Children struggle with conditional disjunction but not with explicit conditionals

Background: This study investigates how monolingual Romanian-speaking 5-year-olds interpret *conditional disjunction*, a structure where disjunction receives a conditional meaning, as in *Go to bed early or you'll be tired tomorrow*, in comparison to explicit *if* conditionals, such as *If you don't go to bed early you'll be tired tomorrow*. Conditional disjunction is typically interpreted by adults as logically equivalent to (¬p → q) (*If you don't go to bed early, you'll be tired*),[1] though on the surface it resembles (p ∨ q). Conditional disjunction has been little explored in acquisition,[2] despite evidence of such structures in CHILDES corpora (e.g*., Don't go too fast or you'll fall down*, Eve, 2;11). Previous acquisition research on disjunction[2-6] has focused on logical uses (e.g., *The mouse carried a banana or an orange*), highlighting children's inclusivity and conjunctivity in contrast to adults' exclusivity. Similarly, studies on conditionals have focused on *if*-clauses, revealing that children comprehend simple conditional statements from as early as age two or three,[7-9] though mastery of more complex/implicit conditionals (involving *unless* 'if not') may be delayed.[10-13] How children handle conditional disjunction remains largely unknown.

Current study: We examine how Romanian 5-year-olds interpret conditional disjunctions (*Go to bed early **or** you'll feel tired*) and conditional conjunctions (*Go to bed early **and** you'll feel fresh*), in comparison to explicit conditionals (such as ***If** you do not go to bed early, you'll feel tired* and *If you go to bed early you'll feel fresh*). Conditional disjunctions should pose greater difficulty than *if not* conditionals, given the implicitness of the conditional and the negation. Conditional conjunctions should pose more challenges than *if* conditionals, given the implicit conditional, though less so than conditional disjunctions, where both the conditional and negation are implicit.

Experiment: Participants had to help Maria master Romanian as a non-native speaker. In the Implicit Conditional Condition, they heard critical items involving disjunction (*sau* 'or') or conjunction (*și* 'and') in conditional contexts and rewarded her with a happy Earth icon if the statement made sense and a sad alien icon otherwise. Participants were also asked to provide justifications for their choices. In the Explicit Conditional Condition, they heard critical items involving *dacă nu* 'if not' and *dacă* 'if'. The task involved 4 warm up items and 32 experimental items: 16 fillers (8 plausible, 8 implausible statements) and 16 critical sentences. In the Implicit Conditional Condition, the critical sentences consisted of 8 critical sentences employing *sau* 'or' (4 plausible, 4 implausible) and 8 control sentences employing *și* 'or' (4 plausible, 4 implausible), while in the Explicit Conditional Condition, the critical sentences consisted of 8 critical sentences employing *dacă nu* 'if not' (4 plausible, 4 implausible) and 8 control sentences employing *dacă* 'if' (4 plausible, 4 implausible) (see Table 1). The Implicit and Explicit Conditional Conditions were run between subjects. For the *Implicit Conditional Condition*, we tested 59 Romanian L1 adults and 30 5-year-old Romanian L1 children (mean age: 5;04); for the *Explicit Conditional Condition*, we tested 30 adults, and 34 5-year-olds (mean age: 5;03). Within each condition, items were presented in two pseudo-randomized lists: AND block followed by OR block and the reverse order, *vs.* IF NOT block followed by IF block and the reverse. In the Explicit Conditional Condition, both adults and children were highly accurate with *if not* (children 92.6%, adults 96.7%) and with *if* (children 96.3%, adults 97.8%). In the Implicit Conditional Condition, adults were highly accurate on both sentence types (95.8% on conditional *and* 85.1% on conditional *or*). Children, however, showed high accuracy with conditional *and* sentences (90.1%) but significantly lower accuracy on conditional *or* sentences (41.3%). Many children's justifications nonetheless reflected a conditional interpretation, even in case of a wrong answer—e.g., interpreting *Drink water or you'll be thirsty* as *If you drink water, you won't be thirsty*. This suggests a developmental awareness of a conditional semantic structure, despite the incorrect mapping between surface structure and logical form. Mixed-effects logistic regressions and post-hoc tests revealed that children were overall less accurate than adults. Moreover, conditional disjunctions proved significantly harder than *if not* conditionals and conditional conjunctions.

Discussions Children generally handle conditional conjunction well; although they are not fully adult-like,[14] they nevertheless display ease in detecting the cause-effect relationship between p and q.[15] In contrast, children exhibit difficulties with conditional disjunction. While a few children

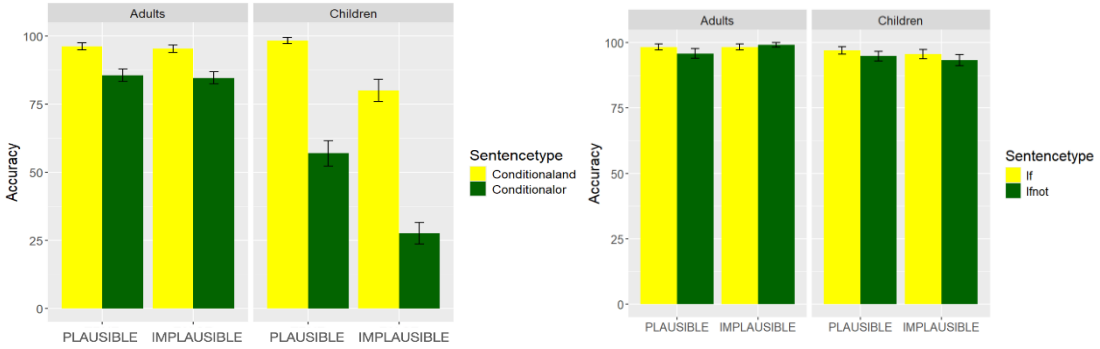
grasp the more complex inference (¬p→q), most children rely on simpler interpretations (understanding (pVq) as (p→q)). Moreover, importantly, children interpret explicit conditionals (both *if not* and *if* conditionals) with high accuracy. This suggests that, in line with the Meaning First Approach,[18] children initially opt for simpler, more direct mappings between surface structure and meaning, facing difficulties when meaning is implicit rather than explicit,[16-18] i.e., when both the conditional and the negation are not expressed linguistically. We propose that (i) children initially interpret *or* as *and,* (ii) they then reason that in conditional disjunction and conjunction there is a causal link between *p* and *q* (i.e. *p→q*). Then (iii) they recognize that *p* and *q* are incompatible in the case of conditional disjunction, ruling out the direct causal link *if p, then q*, ultimately arriving at the adult-like meaning *if not p, then q*. Future research with 7-, 9- and 11-year-olds will further clarify the developmental path of conditional disjunction.

Table 1: Examples of experimental items

Plausibility	Implicit Conditional Condition	Explicit Conditional Condition
	Conditional OR	*If not* Conditionals
Plausible	*Culcă-te devreme sau te vei trezi obosit.* 'Go to bed early or you will wake up tired.'	*Dacă nu te culci devreme, te vei trezi obosit.* 'If you don't go to bed early, you will wake up tired.'
Implausible	*Spală-te pe mâini sau te vei simți curat.* 'Wash your hands or you will feel clean.'	*Dacă nu te speli pe mâini, te vei simți curat.* 'If you don't wash your hands, you will feel clean.'
	Conditional AND	*If* Conditionals
Plausible	*Bea apă și te vei simți proaspăt.* 'Drink water, and you will feel refreshed.'	*Dacă bei apă, te vei simți proaspăt.* 'If you drink water, you will feel refreshed.'
Implausible	*Termină-ți cina și îți va fi foame.* 'Finish your dinner, and you will be hungry.'	*Dacă termini cina, îți va fi foame.* 'If you finish your dinner, you will be hungry.'
	Fillers	
Plausible	*Vacile dau lapte, oile dau lână.* 'Cows give milk, sheep give wool.'	
Implausible	*Lămâile sunt albastre, piersicile sunt violet.* 'Lemons are blue, peaches are purple.'	
Instructions		
Does what Mary said make sense or not? If it makes sense, give Mary a happy Planet Earth. If it does not make sense, give Mary a sad alien. What would you like to give Mary? Can you explain why?		

Figure 1: Accuracy in the Implicit and the Explicit Conditional Tasks

Implicit Conditional vs. Explicit Conditional



References: [1] Russell & Whitehead 1910-1913 [2] Singh et al. 2016 [3] Tieu et al. 2017 [4] Sauerland & Yatsushiro 2018 [5] Huang & Crain 2020 [6] Skordos et al. 2020 [7] Harris & Núntez 1996 [8] Aktepe 2022 [9] Aktepe & Sarisoy 2024 [10] Inhelder and Piaget 1958 [11] Amidon 1976 [12] Aripa & Scholnick 1981 [13] van Rooij & Franke 2013 [14] Noveck & Chevaux 2013 [15] Schulz, Kushnir & Gopnik 2007 [16] Slobin 1973 [17] Sauerland & Alexiadou 2020 [18] Guasti, Alexiadou & Sauerland 2023