Japanese-speaking children's interpretation of *ka* and *ya* 'or': Children's inclusive and conjunctive interpretations

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Listeners interpret an *or* sentence, based on their assumption about the speaker's knowledge of the stronger alternative, 'and' sentences. This study investigates whether Japanese-speaking preschoolers are able to calculate implicatures generated by the use of the connecting particles *ka* and *ya* (both meaning 'or') depending on the context/mode in which the particles are used. Testing the connectives in both the prediction mode (PM) and description mode (DM) will help determine whether children are sensitive to uncertainty or the role of a speaker's knowledge in implicature/inference calculation.

Whether children are able to interpret 'or' on a par with adults has received much attention in extensive investigations of children's (in)ability to calculate scalar implicature (SI). It has been found that children, unlike adults, interpret 'or' inclusively when given in non-downward-entailing (non-DE) contexts (without licensers like a deontic modal verb) (Boster & Crain, 1993; Braine & Rumain, 1981; Chierchia, Crain, Guasti, & Thornton, 2001; Chierchia, Guasti, Gualmini, Meroni, Crain, & Foppolo, 2004; Crain, Gardner, Gualmini, & Rabbin, 2002; Huang & Crain, 2019; Paris, 1973, among others). Previous studies have attributed children's unsuccessful calculation of SIs, including that of 'some' or 'or', to two possible causes. The first is that children are insensitive to informativeness (e.g., Noveck, 2001) or are tolerant of pragmatic infelicity (e.g., Katsos & Bishop, 2011). The second is that despite their ability to draw pragmatic inferences, children are unable to access other more informative scalar terms, such as 'and' or 'all' (e.g., Chierchia et al., 2001; Singh, Wexler, Astle-Rahim, Kamawar, & Fox, 2016). In the latter approach, Singh et al. (2016) and Tieu, Romoli, Zhou, and Crain (2017) report that children incorrectly interpret disjunction conjunctively as well as inclusively. Note that SI does not arise in DE contexts but does tend to do so in non-DE contexts and that SI yielding exclusive interpretation is calculated when the speaker is considered knowledgeable about the truth of disjuncts, whether or not one or both disjuncts are actually true. In this case, the use of 'or' also yields ignorance inferences as to which one of the disjuncts is true. Therefore, calculating SI requires sensitivity to the context/mode in which 'or' is used, such as prediction, wager, or description.

Japanese employs coordinating particles, such as *ya* 'or,' *ka* 'or' and *to* 'and', to express inclusive, exclusive or conjunctive meanings (Kuno, 1973):

Ka can be used for inclusivity and exclusivity, *ya,* for inclusivity and conjunctivity, and *to,* for conjunctivity. How each connective is interpreted generally depends on the DE or upward-entailing (UE) context in which it is used.[1] For example, *ka* is interpreted exclusively in the UE context, but inclusively or exclusively in the DE context, and we can assume that *ka*'s exclusive interpretation stems from SI calculation of informativeness in pragmatics, in line with quantity-based analysis of SIs (e.g., Grice, 1975; Horn, 1972; see fn. 17 for grammatical approaches to SI).

　　This study examines the way Japanese-speaking children interpret *ka* and *ya* depending on the mode/context in which each is used. Testing the connectives in both the PM, considered a non-UE context, and DM, a UE context, will help determine whether children are sensitive to the role of a speaker's knowledge in implicature/inference calculation.[2] *Ya* is included because it is interpreted inclusively or conjunctively. Recent acquisition studies like Singh et al. and Tieu et al. and other earlier studies like Braine & Rumain (1981) and Paris (1973) both report that children incorrectly interpret disjunction conjunctively as well as inclusively. This study will determine if Japanese children assign *ka* non-adult-like interpretations, in line with those previous studies, despite the fact that Japanese also has the inclusive conjunction *ya*. The addition of *ya* as a test item provides a way to test for 'access to alternatives' explanations for children's non-adult

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[1] Typical DE contexts include the antecedent of conditionals, the restrictor of *every*, the scope of a positive quantifier, while the UE contexts, the consequent of conditionals, the scope of *every* or a negative quantifier (e.g., Chierchia, 2013). For example, DE contexts are so called because they give rise to 'subset' inferences.

[2] In the next section, I show readings available in non-UE contexts are also available in the PM, and review interpretations of 'or' which are available in PM/non-UE or DM/UE contexts, anticipating that 'or' sentences are tested both in the PM and DM.

interpretations. Singh et al.'s analysis (and Tieu et al.'s) (based on Fox, 2007) predicts that when alternatives are inaccessible, children should interpret the relevant connective inclusively or conjunctively by calculating SI or not, based only on available 'domain' alternatives (i.e., each disjunct). The assumption here is that the availability of the inclusive conjunction *ya* somehow affects children's interpretation of *ka*. For *ya*, we assume, following Sudo (2018), that its interpretation also involves comparison of alternatives in terms of informativeness and negation of more informative alternatives. This study should contribute to understanding the way *ya* is interpreted, i.e., whether conjunctive interpretation of *ya* is derived from SI, as Sudo proposes, or it is directly interpreted conjunctively because it being a lexical conjunction.

This study aims to investigate the following:

1) How adults interpret *ka* and *ya*; whether interpretations of *ka* and *ya*, which are considered available, are in fact true in the PM/non-UE and DM/ UE contexts.

2) Whether children are able to interpret *ka* or *ya* on a par with adults, depending on the mode/context. Also whether conjunctive interpretations of disjunction 'or' (e.g., Singh et al.) can be replicated;

3) Whether children are able to interpret *ya* 'or' correctly;

4) Whether children are sensitive to contexts/modes in which 'or' is used, and therefore, to the role of the speaker's knowledge in implicature/ inference calculation.

The results show that Japanese-speaking children have difficulty with SI regarding exclusive interpretation of *ka*; they interpreted *ka* conjunctively or inclusively when it was used in both modes/contexts. The children were

also found to interpret *ya* generally in line with *ka*. The results suggest that access to alternatives explanations for children's non-adult interpretation may be correct. The results also seem to suggest that children are insensitive to the PM vs. DM in which 'or' is used, suggesting that they are insensitive to the role of the speaker's knowledge in implicature/inference calculation.[3]

Interpretation of 'Or'

The English *Or*

The disjunction *or* in English is interpreted inclusively and exclusively, depending on the context in which it is used, constrained by principles of pragmatics (e.g., Grice, 1975; Horn, 1972; Levinson, 2000). For example, in (1), a case of the PM/non-UE context, the speaker does not know the outcome yet and is uncertain as to whether one or both of the disjuncts hold (s) true.[4]

(1) I'll bet you $5 that John will bring pizza or pasta to the party.

(Chierchia et al. 2001: 158)

In this situation, (1) is compatible with three situations shown in (2), and the *or* is interpreted inclusively.

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[3] Despite its pragmatic infelicity, *ka* was tested when one disjunct was verified in the DM to compare the results for both connectives obtained in PM and DM. The adult controls were almost always found to assign exclusive interpretation in the DM.

[4] The term 'non-UE' used in this paper does not mean that superset inferences (from a subset to the superset) cannot be made. Its use is intended to show that interpretations available in the DE context become available.

(2)a. John brings pizza.

    b. John brings pasta.

    c. John brings pizza and pasta.

(3)John brought pizza or pasta to the party.

On the other hand, for *or* statements like (3), the hearer may reach one of two conclusions. S/he may conclude the speaker did not know whether or not (2c) was true ('$\neg K (A \wedge B)$'), since the speaker did not use the stronger alternative (2c). S/he may also conclude that the speaker is knowledgeable enough to know or believe (2c) was false (i.e., '$K \neg (A \wedge B)$'). In the former case, (3) is interpreted inclusively on a par with (1), but in the latter case, exclusively. For convenience I will call the speaker's inferred uncertainty or lack of knowledge in the former case Type 1 ignorance inferences. (In the Neo-Gricean framework they are called weak inferences (Horn, 1972; Soames, 1982) and Sauerland 2004 refers to them as primary implicature, which precedes what he calls the 'epistemic step'; see e.g., Fox, 2007; Sauerland, 2004 for ignorance inferences.).

    The latter exclusive interpretation stems from SI computation: Assuming that the speaker is knowledgeable as to whether both disjuncts are true (Grice, 1975; Horn, 1972), the fact that the s/he used *or* rather than *and* leads the hearer to conclude that the more informative connective does not apply (Horn, 1972; van Rooij & Schulz, 2004; Spector, 2003/2007, among others). Hence, the inference involves the negation of its associated lexical alternative, hence, $\neg (A \wedge B)$ (see (4)).

(4)a. John brought pizza or pasta, but not both pizza and pasta, to the party.

    b. $(A \vee B) \wedge \neg (A \wedge B)$

SI tends to be calculated in the UE context, and scalar terms tend to be interpreted logically in the DE context (Chierchia, 2013; Gazdar, 1979). However, as Chierchia (2013: 18-25) mentions, the inclusive or exclusive interpretation is not limited to sentences used in the DE and UE context, respectively, its distinction being a mere tendency. Therefore, when the speaker's truthfulness or informativeness is uncertain or when, for example, in (3), what John brought to the party is not necessarily in question, an inclusive interpretation will also be possible in the UE context, without any negation of the conjunctive alternative $\neg$ (A $\wedge$ B) involved.

Note that (3) also gives rise to another type of ignorance inference as to which disjunct is true (e.g., Fox, 2007; Sauerland, 2004), as briefly mentioned above. Because either one of the disjuncts should be mentioned by the speaker if s/he knows the outcome, (3) yields ignorance inferences. For convenience, I will call these inferences Type 2 ignorance inferences (see Sauerland, 2004 for the 'epistemic step' involved; see also Fox, 2007; Spector, 2003/2007 for discussion). Ignorance inferences themselves, unlike SI, do not involve associated lexical alternatives and their negation.

The Interpretation of *Ka* and *Ya*, the Japanese 'Or'

In Japanese, *ka* and *ya* (both meaning 'or'), *to* (meaning 'and') and others are coordinating particles for nominals (Kuno, 1973; Ohori, 2004; Nakamata 2015). The disjunction *ka* can be interpreted inclusively and exclusively, depending on the context in which it is used, and *ya*, inclusively and conjunctively.[5] Using one connective gives rise to SI, in relation to other

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[5] Nitta & Nagano (1966) refer to *ka* as the selective logical sum (operator) with two usages, inclusive and exclusive.

connectives as alternatives. I summarize the way the Japanese logical operators *ka* or *ya* are interpreted in the PM/non-UE vs. DM/UE contexts. I follow a derived exclusivity analysis of the Japanese disjunction *ka* on a par with the standard analysis of disjunction in other languages, such as the English *or* (e.g., Grice, 1975; Horn, 1972), and a derived conjunction analysis of *ya*, following Sudo (2014).

First, consider the use of *ka* in the PM (e.g., in the subsequent complement of 'I bet' or 'I thought'; cf. (1)), a context in which readings available in the non-UE contexts are available, as shown in (5).

(5) Ken-ga   pasuta ka sushi-o   tyuumon-suru-to omotteta yo.

　　Ken-NOM pasta KA sushi-ACC order-that   thought PAR

　　'(I) thought Ken would order pasta KA sushi.'

The speaker of (5) can be taken as speaking truthfully when it is found that Ken ordered only pasta (or only sushi) (hereafter, 1-item condition), but also when Ken ordered both (hereafter, 2-item condition). We will call this the inclusive interpretation of *ka*. However, unlike the English 'or', *ka* can also be interpreted exclusively in the PM/non-UE context.[6][7]

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[6] It seems true that the availability of exclusive interpretation in the non-UE context depends on the type of the non-UE context. For example, *ka* used in the antecedent of conditionals (DE context) seems to have strongly inclusive interpretations, as shown in (i):

(i) Mosi Ken ka John-ga   dinaa-ni kuru nara, motto biiru-o   kawa-nakereba-naranai
　　daroo.

　　If   Ken KA John-Nom dinner-to come if   more beer-Acc buy-must   will
　　'If John or Bill comes for dinner, we will have to buy more beer.'

　　　　　　　　　　　　　　　　　　　　(Chierchia, personal communication)

If *ka* is interpreted exclusively, (i) would have to mean (ii), which is not the case (except for rare cases).

(ii) If John or Bill comes, we have to buy more beer, but not if they both come.

[7] Some DE contexts, such as negative sentences like subordinate clauses under the scope of matrix negation necessarily require conjunctive interpretations (see Goro &

Next consider the way *ka* is interpreted in the DM, one of the UE contexts, as shown in (6).

(6) Ken-ga   pasuta ka sushi-o   tyuumon-sita.

     Ken-NOM   pasta KA sushi-ACC ordered

     'Ken ordered pasta or sushi.'

In describing events whose outcome is clear, *ka* is interpreted exclusively; sentence (6) is taken as true only when Ken ordered one of the two items, but not both, assuming that the speaker is considered knowledgeable about the truth of both disjuncts. The calculation of SI leads the hearer to assume that the speaker should have made more informative 'and' statements.[8]

Also, as with the English 'or', *ka* generally give rise to Type 1 ignorance inferences (in PM/non-UE contexts) and Type 2 ignorance inferences (in DM/UE contexts). As with the English 'or,' lexical alternatives are not involved in the calculation of Type 2 ignorance inferences; the speaker's failure to mention only one disjunct leads to this type of inference.

Ya is interpreted conjunctively or inclusively in the DE context, but conjunctively in the UE context. The connective has been considered as a

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Akiba, 2004: 103-104). But Japanese *ka* is interpreted exclusively in simple matrix-negation sentences, such as 'John didn't eat A KA B,' because *ka* is a positive polarity item. In the present paper, I will limit the non-UE contexts in which *ka* and *ya* are used to the PM contexts, except for cited examples.

   This section uses the PM as a non-UE context because *ka* and *ya* are presented to children (and adults) in the PM for testing, not in complex sentences, including the antecedent clause of conditionals. Complex sentences/clauses requiring readings available in the DE context pose difficulty for children. Note that readings available in such DE contexts are also available in the PM (cf. (5), (11)).

[8] *Ka* sentences pass a diagnostics for SI, defeasibility, as shown in (i):

(i) Ken-wa kasa   ka boosi-o   kata,   zissai, ryoohoo katta.

   Ken-TOP umbrella KA cap-ACC bought in fact both   bought

   'Ken bought an umbrella or a cap; in fact, he bought both.'

I take this as the involvement of SI.

lexical conjunctive (Kuro, 1973; Ohori, 2004; Nakamata 2015). But Sudo (2014) proposes a derived conjunctive analysis of *ya* in which conjunctive interpretation stems from the SI involved. Sudo observes that the connective is interpreted inclusively and conjunctively in the DE contexts, such as in the antecedent of a conditional (7), but conjunctively in the UE context (8):

(7) [Mosi Taroo-ga [koohii ya kootya]-o nom-eba] yoru nemur-e-nai-darou
　　[if　Taro-NOM [coffee YA tea]-ACC drink-if] night sleep-can-NEG-will
　　'If Taro drinks things like coffee and/or tea, he won't be able to sleep at
　　night.'

(8) Taroo-wa　[koohii ya kootya]-o nonda
　　Taro-NOM [coffee YA tea]-ACC drank
　　'Taro drank things like coffee and/or tea.'

Following Sudo (2014), we consider that the conjunctive interpretation of *ya* results from SI in association with *ka* statement (9) as an alternative, as shown in (10). In (10), an anti-conjunctive inference made in the alternative *ka* statement is negated.

(9) Taroo-wa　　coffee ka kootya-o nonda
　　Taro-NOM [coffee KA tea]-ACC drank
　　'Taro drank coffee or tea.'

(10) (Taro drank coffee $\lor$ Taro drank tea) $\land \neg$ (Taro did not drink both)

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Consider also (11) for the relevant interpretations in the PM (non-UE), where Sudo's observation on interpretations available for the DE *ya* (cf. (7)) also hold true.

(11) Ken-ga　　pasuta ya sushi-o　chuumon-suru-to omotteta yo.

Ken-NOM pasta YA sushi-ACC order-that   thought PAR

'(I) thought (that) Ken would order things like pasta and/or sushi.'

The speaker of (11) can be taken as speaking truthfully in both conditions in which one or both of the disjuncts are true, i.e., 1-item vs. 2-item conditions, respectively, yielding the inclusive interpretation of *ya*. But it is also possible that some hearers would reject the statement in the 1-item condition by assigning a conjunctive interpretation. As will be shown below, the results from the adults showed that both interpretations are in fact possible.[9]

In the DM, one of the UE contexts, *ya* statements, such as (8), are interpreted conjunctively. However, if the truth of the conjuncts is uncertain, the speaker is not knowledgeable enough, or the truth of the conjuncts has no direct relevance to the QUD in context (e.g., Groenendijk & Stokhoff, 1984; Roberts, 1996), the speaker will be taken as speaking truthfully in the 1-item condition.[10] In that case, inclusive interpretation is a minor possibility.[11]

Furthermore, unlike *ka*, *ya* gives rise to anti-exhaustive implicature (Sudo 2014): implicature that 'A and B, but not exclusively both'. I assume, following Sudo, that the anti-exhaustive implicature comes from SI computation in association with *to* as an alternative, as shown in (12).

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[9] Sudo's example, (7) in the text, in which *ya* is used in the antecedent of a conditional, seems to yield inclusive interpretation more easily. It may be that the relative availability of inclusive interpretation of *ya* varies depending on the type of DE/non-UE context given, on a par with *ka* (cf. fn. 6).

[10] I assume the minor possibility stems from *ya*'s anti-exhaustive implicature (see below in the text), conveying the notion that 'Ken ordered things like pasta and sushi'. Even though one of them was in fact not ordered, the speaker will not be thought to be speaking untruthfully.

[11] Sauerland, Tamura, Koizumi, and Tomlinson (2017) in fact seem to show that the inclusive interpretation is also true.

Exhaustive inferences of conjunctive alternatives are negated in (12).

(12) (Taro drank coffee ∨ Taro drank tea) ∧ ¬ (Taro drank nothing else)

(adapted from Sudo 2014)

This anti-exhaustive-implicature calculation may cause *ya* to be rejected in the 2-item condition, but to be accepted in the 3-item condition.

The summary of possible interpretations of *ka* and *ya* is shown in Tables 1a and 1b. (Minor interpretations are given in parentheses.)

Table 1a *Interpretations of Ka and Ya: Prediction Mode (PM/Non-UE)*

ka condition	1 item	2 item	*ya*	1 item	2 item	3 item
inclusive	OK	OK	inclusive	OK	OK	OK
exclusive	OK	OUT	conjunctive	OUT	OK	OK

Table 1b *Interpretations of Ka and Ya: Description Mode (DM/UE)*

ka	1 item	2 item	*ya*	1 item	2 item	3 item
exclusive	OK	OUT	conjunctive	OUT	OK	OK
			(inclusive	OK	OK	OK)

Acquisition of Disjunction 'Or'

Previous Studies

Generally speaking, the way children interpret 'or' sentences seems to be affected by their inability to calculate SI in these sentences (without a deontic modal verb) given in non-DE contexts (Boster & Crain, 1993; Braine & Rumain, 1981; Chierchia et al., 2001, 2004; Crain et al., 2002; Huang, Crain, & Thornton, 2019; Paris 1973; Singh et al., 2016; Tieu et al., 2017, among others). This is in line with their poor performance on SI calculation of other scalar terms such as 'some' (e.g., Noveck, 2001 [English]; Papagragou & Musolino, 2003 [Greek]). Some assert that children's relevant pragmatics

develop late, arguing that, unlike adults' interpretation, children's interpretation tends to be logical. These studies argue that children are unable to calculate pragmatic informativeness as adults do, or are more tolerant of pragmatic infelicity（Katsos & Bishop, 2011; Noveck, 2001）. However, others have proposed that children's unsuccessful performance stems from their failure to access（lexical）alternatives. There are two possible explanations for this failure. The first is found, for example, in Chierchia et al.（2001）and Reinhart（2006）, who suggest that children's non-adult-like interpretation results from their low processing capabilities, which may prevent the access to alternatives for comparison. This analysis, whether the processing aspect is emphasized or not, proposes that children can calculate informativeness, because they can detect pragmatic infelicity when alternatives are accessed or the processing cost involved in accessing alternatives is lessened. The second is found in Singh et al.（2016）and Tieu et al.（2017）, who have attributed children's incorrect interpretations to computation of SI based only on available 'domain' alternatives like disjuncts themselves. Some recent studies seem to show explanations based on the idea of 'access to alternatives' are more plausible; children do not necessarily have difficulty with SI across-the-board, when they are tested in elaborate settings or when contexts or statements make alternatives available（e.g., Barner, Brooks, & Bale, 2011; Barner, Hochstein, Bubenson, & Bale, 2018; Chierchia et al, 2001; Gualmini, Crain, Meroni, Chierchia, & Guasti, 2001; Papafragou & Musolino, 2003）.[12]

　　Among numerous studies which have reported that children assign

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[12] SI associated with the numerical scale is also reported to be accessible to children （Papafragou & Musolino, 2003）.

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disjunction non-adult-like inclusive interpretations in a non-DE context, Chierchia et al. (2001) showed that English-speaking children gave *or* the correct inclusive interpretation in DE linguistic environments such as the restrictor of *every*, but half the time accepted disjunction in the non-DE context when both disjuncts were true.[13] To examine whether children are unable to calculate SI involved in *or*, Chierchia et al. presented both *and* and *or* sentences to children in their Experiment 3 and asked the children to choose the statement which describes the context better. The results showed that when presented with *and* sentences as alternatives, children were able to calculate SIs. Their study shows that children incorrectly assigned inclusive interpretations to the non-DE *or* because they were unable to access *and* as lexical alternatives, and, not because they lack pragmatic knowledge such as SI.

Although Chierchia et al. (2001) show children's sensitivity to DE vs. UE contexts in which *or* is presented, Barner et al. (2018) report in part of their study, four-and five-year-olds are insensitive to ignorance inferences involved in *or* sentences (both Type 1 and Type 2 ignorance inferences in the present paper). When given a disjunctive sentence like 'the Cow took the banana or the orange' when one or both disjuncts were true, children were unable to choose the action figure who did not see the outcome of the story. Hochstein, Bale, Fox, and Barner (2016) also report similar results for the four-year-olds. Unlike Barner et al. (2018), they report the results of ignorance inferences by classifying them as what we refer to as Type 1 and

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[13] However, the children's chance-level performance does not mean they behaved at chance, except for one child; seven out of 15 children generally rejected test items and seven children generally accepted them.

(14)

Type 2 ignorance inferences, and they found the four-year-olds were insensitive to both types. Their results seem to indicate children do not necessarily know that 'or' is felicitously used in a context where ignorance inferences are made.[14] The results raise the possibility that although children are reported to be sensitive to DE vs. UE linguistic contexts, pragmatic contexts involving the speaker's knowledge about the outcome of stories may pose a problem for children.[15] Testing disjunction in both the PM and DM will show whether children are sensitive to modes in which the outcome is or is not certain, and therefore, are sensitive to Type 1 ignorance inferences (this does not extend to their sensitivity to Type 2 ignorance inferences).

　　Recent explanations based on the idea of 'access to alternatives' come from Singh et al. (2016), who studied English-speaking children's interpretation of *or* given in the description of pictures.[16] Their finding was that children assign both inclusive and conjunctive interpretations to disjunction (used in the object position), whether or not their subject nominal may be a single NP or an *every* NP. Following Fox (2007), Chemla's unpublished paper 'Similarity: towards a unified account of scalar implicatures, free choice permission, and presupposition projection' (2009),

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[14] The five-year-olds in Hochstein et al. were found to respond correctly to ignorance inferences about 70% of the time.

[15] For the availability of the disjunction's licit conjunctivity in the DE context, see Chierchia et al. (2001, 2004), Crain, Gardner, Gualmini, and Rabbin (2002), Crain & Khlentzos (2010), Gualmini & Crain (2002), Gualmini et al. (2001, 2003), Notley, Zhou, Jensen, & Crain (2012) and others; but cf. Goro & Akiba 2004 for Japanese children's illicit conjunctive interpretation assigned to *ka* in simple negative sentences.

[16] Braine & Rumain (1981) and Paris (1973) suggest that the observed conjunctivity comes from children's strategy that involves 'matching' disjuncts with items presented in the picture.

Franke (2011), they attribute children's illicit conjunctive interpretation to a (child) mechanism in which *or* lacks the conjunctive alternative, with only two disjuncts available as 'domain' alternatives. In this analysis (based on Fox's (2007) idea of recursive exhaustification), only a subset of alternatives, with conjunction lacking as an alternative, gives rise to conjunctive interpretation on a par with free choice interpretations of disjunction in the scope of modal (Alonso-Ovalle, 2005; Chemla 2009; Fox, 2007; Franke, 2011; Klindinst, 2005; Kratzer & Shimoyama, 2004) or other world languages such as Warlpiri (Bowler, 2014; Davidson, 2013).[17] According to Singh et al., the yielded pragmatic inference of conjunctivity stems from SI, although the relevant conjunctive interpretation happens to be illicit in the case of the conjunctive interpretation children assign to 'or'.

　　Illicit conjunctive interpretation is also reported in Tieu et al. (2017), who found that Japanese- and French-speaking children incorrectly interpret sentences containing 'or' and 'or...or' sentences (e.g., *ka* and *ka-ka* sentences in Japanese) conjunctively in the PM. Their PM task was intended to make 'or' pragmatically felicitous when one disjunct was true. However, the PM makes the interpretation in the non-UE contexts available: Both inclusive

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[17] Strengthening in Fox (2007) results from the application of a covert exhaustivity operator *exh*, being deviant from quantity-based pragmatic accounts as proposed in the Maxim of Quantity or the neo-Gricean analyses (Horn 1972). (Cf. e.g., Groenendijk & Stokhof, 1984; Krifka, 1995 for the covert operator.) The present study takes a quantity-based pragmatic approach for SI calculation and considers that implicatures stem from the pragmatic component (Gazdar, 1979; Grice, 1975; Sauerland, 2004), without any specific commitment. A grammatical approach as taken in Fox (2007) will also need to consider when the exclusivity operator is or is not inserted, leading to exclusive or inclusive interpretation, respectively. The natural assumption in this paper is that in Fox's approach, the covert operator is applied when the speaker is considered knowledgeable enough; therefore, Fox and Singh et al. will also predict variations depending on the mode. (See Chierchia, 2006; Chierchia, Fox, & Spector, 2012; Levinson, 2000 for the semantics approach.)

and exclusive interpretations are potentially possible for *ka* given in that mode.[18] And as the possibility of the relevant inclusive interpretation shows, the PM does not require SI computation. Therefore, Tieu et al.'s findings about Japanese-speaking children seem to show that when inclusive or exclusive interpretation is possible, children interpret the relevant 'or' conjunctively or inclusively (cf. fn. 18). Nonetheless, Tieu et al. is, to the best of my knowledge, the only study which studies Japanese-speaking children's (in)ability to calculate SI.

Nitta & Nagano (1966) investigated whether Japanese-speaking children are able to interpret *ka* (and other connectives) inclusively in imperative sentences, sentences in which *ka* is felicitously interpreted inclusively (see also Hatano & Suga, 1977). They found that Japanese children assign non-adult-like interpretations to *ka*; when two sets intersected, children incorrectly chose items in intersected sets for '∨' (in the authors' classification, both *to* and *ka*), and incorrectly chose items in the union set for '∧' (*de* 'and'). According to them, the former type of error was also found among older children, suggesting that the 'union' of sets, i.e., inclusivity, poses more difficulty to children than the intersection of sets does. Thus, although their test stimuli were in imperative forms, their finding seems to show (Japanese) children's difficulty with inclusivity involved in the logical sum operator '∨' (both *to* and *ka*). Therefore, some interpretation data are necessary.

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[18] Despite the use of PM, Tieu et al.'s test items do not seem to make inclusive interpretation favorable. They in fact report their Japanese-speaking adults interpret both disjunction types predominantly exclusively. Their results may come from their use of past-tense description.

The Present Study: Predictions

The present study aims to see if the 'access to alternatives' explanations recently proposed by Singh et al. (based on Fox and supported further by Tieu et al.) can explain how Japanese-speaking children interpret *ka* or *ya*. If children have knowledge about SI, they should be able to interpret *ka* and *ya* in the PM and DM in line with Tables 1a and 1b. If they have the relevant knowledge of SI, but have trouble accessing lexical alternatives, as Singh et al. propose, then conjunctivity, licit or illicit, should be found in their interpretation of *ka* or *ya*. Assuming that children do not have access to alternatives for both *ka* and *ya*, then similar results for both *ka* and *ya*, conjunctivity in particular, would be expected. The mechanism proposes that a subset of alternatives always leads to a conjunctive interpretation, stemming from SI based on the available 'domain' alternatives.

If children are sensitive to the modes used, and Singh et al's proposed explanation is correct, we can predict that illicit conjunctivity will be found only in DM, because we can assume that SI arises only in DM, even if only domain alternatives are available to children.[19] If illicit conjunctivity is found and is not limited to the DM mode, children's problem with SI may be partly due to their insensitivity to the modes.

Another possible explanation for conjunctivity may be associated with Nitta & Nagano's (and Hatano & Suga's) observation on children's difficulty with 'union': If inclusiveness poses difficulty for children, they will assign conjunctive interpretation more in the PM for *ka* (and for *ya* to some

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[19] Singh et al.'s (and Fox's) explanation would need to insert the covert *exh* operator in 'or' statements only when the speaker is taken as knowledgeable enough (see fn. 17).

extent) only if they are sensitive to modes.

If children are sensitive to Type 1 ignorance inferences associated with *ka*, then they will show sensitivity to the modes presented. If they are sensitive to Type 2 ignorance inferences, then they will accept 1ka in the PM, but will reject it in the DM. However, the DM 1ka results are tentative because of its pragmatic infelicity. (Note that because the experiment is designed so that the main puppet knows the outcome in the DM, Type 2 ignorance inferences involved in the DM *ka* are not directly examined.)

This study will also test the possibility that children are confusing lexical connectives like *ka* and *ya*.[20] Singh et al. and Tieu et al. argue against such a possibility, suggesting that children's adult-like conjunctive readings of disjunction in various DE contexts, such as in the scope of negation (e.g., Crain et al., 2002, among others; cf. Goro & Akiba, 2004) and lack of inclusive interpretations in those contexts are evidence that children do not confuse lexical items like disjunction and conjunction.

This study is novel in two ways: First, to my knowledge, *ya* is being tested for the first time.[21] Second, test items are presented in both PM and DM, to see if children are sensitive to the modes, and thus determine if uncertainty about/knowledge of the outcome affects children's interpretation of *ka*.

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[20] The possibility seems unlikely for connectives like the disjunction *ka* 'or' and the conjunction *to* 'and' because Nitta & Nagano (1966)'s results show that when *to* and *ka* were tested in the set-'disjoint' condition, their responses differed appropriately.

[21] Sauerland et al's (2017) eye-tracking study tests adults' interpretation of *ka* and *ya* given in the DM.

Experiment: Method

Participants

This experiment used a between-participants design with 31 children (15 boys, 16 girls) for the PM and 34 children (15 boys, 19 girls) for the DM as the main sample. The PM group consisted of nine four-year-olds (age range, 4；1-4；10, M_{age} = 4；5), 11 five-year-olds (5；1-5；11, M_{age} = 5；5) and 11 six-year-olds (6；1-6；10, M_{age} = 6；6) and the DM group, 10 four-year-olds (4；1-4；10, M_{age} = 4；5), 13 five-year-olds (5；1-5；11, M_{age} = 5；6) and 11 six-year-olds (6；1-6；11, M_{age} = 6；6). The participants were all monolingual Japanese-speaking children in the central Fukuoka area, Japan. A group of ten and eight adults (all undergraduate students) served as a control group for the PM and DE, respectively.

Procedure

The PM and DM of the Truth Value (or Felicity) Judgment task were used in the experiment (Crain & Thornton, 1998). An experimenter told children a short story while showing a series of pictures on a PC screen. After the children heard the story, a puppet operated by another experimenter said each stimulus sentence. For the PM test, the puppet mumbled something before the outcome of each story was known, but participants were told that the puppet would show up later and explain what he was saying. The mumbling was done to remind the participants when PM items were said that the puppet was making a prediction before the outcome was known. The children's task was to judge whether the given stimulus sentence was *atteru* 'right' or *matigatteru/ hen* 'wrong'/'strange', 'infelicitous' by feeding the puppet either 'cake' or 'a green pepper',

respectively. Once in every three or four rejections, the experimenter asked why the child responded that way. Children were interviewed individually in a quiet room in their nursery school. It took approximately 15 minutes for each child to complete the task. After each response, the children were praised liberally for answering or were given encouraging words. However, the interviewer gave the child no clues to indicate whether the child's response was correct or not, such as sentences containing connectives like the conjunction *to* 'and' or expressions like *dake* 'only' or *ryoohoo* 'both'. When a child did not respond, seemingly at a loss for a response, the experimenter asked whether the child wanted her to repeat the story or the stimulus sentence, then repeated story or stimulus sentence as necessary.

Warm-up trials and two pre-test sentences (one 'T' and one 'F') were given to the children before the main test. The warm-up and pre-test trials, which did not include any connectives, were designed to exclude children who did not understand the experimental procedure. All the children who correctly accepted and rejected the warm-up and pre-test sentences then participated in the main test. Originally, 13 four-year-olds, 14 five-year-olds and 12 six-year-olds took part in the PM test, and 13 four-year-olds, 13 five-year-olds and 11 six-year-olds, in the DM test. From the main sample, eight children were excluded from the PM and 3 from the DM because they failed pre-test trials or controls/fillers, or displayed lack of attention. The results from 31 and 34 children were used for the PM and DM, respectively.

The procedure was the same for the adults, except that they judged test items by saying *ii, atteru* 'felicitous' or *tigau, hen* 'infelicitous'. No adults failed the pre-tests, but two adults failed the fillers for the PM, and their results were excluded from analysis.

Stimulus Sentences

Throughout the following sections, each item type will be identified by the connective and the condition in which it was presented. For example, *ka* items given in 1-item conditions will be called '1ka'. Stimulus sentences used either the connectives *ka* or *ya* and were presented after one or both disjunct items were verified on a PC screen. One variable was the connective, either *ka* or *ya*, and the other variables were the conditions, either 1- or 2-item conditions for *ka*, and 1-, 2- or 3-item conditions for *ya* (all the within-participant factors; Tables 1a, b). The 3-item conditions were intended to see if the participants calculated anti-exhaustive implicature for *ya*. Both connectives were given in PM and DM (the between-participant factor). Each item type consisted of four trials, for a total of 20 items asked (plus four control/filler items and two fillers). All 20 items given in each mode used different stories and pictures. (The test sentences were presented in two randomized orders.) The control/filler items were a *ka* statement and a *ya* statement which were given when neither one of the disjuncts/conjuncts was true (the 0-item condition), and two *to* 'and' statements, one 'T', one 'F'. Two fillers had only 1 NP without any connectives; they were clearly either 'T' or 'F'. (Because pragmatic inferences are in question in the experiment [except for controls and fillers], 'felicitous' or 'infelicitous' notations should be appropriate; but for convenience, 'T' or 'F' notations are used hereafter to state participants' responses.) Depending on whether the participants tended to accept or reject the main test items, 'T' or 'F' fillers were given, respectively, to counterbalance the responses. An example of the PM 1ka items is given in (14) with the story given in (13) and the final scene presented on the PC, as

shown in Figure 1.

(13) Story: *The Cat went groce*ry *shopping and found what she liked, an
orange and a melon. What will she buy?* (The main puppet mumbles
something. The experimenter tells participants 'he will show up later
and tell what he mumbled.) *She decided not to buy a melon, she bought
an orange.*

(14) Test sentence: neko-san-ga　mikan-ka　meron-o　kau-to omotteta yo

　　　　　　Cat-Mr.-NOM orange-KA melon-ACC buy-that thought PAR

　　　　　'(I) thought the Cat would buy an apple KA a melon.'
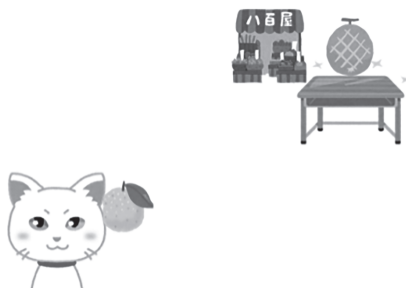
Figure 1. Example of the PM 1ka, final picture of the story

If children (and adults) interpret *ka* inclusively or exclusively, they will
accept (14); however, if they give the connective an incorrect conjunctive
interpretation, they will reject the test item.

The DM versions of stimulus sentences were given to another group of
children. The same stories and pictures were used for both groups, except
for the inclusion of a 'mumbling' part of the story, which was made in the
PM. An example of the DM 1ya is given in (16) with the story given in (15):

(15) Story: *The Sheep came to the park, where he found some friends, the Lion and the Pig. With whom will he have fun there? Oh, he grabbed the Pig by the leg, saying to the Pig 'Let's have fun, playing soccer'.*

(16) test sentence: Hituzi-san-ga   Raion-kun-ya Buta-san-o   hippat-ta yo.

                      Sheep-Mr.-NOM Lion-Mr. YA Pig-Ms.-ACC pull-PAST PAR

                      'The Sheep pulled the Lion YA the Pig.'

If children (and adults) correctly interpret *ya* conjunctively in the mode, they will reject the test item (16).

Results

Adults

Generally speaking, the adults' results were within the expected range, showing that test materials were appropriately designed. As pragmatic interpretation involves some subtlety and some minor interpretations are expected to be accessible, results from the adults are presented before those from the children. The adults' rejections of test items are given in Table 2.

Table 2 *The Adults' Results: Number and Percentage of Rejections*

	prediction mode (PM)	description mode (DM)
item type	N = 10	N = 8
1ka	2/40 (5%)	8/32 (25%)
1ya	19/40 (47.5%)	32/32 (100%)
2ka	20/40 (50%)	30/32 (93.8%)
2ya	4/40 (10%)	2/32 (6.3%)
3ya	8/40 (20%)	3/32 (9.4%)

As expected, the adults' interpretation of *ka* or *ya* generally differed depending on the PM or DM in which each was presented. An overall

analysis of the five item types showed statistical significance in rejection rates for each mode (PM: $\chi^2(4) = 40.215$, $p < .0001$; DM: $\chi^2(4) = 108.219$, $p < .0001$; Cochran-Mantel-Haenszel test, adjusted for participants).[22] A subgroup analysis of item types found statistical significance in both PM and DM for all pairs (ps $< .0001$), except for pairs such as 2ya vs. 3ya.[23] This result shows that the connectives used and the 1 vs. 2-item conditions affected the adults' rejection rates in both PM and DM. The adults' general acceptance of 2ya and 3ya in both the PM and DM shows that they calculated anti-exhaustive implicature, but not strongly enough for them to reject 2ya in both modes.

An analysis of the adults' responses to each item type depending on the mode found that the mode caused statistically significant variations in their rejection rates of 1ya and 2ka, respectively (1ya: $\chi^2(4) = 11.845$, $p < .001$; 2ka: $\chi^2(4) = .392$, $p < .005$).[24] This indicates both *ka* and *ya* can be interpreted differently depending on the mode.[25] The 2ka results, in particular, show that the adults are sensitive to Type 1 ignorance inferences.

To summarize the adults' interpretation of *ka* and *ya*:

1) Inclusive interpretation of *ka* is available in the PM, but an exclusive interpretation is also available in the same mode. But in the DM, the

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[22] To prevent a Type 1 error, throughout this paper a stratified statistical analysis, the Cochran-Mantel-Haenszel test, is used. We first perform overall analyses controlling for responses that depend on factors, such as ages or participants; when the first overall analysis finds statistical significance, further analysis is performed according to condition or age group.

[23] Statistical results of comparisons irrelevant to the interpretation of *ka* or *ya*, such as 1ka vs. 2ya and 2ka vs. 3ya, are not discussed.

[24] An ordinal scale is assumed for the frequency of rejections.

[25] Recall that the 1ka results are tentative because of the pragmatic infelicity involved in the DM 1ka.

adults only interpreted *ka* exclusively.（Note that the percentages for the DM 1ka are not emphasized because of its pragmatic oddity.）

2 ）Inclusive interpretation of *ya* is also available in the PM, along with conjunctive interpretation, whereas in the DM, only conjunctive interpretation is available.

Some minor results differing from predictions in Tables 1a,b were: Anti-exhaustive implicatures to which *ya* gives rise did not lead to rejections because of non-calculation.[26] Because these results were within the expected range, they are not emphasized.

Children's Group Results

All the children's results are given in Table 3. This section reports all the children's group results not according to age group because statistical results obtained from the children as a group also generally patterned with those from each age group in important respects.[27]

Table 3　*The Children's Results: Number and Percentage of Rejections*

	prediction mode（PM）	description mode（DM）
item type	N = 31	N = 34
1ka	56/124 （45.2%）	48/136 （35.3%）
1ya	68/124 （54.8%）	87/136 （64.0%）
2ka	19/124 （15.3%）	21/136 （15.4%）
2ya	3/124 　（2.4%）	2/136 　（1.5%）
3ya	39/124 （31.5%）	47/136 （34.6%）

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[26] It seems inclusive interpretation is unavailable for *ya* in the given DM test context because test stories have no uncertainty leading to inclusive interpretations.

[27] The two randomized orders in which the test items were presented did not result in any differences in responses; we do not discuss this.

First, an overall analysis of all the children's responses to all item types (adjusted for participants) found statistical significance in rejection rates for item types in each mode (PM: $\chi^2(4) = 142.474$, $p < .0001$; DM: $\chi^2(4) = 177.270$, $p < .0001$). A sub-group analysis of all item types also found statistical significance for each age group in both the PM and DM (all ps $< .0001$; adjusted for participants). For all the children as a group, the analysis of item types found statistical significance for all the relevant pairs (PM: 1ka vs. 1ya, $p < .05$, all the other relevant pairs, ps $< .0001$; DM: ps $< .0001$). Significant differences found between the pairs, 1ka vs. 1ya and 2ka vs. 2ya, in particular, show that the children are not confusing *ka* and *ya*.

An analysis of all children' response patterns to each item type yielded no statistically significant variations, regardless of the mode presented (Cochran-Mantel-Haenszel test).[28] This result contrasts with the adults', which showed significant difference for 1ya and 2ka, respectively. The 2ka result, in particular, shows that unlike the adults, children are not sensitive to Type 1ignorance inferences.

Regarding anti-exhaustive implicature to which *ya* gives rise, the results from the children's group were on a par with those of the adults'. The children's general acceptance of 3ya showed that they did calculate implicature, but not strongly enough to reject 2ya items.

Comparison of the Adults' vs. Children's Results
To investigate how the children's interpretation of *ka* and *ya* in the PM and DM compared with the adults', frequency of rejections were analyzed,

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28 Ordinal scales are set for the number of rejections.

using the Cochran-Mantel-Haenszel test (an ordinal scale was set for the number of rejections), based on the way each child and adult responded to each item type (shown in Tables 4 and 5).

Table 4 *Children's and Adults' Responses: Frequency of Rejections per Item Type in PM*

	children (n = 31)					adults (n = 10)				
	4/4	3/4	2/4	1/4	0/4	4/4	3/4	2/4	1/4	0/4
1ka	5	9	3	3	11	0	0	0	2	8
1ya	10	7	3	1	10	1	2	4	1	2
2ka	2	1	1	6	21	1	4	1	2	2
2ya	0	0	0	3	28	0	0	2	0	8
3ya	0	7	6	6	12	0	1	1	3	5

Table 5 *Children's and Adults' Responses: Frequency of Rejections per Item Type in DM*

	children (n = 34)					adults (n = 8)				
	4/4	3/4	2/4	1/4	0/4	4/4	3/4	2/4	1/4	0/4
1ka	9	0	6	0	19	2	0	0	0	6
1ya	12	5	10	4	3	8	0	0	0	0
2ka	3	0	2	5	24	6	2	0	0	0
2ya	0	0	0	2	32	0	0	0	2	6
3ya	7	2	5	3	17	0	1	0	0	7

The results showed statistical significance between the two groups for 1ka and 2ka in the PM (1ka: $\chi^2(4) = 7.690$, $p < .01$; 2ka: $\chi^2(4) = 8.275$, $p < .005$) and 1ya and 2ka in the DM (1ya: $\chi^2(4) = 9.068$, $p < .005$; 2ka: $\chi^2(4) = 18.727$, $p < .0001$).

The result for the PM 1ka seems to come from children's more frequent

rejections of 1ka than the adults'. This shows that while adults accepted the item type by assigning inclusive interpretations to *ka*, most of the children did not accept the item type and assigned conjunctive interpretation to *ka*. (Table 4 shows that some children assigned inclusive interpretation.)

The result for the PM 2ka stems from the children's general acceptance; they interpreted *ka* in the PM inclusively or conjunctively, whereas the adults either rejected or accepted the PM 2ka, interpreting *ka* either exclusively or inclusively.

The statistical significance found for the DM 2ka seems to stem from the children's much higher acceptance of 2ka, whereas adults almost totally rejected it; this demonstrates that in the DM, the children interpreted *ka* conjunctively or inclusively, while the adults interpreted it exclusively.

The result for the DM 1ya is due to the fact that the children accepted 1ya more frequently than the adults did, indicating that when the adults interpreted DM *ya* conjunctively, the children interpreted it inclusively or conjunctively (as shown in Table 5, they accepted or rejected the 1ya).

The Children's Individual Data

To see the interpretations each child assigned to *ka* or *ya* in each mode, we categorize interpretations as plausible based on the children's responses to the 1- and 2-item conditions (Tables 1a,b).[29] Acceptance or rejection was determined by whether three or more out of four trials were accepted or rejected, respectively. When children's responses did not fit the three types

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[29] This way of categorization does not consider the possibility that more than one interpretation (exclusive, inclusive, and illicit conjunctive) for the PM *ka*, for instance, is possible. It is assumed that children consistently assign one interpretation across conditions.

(including their failure to respond T or F consistently three times out of four), the responses were classified as 'others'. Tables 6 and 7 show which interpretation each child plausibly assigned to *ka* or *ya*, respectively, in each mode.

Table 6 *Children's Individual Classification in Both Modes: For Ka*

	PM (N = 31)		DM (N = 34)	
inclusive	14	45.2	16	47.1
conjunctive	11	35.5	8	23.5
exclusive	0	0	1	2.9
others	6	19.4	9	26.5

Table 7 *Children's Individual Classification in Both Modes: For Ya*

	PM (N = 31)		DM (N = 34)	
inclusive	11	35.5	7	20.6
conjunctive	17	54.8	17	50
exclusive	0	0	0	0
others	3	9.7	10	29.4

An overall analysis of all the children's responses did not find statistical significance between the modes for *ka* or *ya* (*ka*: $\chi^2(3) = 1.931$, $p = .586$; *ya*: $\chi^2(3) = 4.251$, $p = .119$ [Cochran-Mantel-Haenszel test, adjusted for ages]), generally on a par with their group results reported above.

The non-significant difference found for both *ka* and *ya*, along with the group results, show that, unlike the adults, the children did not vary their interpretation of the connectives depending on the mode. Tables 6 shows the following for children's interpretation of *ka*: 1) Exclusive interpretation was rarely made or not at all; 2) children assigned both inclusive and conjunctive

interpretations in both modes; 3) the predominant interpretation assigned to *ka* was inclusive.

Recall that the DM 1ka results were tentative because of its pragmatic infelicity. If pragmatic infelicity was the reason some children rejected 1ka, those rejections may have increased the number of 'conjunctive' interpretations, but not 'inclusive' interpretations. Therefore, the predominant 'inclusive' interpretations seen in the DM seem to show that children's problem with interpreting *ka* correctly stems partly from their employing an interpretation strategy which leads to inclusive interpretation of *ka*. As for inclusivity found in the PM, children's responses differed from the adults', as summarized above, but as long as the children's interpretations were licit in that mode, the results are tentative. However, note that the illicit conjunctive interpretation was assigned to the PM *ka* when it could be interpreted exclusively or inclusively. This seems to show children also have problems correctly assigning inclusive (or exclusive) interpretation to *ka* in the PM. This finding is novel.

From the *ya* results, two conclusions can be drawn. First, unlike their interpretations of *ka*, children were more able to access correct interpretations of *ya*. About half the children assigned conjunctive interpretation to *ya* correctly in both modes. Second, the non-adult-like interpretations made were inclusive interpretations made in the DM (and 'other' interpretations). Considering that inclusive interpretation is possible as a minor interpretation, the results are tentative.[30] However, children seem

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[30] The adults did not assign the interpretation and the stories used did not yield the context for uncertainty which may make inclusive interpretation of *ya* available as a minor one.

to assign inclusive interpretation to *ya* in both PM and DM at non-adult frequencies.

Discussion

Ka and *Ya*: Conjunctivity and Inclusivity

The overall results seem to lend further support to the idea that the differing sets of alternatives which are available to children and adults affect each group's interpretations of 'or'. It was predicted that if children have knowledge of SI, then they should be able to assign correct interpretations depending on the modes used. However the children interpreted *ka* inclusively or conjunctively in both PM and DM: This insensitivity to the modes suggests the children did not compute SI as the adults did. In the remainder of this section, we limit our discussion of the knowledge of SI to that of implicature calculation excluding required sensitivity to the modes/ speaker's knowledge.

As the children's (group) results of *ya* generally patterned with those of *ka*, I follow Singh et al.'s (and Tieu et al.'s) analysis of 'or': Because the children did not access the conjunctive as a lexical alternative for *ka*, they interpreted the disjunction inclusively or conjunctively by computing SI in association only with a subset of alternatives.[31] The similar results found for *ka* and *ya* seem to suggest that Singh et al.'s analysis was generally correct because their analysis would predict that conjunctive interpretation will be

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[31] Recent works on disjunction assume two possibilities for available alternatives one associates with disjunction: the 'diamond' space (e.g., Sauerland, 2004) and the 'substring' space (e.g., Fox, 2007; Fox & Katzir, 2011; Katzir, 2007). The former has the conjunction '∧' as a scalar alternative as well as 'domain' alternatives, but the latter, only 'domain' alternatives.

assigned to connectives 'or' licitly (the free-choice 'or' in English, 'or' in Warlpiri) or illicitly (children's interpretation of disjunction), if domain alternatives alone are available. Note that their analysis would predict conjunctivity also for *ya*, coupled with Sudo's derived conjunctivity analysis of *ya*. The prediction was borne out, thus supporting Sudo's analysis of *ya* as well. Children were found to have problems assigning conjunctive interpretations to the DM *ya* and so assigned it inclusive interpretations as logical ones.[32] Thus, inclusive or conjunctive interpretations assigned to *ka* and *ya* can be explained because of children's difficulty with SI. If the present analysis is correct, then we can predict that other disjunctions *aruiha*, *moshikuwa*, or *matawa* (all meaning 'or') will be also interpreted inclusively or conjunctively, if their interpretation is found to involve SI. Further study is necessary.

Next, a possible explanation for the children's difficulty assigning inclusive interpretations to *ka* in PM is found in Nitta & Nagano's (1966) and Hatano & Suga's (1977) studies. In part of their studies, they found that children had difficulty with inclusivity of *ka* used in imperatives, which required inclusive interpretation. I speculate that a sentence A ∨ B, when set A and set B intersect or when three conditions (e.g., (2) for sentence (1)) are compatible with the 'or' statements like (1), poses greater problems for children than a sentence A ∧ B, because for statement 'A *ka* B', inclusive interpretation is compatible with three situations: (set) 'A', (set) 'B', and (set) 'A and B', while A ∧ B is compatible only with the overlapping set of

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[32] Sauerland et al.'s (2017) mouse-tracking experimental results showed a difference between *ya* and the lexical conjunctions *mo* and *to* (in the UE context). This will constitute another evidence supporting the derived conjunctivity analysis of *ya*.

the two intersecting sets or one of the three conditions (cf. (2c)). ('A ∨ B' imperatives used in Hatano & Suga and Nitta & Nagano require children to choose items which are compatible with three sets or conditions.) Note that in this case, for 'A' or for 'B', '¬B' or '¬A', respectively, need to be calculated as implicature and therefore, each implicature conflicts with both the 'or' statement itself and 'A and B'. If this conflict is a reason for children's difficulty with intersection and if children have problems making ignorance inferences (as partly found in this study and other previous studies such as Hochstein et al. (4-year-olds) and Barner et al. (2018)), the conflict among alternatives does not lead to calculation of ignorance inferences (cf. Fox, 2007 for the idea of such conflict and ignorance inferences). Therefore, only the conflict remains, hence children's relevant difficulty and their substitution errors of intersections for inclusivity. On the other hand, intersection 'A ∧ B' does not cause any conflict among alternatives or implicatures. Therefore, I can tentatively conclude that children's difficulty deriving ignorance inferences may cause their difficulty in making inclusive interpretations.

SIs: Insensitivity to Modes and Ignorance Inferences

Japanese-speaking children were found to be insensitive to the modes, and therefore, to the role of the speaker's knowledge, in interpreting *ka* and *ya* (for *ka*, Type 1 ignorance inferences). This paper predicted that if children are (indirectly) sensitive to Type 2 ignorance inferences, then they should accept 1ka in PM, but reject it in DM.[33] Given the mode's pragmatic infelicity, the rejection of the DM 1ka was predicted to be quite likely. These

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[33] I used 'indirectly' in the text, because in the case of DM 1ka, the main puppet saw which disjunct was true.

predictions were not fulfilled: The results found no significant difference between the modes, and in fact the children rejected 1ka in the PM more frequently than in the DM (45.2% [DM] vs. 35.3% [PM]). However, the adults accepted the DM 1ka 75% of the time. This shows that the adults recognized that the 1-item condition and *ka*'s exclusive interpretation are compatible with each other. This suggests that Type 2 ignorance inferences are not strong enough to cause rejection of 1ka based on non-fulfillment of the ignorance inferences. Unlike the PM 1ka results, the DM 1ka results revealed no significant difference between adults and children; neither group showed significant difference in rejecting 1ka depending on the mode. Therefore, the results found no evidence of the children's (and the adults') sensitivity to Type 2 ignorance inferences. Because of the pragmatic infelicity involved in the DM 1ka, these results concerning Type 2 ignorance inferences are not emphasized.

Regarding children's insensitivity to Type 1 ignorance inferences, as mentioned above, Hochstein et al. in particular, reported their four-year-olds were insensitive to Type 1 and Type 2 ignorance inferences (cf. Barner et al., 2018 for the relevant results when both types are combined). The results in the present paper give indirect support to their findings. Note, however, that Hochstein et al.'s five-year-olds were sensitive to Type 1 and Type 2 ignorance inferences about 70% of the time (fn. 14). The difference in sensitivity to Type 1 ignorance inferences shown by Hochstein et al.'s five-year-old children and the children in the present study may be due to the difference in tasks: Hochstein et. al used the binary choice of the puppet which spoke felicitously, while the present study used the TVJT.

Hochstein et al. also report that despite the five-year-olds' sensitivity to

ignorance inferences, the children performed poorly when calculating SI, and argue that sensitivity to both types of ignorance inferences is not directly constitutive of SI.[34] Although my study did not find any discrepancy between the calculation of SI and Type 1 ignorance inferences, I infer, in light of Hochstein et al.'s results, that there are other factors which make it difficult for children to calculate SI, although sensitivity to ignorance inferences is part of SI calculation. Of course, further study is necessary because Barner et al. (2018) also report that four-to-five-year-olds are insensitive to ignorance inferences. However, the following may be a possible explanation. Calculating ignorance inferences for 'or' may or may not require access to lexical alternatives. Consider Type 1 ignorance inferences; since the speaker did not use 'and', the inference arises that the speaker does not know that the alternative does not hold. In this case, the alternative 'and' needs to be accessed. However, Type 2 ignorance inferences do not require access to alternatives (Katzir, 2007). Therefore, the 'access to alternatives' explanations can account for the general success Hochstein et al's five-year-olds' had in making those ignorance inferences, contrasted with their failure to calculate SI. Other problems which may make the calculation of SI more difficult for children than sensitivity to ignorance inferences may come from strengthening informationally weak statements, i.e., negating alternatives. I also suggest that the reason children's reported success in calculating SI (e.g., Chierchia 2001) or ignorance inference (Hochstein et al.'s five-year-olds) can be attributed in part to the researchers' use of 'binary choice'

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[34] In Hochstein et al.'s study, ignorance implicature concerns 'or' while SI concerns the ad-hoc scale. Therefore, their results might not support their argument, given that SIs associated with numerals and ad-hoc scales are acquired early (see e.g., Papafragou & Tantalou, 2004; Skordos & Papafragou, 2016).

tasks. Difficulty accessing (lexical) alternatives and the process of strengthening 'or' by negating alternatives, which are necessary in the TVJT, may also pose problems for children.

Ya vs. *Ka*: Similar Results and Some Differences

Unlike the adults, the children in this study, as shown particularly in their individual classification results, generally assigned inclusive or conjunctive interpretations to both *ka* and *ya*. However, they seemed to distinguish *ka* from *ya* to some extent, as shown in the child classification results. If our analysis of inclusive and conjunctive interpretations and the mechanism which produces them (using only domain alternatives) is correct, the reason for the varying interpretations of *ka* or *ya* need to be addressed. There are two possibilities. First, for *ya*, conjunctivity may be lexically/semantically strong; Kuno (1973), Ohori (2004) and Nakamata (2015) take it as the lexical conjunction. A second possibility may concern some difficulty children may have for *ka* in calculating ignorance inferences and assigning inclusive interpretations (in PM) as well, as mentioned above. The present paper tentatively speculates that these possibilities may lead to somewhat varying interpretations for *ka* and *ya*. I will leave this to further study.

Anti-Exhaustive Implicature for *Ya* and Exhaustive Implicature for *Ka*

The children tended to accept both 2ya and 3ya (the latter to a lesser degree) in both PM and DM, showing that their calculation of anti-exhaustive implicature (as shown by their acceptance of 3ya) is not strong enough to make them reject 2ya; the children's responses patterned with the

adults'. There were some children who rejected 3ya, thus demonstrating sensitivity to SI based on the ad-hoc scales; these children mentioned the third item/character rather than accept the 3ya. Their rejection does not mean they are incapable of calculating anti-exhaustive implicature. These results seem to show that the involvement of more than one type of implicatures/inferences in parallel results in a relative strength/weakness which leads to rejection or acceptance of relevant sentences, respectively.[35] As adults are apparently insensitive to anti-exhaustive implicature, we can say such implicature is not calculated so as to cause rejection of *ya* when only two disjuncts are verified. This contrasts with conjunctive interpretation of *ya*; conjunctivity need to be calculated by SI in association with *ka*, and this need affects rejection and acceptance of *ya* sentences. This points to the possibility that on a par with anti-exhaustive implicature of *ya*, exclusive implicature which *ka* generates does not affect adults' and children's acceptance or rejection of *ka* sentences which is based on SI.

As for *ka*, recently, Huang et al. (2019) and Huang & Crain (2020) argue that because of the exhaustive implicature of 'or', the felicitous use of the disjunction requires more objects/individuals in the experimental discourse than those denoted by the disjuncts. Those researchers suggest that in previous studies, such as Singh et al. and Tieu et al., the children's illicit conjunctivity was due to the experiments' not fulfilling the felicity condition for exhaustive implicature generated by 'or'.[36] Their proposal has important

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[35] Sauerland et al. (2017) also report that Japanese adults almost always accepted 2ya items.
[36] To my knowledge, Braine & Rumain (1981, Task 3) report children's illicit conjunctive interpretation even when other individuals were included in the experimental discourse other than those denoted by disjuncts.

relevance to *ka* in this study because the stories for *ka* used in the experiment did not specifically mention third objects/individuals other than those mentioned with the disjuncts (except for some cases in which pictures of grocery stores and zoos, for example, showed other fruits or animals).

However, recall the following: The adults' and children's calculation of *ya*'s anti-exhaustive implicature was not sufficient to make both groups reject 2ya and neither did the groups tend to reject 1ka in DM. The children had a tendency to accept the DM 1ka (the rejection rate was about 34-36%), but generally did accept the DM 2ka.[37] (Note that Huang & Crain suggest that the lack of felicity condition for 'or' in experimental discourse leads to rejection of the 1-item 'or'.) Therefore, the results of the present study show that when children and adults rejected *ka* statements, the rejection was not caused by the experimental discourse lacking exhaustive implicature and therefore not being felicitous.

I admit that for the more felicitous use of *ka*, third objects/individuals should be included (except for some complications which may lead to an additive load on children's working memory when more items/individuals are added). But I tentatively assume that as shown in the adults' and children's insensitivity to anti-exhausitive implicatures for *ya*, sensitivity to (anti-)exhaustive implicatures generated by *ka* and *ya* was not strong enough to make both groups reject *ka* and *ya* sentences, based on the non-fulfillment of such implicatures. I conclude, until follow-up experiments are done, that in this study, for *ka* the non-fulfillment of such felicity condition had little effect on how adults and children interpreted the disjunction.[38]

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[37] The children tended to reject 1ka in PM slightly more than in DM.

[38] In fact, conjunctive interpretations seem true in my follow-up experiment (in

This paper focused on the way the children differ from the adults in their interpretation of *ka* or *ya* in the same experimental setting, leaving the proposed ideas of exhaustive implicature associated with *ka* for future study.

Conclusion

The present study found that Japanese-speaking children interpret *ka* and *ya* inclusively (licitly or at non-adult frequencies) or conjunctively (always illicitly for *ka*) but do not vary their interpretations depending on the mode in which the particles are presented. These results were compatible with Singh et al.'s, Tieu et al.' (and Fox's) proposals because the availability of the inclusive conjunction *ya* did not affect children's (illicit) interpretations assigned to *ka*. Children were also found to assign non-adult inclusive interpretations to *ya*, showing that they also have problems with another connective called *ya*. The finding about children's insensitivity to the modes was novel since previous studies on disjunction (except for Chierchia et al. 2001) reported their results obtained either in the PM or DM linguistic contexts. The present study showed that when computing inferences/ implicatures (Type 1 ignorance inferences, in particular), the children were insensitive to the role of the speaker's knowledge. This seems to show that children do not compute SI on a par with adults. It may be that children have knowledge of SI, but pragmatic components associated with the speaker's knowledge/opinion may develop late, as widely argued in the literature.

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progress) in which test stories for *ka* always fulfill such felicity conditions; it has been found that nine out of 22 five-to-six-year-olds can be classified as 'conjunctive' children (inclusive: 10; exclusive: one; others: one). This will support the present proposal and those made in Singh et al., Tieu et al. and Fox.

References

Alonso Ovalle, L.（2005）. *Disjunction in alternative semantics*（Doctoral dissertation）.

Barner, D., Brooks N., & Bale A.（2011）. Accessing the unsaid: the role of scalar alternatives in children's pragmatic inferences. *Cognition*, 188, 87-96.

Barner, D., Hochstein, L., Bubenson M., & Bale A.（2018）. Four-year-old children compute scalar implicatures in absence of epistemic reasoning. In K. Syrett, & S. S. Arunachalam（Eds.）, *Semantics in language acquisition*（pp. 325-349）. Amsterdam: John Benjamins.

Boster, T., & Crain S.（1993）. On children's understanding of *every* and *or*. In C. Smith（Ed.）, *Proceedings of Early Cognition and the Transition to Language*, 1-23.

Bowler, M.（2014）. Conjunction and disjunction in a language without 'and'. In T. Snider, S. D'Antonio, & M. Weigand（Eds.）, *Proceedings of SALT*, 24, 137-155.

Braine, D. S., & Rumain B.（1981）. Children's comprehension of 'or': evidence for a sequence of competencies. *Journal of Experimental Child Psychology*, 31, 46-70.

Chierchia, G.（2006）. Broaden your views: implicatures of domain widening and the 'logicality' of language. *Linguistic Inquiry*, 37（4）, 535-590.

Chierchia, G.（2013）. *Logic in grammar: polarity, free choice, and intervention*. Oxford: Oxford University Press.

Chierchia, G., Crain S., Guasti, M. T., & Thornton R.（2001）. "Some" and "or" : a study on the emergence of logical form. In S. C. Howell, S. A. Fish, & T. Keith-Lucas（Eds.）, *Proceedings of Boston University Conference on Language Development*, 24, 22-44. Somerville, MA: Cascadilla Press.

Chierchia, G., Guasti, M. T., Gualmini, A., Meroni, L., Crain, S., & Foppolo F.（2004）. Semantic and pragmatic competence in children and adults comprehension of *or*. In I. Noveck, & D. Sperber（Eds.）, *Experimental pragmatics*（pp. 283-300）. London: Palgrave Macmillan.

Chierchia, G., Fox, D., & Spector B.（2012）. Scalar implicature as a grammatical phenomenon. In P. Portner, C. Maienborn, & K. von Heusinger（Eds.）, *Semantics: an international handbook of natural language meaning*, vol. 3（2297-2331）. Berlin:

Mouton de Gruyter.

Crain, S., Gardner, A., Gualmini, A., & Rabbin B. (2002). Children's command of negation. In Y. Otsu (Ed.), *Proceedings of the 3rd Tokyo Conference on Psycholinguistics*, 71-95. Tokyo: Hituzi Publishing Company.

Crain, S., & Thornton, R. (1998). *Investigations in universal grammar: a guide to experiments on the acquisition of syntax and semantics*. Cambridge, MA: MIT Press.

Crain, S. & Khlentzos D. (2010). The logic instinct. *Mind & Language,* 25, 30-65.

Davidson, K. (2013). 'And' and 'or': general use coordination in ASI. *Semantics and Pragmatics,* 6, 1-44.

Fox, D. (2007). Free choice and the theory of scalar implicatures. In U. Sauerland & P. Stateva (Eds.), *Presupposition and implicature in compositional semantics* (pp. 71-120). Houndmills, Basingstoke and Hampshire: Palgrave Macmillan.

Fox, D. & Katzir R. (2011). On the characterization of alternatives. *Natural Language Semantics,* 19, 87-107.

Franke, M. (2011). Quantity implicatures, exhaustive interpretation, and rational conversation. *Semantics and Pragmatics,* 4(1), 1-82.

Gazdar, G. (1979). *Pragmatics*. New York: Academic Press..

Goro, T. & Akiba, S. (2004). The acquisition of disjunction and positive polarity in Japanese. In V. Chand, A. Kelleher, A.J. Rodriguez, & B. Schemeiser (Eds.), *Proceedings of WCCFL,* 23, 101-114. Somerville, MA: Cascadilla Press.

Grice, P. (1975). Logic and conversation. In D. Donald & G.H. Harman (Eds.), *The logic of grammar* (pp. 64-75). Encino, CA: Dickenson Publishing.

Groenendijk, J. & Stokhoff M. (1984). *Studies on the semantics of questions and the pragmatics of answers* (Doctoral dissertation).

Gualmini, A. & Crain S. (2002). Why no child or adult must learn DeMorgan's laws. In S. C. Howell, S. A. Fish, & T. Keith-Lucas (Eds.), *Proceedings of the 24th Annual Boston University Conference on Language Development*, 367-378. Somerville, MA: Cascadilla Press.

Gualmini, A., Crain S., Meroni L., Chierchia G., & Guasti, M.T. (2001). At the

semantics=pragmatics interface in child language. In H. Rachel, B. Jackson, & Z. Zvolenszky (Eds.), *Proceedings of SALT*, 11, 231-247.

Gualmini, A., Meroni L., & Crain S. (2003). An asymmetric universal in child language. In M. Weisgerber (Ed.), *Proceedings of Sinn und Bedeutung* VI, 136-148.

Hatano, G. & Suga Y. (1977). Understanding and use of disjunction in children. *Journal of Experimental Child Psychology*, 24, 395-405.

Hochstein, L., Bale A., Fox D., & Barner D. (2014). Ignorance and inference: Do problems with Gricean epistemic reasoning explain children's difficulty with scalar implicature? *Journal of Semantics*, 33(1), 107-135.

Horn, L. R. (1972). *On the semantic properties of logical operators in English* (Doctoral dissertation).

Huang, H. & Crain S. (2020). When OR is assigned a conjunctive inference in child Language. *Language Acquisition*, 27(1), 74-97.

Huang, H., Thornton R., & Crain S. (2019). When OR is conjunctive in child Mandarin. In T. Ionin, & M. Rispoli (Eds.), *Three streams of generative language acquisition research* (pp. 125-142). Amsterdam: John Benjamins.

Katsos, N., & Bishop, D.V.M. (2011). Pragmatic tolerance: implications for the acquisition of informativeness and implicature. *Cognition*, 120, 67-81.

Katzir, R. (2007). Structurally defined alternatives. *Linguistics and Philosophy*, 30, 669-690.

Klinedinst, N. W. (2007). *Plurality and possibility* (Doctoral dissertation).

Kratzer, A. & Shimoyama J. (2002). Indeterminate pronouns: the view from Japanese. In Y. Otsu (Ed.), *Proceedings of the Third Tokyo Conference on Psycholinguistics*, 1-25. Tokyo: Hituzi Syobo.

Kuno, S. (1975). *The structure of the Japanese language*. Cambridge, MA: MIT Press.

Levinson, S. (2000). *Presumptive meanings: the theory of generalized conversational implicature*. Cambridge, MA: MIT Press.

Nakamata, N. (2015). Nihongo-heiretsu-hyogen-no taikei [System of parallel coordinations in Japanese language]. Tokyo: Hituzi.

Nitta, N., & Nagano S. (1966). Basic logical operations and their verbal expressions—

child's conception of logical sum and product―. *Research Bulletin of the National Institute for Educational Research*, 1-27. Tokyo.

Notley, A., Peng Z., Britta J., & Crain. S. (2012). Children's interpretation of disjunction in the scope of "before": a comparison of English and Mandarin. *Journal of Child Language*, 39(3), 482-522.

Noveck, I. (2001). When children are more logical than adults: experimental investigations of scalar implicatures. *Cognition*, 78, 165-188.

Ohori, T. (2004). Coordination in Mentalese. In M. Haspelmath (Ed.), *Coordinating constructions* (pp.41-66). Amsterdam: John Benjamins.

Papafragou, A. & Julien M. (2003). Scalar implicatures: experiments at the semantics–pragmatics interface. *Cognition*, 86, 253-282.

Papafragou, A. & Tantalou, N. (2004). Children's computation of implicatures. *Language Acquisition*, 12(1), 71-82.

Paris, S. G. (1973). Comprehension of language connectives and propositional logical relationships. *Journal of Experimental Child Psychology*, 16, 278-291.

Reinhart, T. (2006). *Interface strategies: optimal and costly computations*. Cambridge, MA: MIT Press.

Roberts, C. (1996). Information structure in discourse: towards an integrated formal theory of pragmatics. In J.H. Yoon, & A. Kathol (Eds.), *Ohio State University Working Papers in Linguistics, vol. 49: Papers in Semantics* (pp.91-136). Columbus: Department of Linguistics, The Ohio State University.

Sauerland U. (2004). Scalar implicatures in complex sentences. *Linguistics and Philosophy*, 27, 367-391.

Sauerland, U., Tamura, A., Koizumi, M., & Tomlinson, J.M. (2017). Tracking down disjunction. In *New frontiers in artificial intelligence: JSAI International Symposium on Artificial Intelligence*, 109-121. Cham: Springer.

Skordos, D. & Papafragou A. (2016). Children's derivation of scalar implicatures: alternatives and relevance. *Cognition*, 153, 6-18.

Singh, R., Wexler, K., Astle-Rahim, A., Kamawar, D., & Fox, D. (2016). Children interpret disjunction as conjunction: consequences for the theory of scalar

implicature and child development. *Natural Language Semantics*, 24, 305-352.

Soames, S. (1982). How presuppositions are inherited: a solution to the projection problem. *Linguistic Inquiry*, 13(3), 483-545.

Spector, B. (2007). Scalar implicatures: exhaustivity and Gricean reasoning (revised version of Spector 2003). In M. Aloni, A. Butler, & P. Dekker (Eds.), *Questions in dynamic semantics* (pp.225-249).

Sudo, Y. (2014). Higher-order scalar implicatures of 'ya' in Japanese. Paper presentation at TEAL 9, University of Nantes.

Tieu, L., Yatsushiro, K., Cremers A., Romoli, J., Sauerland U., & Chemla, E. (2017). On the role of alternatives in the acquisition of simple and complex disjunctions in French and Japanese. *Journal of Semantics*, 34(1), 127-152.

Tieu, L., Romoli, J., Zhou, P., & Crain, S. (2015). Children's knowledge of free choice inferences and scalar implicatures. *Journal of Semantics*, 33(2), 269-298.

van Rooij, R. & Schulz, K. (2004). Exhaustive interpretation of complex sentences. *Journal of Logic, Language and Information*, 13, 491-519.