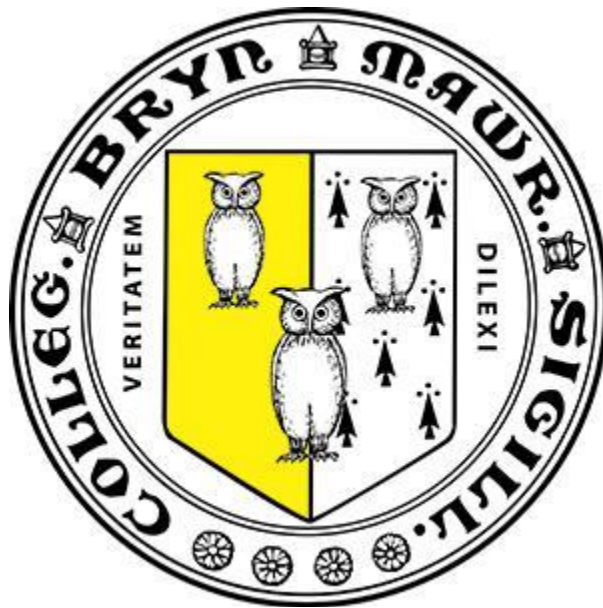


The False Belief Implicature: The Effects of Embedding Individual-Level Predicates

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Abstract

This paper identifies the *false belief implicature* which occurs in sentences which embed a past tense individual-level predicate beneath the past tense verb *believed*. This implicature attributes the contents of the embedded clause as a previously held false belief of the matrix subject. After giving background on the literature on tense based implicatures and theories of semantic tense in the English language, I reported the results of an experiment which empirically tests the creation of the false belief implicature. I then discuss my proposed theoretical account for the creation of the implicature, identifying a process of assumptions which results in the false belief implicature occurring with individual-level, but not stage-level, predicates. Finally, I explore some potential limitations in my experiment and in my proposed account, identifying areas for future research which will increase our understanding of the false belief implicature and the semantics and pragmatics of tense.

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I. Introduction

This paper proposes the false belief implicature which arises in sentences like (1) where a past tense individual-level predicate is embedded beneath the past tense verb *believed*. This implicature attributes the contents of the embedded clause as a previously held false belief of the matrix subject.

(1) Paige believed that Lillian was Italian.

Sentence (1) implies that Paige no longer believes that Lillian is Italian because Lillian is not, and never was Italian. In Section II, I review previous literature surrounding the semantics and pragmatics of tense, ending with my research questions in Section III. I then move on to the methods, results, and discussion of my experiment which empirically tested the existence of the false belief implicature in Sections IV, V, and VI. In Section VII, I offer a theoretical account for the series of assumptions and implicatures which results in the false belief implicature. Finally, I conclude with a discussion of potential limitations and future research in Sections VIII and IX before offering final conclusions in Section X.

II. Literature Review

Previous research has noted that the past tense and the present tense exist on a scale of informativeness where the past tense is less informative than the present tense (Altshuler & Schwarzschild, 2013b). This scalar nature of tense is based on the following assumption in (2), which I will also adopt.

(2) For any stative clause ϕ , if ϕ is true at moment m , then there is a moment m' preceding m at which ϕ is true and there is a moment m'' following m at which ϕ is true.¹

The assumption contained in (2) lends itself to a scalar nature of tense whereby if the present tense of a predicate is true, then that predicate must have been true at some point in the

¹ Altshuler & Schwarzschild (2013b; 1)

past (even if just for a moment). Associated with scalar tense, Altshuler & Schwarzschild (2013b) established a scalar implicature which interacts with predicates that are stative in nature, meaning they describe a state or situation rather than an action or process (Kroeger, 2022). The scalar implicature will only interact with those predicates which are stative; predicates such as *be hungry* or *own a parrot* are considered stative in nature as opposed to *build a house* or *walk* which describe an action or process. Under the implicature, when a speaker uses the past tense of a predicate, they imply that no state of the kind currently holds. The implied meaning in these cases stems from two of Grice's Maxims which state that speakers must be truthful (Maxim of Quality) and be optimally informative (Maxim of Quantity) in order to have successful conversations (Grice, 1975). Altshuler and Schwarzschild term this the *cessation implicature*, an example of which can be seen in (3a), below.

- (3) a. Scotty was tired.
b. Scotty is tired.

The present tense of (3b) is more informative than the past tense of (3a) because (3b) comments on both the past and present moment². When one utters (3a), the listener will assume that the speaker is being maximally informative and, therefore, that the use of the present tense would be a lie in violation of the maxim of quality. It is therefore implied that Scotty is no longer tired.

As stated previously, the cessation implicature occurs with stative predicates; however, there are a few different types of stative predicates (Kratzer, 1989) with which the implicature interacts differently. The two main types I will explore within my research are *stage-level* and *individual-level* predicates³. Individual-level predicates are qualities which generally hold for the entirety of an individual's lifetime (Kratzer, 1989; Musan, 1997). Some examples of individual-level predicates are eye color and nationality. Stage-level predicates, on the other hand, are temporary properties which hold for shorter periods of time throughout an individual's lifetime

² Based on the assumption in (2), it seems that the present tense also comments on some future moment. This assumption, although interesting, is not explored within this paper as it does not have bearing on the presence of cessation implicatures.

³ Kratzer also discusses a third type of stative predicate: *existence independent predicates* (Kratzer, 1989). The pragmatic impacts of this type of predicate are not explored within this paper and remain an area of potential future research.

such as emotions and locations (Kratzer, 1989). The predicate *be tired* contained in (3) is an example of a stage-level predicate.

Both stage-level and individual-level predicates can be subject to cessation implicatures; however, a cessation implicature of an individual-level predicate results in an additional implicature which Musan (1997) calls a *lifetime effect*. Since individual-level predicates generally hold for the entirety of one’s existence, a cessation implicature that the trait has ended additionally implies that the individual’s existence has ended (Musan, 1997). In other words, when one uses the past tense of an individual-level predicate, the speaker implies that that individual is dead⁴. An example of a lifetime effect can be seen in (4a).

- (4) a. Gregory had blue eyes.
- b. Gregory has blue eyes.

If a speaker chooses to say (4a), there is a cessation implicature that Gregory’s eyes are no longer blue. Additionally, because eye color is a trait which generally holds for the entirety of an individual’s existence, the use of (4a) has a lifetime effect which implies that Gregory is dead. Table 1 gives a visual representation of the impact of stage-level vs individual-level predicates.

	Cessation Implicature?	Lifetime Effect?
Stage-Level Predicates	Yes	No
Individual-Level Predicates	Yes	Yes

Table 1: Impact of Stage-Level vs Individual-Level Predicates

Past research has also investigated the ability to block cessation implicatures with certain sentence structures (Altshuler & Schwarzschild 2013b), mainly those consisting of past-under-past

⁴ Prior to Musan’s use of the term lifetime effect, this phenomenon was identified by Kratzer (1989). However, rather than adopting a pragmatic view, Kratzer proposed a semantic denotation for the meaning of sentences like (4a) which required that the individual in question no longer exist. This stands in opposition to Musan’s explanation of that meaning as an implicature. Due to the fact that the lifetime effect can be eliminated based on context, I will adopt Musan’s explanation of the phenomenon as an implicature.

embedded utterances which have a morphological past tense embedded beneath another morphological past tense, as seen in (5).

(5) Jalen believed that Amy was sick.

Past-under-past sentences are ambiguous because they have two potential readings. The first is called a *back shifted reading* where the temporal interval for the embedded clause is interpreted as coming before the temporal interval for the matrix clause (Abusch, 1988). In the case of (5), a back shifted reading would mean “at some point in the past, Jalen believed that Amy had previously been sick”. The second possible reading is called a *simultaneous reading* where the temporal interval for the embedded clause is interpreted as overlapping the temporal interval of the matrix clause (Abusch, 1988). In these cases, the embedded past tense is essentially deleted and instead functions like a semantic present tense. For (5), this would mean “at some point in the past, Jalen believed that (at that same time) Amy was sick.”

Altshuler and Schwarzschild introduce embedded clauses in past-under-past sentences as a limit to the cessation implicature (2013a; 2013b). In these utterances, a simultaneous reading deletes the semantic past tense of the embedded predicate, therefore eliminating the cessation implicature in the embedded clause (Altshuler & Schwarzschild, 2013b). As seen in (5), rather than the hearer interpreting the interval for *be sick* as ending before Jalen’s belief, they interpret Amy’s being sick as overlapping the time of Jalen’s belief. The simultaneous reading of (5) therefore eliminates a cessation implicature in the embedded clause and the hearer does not assume that Amy is no longer sick.

However, embedding a stative predicate in a past-under-past sentence does not always eliminate a cessation implicature of that predicate. A cessation implicature still occurs in the embedded clause when there is a viable present-under-past alternative construction, but a speaker chooses to instead use a past-under-past utterance (Altshuler & Schwarzschild, 2013a). This means that if one could felicitously use a construction which embeds a morphological present tense under a morphological past tense, but instead uses past-under-past, they are implying that the predicate is not true in the present. Abusch termed the meaning of a present-under-past reading a *double access reading*, as it requires that the embedded clause be true both at the sentence’s matrix time

and at the utterance time for the sentence⁵ (Abusch, 1988). Therefore, the morphological present tense in the embedded clause gives information about that predicate in both the present and the past. The difference between a present-under-past and a past-under-past can be seen in (6).

- (6) a. Maria said that the baby is sleeping.
- b. Maria said that the baby was sleeping.

Because tense is scalar in nature, (6a) is more informative than (6b) because it gives information about both the past and present tense of the predicate *be sleeping*. Therefore, when a speaker uses (6b) as opposed to (6a), they imply that the baby is no longer sleeping despite using a past-under-past construction in the utterance. In cases like (6b) it is possible for a cessation implicature to occur in the embedded clause of a past-under-past sentence.

However, when there is not a viable present-under-past construction, as seen in (7), there is not a cessation implicature of the embedded clause. This is the case when a past tense stative verb, such as *believed*, is used in the matrix clause of the sentence.

- (7) a. #Jalen believed that Amy is sick.
- b. Jalen believed that Amy was sick.

The pragmatic oddness associated with sentences like (7a) is explored by Altshuler et al (2015). With *believe* being a stative predicate, the use of it in the past tense results in a cessation implicature that Jalen's period of belief has ended. This implied cessation of belief stands in opposition to the use of *believed* as an evidential⁶ embedding verb, resulting in pragmatic oddness (Altshuler et al. 2015). Matrix verbs serve an evidential function when the main content of the utterance is contained within the embedded clause and the matrix verb instead provides the evidence for the content of the embedded clause (Simmons, 2006). Verbs like *believe* as used in (7) carry information of two sorts: information about the source of the claim and information about the claim's reliability, probability, or desirability (Rooryck, 2001). Because *believe* is a stative

⁵ It could also be the case that, rather than being true at the utterance time, the embedded clause in present-under-past sentences must be in some way relevant at the utterance time of the sentence (Ogihara, 1995).

⁶ Altshuler et al (2015) uses the word *parenthetical* rather than *evidential*, but the definition they give matches that which Simmons (2006) gives to *evidential*. With *evidential* being a word which is more commonly used in the field I have opted to use the term *evidential* rather than *parenthetical*.

verb, the use of *believed* in the past tense results in the cessation implicature seen in (8) that implies that the subject's period of belief has ended.

- (8) a. #John believed that Mary has a parrot.
b. John believed that Mary had a parrot.

Due to the present-under-past construction, in order for (8a) to be true it must be the case that Mary currently has a parrot. However, when one uses *believe* as an evidential for a fact in the present tense, it is pragmatically odd to simultaneously imply that that belief has ended by using the past tense *believed*. It calls into question why that belief should be used as evidence of the truth of the embedded clause if the subject no longer holds the belief (Altshuler, et al 2015). This makes sentences like (8a) seem at least very odd to say, eliminating the present-under-past construction as a viable alternative to (8b). Without a viable present-under-past construction, there is no cessation implicature in the embedded clause of (8b) and it is not implied that Mary no longer has a parrot (Altshuler & Schwarzschild, 2013a).

In summary, previous literature has explored the scalar nature of tense, scalar implicatures of tense (cessation implicatures), additional implicatures with the cessation of individual-level predicates (lifetime effects), the effects of embedding past tense stage-level predicates, and cessation implicatures of words like *believed*. However, there is a lack of research which investigates the pragmatic meaning of utterances which embed an individual-level predicate in a past-under-past utterance. In the same manner that individual-level predicates create additional implicatures in the form of lifetime effects, it seems plausible that there could also be additional implicatures associated with sentence constructions like those seen in (1), repeated below.

- (1) Paige believed that Lillian was Italian.

Throughout the course of my research, I expected to find that an embedded individual-level predicate would result in additional implicatures, similar to a lifetime effect. Theoretically, I had hypothesized that constructions like that seen in (1) do contain an additional implicature as a result of the embedded individual-level predicate. The implicature attributes the contents of the

embedded clause as a previously held false belief of the matrix subject, which I call the *false belief implicature*.

III. Research Questions

This gap in previous research has led to my formation of the following research questions:

Question #1: What are the effects of embedding individual-level predicates in past-under-past utterances?

Question #2: How can pragmatic and semantic theories of tense account for the false belief implicature?

IV. Methods

I recruited a group of 30 participants consisting of a convenience sample of college students, faculty, and staff who volunteered to participate in the study based on flyers posted around the campus of Bryn Mawr College and posts on social media. The initial group of volunteers was vetted to garner a final group which were native English speakers that had no prior instruction in semantics or pragmatics. Volunteers who did not speak English as a first language or had previously taken linguistics classes were excluded from the sample.

Each member of the participant group was asked a series of questions about 15 different example sentences which were generated for the purpose of this study. The sentences were presented to participants in a written format while the questions about each sentence were asked orally. Ten of these sentences were the focus of the study: five featuring individual-level predicates and five featuring stage-level predicates. Apart from the type of embedded predicate, the rest of the sentence followed an identical structure from the construction seen in (9). The remaining five sentences were used as distractor questions to break up any monotony in the example sentences. These used alternative constructions and included other aspects such as negation and varying tenses⁷.

(9) [NAME] + [BELIEVED] + [THAT] + [NAME] + [STATIVE PREDICATE].

⁷ The full list of sentences used within the study can be found within the appendix.

For each sentence, the participant was asked to provide a felicity judgment according to the following three questions, which are presented in (10) as they would be asked for sentence (1).

- (10) Survey Questions for *Paige believed that Lillian was Italian*.
- a. Would this sentence sound odd in a scenario where Lillian is, at the current moment, Italian?
 - b. Would this sentence sound odd in a scenario where Lillian had been Italian at some point in the past?
 - c. Would this sentence sound odd in a scenario where Paige currently believes that Lillian is Italian?

For these questions, participants were asked to first provide a simple yes/no answer to the question. Once that answer was given, participants were asked about the reasoning for their answers. In some instances, follow-up questions were asked to fully understand participant answers.

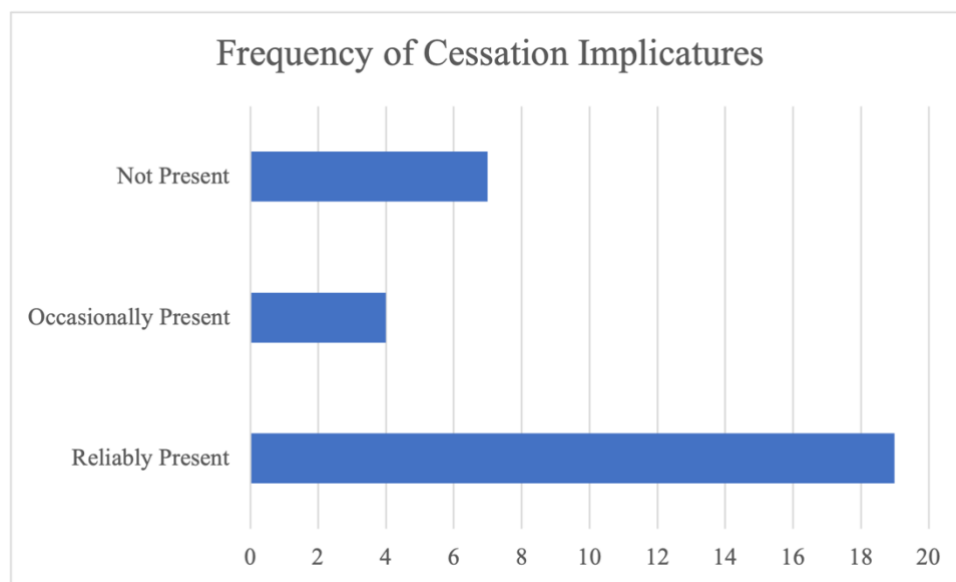
If the false belief implicature holds, then we would expect to see sentences containing individual-level predicates resulting in the following answers: it would be weird for the embedded predicate to currently hold, weird for it to have held in the past, and weird for the belief to currently hold. These would indicate that the participant believes the belief has ended and the embedded predicate does not, and has never, held. If the implicature is truly associated with only individual-level predicates, then sentences containing stage-level predicates would have answers that indicate it being odd for the embedded predicate and the belief to currently hold, but not odd for the embedded predicate to have held in the past.

V. Results

The final sample size for the study included 30 participants which were native English speakers with no formal training in semantics or pragmatics. This resulted in a total of 450 judgements spread evenly across 15 sentences. Of these tokens, 150 were excluded from analysis to focus on the ten sentences which contained the focus construction in this study. This resulted in a final number of 300 tokens to be analyzed.

First, answers were analyzed for each individual participant to determine whether the individual experienced cessation implicatures. This was done by examining how many times the participant indicated a cessation implicature of ‘believed’ in the matrix clause of the ten example sentences. Individuals who experienced a cessation implicature at a rate greater than or equal to 60% of the time (in 6 out of 10 sentences) were categorized as those who reliably experienced the implicature. Those who experienced a cessation implicature less than or equal to 30% of the time (in 3 out of 10 sentences) were categorized as those who did not experience the implicature. Lastly, those who were somewhere in the middle, experiencing a cessation implicature between 40% and 50% of the time, were sorted into a third group. The results of this sorting can be seen in Figure 1, below.

Figure 1: Number of participants at each level of cessation implicature frequency



The resulting size of the sorted groups supports the existence of cessation implicatures associated with the use of past tense stative predicates in the matrix clause as described by Altshuler & Schwarzschild (2013b) with 63.3% of participants (19 out of 30) reliably experiencing cessation implicatures. The number of people who experienced cessation implicatures increases to 76.7% of participants (23 out of 30) when including those who indicated the presence of the implicature some of the time, but not consistently.

Further analysis was performed using the answers provided by the group of participants for which cessation implicatures were reliably present. This group contained 19 individuals with a total of 190 tokens being analyzed to investigate the possibility of additional implicatures associated with constructions which contained past tense individual-level predicates. The tokens from these participants were used to perform a statistical analysis comparing the two different types of predicates.

The focus sentences were categorized based on their predicates and the total number of false belief implicatures for each sentence was recorded. For an answer to indicate the false belief implicature, all of the following must have been indicated: the matrix subject no longer believes the content of the embedded clause, the embedded predicate is not presently true, the embedded predicate has not been true in the salient past.⁸ The number of answers which aligned with the false belief implicature is contained in the tables in Figure 2, below.

Figure 2: Number of False Belief Implicatures for Individual-Level Predicates (left) and Stage-Level Predicates (right)

Predicate	# of FBI's	Total Tokens	Predicate	# of FBI's	Total Tokens
'was tall'	6	19	'was reading a book'	1	19
'had brown eyes'	12	19	'was on the swim team'	4	19
'was Italian'	14	19	'was busy'	1	19
'was a Scorpio'	12	19	'had a pet parrot'	3	19
'was left-handed'	16	19	'worked at Applebee's'	4	19
	60	95		13	95

For individual-level predicates, participant answers indicated the presence of the false belief implicature in 60 out of a total 95 tokens (a rate of 63.2%). This can be compared to the much lower rate of 13 out of a total 95 tokens (13.7%) for sentences containing stage-level predicates. I conducted a Chi-Square Test of Independence to compare the frequency of false belief

⁸ I use the term *salient past* rather than just *past* to allow predicates could have been true at some point while still resulting in the false belief implicature. What would be considered salient changes from predicate to predicate and is not necessarily tied to predicate type. For example, the salient past for *have a pet parrot* represents a much larger interval of time than the salient past for *be busy*.

implicatures resulting from stage-level and individual-level predicates. The test had a resulting p -value of 6.03×10^{-12} which sits well below the determined threshold of statistical significance ($p < 0.05$).

The confirmed statistical significance of the difference between individual and stage-level predicates allows for the rejection of the null hypothesis and reliably indicates the presence of the false belief implicature in the general population of native English speakers. This supports my original hypothesis that there is an additional implicature associated with the construction of interest (*believed* + past tense individual-level predicate) that attributes the contents of the embedded clause as a previously held false belief of the matrix subject.

VI. Discussion

The results of the experiment support my hypothesis that there is an additional implicature associated with individual-level predicates embedded within past-under-past sentences. In the case where participants did experience cessation implicatures as a result of the use of past tense stative predicates, they were likely to indicate that there was an additional meaning implied by sentences containing individual-level predicates compared to their stage-level counterparts. This additional meaning could most often be attributed to the false belief implicature where participants indicated that the subject's period of belief has ended, that the embedded predicate is not currently true, and that the embedded predicate has not held in the salient past. In some cases, participants explicitly identified the presence of a false belief implicature saying, for example: "to me the way the sentence is structured sounds like Paige was wrong about the belief... I feel like Paige was found to be wrong."

In addition to supporting the possibility for past-under-past sentence constructions to result in the false belief implicature, the data collected during the experiment supported that the false belief implicature is far more likely to result from embedded individual-level predicates than stage-level predicates. Individual-level predicates resulted in a false belief implicature 63.2% of the time compared to a much lower 13.7% implicature rate with stage-level predicates. Again, this difference was found to be statistically significant with a Chi Square Test of Independence.

However, the false belief implicature was not the only additional meaning that participants identified as being different between sentences containing stage-level and individual-level predicates. For three participants, rather than seeing the individual-level predicate result in an

additional implicature, the long-lasting nature of the predicate seemed to block the matrix cessation implicature in its entirety. In the case of stage-level predicate sentences, these participants demonstrated similar answer patterns to participants who identified false belief implicatures but deviated with individual-level sentences. Instead, these individuals indicated that there were no cessation implicatures, even in the matrix clause. These participants would say that the period of belief has not ended and that the embedded predicate currently holds and has held in the salient past. This is a particularly interesting alternative to the false belief implicature, yet it represents a small minority of participants in the sample.

Overall, the findings in this study support my hypothesis that there is an additional implicature associated with constructions where a past tense individual-level predicate is embedded beneath the past tense verb *believed*. The most common additional meaning associated with these constructions were those which identified the contents of the embedded clause as a previously held false belief of the matrix subject. This supports the presence of the false belief implicature as a result of embedding individual-level predicates in past-under-past constructions beneath the embedding verb *believed*.

VII. Theoretical Account of Findings

The finding that there is an additional meaning associated with the sentence construction contained in (11) is analyzed to result from an implicature rather than being embedded in the truth conditions of the sentence.

(11) [NAME] + [BELIEVED] + [THAT] + [NAME] + [PAST TENSE
INDIVIDUAL-LEVEL PREDICATE].

The analysis of the meaning as an implicature is based on two factors: the absence of the additional meaning in the semantic representation of the sentence and a contradiction test which indicated that the meaning is part of an implicature. The lambda representation of the simultaneous reading of the sentence *Paige believed that Lillian was Italian* is seen in (12), below.

$$(12) \quad \exists t' \in D_i \left(t' < UT \wedge \left(BEL(p, w_0, t') \subseteq \{w' \in D_s \mid \exists t D_i (t \circ t' \wedge \text{italian}(l, w', t))\} \right) \right)$$

The lambda representation can be translated to mean “At some time before the utterance time, Paige believed in a set of worlds in which Lillian was Italian during Paige’s belief.” While encapsulating the semantic meaning of the sentence, this clearly does not match the interpreted meaning advocated by the participants in this study. This semantic definition has no bearing on the present state of Paige’s beliefs, requiring only that she held the belief at some point in the past. Additionally, it makes no claims about the truth value of Lillian’s being Italian in the ‘real world’, requiring only that she be Italian in the worlds that Paige believed in.

In addition to the meaning conveyed not being present in the truth conditions expressed by the current semantic representation of the sentence, we know that it is not the case that the meaning is a truth condition which we have simply failed to represent. To perform a contradiction test we will compare the original sentence, *Paige believed that Lillian was Italian*, and the negation of the meaning we wish to investigate, *Lillian is not Italian*. The resulting sentence to test for contradiction is contained in (13).

$$(13) \quad \text{Paige believed that Lillian was Italian, and Lillian is Italian.}$$

The sentence contained in (13) does not present a contradiction; therefore, rather than being contained in the truth conditions of the sentence, the conveyed meaning that Lillian is not, in reality, Italian is communicated as the result of an implicature.

Implicatures are created as a result of the assumptions contained in Grice’s Maxims for cooperative communication which advocate that interlocutors must be truthful, optimally informative, and clear in addition to speaking about things which are relevant (Grice 1975). Similar to describing the cessation implicature as a scalar implicature which arises due to the Maxim of Quantity, it should be possible to explain the false belief implicature through a process of assumptions made by interlocutors. The process by which the false belief implicature arises can be described in a series of three steps which lead the hearer to conclude both that the subject no longer holds the belief in question and that the embedded predicate is not, and never was, true.

These steps are condensed to 1) a cessation implicature of the matrix verb, 2) an implicature based on an assumption of justified beliefs, and finally 3) an assumption based on the longevity of the predicate.

The first step, a cessation implicature of *believed*, implies that the subject's period of belief has ended (Altshuler, et al. 2015). This implicature is what allows for the rest of the series of assumptions to take place. The verb *believe* seems to be particular in its creation of the false belief implicature, based on a few key factors.

The first requirement of a matrix verb which will trigger the false belief implicature is that it be *intensional* in nature. Intensional verbs are those which cause the embedded clause to be evaluated in terms of some alternative set of worlds rather than the 'actual world' (Abusch 1988). Words that are considered to be intensional include predicates such as *think*, *hear*, *hint*, and *imagine* (Simmons, 2006). As seen in (14), the use of the word *think* causes the embedded clause to be evaluated based on the subject's perception of the world, rather than based on reality.

(14) Arnold thinks that corn is a fruit.

The truth of (14) is not reliant on corn being a fruit in the real world. It must only be true that Arnold thinks that corn is a fruit. As long as corn is a fruit in the worlds that Arnold believes in, the sentence is judged to be true. Without the use of an intensional embedding verb, there could not be a simultaneous reading of the sentence and the lifetime effect on the embedded clause would remain (Abusch 1988). Importantly, these intensional verbs are also stative in nature which allows for a cessation implicature in the matrix clause.

However, not all past tense intensional verbs will result in the false belief implicature. The verb *to believe*⁹ seems to carry with it a particular degree of evidentiality when compared to other intensional embedding verbs. Predicates like *to see*, *to hear*, *to know* and *to understand* carry with them a very strong evidential as to the reliability of the information contained within the embedded clause¹⁰. Although these words are also interpreted relative to an alternative set of worlds, they are pragmatically interpreted as having a much stronger relation to the real world. On the other end of

⁹ It is possible that the predicate *to think* also carries the same level of evidentiality and could therefore result in the false belief implicature. However, none of the sentences used for my study contained this predicate so I leave this open as an area of future study.

¹⁰ In some cases, these predicates are even described as *factives* where the content of the embedded clause must also be true in the actual world, not just the subject's belief worlds (Simmons, 2006).

the spectrum, predicates like *to hope*, *to wish*, and *to dream* are pragmatically associated with a very weak evidential where listeners are less likely to assume a strong association between the worlds of evaluation and the real world. The predicate *to believe* is associated with a level of evidentiality somewhere in the middle of the spectrum where there is a clear association between the worlds of evaluation and the actual world, but not one so strong that the embedded clause is taken as a fact.

It is this particular level of evidentiality which leads to the second step in the series of assumptions which results in the false belief implicature. I propose that there is a human inclination, likely related to that described by Grice's Maxim of Quality requiring that individuals tell the truth, to assume that people base their beliefs on some sort of justification. Therefore, if one changes their beliefs, that must also be based on some sort of justifiable evidence. In that vein, a cessation implicature of *believed* in the matrix clause calls into question the reasoning for ending that belief. It is important to note that, although it would be possible for someone to identify an implicature that the belief has ended due to the matrix subject ceasing to exist, that is not the implicature advocated by participants in the study. Since *believe* is a stage-level predicate, it is unlikely that one would assume that the predicate has ended due to the death of the matrix subject. Therefore, rather than experiencing a lifetime effect for the matrix subject, the hearer assumes that the period of belief has ended due to a change in beliefs.

When it is implied that the matrix subject's period of belief has ended, it causes the hearer to assume that the content of the embedded clause is no longer true. Otherwise, that change in beliefs would not be based on any justification. In other words, the implied cessation in the matrix clause causes the hearer to assume that the embedded predicate no longer holds true.

How, then, is an implicature based on an assumption of justified beliefs different from a cessation implicature in the matrix clause when both result in the hearer assuming that the embedded stative predicate is no longer true? If this were a true cessation implicature of the embedded clause, it would be based on a decision to use the past tense in the embedded clause when the present tense could have felicitously been used. Importantly, previous research indicates it would not be felicitous to use the present tense in the sentence constructions which result in the false belief implicature. This is seen when comparing (15a) and (15b) below.

- (15) a. Flynn believed that Arya was left-handed.
b. #Flynn believed that Arya is left-handed.

While (15a) is judged to be felicitous, there is something odd about saying something like (15b). As previously discussed, this is due to a clash between the matrix verb resulting in a cessation implicature while simultaneously functioning as an evidential (Altshuler et al. 2015). The past tense use of *believed* results in a cessation implicature that the period of belief has ended. This is pragmatically odd when paired with the use of *believed* as an embedding verb which provides the evidence for the truth of the embedded clause. It causes the hearer to ask why the speaker would use someone's belief to justify the truth of the embedded clause in the present moment when that belief no longer holds. The pragmatic clash associated with (15b) prevents the comparison of (15a) to a viable present-under-past alternative and therefore blocks an embedded cessation implicature.

We also know that implicatures based on an assumption of justified beliefs differ from embedded cessation implicatures based on their interactions with individual-level predicates. If (15a) contained an embedded cessation implicature, speakers would have indicated the presence of a lifetime effect where the reason that Arya is no longer left-handed is because her period of existence has ended. However, that is not what speakers indicated throughout the experiment. This supports the assertion that there is a difference between embedded cessation implicatures and implicatures resulting from an assumption of justified beliefs.

At this point in the process of implicatures and assumptions, it has been implied that the matrix subject's period of belief has ended and that the embedded predicate does not currently hold. Both previous steps in the derivation of a false belief implicature can occur with both stage-level and individual-level predicates, as seen with (16)

- (16) Claudia believed that Piper was busy.

Example (16) still results in a cessation implicature of *believed* in the matrix clause which implies that Claudia's period of belief has ended. This results in an implicature based on the assumption of justified beliefs which implies that Piper is not currently busy. However, speakers do not commonly identify (16) as resulting in the false belief implicature. The final step of the

derivation therefore relies on an assumption based on the longevity of the embedded predicate whereby individual-level predicates result in a false belief implicature and stage-level predicates do not. The requirement that the embedded predicate be individual-level stems from the fact that, in sentences with stage-level predicates, the predicate can cease to hold true without the embedded subject ceasing to exist. In (16), it is possible that Piper has ceased to be busy without dying. This is not the case for individual-level predicates, as seen in (17), below.

(17) Silas believed that Eloise was a Scorpio.

By implying that Silas's period of belief has ended, the speaker calls into question the truth value of the embedded clause. Due to the lack of a lifetime effect, the hearer does not assume that Eloise has died. However, it is pragmatically odd to assert that Silas no longer believes that Eloise is a Scorpio given that she cannot have simply ceased to be a Scorpio. This pragmatic oddness is amended by the false belief implicature, which allows both that Eloise is still alive, and that Silas has changed his beliefs based on some justified evidence.

The full line of reasoning associated with the false belief implicature is outlined in (18), below.

- (18) Working out the implicatures of *Paige believed that Lillian was Italian*.
- a. The speaker has expressed the proposition that *Paige believed that Lillian was Italian*.
 - b. Thus, the speaker is being maximally informative about Paige's beliefs-in particular about the duration of those beliefs.
 - c. If the speaker thought that Paige's believing was not over, they would have expressed that *Paige believes that Lillian was Italian*, since that would have been a more informative alternative utterance concerning the duration of Paige's beliefs.
 - d. Thus, the speaker could not have been maximally informative about Paige's period of belief unless they thought that Paige no longer held that belief.
 - e. The speaker has therefore implied that Paige's belief period has ended.

- f. It is assumed that individuals base their beliefs on some justified evidence. Thus, if an individual changes their beliefs, there must be some justification for doing so.
- g. If Paige no longer believes that Lillian is Italian, then Lillian must not presently be Italian.
- h. Since *be Italian* generally holds for the entirety of one's lifetime, it is unlikely that Lillian has ceased to be Italian.
- i. Since one could not felicitously say *Paige believed that Lillian is Italian*, there is no reason to believe that Lillian no longer exists.
- j. Therefore, if Paige has changed her beliefs based on some justified evidence and Lillian still exists, it must be the case that Lillian is not, and never was, Italian.

VIII. Limitations and Future Research

Despite the clear fact that there is not an embedded lifetime effect associated with (19a) and similar sentences, there is not yet a clear-cut answer as to the reasoning for its absence.

- (19) a. Kennedy believed that Aliya had brown eyes.
- b. Kennedy believed that Aliya has brown eyes.

Under the proposed assumption of justified beliefs, the reasoning for Kennedy's beliefs to have ended could result in both of the following explanations: Aliya no longer has brown eyes because she has died (lifetime effect) and Aliya has never had brown eyes (false belief implicature). The results of the experiment contained within this paper indicate a strong preference for the false belief implicature over an embedded lifetime effect. Previous literature would suggest that the embedded cessation implicature (which would lead to a lifetime effect) is blocked by the pragmatic clash in (19b), previously discussed in sections II and VII. However, the judgment of (19b) as infelicitous in every context seems a bit far reaching. One could imagine the following context in which (19b) seems to be felicitous. In a case where it has been discovered that Aliya has been wearing blue contacts and actually has brown eyes, one friend asks, "Did you know that

Aliya has brown eyes?” and the other replies, “I didn’t know that, but *Kennedy believed that Aliya has brown eyes.*”

In this case, there is no longer a clash between the use of *believed* as an evidential embedding verb and the implied cessation of belief associated with the past tense of the matrix verb. If it is possible for there to be scenarios which allow for (19b) to be a felicitous sentence, then we cannot sweepingly rule out the possibility of an embedded cessation implicature in (19a) based on the inability to produce a felicitous present-under-past utterance. However, there is substantial evidence to support that some other mechanism is preventing hearers from assuming that the embedded subject (in this case Aliya) has died.

The hearer’s strong preference toward the false belief implicature over an embedded lifetime effect is further complicated when we consider the ambiguous nature of past-under-past utterances. The simultaneous reading of (19a) forces consideration of how the matrix subject’s period of belief can have ended if the embedded subject still exists. Under a simultaneous reading where Aliya has not died, it can only be the case that Kennedy no longer believes Aliya’s eyes are brown because they were never brown to begin with. However, preliminary inquiries indicate that sentences which inherently force the hearer into a back shifted reading of the sentence still result in the false belief implicature, as seen in (20).

(20) Kelly believed that Thomas Jefferson had brown eyes.

By using an embedded subject that is commonly known to be deceased, sentence (20) forces the hearer into a back shifted reading of the sentence. If it were truly the simultaneous nature of (19a) which creates the hearer’s preference for a false belief implicature rather than an embedded lifetime effect, a forced back shifted reading in (20) should not result in the false belief implicature. This, however, is not the case. Speakers have indicated that they still experience a false belief implicature with (20) whereby they assume that Thomas Jefferson never had brown eyes, rather than simply assuming that he ceased to have brown eyes when he ceased to exist.

These two issues indicate that additional research needs to be conducted to explore a reason for the strong preference towards the false belief implicature over an embedded lifetime effect which fully accounts for the counter examples I have presented. This additional research could

lead to a few different outcomes which would have an impact on our understanding of the semantics of tense.

One possibility is that the English language does not allow for adequate specification as to the temporal interval being referenced when we use the past tense. This could explain the continuance of the false belief implicature into forced back shifted readings by indicating that individuals have no way of pinpointing whether the embedded past in (20) is referencing a past moment where Thomas Jefferson was alive or one where he had ceased to exist. If the cessation of belief occurred at a past moment where Thomas Jefferson had newly ceased to exist, one would experience an embedded lifetime effect with sentences like (20). However, if the cessation of belief occurred at a moment in the past where Thomas Jefferson was still alive, then one would expect a hearer to experience the false belief implicature. Without an ability to specifically reference one past time over another, it could be the case that individuals naturally lean towards a false belief implicature.

Another potential explanation is that individual-level predicates require tenses to be evaluated in one way and stage-level predicates require tenses to be evaluated in another. If it were the case that individual-level predicates require tenses to function as existential quantifiers and stage-level predicates require tenses to function as an index from the context of the conversation, this would explain the strong tendency towards the false belief implicature in sentences which use individual-level predicates but not with those that use stage-level predicates. This explanation would require future research which investigates the phenomena cross linguistically.

Under either explanation, it is necessary to investigate this phenomenon in a language for which tense functions differently. Research has suggested that there is a pertinent distinction between languages which have a relative past and those which have an indexical past. While English allows that the embedded clause be interpreted relative to the utterance time of the sentence (indexical time), languages like Hebrew, Polish, Japanese, Hindi, and Turkish do not have simultaneous readings of past-under-past sentences and do not traditionally allow for present-under-past constructions (Abusch 1988). By studying the false belief implicature in these languages, one would be able to isolate the back shifted reading of past-under-past utterances and further examine the previously discussed limitations associated with the ambiguity of the English past tense.

Some previous research in Hebrew has demonstrated the possible allowance of present-under-past constructions in contexts where the embedded clause is a false belief of the speaker (Bar-Lev & Boneh, 2014). This sounds remarkably similar to the false belief implicature and would go against the belief that present-under-past constructions are not allowable in languages with an indexical past tense. Therefore, in addition to testing sentences with a past-under-past construction, additional research should test present-under-past sentences with both speakers of English and speakers of a language which utilizes a relative past tense in order to determine a possible relationship between these two phenomena.

A further limitation to the findings in this research is the very limited and specific sentence construction tested in the study. The only embedding verb tested was *believed* in order to account for the impact the choice of embedding verb could have on the presence of the implicature. Future research should investigate whether other types of intensional verbs with a similar level of evidentiality, such as *to think*, would also result in the creation of the false belief implicature. It would also be worthwhile to investigate whether the false belief implicature arises with existence independent predicates.

IX. Conclusion

This thesis has identified an implicature which occurs when a past tense individual-level predicate is embedded under the past tense embedding verb *believed*. The false belief implicature attributes the contents of the embedded clause as a previously held false belief of the matrix subject.

I conducted a study which compared stage-level and individual-level predicates embedded in past-under-past utterances with *believed* as the embedding verb. The study confirmed the existence of the cessation implicature as identified in previous research (Altshuler & Schwarzschild, 2013b; Altshuler et al., 2015). In individuals who reliably experienced cessation implicatures (19 out of 30 participants), the false belief implicature was indicated with sentences containing individual-level predicates at a rate of 63.2% and in those with stage-level predicates at a rate of 13.7%. This difference was found to be statistically significant with a p -value well below the determined threshold ($p < 0.05$). This supports my hypothesis that the false belief implicature arises in constructions where a past tense individual-level predicate is embedded beneath the matrix verb *believed*.

I then proposed a theoretical account for the implicature which frames it within current discussions of tense related implicatures (Altshuler & Schwarzschild, 2013; Musan, 1997; Altshuler, et al. 2015) and Sequence of Tense Theory (Abusch 1988). It was shown that the past tense of the stative predicate, *believed*, results in a cessation implicature in the matrix clause implying that the matrix subject's period of belief has ended. This implied cessation of belief causes the hearer to question what evidence supported that change in belief and, in turn, assume that the embedded predicate no longer holds. Then, in the case of individual-level predicates, the longevity of the predicate causes consideration of how that predicate can no longer hold. Since it is not assumed that the embedded subject has ceased to exist, the hearer then assumes that the embedded predicate never held and the contents of the embedded clause instead constitute a previously held false belief of the matrix subject.

X. Appendix A: List of Test Sentences

Stage-Level Predicates:

- Savannah believed that Dante was reading a book.
- Rocco believed that Nina was on the swim team.
- Claudia believed that Piper was busy.
- August believed that Tony had a pet parrot.
- Damian believed that Joel worked at Applebee's.

Individual-Level Predicates:

- Xavier believed that Cooper was tall.
- Kennedy believed that Aliya had brown eyes.
- Paige believed that Lillian was Italian.
- Silas believed that Eloise was a Scorpio.
- Flynn believed that Arya was left-handed.

Distractor Sentences:

- Murphy does not believe that Henry is hungry.
- Taylor is not a Gemini.
- Peter believes that Naomi is pretty.
- Felix does not believe that Rob works at Dairy Queen.
- Violet believes that Addison is a doctor.

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