis, responses were converted into symbolic codes reflecting the type (but not order) of cards handed over. One type of 1-animal card in any particular trial (e.g., Horse) was coded as X, and the other type of 1-animal card in that same trial (e.g., Elephant) was coded as Y. A 2-animal card (Horse + Elephant) was coded as XY. Each code corresponds to one card, separated by underscores. The sequence of codes does not represent the order in which cards were handed over, but simply records which cards were produced in that trial. Repeated codes indicate repeated card types within a trial. Table 1 illustrates several examples of this coding scheme.

Table 1: Codes used for recording different response types.

<i>Cards handed over by children</i>	<i>Data coded as</i>
Horse, Elephant	x_y
Horse + Elephant, Horse + Elephant	xy_xy
Horse, Elephant, Horse + Elephant, Horse + Elephant	x_y_xy_xy
Horse, Horse	x_x
Horse, Horse, Horse + Elephant, Horse + Elephant	x_x_xy_xy
<i>and so on</i>	

3. Results

We fit separate Bayesian multilevel categorical models for each of the three trial types with the age-group as a fixed effect and the random intercepts for participants. In the disjunctive trials (Table 2), the inclusive response category (x_y_xy_xy) was used as the reference level. Posterior predicted probabilities showed that adults were more likely to respond with the inclusive meaning of disjunction than any other meaning category, whereas children distributed their responses across inclusive, exclusive, and conjunctive interpretations. Children were more likely than adults to give conjunctive-like responses (Est. = 12.55; [5.77, 22.87]). Children and adults had similar rates of exclusive responses to disjunction (Est. = 2.57; [-1.36, 6.85]). The participant-level random effects showed that there was a large between-participant variability in response tendencies (Table 3). A zero-one-beta inflated model indicated that participants were largely consistent in

their response patterns across disjunctive trials ($zoi = 0.77$; $coi = 0.86$). Children tended to be slightly less consistent than adults, but this difference was uncertain (Est. = -0.41 ; $[-1.36, 0.56]$).

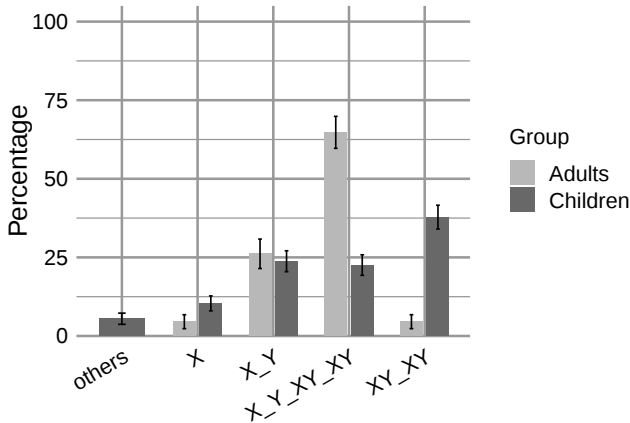


Figure 4: Percentage distribution of response types in the disjunctive trials for children and adults.

Table 2: Summary of the Bayesian multilevel categorical model for disjunctive trials with the fixed effect of age-group and random intercept of participant. Estimates are log-odds relative to the inclusive ($x_y_xy_xy$) response category (reference level).

Parameter	Estimate	SE	95% Credible Interval	Rhat
μ_{others} (Intercept)	-16.90	13.24	$[-49.43, -5.39]$	1.00
μ_X (Intercept)	-10.38	3.86	$[-19.63, -4.69]$	1.00
μ_{X_Y} (Intercept)	-3.52	1.70	$[-7.34, -0.58]$	1.00
μ_{XY_XY} (Intercept)	-11.72	4.06	$[-21.37, -5.50]$	1.00
$\mu_{\text{others}} \times \text{Children}$	13.67	12.99	$[2.40, 45.45]$	1.00
$\mu_X \times \text{Children}$	6.08	3.43	$[0.61, 14.05]$	1.00
$\mu_{X_Y} \times \text{Children}$	2.57	2.04	$[-1.36, 6.85]$	1.00
$\mu_{XY_XY} \times \text{Children}$	12.55	4.37	$[5.77, 22.87]$	1.00

Table 3: Participant-level standard deviations for disjunctive trials indicating between-participant variability in response tendencies.

Parameter	SD	SE	95% CI	Rhat
$\sigma_{\mu_{\text{others}}}$	3.18	1.29	$[1.25, 6.30]$	1.00
σ_{μ_X}	6.11	1.98	$[3.20, 10.93]$	1.00
$\sigma_{\mu_{X_Y}}$	5.56	1.45	$[3.32, 9.00]$	1.00
$\sigma_{\mu_{XY_XY}}$	7.18	2.12	$[4.05, 12.26]$	1.00

In the conjunctive trials (Table 4), adults were equally likely to respond with the conjunctive interpretation (xy_xy) and the inclusive disjunction interpretation (x_y_xy_xy) of ‘and’ (Est. = 1.34; [-2.99, 7.32]). This is likely a scope issue: a conjunctive command like “give me the cards that have X and Y” can be interpreted with wide-scope-“and” as “give me the cards that have X and give me the cards that have Y”. While some children had a similar interpretation of conjunction, the vast majority of them had conjunctive interpretations of conjunction as expected (Est. = -7.71; [-18.55, -2.05]).

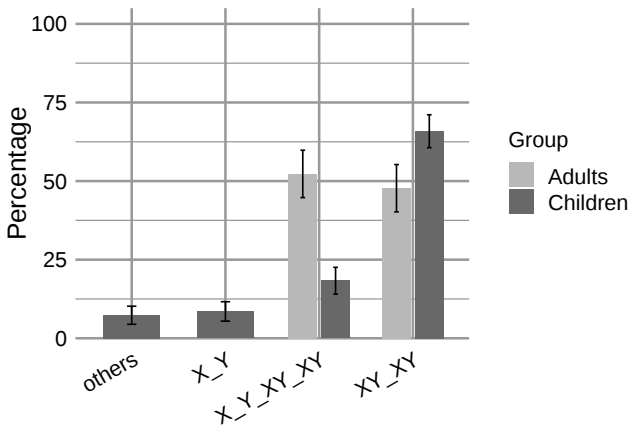


Figure 5: Percentage distribution of response types in the conjunctive trials for children and adults.

Table 4: Fixed effects of age-group for conjunctive trials. Estimates are log-odds relative to the xy_xy response pattern.

Parameter	Estimate	SE	95% CI	Rhat
μ_{others} (Intercept)	-11.10	8.15	[-32.75, -2.98]	1.00
$\mu_{\text{X_Y}}$ (Intercept)	-17.05	14.78	[-59.97, -4.23]	1.00
$\mu_{\text{X_Y_XY_XY}}$ (Intercept)	1.34	2.62	[-2.99, 7.32]	1.00
$\mu_{\text{others}} \times \text{Children}$	8.45	8.14	[0.38, 30.32]	1.00
$\mu_{\text{X_Y}} \times \text{Children}$	12.44	14.35	[0.06, 54.13]	1.00
$\mu_{\text{X_Y_XY_XY}} \times \text{Children}$	-7.71	4.26	[-18.55, -2.05]	1.00

Table 5: Participant-level standard deviations for conjunctive trials.

Parameter	SD	SE	95% CI	Rhat
$\sigma_{\mu_{\text{others}}}$	1.02	0.81	[0.05, 3.01]	1.00
$\sigma_{\mu_{\text{X_Y}}}$	3.32	1.82	[0.76, 7.44]	1.00
$\sigma_{\mu_{\text{X_Y_XY_XY}}}$	8.34	3.44	[3.98, 16.96]	1.00

In simple trials (Table 6), children were more likely than adults to respond with an exhaustive interpretation of sentences (only x and not y) ([4.82, 19.92]). Adults were more likely to respond with a logical interpretation (x, and possibly y too) than an exhaustive interpretation ([−11.24, −1.56])

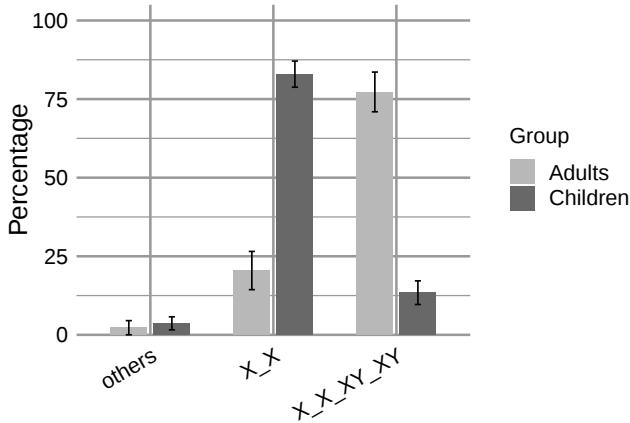


Figure 6: Percentage distribution of response types in the simple trials for children and adults.

Table 6: Fixed effects of age-group for simple trials. Estimates are log-odds relative to the x_x_xy_xy response pattern.

Parameter	Estimate	Est. Error	l-95% CI	u-95% CI	Rhat
μ_{others} (Intercept)	-5.73	2.33	-11.58	-2.56	1.01
$\mu_{\text{x_x}}$ (Intercept)	-4.94	2.49	-11.24	-1.56	1.00
$\mu_{\text{others}} \times \text{Children}$	2.82	1.93	-0.67	7.02	1.00
$\mu_{\text{x_x}} \times \text{Children}$	10.03	3.88	4.82	19.92	1.00

Table 7: Participant-level standard deviations for simple trials.

Parameter	SD	SE	95% CI	Rhat
$\sigma_{\mu_{\text{others}}}$	2.29	1.53	[0.15, 5.94]	1.00
$\sigma_{\mu_{\text{x_x}}}$	5.11	1.97	[2.36, 10.09]	1.00

4. Discussion

Our study investigated children’s interpretation of disjunction using an experimental paradigm that departs from binary forced-choice judgment tasks and minimizes previously identified task artifacts. Across trial types, our findings reveal systematic differences between children’s and adults’ interpretations. The

results bear directly on current theoretical accounts of children's conjunctive interpretation of 'or'. Our design allowed participants to freely select any combination of responses and removed the need for them to judge the informativeness of the sentence, which is a central assumption underlying the task artifacts account. However, we find that in our study, children continued to produce a substantial number of conjunctive responses in disjunctive trials. Adults in our study favoured inclusive interpretations and were more consistent in adhering to this single interpretive strategy, whereas children's responses were distributed across conjunctive, inclusive, and exclusive interpretations. Crucially, even in this heterogeneous response pattern, we found no reliable difference between children and adults' exclusive responses. This result is noteworthy given claims that children's derivation of exclusivity implicature is not comparable to adults (Chierchia et al., 2001). Our data suggest that in some contexts, children access the exclusive reading of disjunction at the same rate as adults.

In the conjunctive trials, children showed consistent semantic-pragmatic comprehension of the conjunctive operator 'and'. Adults, however, exhibited an unexpected pattern. In addition to producing conjunctive responses, adults produced inclusive disjunction-like responses to the conjunctive sentences at comparable rates. In simple trials, children were more likely than adults to adopt exhaustive interpretations, whereas adults tended to allow the logical readings. This pattern provides further evidence that children are capable of pragmatic enrichment in sentence interpretation (Gotzner et al., 2020; Papafragou & Tantalou, 2004). Further, the finding that children produced more exclusive responses than adults (although not reliably) in disjunctive trials is noteworthy, given that much of the prior literature has reported the opposite pattern.

Adults' responses in all three trial types exhibit an overly logical response pattern. While in the disjunctive trials they were highly inclusive, in the simple trials, their interpretations of the simple sentences were highly non-exhaustive. In the conjunctive trials, adults' inclusive disjunction-like responses may be explained by a between-cards interpretation of the conjunctive sentences. In the within-cards interpretation, "give me the cards that have a horse and an elephant on them" means the cards that depict both a horse and an elephant on them. In contrast, in the between-cards interpretation, the sentence can mean the cards that have a horse on them and the cards that have an elephant on them, depicting either animal alone as well as cards depicting both together. Such inclusive disjunction-like interpretations of conjunction have also been observed in children (Jasbi & Frank, 2021).

Although the findings here challenge the task artifacts account, they do not clearly support any single one of the remaining theoretical explanations. On the one hand, the conjunctive responses in our study may reflect children's pragmatic strengthening through recursive exhaustification of a restricted set of alternatives. On the other hand, they may arise from an applied default strategy when the connective was not fully understood, or was treated as ambiguous between conjunctive and disjunctive meanings. Both explanations are compatible with the findings in

our study. Critically, the pragmatic strengthening account requires robust independent evidence to establish that children possess a stable semantic representation of disjunction and that their conjunctive interpretations are not driven by ambiguity about the meaning of the connective. Without such evidence, it remains difficult to rule out the possibility that children's conjunctive responses reflect a default interpretation. Taken together, our findings suggest that children's conjunctive interpretations of disjunction are robust across task types and the pattern cannot be fully explained by experimental artifacts alone.

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