A probabilistic, question-based approach to additivity*

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DRAFT

Abstract

Many analyses of additive particles such as *too*, *also*, and *either* have claimed that any such particle requires a contextually salient antecedent sentence that is a focus alternative of its prejacent or is a partial answer to the Question Under Discussion addressed by the prejacent. There is, however, a previously unstudied use—the argument-building use—which occurs without such an antecedent. This paper proposes an analysis of *too* that accounts for the argument-building use and unifies it with the canonical additive use. The central claim is that *too* is felicitous if and only if its antecedent can be taken to answer a relevant question such that the conjunction of *too*'s antecedent and prejacent evidences some answer to that question more strongly than the antecedent does alone. This analysis relies on the notion of a "resolution" from Inquisitive Semantics and the treatment of context update as Bayesian inference, as is done in the Rational Speech Act framework. The treatment of *too* developed here provides the basis for a new approach to additivity that can be extended to other additive expressions.

1 Introduction

This paper proposes a new approach to additivity that synthesizes insights from Inquisitive Semantics and probabilistic approaches to pragmatics. This approach is motivated by a use of the English additive particle *too* that has not previously been analyzed in the semantics and pragmatics literature, which I call the ARGUMENT-BUILDING USE. Some naturally-occurring examples drawn from the Corpus of Contemporary American English (COCA; Davies 2008–) are shown in (1).

(1)   a.   Ernie who's been raising or helping to raise somebody's children [...] since she was maybe thirteen years old, just naturally took Iree in with no authority but

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her own. [...] Good thing she did **too** because something happened in the birthing time of Iree and she's got epilepsy [...] (COCA)

b. (Online forum discussion) i have never gotten a ticket but i know a cpl people who have.. i guess the fine is a hefty one **too**. depending on what im driving, i chance it. (COCA)

c. A room just opened up at this hotel. [...] It looks kind of fancy, **too**. (COCA)

Intuitively, the argument-building use marks two pieces of information as building an argument together for some conclusion. This differs from the canonical additive use, which has been claimed by Beaver & Clark (2008) and Zeevat & Jasinskaja (2007) to require the presence of two independent answers to a contextually salient question, as in (2).

(2) Q: Who did Avery invite?
A: Avery invited Bailey. She invited Cameron, **too**.

This paper proposes a unified analysis of the argument-building and canonical additive uses of *too*. It argues that *too* uniformly requires the existence of a contextually relevant question that is answered (in a sense to be made precise) by its antecedent, but has a resolution that its antecedent and prejacent argue for more strongly together than either of them does alone. I begin with some background on additivity in Section 2, before presenting some puzzles related to the argument-building use in Section 3. The intuitions behind the analysis are then developed in Section 4 and formalized in Section 5. In Section 6, I suggest how the approach developed here can be extended to other additive expressions and point to some directions for further research.

2 Previous work on *too*

At least since Kripke (2009), it has been widely assumed that *too* and other additive expressions require a contextually salient antecedent. What Kripke points out is that (3), where $[]_F$ indicates prosodic focus, is only felicitous if there is some other salient person besides Sam who is having dinner in New York tonight. This is counter-evidence to any analysis that claims that the presupposition of *too* is simply existential—that is, that there exists someone who is eating dinner in New York tonight, which is true at all times in every context in the actual world.

(3) Tonight $[\text{Sam}]_F$ is having dinner in New York, too. (Kripke 2009)

There is less consensus about how to characterize the relationship between the antecedent and host sentence. Heim (1992) and other authors (e.g. Zeevat 2002; Geurts & van der Sandt 2004) claim that *too* is anaphoric on a contextually salient individual, and that *too* carries the presupposition that the property predicated of the individual focused in the host sentence holds of that antecedent individual. Heim's formulation of this presupposition is shown in (4), where α_F is the individual focused in the host sentence.

(4) $\phi[\alpha_F]too_i$ presupposes $x_i \neq \alpha$ & $\phi[x_i]$.

Other analyses have assumed that *too* requires a propositional antecedent, rather than an individual, to be salient. Many authors (e.g. Rullmann 2003; Winterstein 2011; Ahn 2015) have claimed that the antecedent must be a focus alternative of the host sentence. Focus alternatives, as introduced by Rooth (1985, 1992), are generated by replacing the focused material in a sentence with other expressions of the same semantic type. In (5-a), for instance, the antecedent *I don't like [pizza]$_F$* is a focus alternative of the host sentence *I don't like [spaghetti]$_F$*, and in (5-b), the antecedent *I like [pizza]$_F$* is a focus alternative of the host sentence *I like [spaghetti]$_F$*.

(5)   a.   I like [pizza]$_F$, and I like [spaghetti]$_F$, **too**.
       b.   I don't like [pizza]$_F$, and I don't like [spaghetti]$_F$, **either**.
       (Rullmann 2003)

Rullmann (2003) argues that *too* carries the presupposition that a contextually salient focus alternative of its host sentence is true, as shown in (6). Here Rullmann makes use of Rooth's notions of "ordinary semantic value" and "focus value" of an expression, given by the functions $\llbracket \cdot \rrbracket^o$ and $\llbracket \cdot \rrbracket^f$. (The ordinary semantic value of α is its usual denotation, while the focus value of α is the set of focus alternatives to α.) In (5-a), this presupposition is satisfied by the fact that *I like pizza* is true and contextually salient.

(6)   Semantics of *too*   (Rullmann 2003)
       a.   ordinary semantic value: $\llbracket \alpha \text{ too} \rrbracket^o = \llbracket \alpha \rrbracket^o$
       b.   focus value: $\llbracket \alpha \text{ too} \rrbracket^f = \{\llbracket \alpha \rrbracket^o\}$
       c.   presupposition: [α too] presupposes that there is at least one contextually salient proposition $p \in \llbracket \alpha \rrbracket^f - \{\llbracket \alpha \rrbracket^o\}$ such that p is true.

I adopt the assumption that *too* requires a salient propositional antecedent, but I will not attempt to define "salient" here. There is a great deal of controversy in the literature about what exactly *too* requires to be overtly present in the discourse context and what can be accommodated (see e.g. Kamp & Rossdeutscher 1994; Zeevat 2002; Geurts & van der Sandt 2004; Beaver & Zeevat 2007; Winterstein 2011; Tonhauser et al. 2013; Grubic 2019), but I must leave that question aside. What is clear is that the antecedent proposition need not be explicitly asserted in the context, as the examples in (7) from Winterstein (2011) nicely illustrate.

(7)   a.   Lemmy is proud to be a bass player. Roberto plays bass **too**.
             (Antecedent: Lemmy plays bass.)
       b.   Lemmy, that idiot, came to the party. Ritchie is an idiot, **too**.
             (Antecedent: Lemmy is an idiot.)
       c.   For his breakfast, Lemmy had an apple. Ritchie only had a fruit **too**.
             (Antecedent: Lemmy only had a fruit)

Winterstein (2011) demonstrates, however, that the availability of such an antecedent is not sufficient to license *too* (though he does assume that it is necessary). Note that a proposition that is conversationally implicated in the context can serve as the antecedent of *too*, as in (7-c), where *Lemmy only had a fruit* is conversationally implicated, but not

entailed, by *Lemmy had an apple.* Winterstein points out, however, that *too* is infelicitous in (8) even though the proposition *Lemmy solved some of the problems* is available as an antecedent since it is implicated by *Lemmy did not solve all the problems.*

(8)   Q: Did Lemmy and Ritchie do well at the maths exam?
       A: Lemmy did not solve all the problems. Ritchie solved some of them (#**too**).

Winterstein argues from the infelicity of (8-A) that *too* requires its antecedent and host sentence to have the same "argumentative orientation", a notion borrowed from Anscombre & Ducrot (1983) and Merin (1999). Two sentences have the same argumentative orientation if there is some discourse goal H such that both sentences raise the probability of H, where a discourse goal is a proposition that the speaker wishes to argue in favor of (see van Rooij 2004 for further discussion). According to Winterstein, the antecedent and host in (8-A) do not have the same argumentative orientation because *Lemmy did not solve all the problems* lowers the probability that Lemmy and Ritchie did well at the maths exam, but *Ritchie solved some of them* raises it.

Beaver & Clark (2008: 93–94), rather than stipulating that the antecedent must be a focus alternative of the host sentence,[1] instead seek to explain the apparent focus sensitivity of additive particles by means of an analysis of additivity within Roberts' (1996) theory of discourse. That framework assumes that every utterance addresses some Current Question Under Discussion (CQ), which may be implicit. Beaver & Clark take a *wh*-question to denote the set of propositions (also called "alternatives") corresponding to the possible answers to that question that are generated by replacing the *wh*-element with an expression denoting an individual or the conjunction of such expressions. An example is shown in (9). They call this the "Rooth-Hamblin" semantics for questions because it combines Hamblin's (1973) semantics for questions with Rooth's (1985; 1992) Alternative Semantics.

(9)   ⟦Who does Mary like?⟧
       = {⟦Mary likes Adam⟧, ⟦Mary likes Bertha⟧, ⟦Mary likes Casper⟧,
       ⟦Mary likes Adam and Bertha⟧, ⟦Mary likes Adam and Casper⟧,

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[1]According to Krifka (1998), the associate of *too* does not actually carry the prosody of focus marking, but rather that of contrastive topic marking, and that *too* itself actually seems to bear focus. Krifka argues that the apparent focus marking on *too* is polarity focus and that *too* therefore should be taken to address a polar question.Sæbø (2004) proposes that the function of *too* is to add the topic of its antecedent sentence to the topic of its host sentence. To illustrate, according to him the asserted content of the last sentence in (i-a) is (i-b).

(i)   a.   [To the north]$_T$ lay the yellow-brown desert, a low belt of green cactus-covered ridges and distant blue mountain ranges with sharp peaks. [To the south]$_T$ **too** he could see mountains.
       b.   [To the south and to the north]$_T$ he could see mountains.
       (Sæbø 2004)

Rullmann (2003), on the other hand, claims that *too* although appears to associate with a contrastive topic, it actually associates with a focus-marked trace. For the most part, however, subsequent literature seems not to have taken up the claim that *too*'s associate bears CT-marking and generally assumes that *too* associates with focus. Ahn (2015), for example, proposes an analysis similar to Sæbø's whereby *too*-sentences assert the conjunction of their host sentence and their antecedent, but she assumes that the antecedent must be a focus alternative of the host sentence.

⟦Mary likes Bertha and Casper⟧, ⟦Mary likes Adam, Bertha, and Casper⟧...}

Beaver & Clark propose that additives carry a presupposition that the CQ has already been partially answered by some salient proposition in the common ground. In order to address the same CQ, the antecedent and host sentence must be focus alternatives of each other. In (5), for example, the CQ is *What do you like?*, and *I like pizza* provides a partial answer to that question, thereby satisfying the additive presupposition. Umbach 2010 and Grubic 2018 develop similar QUD-based treatments of the German additives *auch* and *noch*.

(10)   CQ: What do you like?
      a.   Partial answer: I like [pizza]$_F$.
      b.   I like [spaghetti]$_F$, **too**.

Beaver & Clark (2008: 94) also argue that additives carry an additional presupposition that the host sentence does not entail the antecedent. This explains the infelicity of utterances like (11), where *too* seems to be unacceptable because *Sam is happy* is entailed by *He's ecstatic.*

(11)   #Sam is happy. He's ecstatic, **too**.

Too is also unacceptable if its antecedent entails its host sentence, as in (12). However, the infelicity of utterances like (12) might be explained by the fact that *Sam is happy* is redundant after it has been asserted that he is ecstatic, in which case it would not be necessary to stipulate a presupposition that the antecedent does not entail the host sentence.

(12)   #Sam is ecstatic. He's happy, **too**.

Beaver & Clark (2008) only consider CQs that are single *wh*-questions, but Zeevat & Jasinskaja (2007) propose a somewhat more flexible notion of "generalized additivity" that allows the antecedent and host sentence of an additive to address a multiple *wh*-question. Their main objective is to analyze *and* as an additive, but they point out that *too* can also occur in responses to multiple *wh*-questions, as in (13).

(13)   Q: Who loves whom?
      A: I love you.
      B: I love you, **too**.

However, *too*'s occurrence in responses to multiple *wh*-questions seems to be much more restricted than *and*'s: According to Winterstein & Zeevat (2012), *too* occurs almost exclusively with single *wh*-questions. For example, without any additional contextual information, *too* does not seem to be acceptable in (14-A) even though the antecedent and host sentence both address the multiple *wh*-question *Who ate what?* In contrast, *and* is perfectly acceptable in (14-A').

(14)   Q: Who ate what?
      A: John ate pizza. #Mary ate spaghetti, **too**.
      A': John ate pizza, **and** Mary ate spaghetti.

It is not clear, on Zeevat & Jasinskaja's (2007) analysis, why *too* is acceptable in (13-B) but not in (14-A).

To sum up, existing analyses of additives take for granted a close structural similarity between the antecedent and host sentence. This has been accounted for in two main ways: By stipulating either that the antecedent must be a focus alternative of the host sentence, or by stipulating that the two sentences must address the same question. Authors have also sought to account for various other constraints on *too*'s behavior, such as the argumentative parallelism observed by Winterstein (2011) and the fact that the host sentence cannot entail the antecedent. *Too*'s non-uniform behavior in responses to multiple *wh*-questions is a puzzle for all these analyses, however. I turn now to some further puzzles about *too* that have not yet been discussed in the literature.

3   Data: The argument-building use

The argument-building use of *too* occurs without the kind of antecedent that *too* has been taken to require in prior analyses. The examples from (1) are repeated in (15) with additional context. In (15-a), the preceding context does not contain any sentence that is obviously a focus alternative of *Good thing she did*. The same is true for *I guess the fine is a hefty one* and *It looks kind of fancy* in (15-b) and (15-c), respectively.

(15)   a.   Iree was daughter of Ernie's then best friend Sibyl, who died when Iree was about four years old. [...] Anyway, Ernie who's been raising or helping to raise somebody's children, her mama's, her brother, Jeremiah's, even mine, since she was maybe thirteen years old, just naturally took Iree in with no authority but her own. [...] Good thing she did **too** because something happened in the birthing time of Iree and she's got epilepsy [...]   (COCA)

    b.   (Online forum discussion)
        [A:] Cops dont enforce the carpool lane down there in the dirty south?
        [B:] i have never gotten a ticket but i know a cpl people who have.. i guess the fine is a hefty one **too**. depending on what im driving, i chance it.   (COCA)

    c.   (Characters in a comedy film are trying to find a hotel room in Berlin)
        There are no rooms left in the whole city. It says it's the G8 this week. Oktoberfest, too. Folsom Europe. And the Berlin Marathon. This week. [Phone chimes with a message from Orbitz.] Okay. Yeah. A room just opened up at this hotel. Oh, yeah. It looks kind of fancy, **too**. It's the Dandlin Annex and the rooms are "habitable works of art," it says.   (COCA)

If we wanted to maintain a Beaver & Clark-style analysis of *too*, we would need to show that the CQ in each example in (15) is a *wh*-question that the antecedent and prejacent each partially answer. Given any antecedent and prejacent, one can usually construct such a question *ad hoc*. One might, for example, claim that the CQ for the *too*-sentence in (15-a) is something like *What reasons do we have to think that Iree has benefitted from Ernie's support?* Then *Ernie took Iree in with no authority but her own* and *It was a good thing she did* could be taken to be partial answers to that CQ. But discourse coherence is usually taken to require that CQs be somehow relevant to preceding discourse moves, and it is not

at all clear why that question would be relevant since it requests reasons for a conclusion that has not been suggested in the preceding context. It would be rather counter-intuitive for a relevance constraint on CQs to license such a move. If we do not require the CQ to be a *wh*-question, we could take it to be a disjunction of polar questions, like *Did Ernie take Iree in, and if so, was it a good thing she did?* This question is arguably relevant in the context of (15-a) since the assertion of the fact that Iree's mother died could cause a hearer to wonder whether Ernie took her in. But it would rob the theory of any predictive power to allow *too* to access these kinds of conjoined questions, as *too* would then be permitted to link any given antecedent and host sentence. In actual fact, *too*'s distribution is quite constrained: For one thing, *too* sounds odd if there is no apparent relationship between the antecedent and host, as in (16).

(16)   CQ: Are dogs mammals, and did you eat pancakes for breakfast?
         A: Dogs are mammals. #I ate pancakes for breakfast, **too**.

The unacceptability of *too* in (14) is also need of an explanation of *too*'s CQ is not required to be a single *wh*-question. Furthermore, the felicity of the examples in (15) seems to depend on there being a certain parallelism between the two sentences. In particular, *too* becomes odd (at least in any ordinary context[2]) if we modify the host sentences so that they no longer have the argumentative force that they had in (15).

(17)   a.   Ernie took Iree in. It was a bad thing she did, **#too**.
         b.   I know a couple people who've gotten a ticket. The fine is a small one **#too**.
         c.   A room just opened up at this hotel. It looks kind of dingy, **#too**.

A satisfactory question-based analysis of *too* therefore needs to precisely characterize the constraints that govern the relationship between the antecedent, the prejacent, and the question on which *too* is anaphoric.

4   Intuition

This section develops the intuitions on which the analysis to be presented in Section 5 is based. In particular, it is shown in Section 4.2 that in all of the cases considered thus far, there is a sense in which *too*'s antecedent suggests an answer to a contextually relevant question, but the conjunction of the antecedent and prejacent does so more strongly than either the antecedent or prejacent does alone. The relationship between the prejacent and the contextually relevant question is then examined in Section 4.3 before fleshing out what it means to "suggest an answer" in Section 4.4. First, however, a framework for the representation of discourse context needs to be adopted.

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[2]It will be noted in Section 4.2 that the acceptability of (17-a)–(17-c) improves if the interlocutors have rather unusual discourse goals.

4.1 Background: Discourse trees

Discourse is standardly characterized as a cooperative endeavor aimed at developing a shared understanding of how the world is. Interlocutors accomplish this by incrementally expanding the *Common Ground* (henceforth CG), the set of propositions to which they are jointly committed. Following Stalnaker (1978), the common ground is usually represented as the set of possible worlds in which all of these propositions are true. Following Roberts (1996), van Kuppevelt (1996), and Ginzburg (1996), discourse is usually taken to proceed through the resolution of a series of (possible implicit) Questions Under Discussion whose answers are then added to the Common Ground. Every utterance is taken to address some such question.

I represent the progression of discourse as a tree, as in Büring 2003. In Büring's discourse trees (or "d-trees"), every node represents a discourse move—either a question or an assertion—where each question node's daughter nodes form a strategy for answering that question. The question node that immediately dominates any given move is the Current Question Under Discussion (CQ) for that move.

An example of a discourse tree (or d-tree) from Büring (2003) is shown in Figure 1, where the question *Who ate what?* is answered by answering the questions *What did Fred eat?* and *What did Mary eat?*. The question *What did Fred eat?* is the CQ for *Fred ate the beans*, while *What did Mary eat?* is the CQ for *Mary ate the eggplant*.
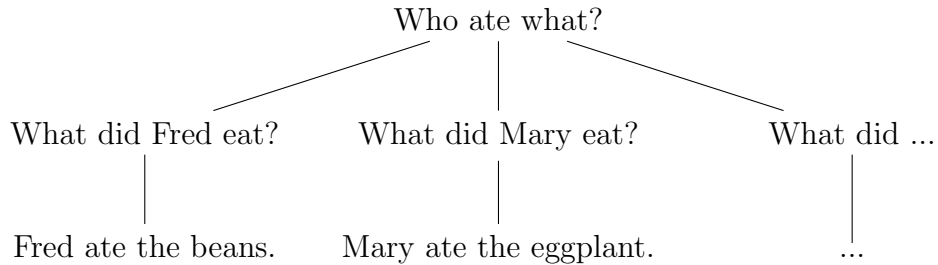

Figure 1: A discourse tree representing a discourse that answers the question *Who ate what?*

In order for discourse to be coherent, each node must be RELEVANT to the node that dominates it. One influential formulation of relevance in the literature is the one from Roberts (1996), according to which an assertion is relevant to a question if and only if it is at least a partial answer to the question. However, as Büring (2003: fn. 6) points out, this definition of relevance is too strong if we want it to capture responses like (18-a), which is not a partial answer in Roberts' sense because it neither entails that A can come to the party nor that A cannot.

(18)   CQ: Can you come to the party?
       A: Presumably.

Büring therefore takes an assertion A to be relevant to a question Q if A "shifts the probabilistic weights among the propositions denoted by Q", and he takes a question Q' to be relevant to Q if some answer to Q' is relevant to Q. By Büring's own admission, this is a "rather vague formulation", but I adopt it for now with the aim of characterizing the intuitions that the present analysis aims to capture. Reformulating this conception of

relevance slightly and provisionally adopting the Rooth-Hamblin semantics for questions used by Beaver & Clark (2008) yields the preliminary definition of relevance shown in (19). A more precise definition will be provided in Section 5.1.

(19)   RELEVANCE: (preliminary)
    a.   An assertion A is relevant to a question Q if A changes the probability that some Rooth-Hamblin alternative $a \in [\![Q]\!]$ is true.
    b.   A question Q' is relevant to a question Q if there is some Rooth-Hamblin alternative $a' \in Q'$ such that asserting a' would change the probability that some alternative $a \in Q$ is true.

4.2   The relationship between the antecedent and prejacent

Intuitively, the prejacent of *too* in each of the puzzling examples in (15) seems to strengthen an argument by providing additional evidence in favor of some conclusion for which an antecedent sentence has already provided evidence. In (15-a), the antecedent is *Ernie … just naturally took Iree in with no authority but her own.* The listener is likely to assume that Ernie's unilateral decision to take Iree in helped Iree a great deal, but it is possible that Ernie's actions were not helpful at all—suppose Ernie was not equipped to care for Iree, for example. The prejacent, *It was a good thing she did*, removes this uncertainty by making it clear that Ernie's actions were helpful, thereby strengthening the argument that Ernie helped Iree a great deal by taking her in. In (15-b), the antecedent is *I know a couple people who have gotten tickets*, which indicates that the risk of getting caught for violating traffic laws is non-negligible. This is evidence that one should worry quite a bit about traffic enforcement. The prejacent, *The fine is a hefty one* provides further evidence for that conclusion. Similarly, in (15-c) the antecedent and prejacent both provide evidence that the hotel in question would be a good place to stay. The antecedent and prejacent in each of (15-a)–(15-c) can therefore be taken to argue for an answer to the questions shown in (20). These observations resonate with Winterstein's (2011) proposal that *too* marks its antecedent and prejacent as having the same argumentative orientation, though he maintains the assumption that they must be focus alternatives of one another, which cannot be maintained here.

(20)   a.   Q: How much has Ernie helped Iree?
        A: Ernie took Iree in with no authority but her own. It was a good thing she did, **too**.
        ⤳ Ernie has helped Iree a great deal.
    b.   Q: How much should I worry about traffic enforcement?
        A: I know a couple people who have gotten tickets. The fine is a hefty one, **too**.
        ⤳ You should worry quite a bit about traffic enforcement.
    c.   Q: What would be a good hotel to stay at?
        A: A room just opened up at this hotel. It looks like a fancy one, **too**.
        ⤳ This hotel would be a good one to stay at.

Note that the antecedents and prejacents in (20) are neither complete answers nor partial answers (in the sense of Roberts 1996 or Beaver & Clark 2008) to the questions shown, as

they do not entail any possible answers or the negation of any possible answers. In certain contexts, they might conversationally implicate a partial answer, but this is not guaranteed: A's statement in (20-c), for example, would not necessarily be understood to be expressing a preference for the hotel in question if uttered in a context where the interlocutors are going down a list of hotels and considering the pros and cons of each one.

Instead, the antecedents in (20) merely provide evidence for an answer. In (20-a), for example, if it is assumed that Iree needed someone to take her in, then *Ernie took Iree in with no authority but her own* provides evidence that Ernie greatly helped Iree by doing so. However, it does not rule out the possibility that Ernie's decision to take Iree in was not actually helpful—perhaps Ernie was not adequately prepared to care for Iree and should have allowed someone else to do it. Similarly, in (20-b), *I know a couple people who have gotten tickets* provides evidence that traffic enforcement is something to worry about, but it does not rule out the possibility that traffic enforcement is actually not worth worrying about—perhaps tickets are rare and fines are small. And in (20-c), the utterance of *A room just opened up at this hotel* provides evidence that the speaker thinks the hotel in question would be a good place to stay, but it does not rule out the possibility that some other hotel would be more suitable.

I do not wish to claim that the questions in (20) are necessarily the CQs for the corresponding responses. (In (20-c), for example, one might wish to claim on the basis of focus congruence that *A room just opened up at this hotel* actually addresses the implicit question *What hotels have rooms opened up at?*) What I claim is that the antecedent and prejacent of the argument-building use of *too* can always be taken to argue for an answer to some (possibly implicit) *wh*-question that is relevant to the interlocutor's discourse goals. Such contextually relevant questions will henceforth be called "Relevant Questions" ("RQs" for short) in order to distinguish them from CQs.

The infelicity of the examples in (17), repeated in (21), seems to be due to the fact that no suitable RQ can be found in the contexts provided in (15). In (21-a), where Iree is an orphan with disabilities and the interlocutors are discussing their evaluation of Ernie's actions toward her, then *Ernie took Iree in with no authority but her own* suggests that Ernie's decision to take Iree in was helpful, but *It was a bad thing she did* argues for the opposite conclusion. Consequently, there is no relevant question to which the conjunction of the prejacent and antecedent provides clear evidence for an answer. Similarly, in (21-b), given that getting a ticket is undesirable but having the fine be small would mitigate its undesirability somewhat, there is no relevant question to which the conjunction of *I know a couple people who have gotten tickets* and *The fine is a small one* would provide evidence for an answer, and in (21-c), given that the interlocutors are looking for a nice hotel room to stay in, there is no question relevant to that goal to which *A room just opened up at this hotel* and *It looks like a dingy one* would provide evidence of a resolution.

(21) a. Q: ???
   A: Ernie took Iree in with no authority but her own. It was a bad thing she did, (#**too**).
  b. Q: ???
   A: I know a couple people who've gotten tickets. The fine is a small one, (#**too**).
  c. Q: ???

A: A room just opened up at this hotel. It looks like a dingy one, (#**too**).

On the other hand, if the contexts of the utterances in (21) are modified so that an appropriate question can be found, then *too* becomes acceptable. If, for example, Ernie was not supposed to make decisions about Iree unilaterally and better caregivers may have been available, then (21-a-A) becomes acceptable and can be taken to answer the question *What did Ernie do wrong?*, as shown in (22-a). And (21-c-A) is acceptable in a context where the interlocutors are looking for a dingy hotel room to provide the setting for a music video, as shown in (22-b).

(22)   a.   **Context:** There were other people besides Ernie who are supposed to be in-
            volved in decisions about Iree's care.
            Q: What did Ernie do wrong?
            A: Ernie took Iree in with no authority but her own. It was a bad thing she did,
            too(, because she had no idea how to manage Iree's epilepsy).
            ↝ It was wrong for Ernie to take Iree in.
       b.   **Context:** A band is looking for a dingy hotel room in which to shoot a music
            video.[3]
            Q: Where would be a good place to shoot our music video?
            A: A room just opened up at this hotel. It looks like a dingy one, **too**.
            ↝ This hotel would be a good place to shoot our music video.

In sum, the antecedent of the argument-building use of *too* provides evidence for a particular answer to an RQ, and the conjunction of that antecedent with the prejacent argues even more strongly for that answer.

4.2.1   Unifying the argument-building use with the canonical additive use

In the canonical additive case, the antecedent and prejacent are related in a different way than they are in the argument-building case: The prejacent, instead of strengthening the argument that the antecedent introduces, provides new information that argues for a conclusion that is not suggested by the antecedent. For example, in (10) (repeated in (23)), the conjunction of the antecedent and prejacent entails that A likes *both* pizza and spaghetti, whereas the antecedent on its own does not provide any evidence that A likes spaghetti.

(23)   Q: What do you like?
       A: I like pizza. I like spaghetti, **too**.   (repeated from (10))

I claim that what the argument-building and canonical additive uses have in common is the existence of an RQ that satisfies the following conditions:

(24)   ANTECEDENT CONDITION: (informal—preliminary)
       The antecedent suggests an answer to the RQ.

(25)   CONJUNCTION CONDITION: (informal—preliminary)
       There is some answer to the RQ that the conjunction of the antecedent and prejacent

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[3]Thanks to Judith Tonhauser for this example.

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suggests more strongly than the antecedent does alone.

What distinguishes the two uses is whether the answers that satisfy these two conditions are distinct: For the argument-building use, the answer suggested by the antecedent is identical to the one suggested by the conjunction of the antecedent and prejacent; for the canonical additive use, the two answers are distinct. In (23), for example, both conditions are satisfied if Q is taken to be the RQ because the antecedent suggests the answer *I like pizza* by entailing it, while the conjunction of the antecedent and prejacent suggests (again by entailment) the answer *I like pizza and spaghetti*—an answer which the antecedent by itself does not suggest at all. But of course a sentence can "suggest an answer" to a question without entailing an answer, as in (26), where *I eat a lot of pizza* merely implicates that the speaker likes pizza.

(26)   RQ: What foods do you like?
         A: I eat a lot of pizza. I like spaghetti, **too**.

If an RQ that satisfies both conditions cannot be found, then *too* is infelicitous. In (27), for example, *too* sounds odd because no ordinary context would allow us to identify a question that satisfies the Conjunction Condition. If, for instance, the RQ were taken to be *What kind of animals are dogs?*, then the conjunction of the prejacent and antecedent would indeed suggest an answer to the RQ (because it entails that dogs are mammals), but it would not do so any more strongly than the antecedent alone since the antecedent entails the same answer. This sets *too* apart from *by the way*, which seem to allow their prejacents to be unrelated to the preceding discourse.

(27)   RQ: ??
         A: Dogs are mammals. #I had pancakes for breakfast, **too**.
         A′: Dogs are mammals. **By the way,** I had pancakes for breakfast.

It is worth noting again that RQs should not be identified with CQs. Consider (28), for example. Here the interlocutors seek to resolve the question *Who ate what?* by answering the explicitly uttered subquestions *What did Peter eat?*, *What did Pia eat?*, etc. for each relevant person. *Too* seems to be licensed in (28) because *Peter ate pasta* and *Pia ate pasta* can both be taken to answer the RQ *Who ate pasta?* But at no point is *Who ate pasta?* the CQ, nor is it a higher question in the discourse tree. This shows that RQs need not be in the discourse tree at all.

(28) Q_0: Who ate what?
         Q_1: What did Peter eat?
         A: Peter ate pasta.
         Q_2: What did Pia eat?
         A: Pia ate pasta, **too**.

The behavior of *too* in embedded clauses further illustrates this point. Consider the naturally-occurring example in (29). Here the antecedent *Ivan has a new violin just his size* is an apparent answer to the question *Who has a violin just their size?* That question is nonetheless not the CQ for the host sentence of *too*, which seems to address a question like *What could you and Ivan do if you had a violin? Too* is licensed by the fact that the *if*-clause

it appears in answers *Who has a violin just their size?* even though the sentence as a whole does not answer that question. (A similar kind of access to questions that are not the CQ has also been observed in exclusives by Coppock & Beaver (2011) and in embedded focus marking by Zimmermann (2014).)

(29)   "Ivan has a new violin just his size," said Sebastian. "If I had one, **too**, he and I could play together at the Easter dances."   (COCA)

4.3   Constraints on the prejacent

In addition to the Antecedent Condition and the Conjunction Condition, something needs to be said about the relationship between the prejacent and the RQ. Unlike the antecedent, the prejacent need not suggest an answer by itself. To see why, consider the prejacent in (30): *He studied hard for it* does not suggest any answer to *In what ways is Dana struggling at school?* because on its own, studying hard for an exam is not a way of struggling at school. The prejacent's relevance to the question is only clear in view of the information provided by the antecedent, that is, failing a test *in spite of* studying hard for it can be considered struggling.

(30)   RQ: In what ways is Dana struggling at school?
        A: He failed the test. He studied hard for it, **too**.

However, the prejacent is subject to some constraints of its own. In (31-a), for example (repeated from (11)), the question *What is Sam's emotional state?* satisfies the Antecedent Condition and Conjunction Condition, yet *too* is infelicitous. *Too* is similarly infelicitous in (31-b-A) (in contrast to the argument-building use in (31-b-A′)). Beaver & Clark (2008) account for the unacceptability of *too* (31-a) with a presupposition that *too*'s prejacent does not entail its antecedent, but that will not account for (31-b) since *Sam stole the cookies* does not entail *Sam's fingerprints were found on the cookie jar*.

(31)   a.   RQ: What is Sam's emotional state?
             A: Sam is happy. #He's ecstatic, **too**.   (Beaver & Clark 2008)
        b.   RQ: Who stole the cookies?
             A: Sam's fingerprints were found on the cookie jar. #He stole the cookies, **too**.
             A′: Sam's fingerprints were found on the cookie jar. He has crumbs on his shirt, **too**.

Too also sounds odd in (32-a) because it suggests that Avery is believed to play the cello, which has not been claimed. Analyses that require the antecedent and prejacent to be focus alternatives of each other have no trouble ruling out (32-A), but such a requirement is out of the question if we are to account for the argument-building use. Note that if *instrument* and *cello* are swapped, *too* becomes perfectly acceptable, as shown in (32-A′). This asymmetry indicates that the constraint that prevents *too* from appearing in (32-A) does not have an analogous counterpart that applies to the antecedent.

(32)   RQ: Who plays an instrument?
        A: Avery plays an instrument. Bailey plays the cello, **(#too)**.

A′: A: Avery plays the cello. Bailey plays an instrument, **too**.

To account for the data in (31), I propose the condition in (33-a), and to account for (32), I propose the condition in (33-b).

(33)   PREJACENT CONDITIONS: (informal—preliminary)
    a.   The prejacent does not entail the answer to the RQ that is suggested by the conjunction of the antecedent and the prejacent.
    b.   The conjunction of the antecedent and the prejacent suggests an answer to the RQ more strongly than the conjunction of the antecedent with any sentence that is informationally weaker than the prejacent.

(31-a) violates (33-a) because the answer suggested by the conjunction of the antecedent and prejacent is *Sam is ecstatic*, which is entailed by the prejacent. Similarly, (31-b) violates (33-a) because the answer suggested by the conjunction of the antecedent and the prejacent is *Sam stole the cookies*, which is entailed by the prejacent. (32-a) violates (34-b) because the conjunction of the antecedent and prejacent entails the answer *Avery and Bailey play instruments*, which is also entailed by the conjunction of the antecedent with *Bailey plays an instrument*—a weaker proposition than the prejacent. (Since both conjunctions entail the same answer, there is no answer that the conjunction of the antecedent and prejacent suggests more strongly.)

    With the basic intuitions behind the analysis established, I turn now to making the notion of "suggesting an answer" more precise.

4.4   What does it mean to "suggest an answer" to a question?

As seen with the argument-building use in Section 4.2, an antecedent can suggest an answer to an RQ by merely providing evidence for a particular answer, without entailing or even conversationally implicating that answer. Providing evidence also suffices to suggest an answer in the case of the additive use. This was demonstrated by (26), repeated in (34), where the fact that A eats a lot of pizza can be taken as evidence that A likes pizza.

(34)   Q: What foods do you like?   (repeated from (26))
    A: I eat a lot of pizza. I like spaghetti, **too**.

    It is also possible for an antecedent to suggest an answer by conversationally implicating one without providing any information that could be straightforwardly be considered evidence for it. Consider (35), for example. Here A implicates that Q is allowed to drink soda by saying *There's soda in a fridge*. By itself, however, the information that there is soda in the fridge is not evidence that Q is allowed to drink it.

(35)   Q: What am I allowed to drink?
    A: There's soda in the fridge. You can drink tea, **too**.

    To further complicate the issue, *too* also accepts non-linguistic antecedents, as exemplified in (36). In (36-a), Bailey infers from Avery's facial expression that Avery likes the cake, and

this licenses Bailey's use of *too* in an utterance that can be taken to answer the RQ *Who likes the cake?*.

(36) (Avery and Bailey are eating a cake. They take their first bite at the same time. An expression of bliss immediately crosses Avery's face.)
Bailey: I like it, **too**!

Thus there are several ways in which an answer to question can be suggested: A contextually salient utterance can entail, conversationally implicate, or provide evidence for an answer, or salient non-linguistic information in the context can provide evidence for one. To allow the Antecedent Condition to capture all of these in a unified way, I henceforth take the antecedent of *too* not to be a contextually salient sentence, but rather to be a salient fact about the discourse context.[4] Such a fact can be either the fact that an interlocutor produced a particular utterance or a non-linguistic fact such as Avery's expression in (36). For an antecedent to "suggest an answer" is then simply to make the probability that a particular answer is true higher than the probability of any other answer: Avery's expression increases the probability that Avery likes the cake in (36), and in any context the fact that someone has said something that entails, implicates, or provides evidence for an answer to a question increases the probability of that answer being true (assuming that the speaker is cooperative and knowledgeable, of course). This intuition will be formalized within a probabilistic pragmatic framework in Section 5.1.2 by treating context update as Bayesian inference.

4.4.1 The notion of answerhood

The last thing that needs to explicated before the intuitions laid out in this section can be formalized is what exactly constitutes an "answer" for the purposes of the Antecedent, Conjunction, and Prejacent Conditions. As pointed out by Theiler (2019), Beaver & Clark's 2008 proposal that the antecedent is a partial answer to the CQ does not account for the unacceptability of discourses like (37), where the antecedent is a partial answer to the question since it rules out one possible answer, but the antecedent and prejacent have opposite polarity.

(37) Q: What do you like?
A: I don't like pizza. #I like spaghetti, **too**.

Thus it is clear that an antecedent that partially answers an RQ is not sufficient to satisfy the Antecedent Condition. It is also clear that it is not necessary for it to be a complete answer, as *I like pizza* in (23) cannot plausibly be interpreted as such, since there is surely more than one food that A likes. We might then conclude that *too* is licensed in (23) but not in (37) simply because *I like pizza* is one of the Rooth-Hamblin alternatives that Beaver & Clark take to constitute the denotation of the question *What do you like?*, while *I don't like pizza* is not.

Too's interaction with multiple *wh*-questions complicates the picture, however. Recall from Section 2 that the appearance of *too* in responses multiple *wh*-questions presents a challenge for existing analyses. Consider the contrast between (38) and (39), for example. In

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[4]Thanks to Ashwini Deo for suggesting this.

both cases, the sentence uttered by A is not only a partial answer to the multiple *wh*-question but also identical to one of that question's Rooth-Hamblin alternatives. In (38), however, *too* is infelicitous. By itself, this may not be a problem for Beaver & Clark's (2008) analysis since their claim is that the antecedent and prejacent must be partial answers to the CQ, but that requirement might not be satisfied here since responses to multiple *wh*-questions are standardly taken to address implicit subquestions (see e.g. Roberts 1996; Büring 2003), in which case the CQ for (38-A) would be *What did Avery eat?* and the CQ for (38-B) would be *What did Bailey eat?* But analyzing (38) in this way leaves us in need of an explanation for the occurrence of *too* in (39): A Beaver & Clark-style analysis can account for it if we take *Who is married to whom?* to be the CQ, but then it is not at all clear why the multiple *wh*-question would not be allowed to function as the CQ in (38) if it can do so in (39).

(38)   **Context:** Avery and Bailey are known to have gone to a restaurant together. It is presumed that both of them ate something there.
Q: Who ate what?
A: Avery ate pizza.
B: Bailey ate spaghetti, (**#too**).

(39)   **Context:** Avery, Bailey, Cameron, Dana, and others are attending a large party. It is likely that there are some married couples among the attendees, but it is not presumed that any of them are married to each other.
Q: Who (at this party) is married to whom?
A: Avery is married to Bailey.
B: Cameron is married to Dana, **too**.

I claim that the acceptability of *too* in (39) is related to the fact that, until the utterance of the prejacent, the antecedent can be taken to fully satisfy the question asker's informational needs. In particular, the asker wants to know *all* of the attendees who are married to another attendee, and *Avery is married to Bailey* could be taken to provide that information since the asker does not know how many married couples there are at the party. In contrast, the antecedent in (38) clearly cannot be taken to satisfy the asker's informational needs because the asker knows that *both* Avery and Bailey went to the restaurant and wants to know what each of them ate.

The sense in which the antecedent in (39) satisfactorily answers the question is captured by the notion of a *resolution* from Inquisitive Semantics. In Inquisitive Semantics, a question is said to be resolved by any information state (that is, any set of possible worlds) that contains enough information to settle the issue that the question raised (see Ciardelli et al. 2019). What counts as resolving a question, then, depends on how much information is needed to satisfy the questioner. As pointed out by Hintikka (1976) and others, *wh*-questions are ambiguous between "mention-some" and "mention-all" interpretations. Mention-all questions require exhaustive answers, but mention-some questions do not. For example, the question *What foods do you like?* will generally receive a mention-some interpretation since it would be unreasonable to expect an interlocutor to state every food that they like, while *Who did Avery invite to dinner?* is more likely to be interpreted as a mention-all question since someone who utters it is likely interested in knowing every individual who Avery invited. (For clarity, I will henceforth usually use *all* and *some* to construct mention-all and mention-some

questions, respectively (e.g. *Who all did Avery invite?* or *Who is someone Avery invited?*), but the presence of *all* is not necessary for the mention-all interpretation to arise, as context can make it clear whether an exhaustive answer is required.)

I wish to make the usual mention-some/mention-all distinction a bit more granular by pointing out that the amount of information necessary to resolve a mention-some question varies. The question *What are some foods that you like?*, for example, seems request at least two foods that A likes. I will call this kind of question a "mention-two" question. There are other mention-some questions, however, which can be resolved by supplying only one individual with a specified property. To resolve the question in (40), for example, it suffices to supply only one individual who can give Bailey a ride.

(40)   Context: Bailey does not have a car and therefore needs a ride to Avery's party. Avery asks the other attendees:

    a.   Who can give Bailey a ride?   (cf. Ciardelli et al. 2017)

A questioner can in fact request any arbitrary number of entities having some property, as illustrated by the naturally-occurring mention-three question and mention-four question in (41-a–b).

(41)   a.   Class started off with a question: What are three books that you remember reading?   (COCA)
    b.   What are four sources of natural energy?   (COCA)

The multiple *wh*-questions in both (38) and (39) are mention-all questions: The question in (38) can only be resolved by saying what Avery ate *and* what Bailey ate, and the question in (39) can only be resolved by providing *all* of the married couples at the party. *Too*'s acceptability in (39) is due to the fact that its antecedent can be interpreted (until the prejacent is uttered) as an exhaustive answer—and thus a resolution—to the question that was asked. *Too* is similarly acceptable in the dialogues in (42), which show that the antecedent is not required to be interpretable as an exhaustive answer to an RQ—it suffices for it to provide a resolution, which need not be exhaustive if the question is mention-some.

(42)   a.   Q: Who can give Bailey a ride?
          A: Cameron can. Dana can, **too**.
    b.   Q: What are some foods that you like?
          A: I like pizza and spaghetti. ... (Oh, and) I like lasagna, **too**.
    c.   Q: What are three books you've read recently?
          A: I've read *War and Peace*, *Crime and Punishment*, and *Pride and Prejudice*. I've read *Sense and Sensibility*, **too**.

This indicates that providing a resolution to an RQ is a sufficient condition for the antecedent to satisfy the Antecedent Condition. It is worth noting that there are cases in which *too* is acceptable even though its antecedent fails to resolve an explicitly asked question. Some examples are shown in (43-a–c). (Such antecedents are most naturally uttered with a signal of some sort that they do not resolve the question, such as rising intonation or *well*.) Since an RQ is not required to be explicitly uttered or even to be a CQ, (43-a–c) can be

accounted for by identifying some other contextually relevant question that the antecedent can be taken to resolve. The notion of relevance still needs to be made precise, but for now I wish to point out that the indicated RQs in (43-a–c) satisfy the Antecedent, Conjunction, and Prejacent conditions. A suitable definition of relevance according to which these questions are relevant to the explicitly asked questions will be provided in Section 5.1.

(43) a. Q (explicit): What are some foods that you like?
          RQ (implicit): What is (at least) one food that you like?
          A: (Well,) I like pizza↑... I like spaghetti, **too**.
      b. Q (explicit): What are three books you've read recently?
          RQ (implicit): What are some books that you've read recently?
          A: (Well,) I've read *War and Peace* and *Crime and Punishment*↑... I've read *Pride and Prejudice*, **too**.
      c. Q (explicit): Who all did Avery invite?
          RQ (implicit): Who is (at least) one person that Avery invited?
          A: (Well,) he invited Bailey↑... He invited Cameron, **too**.

Let us consider what happens in (38). I claim that once we adopt resolution as our notion of answerhood, it is not possible to identify an RQ that satisfies both the Antecedent and Conjunction Conditions. The resolution of a multiple *wh*-question seems to always require that a particular issue be settled for *every* member of a salient set of entities associated with one of the *wh*-elements; that is, they are mention-all questions with respect to at least one of the *wh*-elements. In particular, the question *Who ate what?* in (38) is mention-all on its first *wh*-element—it can only be interpreted as asking what Avery ate *and* what Bailey ate.[5] Thus there is no mention-some interpretation of *Who ate what?* that could serve as RQ in (38) analogously to how *Who is someone Avery invited?* does in (43-c). The question *Who ate Italian food?* would satisfy the Antecedent and Conjunction Conditions if pizza and spaghetti are understood by the interlocutors to be Italian foods, but it would not satisfy the Prejacent Condition since *Bailey ate Italian food* is a weaker alternative to the prejacent whose conjunction with the antecedent entails the same resolution to the question as the conjunction of the antecedent prejacent. The only other *wh*-questions that would satisfy the Antecedent Condition are *What did Avery eat?* and *Who ate pizza?*, neither of which satisfy the Conjunction Condition. Hence *too*'s infelicity in (38).

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[5]In the literature on multiple *wh*-questions (e.g. Dayal 1996; Bošković 2001; Dayal 2002; Surányi 2007; Kotek 2016), authors distinguish between "pair list" and "single pair" interpretations of multiple *wh*-questions. The difference between them is that "single pair" interpretations carry a presupposition that there is only one pair of entities that stands in the specified relation, e.g. the single-pair interpretation of *Who is married to whom?* would presuppose that there is only one married couple among the salient set of individuals. Thus I take both "pair list" and "single pair" multiple *wh*-questions to be mention-all questions with respect to at least one *wh*-element. It does seem to be possible for such question to be mention-some with respect to the other *wh*-element, i.e., there may be an interpretation of *Who ate what?* that can be resolved by supplying one food that each individual ate even if some of them ate more than one thing. But this need not concern us here.

4.5   Interim Summary

In view of the conclusion that to "suggest an answer" to a question is to raise the probability of some resolution to it, the Prejacent, Conjunction, and Antecedent Conditions can now be refined as follows:

(44)   **Felicity conditions of additive *too*** (informal)
  A sentence containing *too* is felicitous in any context in which there is a contextually relevant *wh*-question RQ and a salient antecedent fact such that the following conditions hold:
  a.   ANTECEDENT CONDITION: The antecedent fact makes some resolution to the RQ more probable than any other resolution.
  b.   CONJUNCTION CONDITION: The conjunction of the antecedent and prejacent makes some resolution to the RQ more probable than any other resolution, and it increases that probability to a higher degree than the antecedent does alone.
  c.   PREJACENT CONDITIONS:
    (i)   The prejacent does not entail the answer to the RQ that is suggested by the conjunction of the antecedent and the prejacent.
    (ii)   The conjunction of the antecedent and the prejacent makes the probability of some resolution to the RQ more probable than does the conjunction of the antecedent with any sentence that is informationally weaker than the prejacent.

5   Analysis

This section formalizes the felicity conditions described in (44). I begin with some preliminaries in Section 5.1, propose a formal analysis in Section 5.2, and then apply that proposal in Sections 5.3 and 5.4 to account for the data presented in the preceding sections.

5.1   Formal preliminaries

The present analysis is formulated in the version of Inquisitive Semantics presented by Ciardelli et al. (2019) and a Question Under Discussion framework based on those of Roberts (1996) and Büring (2003) but with a Bayesian conception of linguistic inference borrowed from the Rational Speech Act (RSA) framework (see Frank & Goodman 2012; Goodman & Frank 2016). I summarize the essential features of those frameworks in this section before presenting the analysis in Section 5.2.

5.1.1   Inquisitive Semantics

A proposition is standardly identified with the set of worlds (or *information state*) in which it is true. In Inquisitive Semantics, however, propositions are non-empty, downward-closed sets of information states known as *issues*. Under this conception of a proposition, the semantic content of a declarative sentence is the proposition that contains the set of worlds in which the sentence is true, plus all of the subsets of that set. For instance, the meaning of the

sentence *Avery invited Bailey* is the set containing the set of worlds in which Avery invited Bailey as well as all the subsets of that set, as shown in (45). (As in Ciardelli et al. 2019, $|\phi|$ will be used throughout as shorthand for the set of worlds in which ϕ is true, and a superscripted $\downarrow$ will be used to indicate downward closure of sets.)

(45) $[\![$Avery invited Bailey$]\!] = \{s | s \subseteq |$Avery invited Bailey$|\} = \{|$Avery invited Bailey$|\}^{\downarrow}$

As is the case with classical propositions, entailment in Inquisitive Semantics amounts to set inclusion, as shown in (46).

(46)   ENTAILMENT: For any propositions P and Q, $P \models Q$ iff $P \subseteq Q$.

The maximal elements of a proposition are called its *alternatives*. A proposition which, like (45), has a unique maximal element is said to be *non-inquisitive*. A proposition that has more than one maximal element is said to be *inquisitive*. The meaning of a question is the inquisitive proposition whose alternatives correspond to its minimally resolving answers— that is, the answers that provide just enough information to resolve the question. Thus one advantage of Inquisitive Semantics is that it allows for a uniform treatment of declaratives and interrogatives, as both are taken to denote propositions. For example, as shown in (47), the meaning of the polar question *Does Cameron like pizza?* is the inquisitive proposition containing the set of worlds in which Cameron likes pizza, the set of worlds in which Cameron does not like pizza, and all of the subsets of those sets.

(47) $[\![$Does Cameron like pizza?$]\!]$
        $= \{s | s \subseteq |$Cameron likes pizza$|$ or $s \subseteq |$ Cameron does not like pizza$|\}$

Note that (47) is equivalent to the union of the proposition expressed by *Cameron likes pizza* and that expressed by its negation *Cameron does not like pizza*, as shown in (48). A proposition P is negated by taking its set complement, notated $\overline{P}$.

(48) $[\![$Does Cameron like pizza?$]\!]$
        $= \{s | s \subseteq |$Cameron likes pizza$|\} \cup \{s | s \subseteq |$Cameron does not like pizza$|\}$
        $= [\![$Cameron likes pizza$]\!] \cup [\![$Cameron does not like pizza$]\!]$
        $= [\![$Cameron likes pizza$]\!] \cup \overline{[\![\text{Cameron likes pizza}]\!]}$

In general, taking the union of two mutually non-entailing, non-inquisitive propositions yields an inquisitive proposition, and the semantic value of a question is the union of the propositions corresponding to its minimally sufficient possible answers. Thus the semantic value of the polar question of whether a proposition is true is the union of a proposition and its complement, as in (48).

As discussed in section 4, it is necessary to distinguish between mention-all questions, such as (49-a), and mention-some questions, such as (50-a).

(49)   **Context:** Cameron is deciding whether to attend Avery's dinner party tonight. Cameron and Dana are arch-enemies, so Cameron will not attend if Dana will be there. To find out whether Dana will be there, Cameron asks Bailey:
        a.   Who (all) did Avery invite to the party tonight?

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(50)   **Context:** Bailey does not have a car and therefore needs a ride to the party. Avery asks the other attendees:

    a.   Who can give Bailey a ride to the party?

I adopt Ciardelli et al.'s (2019) treatment of the mention-some/mention-all distinction. Since the minimally resolving answers to mention-some and mention-all questions are different, they have different sets of alternatives, so they express different propositions. The alternatives in a mention-all question form a partition of the Common Ground, as in (51), which is the proposition such that for every individual x in a contextually salient domain of individuals, each alternative specifies whether Avery invited x. The alternatives in a mention-some question, on the other hand, do not form a partition because they overlap. This is illustrated by (52), which is the proposition whose alternatives correspond to answers of the form *x can give Bailey a ride home* for some individual x, which entails that x can give Bailey a ride home but does not provide any information about whether anyone else can. The alternatives corresponding to *Cameron can give Bailey a ride* and *Ezra can give Bailey a ride*, for example, overlap because either one resolves the question in a world where Cameron and Ezra can both give Bailey a ride. As suggested in Section 4.4.1, I refine Ciardelli et al.'s classification of *wh*-questions slightly by distinguishing subclasses of mention-some questions according to how many entities their minimally resolving answers require. Mention-one questions, like (52), can be resolved by providing only one individual with the specified property, while mention-two questions require at least two such individuals, as exemplified by (53). In principle, there are mention-n questions for any integer n, as illustrated in (41).

(51)   MENTION-ALL:
    ⟦Who all did Avery invite?⟧
    $= \{s | \forall x \in D : s \subseteq |\text{Avery invited x}| \text{ or } s \subseteq \overline{|\text{Avery invited x}|}\}$

(52)   MENTION-ONE:
    ⟦Who can give Bailey a ride to the party?⟧
    $= \{|x \text{ can give Bailey a ride to the party}| \mid x \in D\}^{\downarrow}$

(53)   MENTION-TWO:
    ⟦What are some foods that Cameron likes?⟧
    $= \{|\text{Cameron likes } x \text{ and } y| \mid x, y \in D\}^{\downarrow}$

The union of all the information states in a proposition P is called the informative content of P and notated $\mathsf{info}(P)$, as shown in (54). If P is a non-inquisitive proposition, $\mathsf{info}(P)$ is identical to the maximal element of P.

(54)   INFORMATIVE CONTENT: For any proposition P, $\mathsf{info}(P) := \bigcup P$.

5.1.2   Probabilistic pragmatics

In view of the observations in Section 4.4, I assume that agents have probabilistic belief states. Given a set of interlocutors and a question Q, the beliefs of an interlocutor S about the correct answer to Q can be modeled as a probability distribution over the question's alternatives, where the probability $P_S(A)$ assigned to an alternative $A \in \mathsf{alt}(Q)$ represents

the degree to which S believes that A is true in the actual world.

Given another information state B, the conditional probability $P_S(A|B)$, then, is the degree of S's belief in A given that S is certain that B is true. As is done in the Rational Speech Act (RSA) framework (see Frank & Goodman 2012; Goodman & Frank 2016), I assume that interlocutors update their belief states via Bayesian inference: When a listener L hears a speaker S utter a sentence ϕ, L revises their belief state by using Bayes' Rule (shown in (55)) to update the probability of each alternative in the CQ in view of the fact that S uttered ϕ.

(55)   BAYES' RULE: For any two information states A and B, $P(A|B) = \frac{P(B|A)P(A)}{P(B)}$.

Modifying a notational convention from Lauer (2013), I use to $\mathsf{utter}(S, C, \phi)$ to represent the proposition that S uttered ϕ in a context C, as shown in (56).[6] L's new belief state after S utters ϕ in C is then given by (57), which says that the probability (from L's perspective) that any alternative A is true given that S uttered ϕ is proportional to the probability that S would choose to utter ϕ (out of some set of possible alternative utterances) if A were true, multiplied by L's prior probability that A is true (that is, the degree to which L believes A before S's utterance of ϕ).

(56) $\mathsf{utter}(S, C, \phi) = \{w : S \text{ uttered } \phi \text{ at context } C \text{ in world } w\}^{\downarrow}$

(57) $P_L\big(A|\mathsf{info}(\mathsf{utter}(S, C, \phi))\big) \propto P_S\big(\mathsf{info}(\mathsf{utter}(S, C, \phi))|A\big)P_L(A)$

Thus L's belief revision results from reasoning about what S would be expected to say in each of the possible worlds under consideration. This reasoning corresponds to that which is done by the "pragmatic listener" in the RSA literature. The probabilities P_S correspond to those computed by what is called the "pragmatic speaker" in the RSA literature. That computation involves optimizing each possible utterance's utility for communicating each possible information state to a hypothetical "literal listener" who understands only the conventional meaning of each utterance.

How exactly utterance utility is calculated in RSA is beyond the scope of the present discussion. The interested reader may consult Goodman & Frank (2016) and Franke & Jäger (2016) for details. I simply assume that if a sentence ϕ entails an alternative A in some question Q and L takes S to be cooperative and knowledgeable, then

$$P_L\big(A|\mathsf{info}(\mathsf{utter}(S, C, \phi))\big) = 1.$$

If, on the other hand, the utterance of ϕ only conversationally implicates A, then I assume that for any other alternative $A' \in \mathsf{alt}(Q)$,

$$P_L\big(A'|\mathsf{info}(\mathsf{utter}(S, C, \phi))\big) < P_L\big(A|\mathsf{info}(\mathsf{utter}(S, C, \phi))\big) < 1.$$

5.1.3   Relevance and answerhood

I follow Büring (2003) in using discourse trees to track the flow of questions and responses in discourse, as discussed in 4.1. However, Büring's notions of relevance and answerhood require some refinement to capture the intuitions discussed in Section 4.

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[6]Lauer (2013: 21) uses this notation slightly differently, treating $\mathsf{utter}(i_1, i_2, \varphi)$ as the *event* of i_1 uttering φ toward i_2. Rather than adopting an ontology that includes events, I define $\mathsf{utter}(S, C, \phi)$ to be a proposition.

For Büring, there is no distinction between relevance and answerhood for assertions: An assertion is relevant if and only if it answers its QUD, and it answers the QUD if it "shifts the probabilistic weights among the propositions denoted by the question." I make this probabilistic notion of relevance more precise by taking an assertion to be relevant to a question if and only if it changes the probability of some alternative in that question—that is, according to a listener L, an assertion R is relevant to a question Q if and only if there is some alternative $A \in \mathsf{alt}(Q)$ such that the conditional probability $P_L(A|R)$ is different from the prior probability $P_L(A)$.

We also need to define the relevance of a question to another question. Intuitively, a question Q_1 is relevant to a question Q_2 if Q_1 can be used as part of a strategy for answering Q_2. Roberts (1996) cashes out this intuition by requiring Q_1 to be a *subquestion* of Q_2, that is, requiring every complete answer to Q_2 (the *superquestion*) to entail an answer to Q_1. However, the question semantics that Roberts borrows from Hamblin does not distinguish between mention-all and mention-some questions, and it turns out that subquestionhood is not a necessary condition for relevance once mention-some questions enter into the equation. In (58), for example, the polar question *Does Cameron like pizza?* is intuitively relevant to the mention-some CQ *What are some foods Cameron likes?*, but it is not a subquestion according to Roberts' definition since there are answers to that CQ—such as *Cameron likes spaghetti*—that do not entail any answer to *Does Cameron like pizza?*

(58)   CQ: What are some foods Cameron likes?
        Q: Does Cameron like pizza?

I therefore follow Büring (2003) in assuming that a question is relevant to another question if at least one of its answers is relevant to that question. The uniform treatment of declaratives and interrogatives in Inquisitive Semantics allows for the formulation of a single Relevance principle that covers both assertions and questions:

(59)   RELEVANCE:
        a. Given any proposition R and an inquisitive proposition S, a listener L takes R to be Relevant to S iff there is an alternative $A \in \mathsf{alt}(R)$ and an alternative $A' \in \mathsf{alt}(S)$ such that $P_L(A'|A) \neq P_L(A')$.
        b. Given any two sentences ϕ and ψ, if $[\![\phi]\!]$ is Relevant to $[\![\psi]\!]$, then ϕ is licensed as a daughter of ψ in the discourse tree.

For the purposes of the present analysis, Answerhood needs to be a stronger notion that Relevance—that is, all Answers are Relevant, but not all Relevant assertions are Answers. In particular, a proposition Answers a question if it makes the probability of some resolution to that question higher than any other resolution. This definition of Answerhood, formalized in (60), ensures that if the antecedent of *too* Answers an RQ, the Antecedent Condition in (44) is satisfied. Note here that the notion of a resolution is weaker than the notion of an alternative: For mention-some questions—whose alternatives do not partition the Common Ground—the conjunction of any two alternatives is also resolution. Accordingly, raising the probability of the conjunction of some proper subset of $\mathsf{alt}(\textsc{rq})$ higher than that of the conjunction of any other subset is sufficient to make a proposition an Answer, as per (60).

(60)   ANSWERHOOD: For a listener L, a proposition R Answers an inquisitive proposition Q iff there is a nonempty (possibly singleton) set of alternatives $\mathcal{A} \subset \mathsf{alt}(Q)$ such that

    a. $P_L\big(\bigcap\mathcal{A}|\mathsf{info}(R)\big) > P_L\big(\bigcap\mathcal{A}\big)$, and

    b.   for all $\mathcal{A}' \subset \mathsf{alt}(Q)$, if $\bigcap\mathcal{A}' \not\supseteq \bigcap\mathcal{A}$, then $P_L\big(\bigcap\mathcal{A}|\mathsf{info}(R)\big) > P_L\big(\bigcap\mathcal{A}'|\mathsf{info}(R)\big)$.

    If such a set $\mathcal{A}$ exists, it is unique. Call $\bigcap\mathcal{A}$ the **resolution of Q evidenced by R**, or $Q|_R$ for short.

One last definition will be useful for formulating the analysis: One proposition R evidences a resolution **more strongly** than another proposition R' does if R raises the probability of that resolution by a greater degree than R' does. This is shown formally in (61).

(61)   Given a listener L, an inquisitive proposition Q, any two propositions R and R', and a nonempty (possibly singleton) set of alternatives $\mathcal{A} \subset \mathsf{alt}(Q)$, R Evidences $\bigcap\mathcal{A}$ **more strongly** than R' does iff $P_L\big(\bigcap\mathcal{A}|\mathsf{info}(R)\big) > P_L\big(\bigcap\mathcal{A}|\mathsf{info}(R')\big)$.

5.2   Proposal

I propose that additive *too* has the felicity conditions shown in (62), which formalizes (44).[7]

(62)   **Felicity conditions of additive *too***   (final)
    TOO(π) requires the existence of a salient antecedent proposition ANT embodying a fact about the context and a (single or multiple) *wh*-question RQ that is Relevant to some question DQ in the discourse tree such that the following conditions hold:

    a.   ANTECEDENT CONDITION: ANT Answers RQ.

    b.   CONJUNCTION CONDITION: ANT$\cap[\![\pi]\!]$ Answers RQ, and RQ$|_{\mathrm{ANT}\cap[\![\pi]\!]}$ is Evidenced more strongly by ANT $\cap [\![\pi]\!]$ than by ANT.

    c.   PREJACENT CONDITIONS:

        (i) $[\![\pi]\!] \not\subseteq \mathrm{RQ}|_{\mathrm{ANT}\cap[\![\pi]\!]}$.

        (ii) For any proposition $S \supset [\![\pi]\!]$, ANT$\cap[\![\pi]\!]$ Evidences RQ$|_{\mathrm{ANT}\cap[\![\pi]\!]}$ more strongly than ANT $\cap S$ does.

I turn now to demonstrating that this analysis accounts for the data that have been presented.

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[7]It is worth noting that (62) does not say anything about the polarity of the antecedent and prejacent. Many authors have noted that the acceptability of *too* is degraded when the prejacent contains negation, and *either* is preferred in such contexts. However, nothing in (61) rules out utterances like (i-A).

(i)   Q: What are some foods you don't like?
       A: I don't like pizza. ?I don't like spaghetti, **too**.
       A': I don't like pizza. I don't like spaghetti, **either**.

My own intuition is that, although *either* sounds more natural than *too* in (i), *too* is not entirely unacceptable. I therefore do not propose any constraint that would rule out (i-A), and I concur with Rullmann (2003) that the awkwardness of *too* in sentences like (i-A) is likely the result of competition with *either*. A full explication of the felicity conditions of *either* must be left to future work, however.

5.3 Accounting for the argument-building use

To see how the conditions in (62) are satisfied by the argument-building use, consider (20-c), repeated in (63), as an illustrative example.

(63) Context: A and some traveling companions need to find a suitable to place to stay during their upcoming vacation. A is searching for a hotel room on the internet.
Q: What would be a good hotel for us to stay at?
A: A room just opened up at this hotel.
   It looks kind of fancy, **too**.

Here we have $[\![\pi]\!] = \{|\text{The room looks kind of fancy}|\}^{\downarrow}$. As discussed in Section 4.4, I take the antecedent to be the fact that A uttered *A room just opened up at this hotel* in context C—that is, $\textsc{ant} = \mathsf{utter}(A, C, (63\text{-}A))$. Q is a mention-one question, so

$$[\![Q]\!] = \{|\text{Hotel A would be a good place to stay}|, |\text{Hotel B would be a good place to stay}|,$$
$$|\text{Hotel C would be a good place to stay}|, ...\}^{\downarrow}$$

Let $\textsc{rq} = [\![Q]\!]$. Then it can be shown as follows that the felicity conditions in (62) are satisfied:

a. ANTECEDENT CONDITION: A hotel can only be a good place to stay if it has available rooms, so the fact that a room just opened up at the hotel in question increases the probability that it is a good place to stay. Thus

$$P_L\big(|\text{This hotel would be a good place to stay}| \,\big|\, \mathsf{info}(\textsc{ant})\big)$$
$$> P_L\big(|\text{This hotel would be a good place to stay}|\big).$$

ANT does not, however, increase the probability that any other hotel would be a suitable place to stay, so

$$P_L\big(|\text{This hotel would be a good place to stay.}| \,\big|\, \mathsf{info}(\textsc{ant})\big) > P_L\left(\bigcap \mathcal{A}' \,\Big|\, \mathsf{info}(\textsc{ant})\right)$$

for all $\mathcal{A}' \subset \mathsf{alt}(\textsc{rq})$ such that $\bigcap \mathcal{A}' \not\supseteq |\text{This hotel would be a good place to stay}|$. Thus ANT Answers RQ, with $\textsc{rq}|_{\textsc{ant}} = |\text{This hotel would be a good place to stay}|$.

b. CONJUNCTION CONDITION: ANT and $[\![\pi]\!]$ each increase the probability that the hotel in question would be a good place to stay but do not increase the probability that any other hotel would be, so we have

$$P_L\big(|\text{This hotel would be a good place to stay}| \,\big|\, \mathsf{info}(\textsc{ant} \cap [\![\pi]\!])\big)$$
$$> P_L\big(|\text{This hotel would be a good place to stay}|\big)$$

and

$$P_L\big(|\text{This hotel would be a good place to stay}| \,\big|\, \mathsf{info}(\textsc{ant} \cap [\![\pi]\!])\big)$$
$$> P_L\left(\bigcap \mathcal{A}' \,\Big|\, \mathsf{info}(\textsc{ant} \cap [\![\pi]\!])\right)$$

for all $\mathcal{A}' \subset \mathsf{alt}(\mathrm{RQ})$ such that $\bigcap \mathcal{A}' \not\supseteq$ |This hotel would be a good place to stay|. Thus $\underline{\mathrm{ANT} \cap [\![\pi]\!]}$ Answers RQ, and the resolution of RQ provided by $\mathrm{ANT} \cap [\![\pi]\!]$ is that the hotel in question would be a good place to stay (that is,

$$\mathrm{RQ}|_{\mathrm{ANT} \cap [\![\pi]\!]} = |\text{This hotel would be a good place to stay}|).$$

Since $[\![\pi]\!]$ contributes evidence that ANT does not, we have

$$P_L\big(\mathrm{RQ}|_{\mathrm{ANT} \cap [\![\pi]\!]}\big|\mathsf{info}(\mathrm{ANT} \cap [\![\pi]\!])\big) > P_L\big(\mathrm{RQ}|_{\mathrm{ANT} \cap [\![\pi]\!]}\big|\mathsf{info}(\mathrm{ANT})\big).$$

Thus $\underline{\mathrm{ANT} \cap [\![\pi]\!]}$ Evidences $\mathrm{RQ}|_{\mathrm{ANT} \cap [\![\pi]\!]}$ more strongly than ANT does.

c. PREJACENT CONDITIONS:

  i. The fact that the hotel room looks fancy does not entail that the hotel in question would be a good place to stay. Thus $\underline{[\![\pi]\!] \not\subseteq \mathrm{RQ}|_{\mathrm{ANT} \cap [\![\pi]\!]}}$.

  ii. For any proposition $S \supset [\![\pi]\!]$,

$$P_L\big(|\text{This hotel would be a good place to stay}|\big|\mathsf{info}(\mathrm{ANT} \cap S)\big) <$$
$$P_L\big(|\text{This hotel would be a good place to stay}|\big|\mathsf{info}(\mathrm{ANT} \cap [\![\pi]\!])\big)$$

because any proposition weaker than *It looks kind of fancy* (such as *It looks nice enough*) provides a less compelling reason to think that the hotel in question is a good place to stay. Thus $\underline{\mathrm{ANT} \cap [\![\pi]\!]}$ Evidences $\mathrm{RQ}|_{\mathrm{ANT} \cap [\![\pi]\!]}$ more strongly than $\underline{\mathrm{ANT} \cap S}$ does.

It was noted in Section 3 that the acceptability of *too* in the context of (63) depends on the fact that the antecedent and host sentence are both desirable to the interlocutors: *Too* becomes unacceptable if *fancy* is replaced by *dingy*, for example, as shown in (64).

(64)   Context: A and some traveling companions need to find a suitable to place to stay during their upcoming vacation. A is searching for a hotel room on the internet.
        A: A room just opened up at this hotel. It looks kind of dingy, (#**too**).

The infelicity of *too* in (64) is accounted for by the requirement for the existence of an RQ that is relevant to some question DQ in the discourse tree. This requirement was satisfied in (63) because the question *Where would be a good place for us to stay?* can itself be taken to be a node in the discourse tree if finding a good place to stay is a goal of the interlocutors. But that question cannot serve as the RQ in (64) because $\mathrm{ANT} \cap [\![\pi]\!]$ does not raise the probability of any resolution to it (assuming that a dingy hotel room is undesirable). Moreover, there is no other question relevant to the interlocutors' discourse goals in (64) that $\mathrm{ANT} \cap [\![\pi]\!]$ Answers. Hence *too*'s infelicity.

In contrast, the context in (65) (repeated from (22) does allow a suitable RQ to be identified, namely *Where would be a good place to shoot our music video?*

(65)   Context: A's band is looking for a dingy hotel room in which to shoot a music video.
        RQ: Where would be a good place to shoot our music video?
        A: A room just opened up at this hotel. It looks kind of dingy, **too**.

5.4 Accounting for the canonical additive use

Let us first consider the canonical additive use in responses to mention-some questions, as in (66).

(66) Q: Who are some people Avery invited?
A: She invited Bailey and Cameron.
B: She invited Dana, **too**.

Here we have $\text{ANT} = \mathsf{utter}(A, C, (66\text{-A}))$, $[\![\pi]\!] = \{|\text{Avery invited Dana}|\}^{\downarrow}$, and $[\![Q]\!] = \{|\text{Avery invited Bailey}|, |\text{Avery invited Cameron}|, |\text{Avery invited Dana}|, ...\}^{\downarrow}$. Again, let $\text{RQ} = [\![Q]\!]$. Then it can be shown as follows that the proposed felicity conditions of *too* are satisfied:

a. ANTECEDENT CONDITION: Assuming that A is cooperative and knowledgeable,

$$P_L\big(|\text{Avery invited Bailey and Cameron}|\,\big|\,\mathsf{info}(\text{ANT})\big) = 1$$

since (66-A) entails that Avery invited Bailey and Cameron. As required by (60), |Avery invited Bailey and Cameron| is the intersection of a proper subset of $\mathsf{alt}(\text{RQ})$, namely $\{|\text{Avery invited Bailey}|, |\text{Avery invited Cameron}|\}$. For all $\mathcal{A}' \subset \mathsf{alt}(\text{RQ})$, if $\bigcap \mathcal{A}' \not\supseteq |\text{Avery invited Bailey and Cameron}|$, we have

$$P_L\left(\bigcap \mathcal{A}' \,\Big|\, \mathsf{info}(\text{ANT})\right) < 1$$

since (66-A) does not entail that Avery invited anyone other than Bailey and Cameron. Thus $P_L\left(\bigcap \mathcal{A}'|\mathsf{info}(\text{ANT})\right) < P_L\big(|\text{Avery invited Bailey and Cameron}|\,\big|\,\mathsf{info}(\text{ANT})\big)$ for all such $\mathcal{A}'$, so <u>ANT answers RQ,</u> with $\text{RQ}|_{\text{ANT}} = |\text{Avery invited Bailey and Cameron}|$.

b. CONJUNCTION CONDITION: Assuming again that A is cooperative and knowledgeable, we have

$$P\big(|\text{Avery invited Bailey, Cameron, and Dana}|\,\big|\,\mathsf{info}(\text{ANT} \cap [\![\pi]\!])\big) = 1.$$

For all $\mathcal{A}' \subset \mathsf{alt}(\text{RQ})$, if $\bigcap \mathcal{A}' \not\supseteq |\text{Avery invited Bailey, Cameron, and Dana}|$, then

$$P_L\big(\bigcap \mathcal{A}' \mid \mathsf{info}(\text{ANT} \cap [\![\pi]\!])\big) < 1$$

because $\text{ANT} \cap [\![\pi]\!]$ does not entail that Avery invited anyone other than Bailey, Cameron, and Dana. Thus <u>ANT $\cap [\![\pi]\!]$ answers RQ,</u>
with $\text{RQ}/\text{ANT} \cap [\![\pi]\!] = |\text{Avery invited Bailey, Cameron, and Dana}|$. Furthermore,

$$P_L\big(|\text{Avery invited Bailey, Cameron, and Dana}|\,\big|\,\mathsf{info}(\text{ANT})\big) < 1$$

because (66-A) does not entail that Avery invited Dana. Thus <u>ANT $\cap [\![\pi]\!]$ argues for RQ$|_{\text{ANT} \cap [\![\pi]\!]}$ more strongly than ANT does.</u>

c. PREJACENT CONDITIONS:

i. *Avery invited Dana* does not entail that Avery invited Bailey, Cameron, and Dana, so $\llbracket \pi \rrbracket \not\subseteq \text{RQ}|_{\text{ANT} \cap \llbracket \pi \rrbracket}$.

ii. For any proposition $S \supset \llbracket \pi \rrbracket$,

$$P_L\big(|\text{Avery invited Bailey, Cameron, and Dana}| \,\big|\, \text{info}(\text{ANT} \cap S)\big) < 1$$

because neither (66-A) nor S entails that Avery invited Dana. (For example, consider $S = \llbracket \text{Avery invited Dana or Ellis} \rrbracket$.) Thus $\underline{\text{ANT} \cap \llbracket \pi \rrbracket \text{ argues for RQ}/\text{ANT} \cap \llbracket \pi \rrbracket}$ $\underline{\text{more strongly than ANT} \cap S \text{ does}}$.

5.4.1 Antecedents that do not entail a resolution to the RQ

In (66), ANT and $\text{ANT} \cap \llbracket \pi \rrbracket$ each answer Q by entailing a resolution to it. The definition of answerhood in (60) also allows for dialogues like (67), where ANT does not entail a resolution.

(67)   Q: What are some foods you like?
        A: I eat a lot of pizza.
        I like spaghetti, **too**.

Here we have $\text{ANT} = \text{utter}(A, C, (67\text{-A}))$ and $\llbracket \pi \rrbracket = \{|\text{A likes spaghetti}|\}^{\downarrow}$. Since ANT provides evidence that A likes pizza but does not provide evidence that A likes anything else, we have

$$P_L\big(|\text{A likes pizza}| \,\big|\, \text{info}(\text{ANT})\big) > P\left(\bigcap \mathcal{A}' \,\Big|\, \text{info}(\text{ANT})\right)$$

for all $\mathcal{A}' \subset \text{alt}(\text{RQ})$ such that $\bigcap \mathcal{A}' \not\supseteq |\text{A likes pizza}|$. Thus ANT Answers RQ, satisfying the Antecedent Condition. The Conjunction Condition and the Prejacent Conditions are satisfied here in the same way that they were in (66).

5.4.2 Mention-all RQs

If RQ is a mention-all question, then ANT may resolve it via Quantity implicature. In (68), for example, A's utterance implicates (but does not entail) that Avery invited Bailey, Cameron, Dana, *and no one else*.

(68)   Q: Who all did Avery invite?
        A: She invited Bailey, Cameron, and Dana.
        B: She invited Ellis, **too**.

Here $\text{ANT} = \text{utter}\big(\text{A,C}, (68\text{-A})\big)$, $\llbracket \pi \rrbracket = \{|\text{Avery invited Ellis}|\}^{\downarrow}$, and

$$\llbracket Q \rrbracket = \big\{|\text{Avery invited only Bailey}|, |\text{Avery invited only Cameron}|, |\text{Avery invited only Dana}|,$$
$$|\text{Avery invited only Bailey and Cameron}|, |\text{Avery invited only Bailey and Dana}|,$$

$|\text{Avery invited only Cameron and Dana}|, |\text{Avery invited only Bailey, Cameron, and Dana}|, ...\big\}^{\downarrow}$.

Once again, it can be shown that the proposed felicity conditions of *too* are satisfied by setting $\text{RQ} = \llbracket Q \rrbracket$:

a. ANTECEDENT CONDITION: If A knew that Avery invited anyone else besides Bailey, Cameron, and Dana, A would be expected to say so in order to comply with the Maxim of Quantity. It follows[8] that

$$P_L\big(|\text{Avery invited only Bailey, Cameron, and Dana}|\,\big|\,\text{info}(\textsc{ant})\big) > P_L\left(\bigcap\mathcal{A}'\,\middle|\,\text{info}(\textsc{ant})\right)$$

for all $\mathcal{A}' \subset \text{alt}(\textsc{rq})$ such that $\bigcap\mathcal{A}' \not\supseteq |\text{Avery invited only Bailey, Cameron, and Dana}|$. (Note that $\bigcap\mathcal{A}' = \emptyset$ when $\mathcal{A}'$ is a non-singleton set since the alternatives of a mention-all question are non-overlapping.) Thus ANT answers RQ.

b. CONJUNCTION CONDITION: Although the assertion of $[\![\pi]\!]$ cancels the implicature that Avery invited no one besides Bailey, Cameron, and Dana, it only provides the information that Avery invited Ellis, so $\textsc{ant} \cap [\![\pi]\!]$ constitutes evidence that Avery did not invite anyone besides Bailey, Cameron, Dana, and Ellis. (In other words, a weaker version of the exhaustive inference survives the assertion of π.) Therefore,

$$P_L\big(|\text{Avery invited only Bailey, Cameron, Dana, and Ellis}|\,\big|\,\text{info}(\textsc{ant} \cap [\![\pi]\!])\big)$$
$$> P_L\left(\bigcap\mathcal{A}'\,\middle|\,\text{info}(\textsc{ant} \cap [\![\pi]\!])\right)$$

for all $\mathcal{A}' \subset \text{alt}(\textsc{rq})$ such that $\bigcap\mathcal{A}' \not\supseteq |\text{Avery invited only Bailey, Cameron, Dana, and Ellis}|$. Thus $\textsc{ant} \cap [\![\pi]\!]$ Answers RQ, with
$\textsc{rq}|_{\textsc{ant} \cap [\![\pi]\!]} = |\text{Avery invited Bailey, Cameron, Dana, and Ellis}|$. Since ANT by itself suggests that Avery did *not* invite Ellis,

$$P_L\big(|\text{Avery invited only Bailey, Cameron, Dana, and Ellis}|\,\big|\,\text{info}(\textsc{ant} \cap [\![\pi]\!])\big)$$
$$> P_L\big(|\text{Avery invited only Bailey, Cameron, Dana, and Ellis}|\,\big|\,\text{info}(\textsc{ant})\big).$$

Thus $\textsc{ant} \cap [\![\pi]\!]$ Evidences $\textsc{rq}|_{\textsc{ant} \cap [\![\pi]\!]}$ more strongly than ANT does.

c. PREJACENT CONDITIONS:

   i. The fact that Avery invited Ellis does not entail that Avery invited Bailey, Cameron, Dana, and Ellis. Thus $[\![\pi]\!] \not\subseteq \textsc{rq}|_{\textsc{ant} \cap [\![\pi]\!]}$.

   ii. For any proposition $S \supset [\![\pi]\!]$,

$$P_L\big(|\text{Avery invited Bailey, Cameron, Dana, and Ellis}|\,\big|\,\text{info}(\textsc{ant} \cap S)\big)$$
$$< P_L\big(|\text{Avery invited Bailey, Cameron, Dana, and Ellis}|\,\big|\,\text{info}(\textsc{ant} \cap [\![\pi]\!])\big)$$

because S is weaker evidence that Avery invited Ellis than $[\![\pi]\!]$ is. (For example, consider $S = [\![\text{Avery invited Ellis or Francis}]\!]$.) Thus $\textsc{ant} \cap [\![\pi]\!]$ Evidences $\textsc{rq}|_{\textsc{ant} \cap [\![\pi]\!]}$ more strongly than $\textsc{ant} \cap S$ does.

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[8]See Goodman & Stuhlmüller (2013), Degen et al. (2013), and Degen & Tanenhaus (2015) for explanation of how Quantity implicatures can be modeled in RSA.

5.4.3 RQs that are not explicitly asked

It has been shown that the conditions in (62) are satisfied in (66)–(68) when RQ is taken to be the question that was explicitly asked. But (62) does not require this; it only requires RQ to be relevant to some question DQ in the discourse tree. As seen in Section 4, there are cases in which the RQ that must be identified to satisfy *too*'s felicity conditions is not an explicitly asked question. For example, consider (69). Since the explicitly asked question Q is a mention-two question, each of its alternatives entail that Bailey invited at least two individuals. The antecedent (*She invited Bailey*) only provides one individual. (Such an antecedent sounds most natural when it is introduced by *well* and uttered with rising intonation, as indicated in (69).)

(69)   Q: Who are some people Avery invited?
        A: (Well,) she invited Bailey.$^\uparrow$... She invited Cameron, **too**.

Assuming that the alternatives in Q are independent and the prior distribution over them is uniform, *She invited Bailey* increases the probability of every alternative that entails that Avery invited Bailey by the same amount, which is to say

$$P_L(|\text{Avery invited Bailey and Cameron}|\,\|\,|\text{Avery invited Bailey}|)$$
$$= P_L(|\text{Avery invited Bailey and Dana}|\,\|\,|\text{Avery invited Bailey}|)$$
$$= P_L(|\text{Avery invited Bailey and Ellis}|\,\|\,|\text{Avery invited Bailey}|)$$
$$= \cdots .$$

This means that *She invited Bailey* does not Answer Q, so the Antecedent Condition is not satisfied here if $\text{RQ} = [\![\text{Q}]\!]$.

However, there is a question Relevant to Q that is answered by *She invited Bailey*, namely the mention-one question *Who is someone that Avery invited?* That question is Relevant, according to (59), because each of its alternatives increases the probability of some of Q's alternatives: For example,

$$P_L\left(|\text{Avery invited Bailey and Cameron}|\,\|\,|\text{Avery invited Bailey}|\right)$$
$$> P_L\left(|\text{Avery invited Bailey and Cameron}|\right).$$

The Conjunction and Prejacent conditions can also be shown to be satisfied by taking $\text{RQ} = [\![\text{Who is someone that Avery invited?}]\!]$. I omit the proof because it is analogous to the one in the mention-some case considered above. The examples in (42) can be treated along similar lines.

5.5 Accounting for constraints on *too*'s distribution

The Conjunction Condition accounts for the fact that *too* is unacceptable in contexts where π does not contribute any information that would make $\text{ANT} \cap [\![\pi]\!]$ a more satisfactory resolution than ANT to any contextually relevant question. An example of such a context can be seen in (70).

(70)   Q: Who are some people Avery invited?
           A: She invited Bailey and Cameron.
           B: #Dogs are mammals, **too**.

Here we have $\textsc{ant} = \mathsf{utter}(A, C, (70\text{-}A))$ and $[\![\pi]\!] = \{|\text{Dogs are mammals}|\}^{\downarrow}$. Since $\textsc{ant}$ is evidence that Avery invited Bailey and Cameron but *Dogs are mammals* provides no information about who Avery invited, we have $Q|_{\textsc{ant}\cap[\![\pi]\!]} = |\text{Avery invited Bailey and Cameron}|$ and

$$P_L\big(|\text{Avery invited Bailey and Cameron}|\,\big|\,\mathsf{info}(\textsc{ant} \cap [\![\pi]\!])\big)$$
$$= P_L\big(|\text{Avery invited Bailey and Cameron}|\,\big|\,\mathsf{info}(\textsc{ant})\big).$$

Thus $\textsc{ant}\cap[\![\pi]\!]$ does not Evidence $Q_{\textsc{ant}\cap[\![\pi]\!]}$ any more strongly than $\textsc{ant}$ does. This means the Conjunction Condition is not satisfied by taking $\textsc{rq} = [\![Q]\!]$. There is no other contextually relevant that satisfies the Conjunction Condition, either, so the analysis correctly predicts that *too* is infelicitous in (70-B).

     Part (i) of the Prejacent Condition accounts for the fact, observed by Beaver & Clark (2008), that *too* is infelicitous in (71-A).

(71)   Q: What is Sam's emotional state?   (repeated from (11))
           A: Sam is happy. #He's ecstatic, **too**.

Here we have $\textsc{ant} = \mathsf{utter}(A, C, \text{Sam is happy})$ and $[\![\pi]\!] = \{|\text{Sam is ecstatic}|\}^{\downarrow}$. The Antecedent Condition and the Conjunction Condition can be satisfied by taking $\textsc{rq} = [\![Q]\!]$. This fails to satisfy part (i) of the Prejacent Condition, however, because $Q|_{\textsc{ant}\cap[\![\pi]\!]} = |\text{Sam is ecstatic}|$, which is entailed by $[\![\pi]\!]$.

     Part (ii) of the Prejacent Condition rules out dialogues like (72).

(72)   Q: Who plays an instrument?   (repeated from (32))
           A: Avery plays an instrument. #Bailey plays the cello, **too**.

Here we have $\textsc{ant} = \mathsf{utter}(A, C, \textit{Avery plays an instrument})$ and $[\![\pi]\!] = \{|\text{Bailey plays the cello}|\}^{\downarrow}$. The Antecedent and Conjunction Conditions are both satisfied if

$$\textsc{rq} = [\![\text{Who is someone who plays an instrument?}]\!],$$

which yields $\textsc{rq}|_{\textsc{ant}\cap[\![\pi]\!]} = \{|\text{Avery and Bailey play instruments}|\}^{\downarrow}$. There is no other possible $\textsc{rq}$ that would satisfy both the Antecedent and Conjunction conditions. (Although *Who is someone who plays the cello?* is relevant to Q, it will not work as $\textsc{rq}$ because $\textsc{ant}$ does not answer it.) However, the Prejacent Condition is not satisfied because

$$\{|\text{Bailey plays an instrument}|\}^{\downarrow} \supset [\![\pi]\!]$$

but $\textsc{ant} \cap \{|\text{Bailey plays an instrument}|\}^{\downarrow}$ Evidences $|\text{Avery and Bailey play instruments}|$ just as strongly as $\textsc{ant} \cap [\![\pi]\!]$ does.

5.5.1 Responses to multiple *wh*-questions

In addition, the proposal accounts for the observed behavior of *too* in responses to multiple *wh*-questions (see Section 4.4). Consider (38), repeated in (73).

(73) **Context:** Avery and Bailey are known to have gone to a restaurant together. It is presumed that both of them ate there.
Q: Who ate what?
A: Avery ate pizza.
B: Bailey ate spaghetti, (**#too**).

Here $\text{ANT} = \mathsf{utter}(A, C, (73\text{-A}))$, $[\![\pi]\!] = \{|\text{Bailey ate spaghetti}|\}^{\downarrow}$, and

$$[\![Q]\!] = \{|\text{Avery and Bailey ate pizza}|, |\text{Avery ate pizza and Bailey ate spaghetti}|,$$
$$|\text{Avery and Bailey ate spaghetti}|, |\text{Avery ate spaghetti and Bailey ate pizza}|,$$
$$|\text{Avery and Bailey ate lasagna}|, ...\}^{\downarrow}.$$

In this context, every resolution to *Who ate what?* specifies what Avery ate and what Bailey ate. Therefore, if $\text{RQ} = [\![Q]\!]$, the Antecedent Condition is not satisfied because ANT does not provide any information as to what Bailey ate. The only contextually relevant *wh*-questions that ANT does resolve are the ones shown in (74).

(74) a. What did Avery eat?
b. Who ate pizza?
c. What is something that was eaten?

If $\text{RQ} = [\![(74\text{-a})]\!]$ or $\text{RQ} = [\![(74\text{-b})]\!]$, then the Conjunction Condition is not satisfied because we have $\text{RQ}|_{\text{ANT} \cap [\![\pi]\!]} = |\text{Avery ate pizza}|$, which ANT Evidences just as strongly as $\text{ANT} \cap [\![\pi]\!]$ does. If $\text{RQ} = [\![(74\text{-c})]\!]$, then $\text{RQ}|_{\text{ANT} \cap [\![\pi]\!]} = \{|\text{Pizza and spaghetti were eaten}|\}^{\downarrow}$ and the Prejacent Condition is not satisfied because $\{|\text{Spaghetti was eaten}|\}^{\downarrow} \supset [\![\pi]\!]$ but $\text{ANT} \cap \{|\text{Spaghetti was eaten}|\}^{\downarrow}$ argues just as strongly for $\text{RQ}|_{\text{ANT} \cap [\![\pi]\!]}$ as $\text{ANT} \cap [\![\pi]\!]$ does. This accounts for *too*'s infelicity in (73).

In contrast, *too* is acceptable in (75) (repeated from (39)).

(75) **Context:** Avery, Bailey, Cameron, Dana, and others are known to have attended a large party. It is likely that there were some married couples among the attendees, but it cannot be assumed that any of them were married to each other.
Q: Who is married to whom?
A: Avery is married to Bailey.
B: Cameron is married to Dana, **too**.

Here $\text{ANT} = \mathsf{utter}(A, C, (75\text{-A}))$, $[\![\pi]\!] = \{|\text{Cameron is married to Dana}|\}^{\downarrow}$, and

$$[\![Q]\!] = \{|\text{Avery is married to Bailey}|, |\text{Avery is married to Cameron}|, |\text{Avery is married to Dana}|,$$
$$|\text{Bailey is married to Cameron}|, |\text{Bailey is married to Dana}|, |\text{Cameron is married to Dana}|, ...\}^{\downarrow}.$$

The felicity conditions of *too* are satisfied by taking $\text{RQ} = [\![Q]\!]$: Since Q can be resolved in this context by supplying only one married couple, (75-A) Answers Q, thereby satisfying the

Antecedent Condition. The Conjunction Condition and Prejacent Condition are satisfied in the same way they are with mention-some single *wh*-questions (see (66) above).

5.5.2 Cases where *too* takes narrow scope

In the data discussed so far, *too*'s prejacent is the entire host sentence. However, it is not a problem for the proposed analysis that *too* can also take narrow scope.

For example, Rullmann (2003) points out that *too* can occur in negated sentences, as in (76).[9] Rullmann argues that the negation in (76) outscopes *too*, so I take the prejacent to be the positive sentence *Ian washes the dishes*, as shown in (77-a).

(76)   Ian cooks the food. He shouldn't wash the dishes **too**.   (cf. Rullmann 2003: 330)

The antecedent is the fact that the speaker asserted that Ian cooks the food, as shown in (77-b). This utterance would presumably occur in a conversation about what tasks Ian should be responsible for (perhaps with the goal of dividing up chores between members of a household), so I assume that the question *What should Ian do?* is in the discourse tree. The felicity conditions of *too* are satisfied if the RQ is taken to be *What does Ian do?* (with a mention-one interpretation, as shown in (77-c)). This question is Relevant to the DQ *What should Ian do?* because information about what Ian already does affects how the interlocutors are likely to resolve that DQ: If Ian already has one task, the probability that he should do others decreases.

(77)   a. $[\![\pi]\!] = \{|\text{Ian washes the dishes}|\}^{\downarrow}$
        b.   ANT $= \mathsf{utter}(Sp, C, \text{Ian cooks the food})$
        c.   RQ $= \{|\text{Ian cooks the food}|, |\text{Ian washes the dishes}|, |\text{Ian sweeps the floor}|, ...\}^{\downarrow}$

Note that *too*'s felicity depends only on the existence of an RQ that has the required relationship to $[\![\pi]\!]$ and ANT. The host sentence *He shouldn't wash the dishes* does not come into consideration.

Too also occurs in subordinate clauses. An example is shown in (78). In this case the prejacent is the clause in which *too* appears, so again the host sentence does not come into consideration. In (78), the felicity conditions of *too* are satisfied by taking the RQ to be *What does Ian do?*, just as in (77).

(78)   Ian cooks the food. If he washes the dishes **too**, that's very kind of him.
        a. $[\![\pi]\!] = \{|\text{Ian washes the dishes}|\}^{\downarrow}$
        b.   ANT $= \mathsf{utter}(Sp, C, \text{Ian cooks the food})$
        c.   RQ $= \{|\text{Ian cooks the food}|, |\text{Ian washes the dishes}|, |\text{Ian sweeps the floor}|, ...\}^{\downarrow}$

When *too* appears in polar questions, as in (79), I assume that it takes scope under a polar question operator. Then the prejacent in (79) is *Bailey went to the party*, and the felicity conditions of *too* are straightforwardly satisfied by taking RQ to be *Who is someone who went to the party?*

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[9]The antecedent in Rullmann's example is actually *Ian cooked the food*, which requires a more complicated analysis since it is a past-tense sentence. I consider only this simpler present-tense version and leave the investigation of how *too* interacts with tense to future work.

(79)   Q: Who went to the party?
        A: Avery went to the party. Did Bailey go, **too**?

    a. $[\![\pi]\!] = \{|\text{Bailey went to the party}|\}^{\downarrow}$
    b. $\text{ANT} = \text{utter}(A, C, \text{Avery went to the party})$
    c. $\text{RQ} = \{|\text{Avery went}|, |\text{Bailey went}|, |\text{Cameron went}|, ...\}^{\downarrow}$

Too also appears in certain kinds of *wh*-questions. Theiler (2019) examines the behavior of *also* in such questions and points out that *also*'s acceptability in (80) hinges on the domain restriction *other books (besides Middlemarch)*. According to her, *also* is also acceptable in (81-a) (which she calls a "summoning question") because such questions implicitly restrict their domain to the group of listeners being addressed by the speaker. *Too*, which Theiler (2019) does not analyze, is just as acceptable as *also* in these two kinds of questions.[10]

(80)   ***Wh*-questions with explicit domain restriction:**

    a.   John read Middlemarch. What #(other books) did John **also** read?
    b.   John read Middlemarch. What #(other books) did John read, **too**?

(81)   **Summoning questions:**

    a.   I'm getting an ice cream for Mary. Who **also** wants one?
    b.   I'm getting an ice cream for Mary. Who wants one **too**?

In Inquisitive Semantics, *wh*-questions are analyzed as involving quantification (see Ciardelli et al. 2019), so on the present analysis, I take it that *too*'s prejacent in (80-b) and (81-b) contains a variable that is bound by an quantifier that takes scope over *too*, as shown in (82) and (83). A rigorous analysis of *too*'s behavior in *wh*-questions must be left to future work, but I suggest that *too* is licensed in *wh*-questions only if its felicity conditions are satisfied for all possible assignments of the variable in the prejacent. The Prejacent Condition will then be satisfied only if the domain of quantification is properly restricted.

(82)   John read Middlemarch. What #(other books) did John read, **too**?

    a. $[\![\pi]\!] = \{|\text{John read } x| : x \neq \text{Middlemarch}\}^{\downarrow}$
    b.   RQ: What did John read?

(83)   I'm getting an ice cream for Mary. Who (among you) wants one **too**?

    a. $[\![\pi]\!] = \{|x \text{ wants an ice cream}| : x \text{ is an addressee}\}^{\downarrow}$
    b.   RQ: Who wants an ice cream?

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[10] *Also* is known to also appear in showmaster questions, which convey that the asker has a particular answer in mind (see Umbach 2010). Interestingly, the showmaster interpretation does not seem to be available to *too*, as evidenced by the infelicity of (i-b). The explanation for this difference between *also* and *too* must be left to future work.

(i)   **Showmaster questions:**
       (Little Lisa tells her mother what happened when she visited the zoo with Auntie.)

    a.   Auntie to Lisa: And what **also** happened at the zoo?   (Umbach 2010)
    b.   Auntie to Lisa: #And what happened at the zoo, **too**?

6   Conclusion and directions for future work

This paper offers an analysis of *too* that provides greater empirical coverage than previous approaches by accounting for the argument-building use of *too*. According to the proposed analysis, *too* uniformly requires the existence of a contextually relevant question that is answered by its antecedent but has some resolution that its antecedent and prejacent together argue for more strongly than the antecedent does alone. This analysis crucially relies on a notion of Answerhood that brings Inquisitive Semantics together with probabilistic approaches to pragmatics.

In future work, the approach taken here for the analysis of *too* can be extended to other additive expressions. I suggest that the felicity conditions of other additives vary around a shared semantic core that requires the existence of an RQ that is Answered by both an antecedent proposition and the conjunction of that antecedent with the additive's prejacent.

Also quite similar to *too*, but unlike *too*, *also* can appear sentence-initially, and in that position it does not seem to be subject to part (ii) of the Prejacent Condition, as (84-A) sounds perfectly natural.

(84)   Q: Who plays an instrument?
A: Avery plays an instrument. **Also,** Bailey plays the cello.
A′: Avery plays an instrument. #Bailey plays the cello, **too**.

In addition, *also* seems to have a preference for canonical additive uses over argument-building uses. Argument-building interpretations of *also* are perhaps possible, as in (85), but tend to sound less natural than those of *too*. On the other hand, the additive *as well* seems to lack argumentative uses entirely. This might indicate that *as well* has a Conjunction Condition that requires ANT and ANT ∩ $[\![\pi]\!]$ to argue for different resolutions to the RQ.

(85)   a.   A room opened up at this hotel. It looks like a fancy one **(?also/#as well)**.
b.   I know people who've gotten tickets. The fine is a hefty one **(?also/#as well)**.

There is also a close kinship between *too* and *either*, though *either* is a negative polarity item with a distribution nearly complementary to *too*'s (see Rullmann 2003). Like *too*, *either* has non-canonical uses, as reported by Thomas (2021) and exemplified by the naturally-occurring (86-b). *Either* likely shares some of *too*'s felicity conditions, but additional constraints will need to be stipulated to explain *either*'s NPI behavior.

(86)   a.   I don't like pizza. I don't like spaghetti, **either**.   (Rullmann 2003)
b.   I can name at least a half dozen now-dead couples...who've worked and succeeded in the same fields in my country and yet somehow managed to stay married. And not because of societal pressures **either**.   (Thomas 2021)

Future work can determine the extent to which the Antecedent, Conjunction, and Prejacent Conditions are shared with other additive expressions and uncover dimensions along which they vary within English and across languages.

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