The Pragmatic Development of *and*

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1. Introduction: *And* and its implications

From a logical perspective, the two conjunctive utterances in (1) are equivalent because they both contain the same two components and, in standard formal systems of propositional logic, order is not consequential, i.e. *P & Q = Q & P*:

(1) a. Mary got married and got pregnant.
b. Mary got pregnant and got married.

However, once one considers how the sequence of components conveys at least a temporal order the two statements prompt two very different sets of implications. Whereas it would be considered a normal occurrence to hear about someone getting married before getting pregnant (1a); in some parts of the world, it would be considered scandalous to get pregnant before getting married (1b).

As Grice (1981) pointed out, there is a distinction to be drawn between the logical truth-functional sense of *and* and the way it is normally understood. Grice suggested that *and* is equivalent to the logical conjunction operator at the semantic level and that the divergent interpretations of the two utterances are arrived at pragmatically, attributable to his maxim of orderliness. The pragmatic step concerning the sequential nature of *and* is considered a *generalized* conversational implicature. Competing contemporary accounts in the linguistic-pragmatic literature agree that the presence of a conjunction can prompt an implicature, but they disagree about the way it works. Levinson (1983; 2000) argues that interlocutors "buttress" the conjunction by readily interpreting *and* to mean *and then*. While drawing on Relevance Theory (Sperber & Wilson, 1985/1996), Carston (in press) argues that *and* can be

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enriched in a host of ways *including* buttressing; context determines how. Consider the five kinds of implications in the conjunctive utterances in (2a-e) below:

(2) a. *Contrast:* It's autumn in the U.S. and it's spring in Chile.
b. Sequential: She took the scalpel and made the incision.
c. *Containment*: We spent the day in town and went to Macy's.
d. *Causal*: She shot him in the head and he died instantly.
e. *Indirect Causal*: He left her and she took to the bottle.

As will be discussed below, children's treatment of logical terms like *and* can shed light on semantic/pragmatic distinctions (even though developmental approaches can not as readily adjudicate between the competing pragmatic accounts). The present work is concerned with determining children's ability to capture implicatures from conjunctive utterances. The questions we ask in this work are (1) Does a child draw an implicature from a conjunctive sentence in the way an adult does? and; (2) Do developmental findings with conjunctive sentences resemble those found for another class of pragmatic inferences, *scalar implicatures*?

1.2 Empirical Background and Motivation

Scalar implicatures are paradigmatic pragmatic inferences that are derived when an utterance of a relatively weak term implicates the negation of a stronger term from the same scale. For example, a speaker's use of a term like *Some* indicates that the speaker had reasons not to use a more informative quantifier from the same scale, e.g. *All*; thus, *Some* implicates *Not all*. In Noveck (2001), it was found that adults are more likely than children to generate *Not All* from *Some* as well as *Not* (the case that) *Must* from *Might*. Furthermore, classic work has shown that adults are more likely to implicate *But not both* from *Or* (e.g. Paris, 1973). Thus, prior work shows that adults are more likely than children to draw scalar implicatures.

To present one experiment from Noveck (2001) in detail, consider its modal reasoning task (see also Noveck, Ho, & Sera, 1996). Participants are presented with three boxes: One is open and has a toy parrot and a toy bear in it (the Parrot+Bear Box), the second is open and has only a parrot (the Parrot-only Box), and the third stays covered (Box C). Participants are told that Box C has the same content as either the Parrot+Bear Box or the Parrot-only Box. The puppet presents eight statements and it is the child's task to say whether or not the puppet's claim is right. The critical statement that allows for the study of implicature is *There might be a parrot in the box* when the evidence shows that there *must* be a parrot. On the one hand, if the participant adopts an explicit, logical interpretation of *Might* (where *Might* is compatible with *Must*), one would expect an affirmative reply ("the puppet is right"). On the other hand, if the participant adopts a pragmatic, restrictive interpretation for *Might*

(where *Might* is not compatible with *Must*) one would expect a negative reply ("the puppet is wrong") or at least some equivocation. Seven-year-olds' rate of logical interpretations with respect to *There might be a parrot in the box* (80%) is intriguing not only because they respond at rates that are significantly above chance levels but because they do so at a rate that is significantly higher than that of the adults' (35%), which resembles chance levels. This effect is applicable to findings with other scalar terms and thus appears to be rather robust.

The present research is an appropriate extension of the prior work because, according to one of the prominent accounts mentioned above (Levinson, 2000), the implicature related to *and* is considered to be representative of a class of implicatures that is to be distinguished from scalar implicatures. Whereas scalars are classic examples of Q-implicatures (where Q refers to Grice's Quantity maxim), conjunctions are prone to I-implicatures (where I refers to Informativeness). This work can determine whether or not the developmental-implicature effect linked to scalars can be generalized to implicatures involving conjunctions.

2. Experiment 1

In this experiment (as well as the next one) we present children and adults with stories in which a short series of events take place. We prepared four different stories that appeared along with 8 filler stories. After each story, the participants were asked to answer a question, which concerned two of the events. The question presented the two events, either in their "proper" order or in an "inverted" order, linked by the conjunction *and.*

2.1 Method

Twenty-six seven-year-olds, 26 ten-year-olds and 31 eighteen-year-olds participated. All participants were native French speakers. The participants' mean ages (range) were 7;3 (7;1 - 8;0), 10;9 (10;2 –11;11) and 18;6 (17;3 – 20;3). The participants were recruited from middle class regions in Lyon.

Booklets were prepared that included 12 stories, 4 of which were relevant to the present study. The remaining 8 stories formed part of another study concerning children's answers to *Yes/No* questions. These eight stories served as useful filler items because a) the intention of the present experiment was better hidden, and; b) they included questions that necessarily required *No* responses. Each story was made up of five lines and had its own page and there was a followup question after each story that appeared at the bottom of the page along with the response options *Yes* or *No*. The participants were required to circle the appropriate choice. Thus, the stories remained in view as the participants answered each question.

A follow-up question came in one of two varieties : It presented events from the story in their proper order or in an inverted order. Event Order was a

Within-participant factor. For example, consider the (translated) story in (3) below and its two possible follow-up questions in (4):

(3) Laurent broke his ankle while playing basketball.
His teacher took him to the school's infirmary.
In the meantime, his friends called the paramedics.
The paramedics put him in their van.
Then, they took him to the hospital.

(4) a. Laurent broke his ankle and went to the hospital?
b. Laurent went to the hospital and broke his ankle?

The three other stories can be found in the Appendix. Their follow-up questions (in both their proper and inverted orders) were:

(5) a. Julie picked up the phone and accepted an invitation?
b. Julie accepted an invitation and picked up the phone?

(6) a. Guillaume and Jack heard a meow and found a cat?
b. Guillaume and Jack found a cat and heard a meow?

(7) a. Charles ran into Emilie and went shopping?
b. Charles went shopping and ran into Emilie?

We will refer to the stories associated with the conjunctive statements in (4) through (7) as the Injury, Invitation, Cat, and Shopping stories, respectively. For all four stories, the events presented in the (a) versions (i.e. the proper order) allow for, at least, an *and then* interpretation. There are arguably additional, e.g. causal, interpretations for two of the conjunctive sentences in their proper order (i.e. for the Injury and Cat stories). Nevertheless, at minimum the (a) versions in all four stories recount what happened in their proper order.

Participants saw all four stories, two with questions about the events in their proper order and two with questions about the events in an inverted order. The Injury and Invitation stories were paired as were the Cat and Shopping stories so that both members in a pair were either presented in their proper order or in their inverted order. This way, one story in each pair has one potentially causal interpretation among its properly-ordered questions. The four stories (in fact, all 12) were presented in a random order.

2.2 Results

We first verify that the four stories and its questions led to similar performance before addressing the participants' responses to the two conjunctive orders. Within each age group and condition, responses to the

question to each of the four stories were highly similar. There were no significant differences to be found when treating stories as a factor. Thus, there is no effect based on story.

As shown on Table 1, the questions presenting the events in their proper order led to a high rate of agreement and were all significantly above chance levels. There was a slight increase in affirmative responses as the age of the participants increased, however age was not a significant factor when Proper Order was treated separately.

Table 1. **Percentage of seven-year-olds, ten-year-olds and eighteen-year-olds who respond "Yes" to two kinds of follow-up conjunctive questions (N=83).**

	Order of Conjuncts	
	Proper Order	Inverted Order
Age	(A & B)	(B & A)
7	90	87
10	94	63
18	98	29

A 3 (Age: 7, 10, 18) X 2 (Event Order: Proper vs. Inverted) ANOVA with repeated measures on the second factor was conducted. We found two main effects and an interaction. First, there was a main effect for age, $F(2,80)=8.461$, $p<.0005$. This shows that the tendency to say "Yes" decreases with age overall. Post-hoc Bonferroni tests (i.e. with a level of significance adjusted to .0167) showed that the difference was significant between the seven-year-olds and the eighteen-year-olds, $p=.0007$; the difference between the ten-year-olds and the eighteen-year-olds was marginally significant, $p=.0358$. The difference between the seven-year-olds and ten-year-olds was not significant. Second, questions containing the events in their proper order consistently prompted higher rates of "Yes" responses than those containing the conjuncts in their inverted order, $F(1,80)=61.693$, $p<.0001$. Most revealing, however, is the Age X Event Order effect $F(2,80)=36.655$, $p<.0001$. As Table 1 shows, only an Inverted Order prompts fewer "Yes" responses as the participants increase in age.

Among the Inverted-order questions, only the seven-year-olds' responses were at rates that were above chance levels, $Z=6.17$, $p < .01$. However, the equivocality found among the ten-year-olds is not of the same sort as the equivocality found among the eighteen-year-olds. While treating the Inverted-order questions separately and conducting Bonferroni post-hoc tests (i.e. with a level of significance adjusted to .0167), one finds a significant difference between the oldest group and the ten-year-olds, $p = .0019$ and a significant difference between the oldest group and the seven-year-olds, $p < .001$. The

difference between the seven-year-olds and ten-year-olds is marginally significant, $p = .0418$.

2.3 Discussion

Whereas seven-year-olds tend to affirm both types of questions, i.e. regardless of the way the order of events is presented, the ten-year-olds and the eighteen-year-olds are more likely to respond negatively when event order is inversed. The results suggest that the implicit relations (i.e. sequential order or causal links) concerning the two events in each of the conjunctive statements become more readily available to a participant as she gets older. Until these relations become available the child's reading is compatible with a logical interpretation, where event order is immaterial.

Note that a relatively high percentage of adult participants (29%) respond affirmatively when the question's event order inverts the actual chain of events. This percentage is not significantly different than that predicted by chance, which can indicate that they are equivocal (between a logical reading and a pragmatic reading). It could thus be argued that the ten-year-olds are also equivocal. However, judging from the developmental curve (specifically that seven-year-olds appear oblivious to the inverted order of the conjuncts) and the finding that the difference between the ten-year-olds and eighteen-year-olds is significant when the Inverted Order condition is treated separately, it strikes us as more likely that the ten-year-olds are simply less aware of the implicit readings linked to the connective *and* than the adults are.

3. Experiment 2

The seven-year-olds revealed no tendency to reject statements based on conjunction order; their rates of "Yes" responding was roughly equal in the two conditions. Is this due to a inability to draw implicit information from an inversely-ordered conjunctive statement or is it due to an complete inability to properly represent information (that is then reconciled with a "Yes" bias)? Here we determine how well children perform if we make the implicit relation between the two events explicit. We conduct exactly the same experiment as in Experiment 1; the only difference is that the followup question conjoins the two elements with *and then*. This way we can determine the extent to which the younger participants are capable of treating the inverted order as incorrect and better analyze the age effect found in Experiment 1.

3.1 Method

Nineteen seven-year-olds, 23 ten-year-olds and 26 eighteen-year-olds participated. All participants were native French speakers. The participants' mean ages (range) were 7;9 (7;4 - 8;6), 10;9 (10;4 –11;6) and 18;5 (17;7 – 20;0). The participants were recruited from middle-class schools in Lyon.

Booklets were identical to those in Experiment 1, except that this time the questions presented the conjunctions as "and then." As before, the participants were required to circle the appropriate choice and the stories remained in view as the participants answered each question. For example, the story in (3) had one of these two questions as a follow-up:

(8) a. Laurent broke his ankle and then went to the hospital?
b. Laurent went to the hospital and then broke his ankle?

3.2 Results

We first verify that the four stories and its questions led to similar performance before addressing the participants' responses to the two conjunctive orders. Within each age group and condition, responses to the question to each of the four stories was highly similar. There were no significant differences to be found when treating stories as a factor. Thus, there is no effect based on story.

As shown in Table 2, the questions presenting the events in their proper order led to a high rate of agreement and were all significantly above chance levels. As in Experiment 1, age was not a significant factor when Proper Order was treated separately. Among the questions presenting events in an Inverted order, only seven-year-olds respond affirmatively at levels that are significantly above predictions based on chance, z=2.45, p< .01.

Table 2. Percentage of seven-year-olds, ten-year-olds and eighteen-year-olds who respond "Yes" to two kinds of follow-up questions (N=68).

	Order of Conjuncts	
	Proper Order	Inverted Order
Age	(A & B)	(B & A)
7	97	74
10	92	8
18	96	0

A 3 (Age: 7, 10, 18) X 2 (Event Order: Proper vs. Inverted) ANOVA with repeated measures on the second factor was conducted. We found two main effects and an interaction. First, there was a main effect for age, $F(2,70)=53.825$, $p<.0001$. This shows that the tendency to say "Yes" decreases with age overall. Post-hoc tests showed that the difference was significant between the seven-year-olds and both the ten-year-olds and eighteen-year-olds. Second, questions containing the conjuncts in their proper order consistently prompted higher rates of "Yes" responses than those containing the conjuncts in their inverted order, $F(1,70)=362.473$, $p<.0001$. As in the prior Experiment, there is an Age X Event Order effect $F(2,70)=86.682$, $p<.0001$. As the Table

shows, the Inverted Order prompts fewer "Yes" responses as the participants increase in age.

For the seven-year-olds, there is a significant difference between the Proper and Inverted orders, $t(1)=2.632$, $p< .05$. Thus, there appears to be a small, significant percentage of seven-year-olds who respond negatively when the conjunction is used explicitly to point out a temporal order. Of course, for the ten-year-olds and eighteen-year-olds the difference between those responding affirmatively in the two conditions is much more clearerly significant. There is no difference between the ten-year-olds and the eighteen-year-olds in this experiment.

3.3 Discussion

This experiment shows that the ten-year-olds resemble the eighteen-year-olds once the conjunction's meaning is made explicit. That is, the two older groups respond negatively to questions that invert the order of events and express the conjunction as *and then*. The seven-year-olds are the only ones who respond affirmatively to the Inverted-order questions at all, though even their responses to the Inverted-order questions differ from those in the Proper-order condition.

A comparison of the outcomes from the two experiments shows that the ten-year-olds' and eighteen-year-olds' behavior changes significantly across the two experiments, i.e. as a function of the way the connective is employed (as underdetermined vs. explicitly temporal). Whereas ten-year-olds are prone to agree with a conjunctive question when (a) it is in an inverted order and (b) the connector is expressed simply as *and*, they are very likely to reject the statement once the connective is expressed explicitly as *and then*. The eighteen-year-olds behave similarly, though they are more likely to reject a conjunctive statement in an inverted order even with an underdetermined conjunction like *and*. Of course, comparisons across experiments need to be taken with some caution because the data were not collected at the same time and place. However, indications are rather strong that a follow-up experiment ought to produce the same kind of results in one overarching procedure.

4. 1 General Discussion

According to logical principles, order does not determine whether a conjunctive statement is true or not. *Laurent went to the hospital and broke his ankle* is not inconsistent with a story telling us how Laurent broke his ankle and went to the hospital, unless one adds some implicit meanings to the conjunction so that it is understood, for example, as *and then* or *because*. These implicit additions are pragmatic in nature.

The present experiments show that children appear less likely than adults to draw such implicit meanings from the conjunction in statements that invert a series of events. Taking the two experiments together, it becomes clear that

the oldest participants are more sensitive to an implicit event order than the younger participants. Adults generally respond negatively to statements when its component events are inverted, even when the connector is simply *and*, and their responses become negative to an even greater degree when the conjunction is rendered explicitly temporal (with *and then*). The ten-year-olds are most exemplary of the claims here, though. They are apparently equivocal when the statement's connective is simply *and*, but their rates of agreement are significantly higher than those of the eighteen-year-olds. With the explicit conjunction, *and then*, the ten-year-olds are indistinguishable from the eighteen-year-olds.

It could be argued that the developmental effect is due to the younger children's inability to properly store the events in the story or that the events become scrambled in their memory. We find this difficult to support. By the time children are 28 months old, they appear able to reproduce lengthy, arbitrarily ordered event sequences up to two weeks after having learned them (Bauer, Hertsgaard, Dropik, & Daly, 1998). Moreover, the stories are available to the participants as they answer the provided question. Thus, there is little reason to doubt that children do not have the ability to properly represent incoming event information .

The importance of the present work is that, according to some experts, the conjunction is a different sort of implicature (thus, unlike a scalar implicature). However, at least from an experimental perspective, it appears that developmental phenomena linked to scalar terms can be generalized to this other class of implicatures. That is, the findings here are comparable to those found in Noveck (2001) for a quantifier like *Some* (see also Smith, 1980); Noveck showed that adults were significantly more likely than children to draw scalar implicatures like *Not All* from *Some* and more likely to see the incompatibility between the modals *Might* and *Must*. This kind of developmental effect has also been reported with respect to *or* (Braine & Rumain, 1981; Paris, 1973; Sternberg, 1979) where children tend to accept inclusive readings more readily than adults. In other words, children are more likely than adults to accept compatibility between a weak scalar term and stronger one, e.g. between *Some* and *All*, as does formal logic. Children initially seize a weaker, logical interpretation before considering other potentially more informative readings. Thus, the data described here add to a growing body of work that shows that a child's initial treatment of utterances (such as these) is consistent with logical interpretations and that linguistic-pragmatic interpretations evolve with age.

This work is important not only to child language itself. The growing literature on implicature development (e.g. Chierchia, Crain, Guasti, Gualmini, & Meroni, 2001) demonstrates how experimental work with children can render psychologically real distinctions drawn from linguistic-pragmatics and how children's data have a role to play in the emerging field of experimental pragmatics. By developmentally teasing apart the logical and non-logical

aspects of utterance interpretation, one can see how linguistic-pragmatics is an indispensable aspect of sentence comprehension.

Appendix

The three remaining stories employed in both Experiments (referred to respectively as Invitation, Cat, and Shopping):

While sitting on her couch, Julie was reading a comic strip.
Suddenly, the phone rang.
She went out the living room and ran to answer.
It was Isabelle who was inviting Julie to celebrate her birthday Saturday.
Since they were very good friends, Julie accepted the invitation.

Guillaume and Jack took a walk in the forest.
They were walking pleasantly when they heard a meow.
They walked towards a bush, where they heard the sound come from.
They separated the branches a bit and discovered a little cat.
Jack gathered the little cat into his arms and petted its head.

Charles's mother asked him to go do some shopping.
He put on his coat and took his wallet from the table.
In the elevator he ran into Emily, his best friend.
They chatted a bit, then Charles went off by himself to the supermarket.
He bought some bread and milk before returning home.

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