Lifetime Effects as Presuppositional Scalar Strengthening*

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Abstract

Certain stative predicates (e.g. *be a Ragdoll*) used with past tense tend to give rise to an inference that the subject is dead (*Lifetime Effects*; LEs). We propose a semantic analysis that makes use of a general mechanism of presuppositional strengthening to generate LEs. It is shown that this analysis gives a better account of LEs in projective and ignorance contexts than previous proposals.
Keywords: lifetime effects, temporal implicatures, presupposition, scalar implicature, anti-presupposition

1 Introduction

When used in a past tense sentence, a stative predicate like *be a Ragdoll* tends to give rise to an inference that the subject of the predicate is dead (Musan 1995, 1997; Magri 2009; Thomas 2012 among others). Following these authors, we call this inference a *Lifetime Effect* (LE). For example, (1a) suggests that Oscar is dead now, as indicated by $\rightsquigarrow$. This becomes especially palpable in comparison to its present tense counterpart, (1b), which clearly does not have the same inference.[1]

(1) a. Oscar was a Ragdoll. $\rightsquigarrow$ Oscar is dead
b. Oscar is a Ragdoll. $\not\rightsquigarrow$ Oscar is dead

It is noticeable that not all predicates give rise to LEs. Generally, non-stative predicates do not, as in (2a). Also even among stative predicates, ones like *be hungry* do not, as in (2b).

(2) a. Oscar jumped. $\not\rightsquigarrow$ Oscar is dead
b. Oscar was hungry. $\not\rightsquigarrow$ Oscar is dead

These observations suggest that a crucial ingredient for LEs is that the predicate is assumed to hold throughout one's lifetime. It should also be noticed that what matters is whether the predicate is assumed to hold throughout one's lifetime in the current conversational context. For example, a predicate like *be British* normally gives rise to LEs, but could also be construed as not holding throughout one's lifetime, and in such contexts, LEs do not arise, as demonstrated in (3).

(3) Chris was British, but he gave up his British citizenship when he became American at the age of 25.

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[1] In fact, we will later claim that (1b) *presupposes* that Oscar is alive now.

Previous studies analyze LEs as arising from an interplay between scalar implicatures and discourse felicity (Musan 1995, 1997; Magri 2009; Thomas 2012). We propose an alternative presupposition-based analysis, according to which Les arise from a general mechanism of *presuppositional scalar strengthening*. Under our account, LEs are presuppositional in nature and we straightforward explain their projective behavior in sentences like the following, because these contexts are presupposition holes.

(4) a. I doubt that Oscar was a Ragdoll. ⇝ Oscar is dead
b. Was Oscar a Ragdoll? ⇝ Oscar is dead

The gist of the idea is as follows. We assume that the past and present tenses are scalar alternatives to each other, and a predicate like *be a Ragdoll* presupposes that the subject is alive during the time specified by the tense. Thus, the sentences in (1) have the following presuppositions, respectively.

(5) a. Oscar was alive.
b. Oscar is alive.

As we discuss in detail later, under certain assumptions, (5b) is stronger than (5a). As a consequence, the presupposition of (1a) gets strengthened with the negation of (5b), which amounts to the inference that Oscar was alive before but not now, which corresponds to the LE. We will explain the details of this derivation and its ingredients in the next section.

2 Lifetime Effects and Entailment

2.1 Lifetime Presupposition

Firstly, it is crucial for our account that predicates like *be a Ragdoll* presuppose that the subject is alive at the time specified by the tense (see Musan 1995, 1997; Thomas 2012). This can be demonstrated using the standard 'family of sentences' tests. For example, the following data show that the present tense sentence *Oscar is a Ragdoll* presupposes that Oscar is alive now.

(6) My cat, Oscar, died recently…
a. #… He is a Ragdoll.
b. #… He isn't a Ragdoll, but a Maine Coon.

(7) A: My cat, Oscar, died recently.
B: #Is he a Ragdoll?

Importantly, these sentences all become felicitous in the past tense, which is in line with our assumption that the past tense versions of these sentences presuppose that Oscar was alive in the past. Let us call a presupposition like this, which for us are the basis of LEs, *a lifetime presupposition*.

It should be noted at this point that there are stative predicates that do not have lifetime presuppositions, e.g. *be famous*. The reason for this is intuitively clear: in order for an animal to be a Ragdoll, it must exist, and so alive, while for something/someone to be famous, it/he/she does not even need to exist or alive. Under our account, LEs ultimately come from lifetime presuppositions, so predicates like *be famous* are predicted to not give rise to LEs,

which is borne out. Concretely, *Oscar was famous on the internet* does not suggest that Oscar is dead now (although it is certainly compatible with Oscar being dead).

For the sake of concreteness, let us adopt the existential theory of tense (Kusumoto 1999; Thomas 2012; Altshuler & Schwarzschild 2013, among others), where the past tense existentially quantifies over a time interval prior to the utterance time, $\texttt{time}(c)$ (we will introduce domain restriction on the existential quantification in Section 4.1). We assume that there are uncountably many moments, of which $\texttt{time}(c)$ is one, and moments are totally ordered by the precedence relation $<$. Time intervals are convex sets of moments that are partially ordered by the interval precedence relation, $\prec$, such that $t_1 \prec t_2$ iff for each $m_1 \in t_1$, and for each $m_2 \in t_2$, $m_1 < m_2$. Given this meaning of the past tense, the example above in (1a) is analyzed as follows:[2]

(8) $[\![\textbf{Oscar was a Ragdoll}]\!]^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{ragdoll}(\texttt{oscar}, t)]$

We assume that a stative predicate like `ragdoll` is homogenous with respect to its temporal argument in the sense that whenever $\texttt{ragdoll}(x, t)$ holds, $\ulcorner\texttt{ragdoll}(x,\{m\})\urcorner$ is true, for each $m \in t$.

Recall now that be a Ragdoll has a lifetime presupposition. We assume that this presupposition projects existentially through existential quantifiers in general, including the past tense (Heim 1983; Beaver 2001; Chemla 2009; Sudo 2012 among others). We write $\langle\!\langle \alpha \rangle\!\rangle$ for the presupposition of α.[3]

(9) $\langle\!\langle\textbf{Oscar was a Ragdoll}\rangle\!\rangle^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{alive}(\texttt{oscar}, t)]$

Let us now turn to the present tense counterpart (1b). Again for concreteness, we assume that the present tense is not semantically vacuous and denotes an existential quantifier (with Thomas 2012, 2015 and contra Sauerland 2002), as illustrated below.

(10) $[\![\textbf{Oscar is a Ragdoll}]\!]^c = \exists t[\texttt{time}(c) \in t \wedge \texttt{ragdoll}(\texttt{oscar}, t)]$

The only difference from the past tense version of the sentence is that it asserts that there is a time interval that includes $\texttt{time}(c)$. Similarly, the lifetime presupposition of this sentence will look as follows with an existential quantifier.

(11) $\langle\!\langle\textbf{Oscar is a Ragdoll}\rangle\!\rangle^c = \exists t[\texttt{time}(c) \in t \wedge \texttt{alive}(\texttt{oscar}, t)]$

2.2 Entailment with Stative Predicates

The second ingredient of our analysis is that there is an asymmetric relation between the presupposition of the past tense sentence (9) and the presupposition of the present tense sentence (11) such that the latter asymmetrically entails the former. This follows from an

[2] Throughout this paper we assume a predicate logic-like intermediate language and take $[\![\cdot]\!]^c$ to be a translation function from natural language LFs to expressions in that language. Similarly for $\langle\!\langle\cdot\rangle\!\rangle^c$ introduced below. Nothing crucial hinges on this, and as usual, the intermediate language is in principle eliminable.

[3] Note that this bi-dimensional representation suffers from the well-known Binding Problem of presupposition (Karttunen & Peters 1979; Beaver 2001; Sudo 2012), but we are using it only for expository purposes here, and our analysis can be restated in any theory of presupposition that does not run into the Binding Problem to the extend that it offers an account of existential projection through existential quantifiers.

auxiliary assumption that is both intuitive and reasonable, namely, that a stative predicate never holds only for a single moment (Altshuler & Schwarzschild 2013):

(12) If P is an n-place stative predicate, and if $\ulcorner P(x_1,\ldots,x_n,\{m\})\urcorner$ is the case, then there is $n < m$ such that $\ulcorner P(x_1,\ldots,x_n,\{n\})\urcorner$ is the case.

Note that this does not imply that P holds for $x_1,\ldots,x_n$ at every moment prior to m, thanks to the uncountability of the domain of moments.

Now, suppose that the presupposition of the present tense sentence, (11), is true. By assumption, $\ulcorner\texttt{alive(oscar, }t\texttt{)}\urcorner$ holds iff $\ulcorner\texttt{alive(oscar, }\{m\}\texttt{)}\urcorner$ holds for each $m \in t$. Thus, (11) entails $\ulcorner\texttt{alive(oscar, }\{\texttt{time(}c\texttt{)}\}\texttt{)}\urcorner$. Now, because the predicate alive is stative, there must be a moment $m < \texttt{time}(c)$ such that $\ulcorner\texttt{alive(oscar, }\{m\}\texttt{)}\urcorner$ holds. Since $\{m\} \prec \{\texttt{time}(c)\}$, the presupposition of the past tense sentence, (9), will hold. By contrast, even if (9) is true, it does not guarantee that Oscar is alive at a time interval that includes $\texttt{time}(c)$. Specifically, if Oscar died before $\texttt{time}(c)$, (9) is true while (11) is false. This is to say that (11) asymmetrically entails (9).

2.3 Presuppositional Scalar Strengthening

Finally, following Spector & Sudo (2017), we postulate a principle that strengthens the presupposition of a sentence with reference to alternatives with stronger presuppositions. We call this mechanism *Presuppositional Scalar Strengthening*, and formulate it as follows.

(13) *Presuppositional Scalar Strengthening*
If ϕ has an alternative ψ such that the presupposition of ψ asymmetrically entails the presupposition of ϕ, the ϕ will have as an additional presupposition the negation of the presupposition of ψ.

This derives the LE of the past tense sentence in (1a) as follows. We saw above that the present tense counterpart in (1b) has a stronger presupposition. Assuming that (1b) is an alternative to (1a), (1a) will have an additional presupposition that the presupposition of (1b) is false, which is the negation of (11). This is the LE of (1a), as desired.

A few remarks on the above mechanism of presuppositional scalar strengthening are in order. It bears resemblance to the principle of *Maximize Presupposition* (*MP*) (Heim 1991; Percus 2006; Sauerland 2008; Percus 2010), which is standardly formulated as follows.

(14) *Maximize Presupposition* (*MP*)
ϕ can be used felicitously in context c only if there is no alternative ψ to ϕ that satisfies all of the following.
a. $[\![\phi]\!]^c$ and $[\![\psi]\!]^c$ are contextually equivalent in c.
b. $\langle\!\langle\psi\rangle\!\rangle^c$ is stronger than $\langle\!\langle\phi\rangle\!\rangle^c$.
c. c satisfies $\langle\!\langle\psi\rangle\!\rangle^c$.

One of the crucial differences between our principle and MP is that MP requires the two sentences to have contextually equivalent assertive meanings. Notice that this means that MP will not derive any inference for the pair in (1), because their assertive meanings are evidently not contextually equivalent. In fact, the assertive meaning of the present tense sentence (1b) asymmetrically entails that of the past tense sentence (1a), due to the same reasoning that reveals the asymmetric entailment relation between their presuppositions.

It should be also remarked that Spector & Sudo (2017) propose a version of MP without the clause on contextual equivalence, which they call *Presupposed Ignorance Principle* (*PSP*).

(15) *Presupposed Ignorance Principle* (*PSP*)
ϕ can be used felicitously in context c only if there is no alternative ψ to ϕ that satisfies all of the following.
a. $\langle\!\langle \psi \rangle\!\rangle^c$ is stronger than $\langle\!\langle \phi \rangle\!\rangle^c$.
b. c satisfies $\langle\!\langle \psi \rangle\!\rangle^c$.

The essential difference between PSP and our mechanism of presuppositional scalar strengthening is that the inference derived by PSP is weaker. For example, for (1a), it only requires it to be not commonly believed that Oscar is alive now, while the inference we derive demands it to be commonly believed that Oscar is dead now.

Empirical considerations favor our analysis, as least for LEs. Specifically, as Thomas (2012) points out, LEs are observed even in contexts where the speaker makes explicit that they do not know whether the subject of the predicate is dead or alive, as evidence by the infelicity of the second sentence in the following example.

(16) I don't know if John's cat, Oscar, is dead or alive now. #He was a Ragdoll.

The inference predicted by PSP cannot explain the anomaly of this example.[4]

3 Two Types of Scalar Strengthening

3.1 Assertive Scalar Strengthening

In the previous section we spelled out our analysis of LEs, according to which LEs arise due to the stronger presupposition of the present tense alternative. Notice, however, that the exact same mechanism should apply to a pair like the following and generate LEs, given that predicates like *be hungry* also have lifetime presuppositions.

(17) a. Oscar was hungry.
b. Oscar is hungry.

This prediction might at first seem to be incorrect, but we claim that this is in fact one of the possible readings in this case, but due to the existence of another salient possible reading, the LE is not as robustly perceived here, in comparison to sentences like (1a). Specifically, we claim that (17a) is ambiguous between a reading with a LE and a reading with a *cessation implicature* that Oscar is no longer hungry.

Let us first be clear about what exactly the cessation implicature is and how it comes about. Recall that according to our account, LEs arise due to scalar strengthening in the domain of presupposition. We claim that there's a separate mechanism of scalar strengthening

[4] There is, however, other empirical reason why Spector & Sudo (2017) formulated PSP as above, to which we will come back in Section 4.3.

in the domain of assertive meaning, which is responsible for the cessation implicature of (1a). Following Spector & Sudo (2017), we formulate this mechanism as follows.[5]

(18) *Assertive Scalar Strengthening*
If ϕ has an alternative ψ such that ψ Strawson-entails ϕ, then the presupposition of ϕ will be strengthened by whatever ψ presupposes and its assertive meaning will be strengthened with the negation of the assertive meaning of ψ.

The intuition behind this is that the assertive meaning of ϕ is strengthened with the negation of the assertive meaning of ψ, but this requires the presupposition of ψ to be met as well, given the negation of ψ presupposes the same thing as ψ. Or in other words, the meaning of ϕ is strengthened with strong negation of the meaning of ψ, where strong negation preserves the presupposition of ψ.

This mechanism is essentially the same thing as the exhaustivity operator postulated by previous studies like Chierchia 2006, Fox 2007 and Chierchia, Fox & Spector 2012, except that it is explicit about how the presupposition projects through it.[6]

Let us analyze (17a) as an example to see how this works more concretely. For the purposes of exposition, we will henceforth treat the two scalar strengthening mechanisms as grammatical operators and write $\ulcorner\mathbb{P}(\phi)\urcorner$ to mean the presuppositional strengthening mechanism applied to ϕ and $\ulcorner\mathbb{A}(\phi)\urcorner$ to mean the assertive strengthening mechanism applied to ϕ. The two mechanisms can be succinctly summarized as follows. $\ulcorner Alt(\phi)\urcorner$ is the set of alternatives to ϕ and $\ulcorner\texttt{Stronger}(\Phi,\Psi)\urcorner$ means $\ulcorner\Phi\urcorner$ is stronger than $\ulcorner\Psi\urcorner$, i.e. all models that make $\ulcorner\Phi\urcorner$ true make $\ulcorner\Psi\urcorner$ true.[7]

(19) a. $[\![\mathbb{P}(\phi)]\!]^c = [\![\phi]\!]^c$

b. $\langle\!\langle\mathbb{P}(\phi)\rangle\!\rangle^c = \langle\!\langle\phi\rangle\!\rangle^c \wedge \forall\psi \in Alt(\phi)[\texttt{Stronger}(\langle\!\langle\psi\rangle\!\rangle^c,\langle\!\langle\phi\rangle\!\rangle^c) \rightarrow \neg\langle\!\langle\psi\rangle\!\rangle^c]$

(20) a. $[\![\mathbb{A}(\phi)]\!]^c = [\![\phi]\!]^c \wedge \forall\psi \in Alt(\phi)[\texttt{Stronger}([\![\psi]\!]^c,[\![\phi]\!]^c) \rightarrow \neg[\![\psi]\!]^c]$

b. $\langle\!\langle\mathbb{A}(\phi)\rangle\!\rangle^c = \langle\!\langle\phi\rangle\!\rangle^c \wedge \forall\psi \in Alt(\phi)[\texttt{Stronger}([\![\psi]\!]^c,[\![\phi]\!]^c) \rightarrow \langle\!\langle\psi\rangle\!\rangle^c]$

We assume furthermore that if a sentence contains a scalar item like a past tense, either of these two mechanisms must be used to strengthen the meaning.

Let us consider the example in (17a) in detail. Its assertive meaning and presupposition look as follows.

(21) a. $[\![\textbf{Oscar was hungry}]\!]^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{hungry}(\texttt{oscar}, t)]$

b. $\langle\!\langle\textbf{Oscar was hungry}\rangle\!\rangle^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{alive}(\texttt{oscar}, t)]$

The present tense alternative in (17b) will have the following meaning.

[5] Strawson entailment is define as follows: ϕ Strawson-entails ψ if whenever the presuppositions of ϕ and ψ are met, if ψ is true, ϕ is also true.

[6] See Spector & Sudo (2017) for more discussion of this mechanism, as well as reasons why weak negation should not be used.

[7] We could use a more elaborate condition like Fox's (2007) notion of Innocent Exclusion, but the simpler option will do for now, See Section 4.3. for relevant discussion.

(22) a. $[\![\textbf{Oscar is hungry}]\!]^c = \exists t[\texttt{time}(c) \in t \wedge \texttt{hungry}(\texttt{oscar}, t)]$

b. $\langle\!\langle\textbf{Oscar was hungry}\rangle\!\rangle^c = \exists t[\texttt{time}(c) \in t \wedge \texttt{alive}(\texttt{oscar}, t)]$

By the same reasoning as before, (22a) asymmetrically entails (21a) and (22b) asymmetrically entails (21b). Suppose we apply $\mathbb{A}$ to (17a), then we obtain the cessation implicature with an additional presupposition that Oscar is alive now.

(23) a. $[\![\mathbb{A}(\textbf{Oscar was hungry})]\!]^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{hungry}(\texttt{oscar}, t)] \wedge \neg\exists t[\texttt{time}(c) \in t \wedge \texttt{hungry}(\texttt{oscar}, t)]$

b. $\langle\!\langle\mathbb{A}(\textbf{Oscar was hungry})\rangle\!\rangle^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{alive}(\texttt{oscar}, t)] \wedge \exists t[\texttt{time}(c) \in t \wedge \texttt{hungry}(\texttt{oscar}, t)]$

In words, the assertive meaning is that Oscar was hungry but is not hungry now, and the presupposition is that Oscar was alive and still is. This reading is the cessation implicature reading of (17a).

Furthermore, according to our account, (17a) has another reading, which has an LE. In words, the assertive meaning is that Oscar was hungry, and the presupposition is that Oscar was alive (then) but is now dead.

(24) a. $[\![\mathbb{P}(\textbf{Oscar was hungry})]\!]^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{hungry}(\texttt{oscar}, t)]$

b. $\langle\!\langle\mathbb{P}(\textbf{Oscar was hungry})\rangle\!\rangle^c = \exists t[t \prec \{\texttt{time}(c)\} \wedge \texttt{alive}(\texttt{oscar}, t)] \wedge \neg\exists t[\texttt{time}(c) \in t \wedge \texttt{alive}(\texttt{oscar}, t)]$

Note that the two readings have presuppositions that are not compatible with each other. Therefore, in a given context, only one of them is a possible reading. That is, if Oscar is known to be alive now, the cessation implicature reading in (23) is the only felicitous option, and if he is known to be dead now, the LE reading in (24) is the only felicitous option.[8]

3.2 When Assertive Scalar Strengthening is Not Available

Unlike (17a), we do want our first example (1a) to be unambiguous and have the LE reading to be the only possibility. We propose that this is because the cessation implicature reading of (1a) (in most contexts) contradicts the contextual assumption that the cat breed does not change throughout a cat's lifetime. That is, its cessation implicature reading would presuppose that Oscar was and is alive and asserts that he used to be a Ragdoll but not anymore. Given that it is common assumption among the discourse participants that his breed does not change, this reading is trivially false. It is then reasonable to assume that a speaker would not express this meaning.

This analysis nicely accounts for the context dependence of LEs with predicates like *be British*, as illustrated in (3). In contexts where it is commonly assumed that Chris never

[8] One might wonder if there are more readings, if both of the two mechanisms apply at the same time, but it turns out that this possibility will not yield different readings for (17a). If $\mathbb{A}$ applies first, the input to $\mathbb{P}$ already presupposes the same thing as its present tense alternative. If $\mathbb{P}$ applies first, then the resulting reading has a presupposition that is incompatible with, rather than weaker than, the presupposition of the present tense alternative. See Spector & Sudo (2017) for cases where assertive scalar strengthening and their principle of Presupposed Ignorance Principle both apply.

changed his nationality, the cessation implicature reading becomes unavailable, as it would be (nearly) trivially false, and correspondingly, the LE reading becomes more salient.

It should also be discussed what will happen when the sentences in (17) are put in negative contexts. In such contexts, the entailment relation between the two sentences will reverse, and with $\mathbb{A}$ the present tense version should give rise to an inference that the past tense version is not true. However, this prediction does not seem to be correct. For instance, consider the following example.

(25) No one who is poor should be forced to pay.

This does not seem to have an inference that someone who was (ever) poor should be forced to pay. One way to solve this overgeneration problem would be to assume that while the present tense is an alternative for the past tense, the past tense is not an alternative for the present tense. As Thomas (2012) proposes, this could be due to their structural properties (see also Kane, Cremers, Tieu, Kennedy, Sudo, Folli & Romoli to appear for experimental support and further discussion).

To summarize, we postulate two different mechanisms of scalar strengthening, assertive scalar strengthening $\mathbb{A}$ and presuppositional scalar strengthening $\mathbb{P}$. A sentence containing a scalar item, e.g. a past tense, needs to be strengthened via either one of these mechanisms. Sentences like (17a) are therefore ambiguous between two readings. Sentences like (1a) are in principle ambiguous as well, but the cessation implicature reading derived by $\mathbb{A}$ is much less salient, as it is trivially false in normal contexts.

4 Some Refinements and Open Issues

4.1 When Assertive Scalar Strengthening is Not Available

Our analysis can be easily tweaked to account for the fact that LEs tend to be absent, when a particular past time interval is made salient in the discourse, as illustrated by the following example (Musan 1995).

(26) One month ago, a friend of mine, whose cat had given birth to many kittens, asked me to adopt one of them. It was a Ragdoll. ↛ The kitten is dead now.

This observation is given a straightforward account under our analysis, if contextual domain restriction is postulated for tenses. Specifically, we assume that the existential quantifier in the meaning of a tense has (implicit) domain restriction D, which we model here as an interval.[9] The intervals the tense existentially quantifies over need to be sub-intervals of this interval D. $\ulcorner t \sqsubseteq D \urcorner$ means t is a convex subset of D.

(27) a. $\langle\!\langle \textbf{Oscar is a Ragdoll} \rangle\!\rangle^c = \exists t \sqsubseteq D[\texttt{time}(c) \in t \wedge \texttt{alive}(\texttt{oscar}, t)]$

b. $\langle\!\langle \textbf{Oscar was a Ragdoll} \rangle\!\rangle^c = \exists t \sqsubseteq D[t \prec \{\texttt{time}(c)\} \in t \wedge \texttt{alive}(\texttt{oscar}, t)]$

Suppose that the context makes it clear that the intended value for D is some past interval that does not contain $\texttt{time}(c)$. Then, the LE, which is the negation of (27a), is guaranteed to be true, regardless of whether Oscar is dead or alive now, because the first conjunct requiring

[9] It could alternatively be modelled as a set of intervals, but we will stick to the simpler analysis.

$\texttt{time}(c) \in t$ will be false, for each $t \sqsubseteq D$. Therefore, in such a context, the LE reading does not entail that Oscar is dead now.

4.2 Lifetime Effects with Plural Subjects

The theoretical literature tends to focus on simple examples of LEs like (1a), but theories, including ours, make testable predictions about complex example that involve lifetime presuppositions about multiple individuals.[10] For instance, consider the following example.

(28) Andy and Bill were friends.

As in the case of *be hungry* in (17a), we predicate this sentence to be ambiguous between a cessation implicature reading and LE reading. The cessation implicature reading presupposes that both of Andy and Bill are alive now and asserts that they were friends before but not anymore. The LE reading presupposes that Andy and Bill were alive but at least one of them is dead now and asserts that when both of them were alive, they were friends. This seems to comply well with our intuitive judgments.

The following example is similar in nature to (1a).

(29) Andy and Bill were brothers.

On the assumption that two people do not cease to be brothers during their lifetime, the cessation implicature reading would be infelicitous, because it would that Andy and Bill were brothers but are no longer brothers. That leaves us with the LE reading as the only felicitous reading, which presupposes that at least one of John or Bill is dead now. This, again, seems to be a good prediction. Further support comes from the observation that one could say *Andy and I were brothers*, at Andy's funeral but not at his wedding.

It is interesting to notice is that when the predicate is distributive, the LE feels stronger. For instance, consider the following example.

(30) Oscar and Bella were Ragdolls.

The LE we predict for this sentence is essentially the same as above, namely, that at least one of Oscar and Bella is dead now. However, the actually observed LE here is intuitively stronger than that, namely that both of them are dead now. We account for this difference between (29) and (30) by assuming that the presuppositions of their present tense counterparts have slightly different representations with respect to the homogeneity. More specifically, the predicate *be Ragdolls* is semantically pluralized in (30), and by assumption pluralized predicates exhibit *homogeneity effects* (Fodor 1970; Schwarzschild 1994; Križ 2015, 2016). We assume that homogeneity effects arise both in the assertive meaning and presupposition. On the other hand, the predicate *be brothers* in (29) is not semantically plural, and we assume that it has not homogeneity effects in the assertion or presupposition. We therefore represent the LEs inferences of these two sentences as follows, which are the negations of the presuppositions of their present-tense alternatives.

[10] We would like to thank Maria-Margarita Makri, Hanna de Vries and other people in the audience of our talk at the University of York for insightful discussion relating to some of the material presented in this section.

(31) a. $\neg\exists t[\texttt{time}(c) \in t \wedge \texttt{alive}(\texttt{andy}, t) \wedge \texttt{alive}(\texttt{bill}, t)]$
b. $\neg\exists t[\texttt{time}(c) \in t \wedge \texttt{*alive}(\texttt{andy} \oplus \texttt{bill}, t)]$

Crucially, the pluralization operator * introduces homogeneity and the latter, but not the former, entails that both of Andy and Bill are dead now.

4.3 Presupposed Ignorance

As mentioned in Section 2.3, our mechanism of presupposed scalar strengthening derives a stronger inference than Spector & Sudo's (2017) Presupposed Ignorance Principle (PSP). They formulate it as such to account for the following type of sentence.

(32) Andy lives in Aberdeen. #Bill lives in Aberdeen or Brighton, too.

They crucially assume that the alternatives for the second sentence here include the following two (Sauerland 2004).

(33) a. Bill lives in Aberdeen, too.
b. Bill lives in Brighton, too.

Assuming that *too* is anaphoric to Andy, these presuppose that Andy lives in Aberdeen and that Andy lives in Brighton, respectively. These presuppositions are stronger than the presuppositions of the disjunctive sentence above, so PSP requires them to be not satisfied. In the example above, when the second sentence is uttered, it is already known that Andy lives in Aberdeen. Therefore, the inference derived by PSP is not satisfied, which accounts for the infelicity.

Our account, as it stands now, predicts contradictory presuppositions with the same alternatives. That is, it negates the presuppositions of both of these alternatives, which is to say that Andy does not live in Aberdeen and Andy does not live in Brighton. This inference is too strong, because the following example is felicitous.

(34) Andy lives in Aberdeen or Brighton. Bill lives in Aberdeen or Brighton, too.

We could adopt a more stringent condition on which alternatives to negate (cf. *innocently excludable alternatives* in the sense of Fox 2007), but that would not predict any inference for the disjunctive sentence in question, failing to account for the infelicity of (32).

However, recall that the example in (16) indicates that the ignorance inference that PSP generates is not strong enough for LEs.

(16) I don't know if John's cat, Oscar, is dead or alive now. #He was a Ragdoll.

Generally, weaker inferences like the one we observe for (32) are only observed with scalar items that trigger ignorance inferences like disjunction, *at least*, etc.

We haven't found, at the moment, a way to reconcile the facts exemplified by (16) and (32), but we would like to note that a similar tension arises in the domain of assertive scalar strengthening. Concretely, one normally gets a strong scalar inference (so-called *secondary scalar implicature* by Sauerland 2004) for sentences like (35a) and (35b), in comparison to the ignorance inference of sentences like (35c).

(35) a. Most of my students speak Mandarin Chinese. ⇝ Not all of them do.
b. It is chilly in Chicago. ⇝ It is not terribly cold in Chicago.
Daniel is in Denver of Detroit.

Fox (2007), for example, claims that the stronger inferences of the first two examples above are due to a grammatical operator, while the ignorance inference of the kind exhibited by (35c) is due to Gicean reasoning. If this is on the right track, it is perhaps not entirely inconceivable that a similar division of labor between semantics and pragmatics is observed in the domain of presuppositions. We will have to leave this issue open here.

5 Comparison with Previous Accounts

Lastly we would like to briefly compare our account of LEs with representative precedents. Musan (1995, 1997) assumes that LEs are essentially the same inference as cessation implicatures. That is, (1a), for example, has a cessation implicature that Oscar is no longer a Ragdoll, and given that a cat does not change its breed throughout its lifetime, so her reasoning goes, this implies that Oscar is dead. As Thomas (2012) discusses in detail, certain aspects of her analysis are unclear, especially regarding how presuppositions ought to project. However, even putting these issues aside, it makes a problematic prediction with respect to the projection of LEs. When (1a) is put in a scalar implicature cancelling context, it is predicted that LEs cease to arise. As we saw in (4), this prediction is not borne out. On the other hand, this is exactly what our presuppositional account predicts, because according to our account, the presuppositions of the past tense and present tense sentences are compared, and being presuppositions, they are expect to project out in contexts like above. Consequently, LEs are predicted just as in the simple example in (1a).

Magri (2009, 2011) derives LEs by an interplay between cessation implicatures and contextually determine alternatives. Unlike Musan, Magri assumes that the cessation implicature of (1a) is infelicitous. He then proposes that (1a) is felicitous in contexts where the cessation implicature is blocked. Specifically, he argues that in contexts where it is known that Oscar is alive, the past tense sentence (1a) and its present tense alternative (1b) are contextually equivalent, and in such contexts, the cessation implicature obligatorily arises. On the other hand, in contexts where the two sentences are not contextually equivalent, the cessation implicature can be blocked. He argues that these contexts are exactly the contexts where Oscar is not known to be alive.

However, one shortcoming of this account is, as Thomas (2012) points out, that it predicts LEs to be blocked in an ignorance context like (16), because the two sentences are not contextually equivalent in such a context. Recall that we have a straightforward account of (16) as for us the LE of this example is a *bona fide* presupposition. In addition, the observations made in Section 4.2 appear also problematic for Magri's account. Recall that we account for the difference between collective and distributive predicates by assuming that the latter give rise to homogeneity effects with respect to plural subjects, which results in a stronger inference. Since LEs do not involve negation of the present tense alternative under Magri's account, it is unclear to us how the contrast could be explained.

6 Conclusion

When used in combination with past tense, most stative predicates (e.g. *be a Ragdoll*) tend to give rise to a Lifetime Effect inference that the subject is dead. Previous studies analyzed

these effects as arising from the interaction between scalar implicatures and discourse felicity. In this paper, we have proposed an alternative presuppositional analysis based on recent work by Spector & Sudo (2017). The resulting system is one in which cessation implicatures and lifetime effects arise in parallel as a result of an implicature strengthening mechanism applying at different levels: at the assertion level for cessation implicatures and at the presuppositional level for lifetime effects inferences. As we discussed, the presuppositional approach proposed here makes better predictions than the scalar implicature one, in particular with respect to the projection behaviour of LEs, ignorance inference contexts and the interaction between plurality and LEs.

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