University of California, Santa Cruz

STRICT AND SLOPPY REFLEXIVES IN VP-ELLIPSIS

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by

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1 Introduction

This paper looks at a curious phenomenon involving VP-ellipsis and binding theory. Sentences (1) and (2) involve two clauses where the first one (called the *source clause*) provides the interpretation for the second one containing the elided VP (called the *target clause*).

(1) John saw his mother, and Bill did too.

(2) John saw his mother because Bill did too.

The target clause can have two meanings, one where Bill saw John's mother (the *strict* reading) and the other where Bill saw Bill's mother (the *sloppy* reading). Both the *and*-sentence and the *because*-sentence seem to allow strict and sloppy readings equally. Moreover the ellipsis construction is on par with that involving no ellipsis:

(3) John saw his mother, and Bill saw his mother, too.

(4) John saw his mother because Bill saw his mother too.

That is, 'his mother' can refer to either John's or Bill's. However when we switch to sentences with reflexive pronouns an asymmetry emerges:

(5) John blamed himself, and Bill did too.

(6) John blamed himself because Bill did too.

Here it is more difficult to get a strict reading for (5) while (6) allows it more readily. This difference crucially involves VP-ellipsis since when we take it out and use reflexives in both clauses, binding theory rules out strict readings quite strongly. In addition, it is not specific to the lexical item *because* since we can replace with other subordinating conjunctions, as in

(7) John blamed himself before Bill did.

(8) John blamed himself when Bill did.

(9) John blamed himself even though Bill didn't.

This paper is an investigation into why the above asymmetry (hereafter called the *Causality Effect*) occurs. Specifically it compares two competing explanations. One comes from Hestvik 1995 and is syntactic in nature, while the other is based on Kehler 2002's theory of discourse relations.

The paper also asks whether the asymmetry can be influenced by the semantics of the verb above and beyond the syntactic- and/or discourse-relation between the two clauses. Since subordinating clauses (exemplified by *because*) often involve causality relations, it is worth asking whether *implicit causality* in the verb's meaning itself can trigger the same strict/sloppy bias.

The paper investigated these 2 issues in a series of 3 forced-choice experiments that look at multiple aspects of the Causality Effect. These experiments are an extension of previous work by Kim and Runner 2009 which centered around the effect of discourse connectives on strict vs. sloppy readings of reflexives. In their work, the focus was on *parallelism* vs. *cause-effect* discourse relations in sentences such as 'Mary voted for herself, and/so Jane did too'. The experiments in the present paper, on the other hand, expanded on this idea in 3 ways. 1) It expanded the type of discourse connectives used while controlling for syntactic configuration. 2) It examined the role of negation in affecting the strict vs. sloppy bias. 3) It specifically addressed the role of the verb's semantics in facilitating the Causality Effect (i.e. via implicit causality).

To summarize their conclusions, both Experiment 1 and 2 show that Kehler's theory is a better model of the Causality Effect. That is, the discourse relation between source and target clauses seems to be the major factor in determining

whether strict readings are available, and not the syntactic configuration. Results from all 3 experiments also show that lexical causality plays a role in the availability of strict readings even when such causality it not specifically marked in the discourse relation.

The rest of the paper is structured as follows. Section 2 offers a brief review of theories of VP-ellipsis. Then come the 3 major theoretical aspects of the problem. Sections 3 and 4 present the background and specific proposals for the syntactic and discourse-theory explanations of the Causality Effect respectively, while Section 5 goes through the possible lexical contribution from *implicit causality*. Sections 6, 7, and 8 then describe the first, second, and third experiment respectively. The first was designed to test which theory, Hestvik's or Kehler's, makes better empirical predictions. The second expanded on the first by looking at the interaction of the Causality Effect with negation. The third focused specifically on the role implicit causality played in biasing the ellipsis toward strict or sloppy readings in parallel clause constructions. Finally Section 9 presents conclusions.

2 Background

There have been two general approaches to analyzing VP-ellipsis, structural and semantic. The former holds that the whole syntactic configuration of a VP is silently copied over to the target clause or is deleted from it, while the latter only holds that the semantic representation of the VP is reduplicated. Both are supported by their own broad set of facts which nevertheless do not establish one as a superior candidate over the other.

In a deletion theory such as Sag 1976, material is present at the ellipsis site early on in the derivation subject to an identity requirement (usually semantic) with the source VP. It is subsequently deleted at PF. In a copy account like

Dalrymple 1991 on the other hand, the ellipsis site is initially an empty category and only gets its interpretation at LF via a kind of anaphoric reference to the source VP. Thus for the sentence 'John likes candy and Bill does too', the two theories would predict the relations between DS, PF, and LF shown in Table 1.

	PF		DS		LF
Deletion account	John likes candy Bill ~~[likes candy]~~	←	John likes candy Bill [likes candy]	→	John likes candy Bill [likes candy]
Copy account	John likes candy Bill e	←	John [likes candy] Bill e	→	John [likes candy]$_i$ Bill PRO$_i$

Table 1: Copy and deletion accounts of VP-ellipsis.

The condition of semantic identity is used to explain strict and sloppy readings for sentences like

(10) John saw his mother, and Bill did too.

in that the first clause of (10) can be represented as $P(John)$, where $P = \lambda x$ x saw x's mother or $P = \lambda x$ x saw John's mother. The first property, when composed with *Bill* gives the sloppy reading, while the second gives the strict reading.

The above descriptions are admittedly very simple and do not do justice to the variety of complications of VPE or the theories that have been developed to account for them. For further discussion, see Hardt 1999 and Stone and Hardt 1999.

3 The syntactic account of the asymmetry

3.1 The position of the *because* and *and* clauses

In Hestvik's account, coordination and subordination structures like (11) and (12) have a clear difference in terms of c-command.

(11) John blamed himself and Bill did too.

(12) John blamed himself because Bill did.

While coordination does not involve clear c-command of the first conjunct over the second, in subordination structures the second clause sits below the subject of the first clause. Indeed, there are a few reasons to think that these subordinate structures are indeed at the VP level. First, there are Condition C violation in sentences like

(13) *He$_i$ sings because John$_i$ is happy.

(14) *He$_i$ washes before John$_i$ eats dinner.

Evidence also comes from bound variable anaphora.

(15) Every boy$_i$ listens well when his$_i$ mother talks to him.

(16) Every girl$_i$ does her hair before she$_i$ goes to school.

Ellipsis may also indicate where the subordinate clause lies.

(17) John will leave before the party is over, and Bill will [~~leave before the party is over~~] too.

As Chierchia 1995 notes, there is particularly compelling evidence for VP-adjunction in the case of sentence final *if*-clauses. In addition to Condition C (18) and simple cases of bound variable anaphora (19), there is VP topicalization (20) and scope under negation (21).

(18) *He$_i$ sings if John$_i$ is happy.

(19) Every boy$_i$ listens well if his$_i$ mother talks to him.

(20) I told Peter to take out the dog if it rains, and take out the dog if it rains he will. (Iatridou 1991)

(21) Mary doesn't yell at Bill if she is hungry (but rather if she's sleepy) (Bhatt and Pancheva 2006)

As will be explained in Section 6, these clear diagnostics for the position of sentence final if-clauses provided the motivation for using them in Experiment 1, which was designed to test Hestvik's syntactic account involving c-command between the subordinate and main clauses. At the same time sentence final if-sentences constitute an improvement over the design of Kim and Runner 2009 in that it is less clear where their *so*-clauses sit syntactically relative to the main clause. Better control over the syntactic constituents is thus the result.

On the other hand, clauses introduced by *and* are not likely to sit in a subordinate relation to the first clause. There are a few reasons for this. First, as Kehler 2000 notes, clauses introduced by subordinating conjunctions like *because*, *before*, etc. can be fronted, as in

(22) Because it was raining, John stayed inside.

(23) Before he went out, John grabbed an umbrella.

(24) Even though he was tired, John kept running.

However such a thing is not possible for clauses introduced by *and* or *but*:

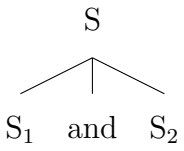
(25) *And Bob likes pizza, John likes ice cream.

(26) *But he was tired, John kept running.

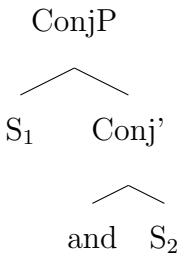
Moreover, it is harder to get bound variable readings for clauses linked by *and* (modulo the issue of telescoping - see Poesio and Zucchi 1992, Roberts 1987):

(27) #Every boy$_i$ went to the store and he$_i$ bought ice cream. (cf. Every boy$_i$ went to the store because he$_i$ liked ice cream)

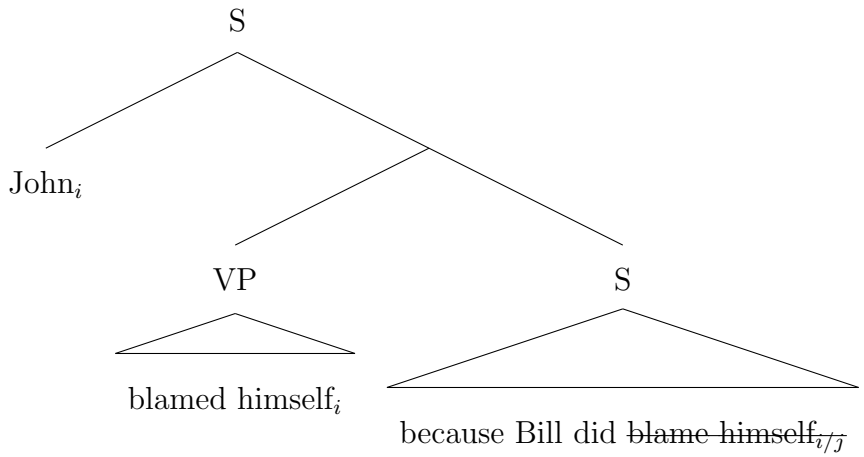
Note that this does not say anything about whether *and*-clauses exhibit a perfectly parallel structure, as in

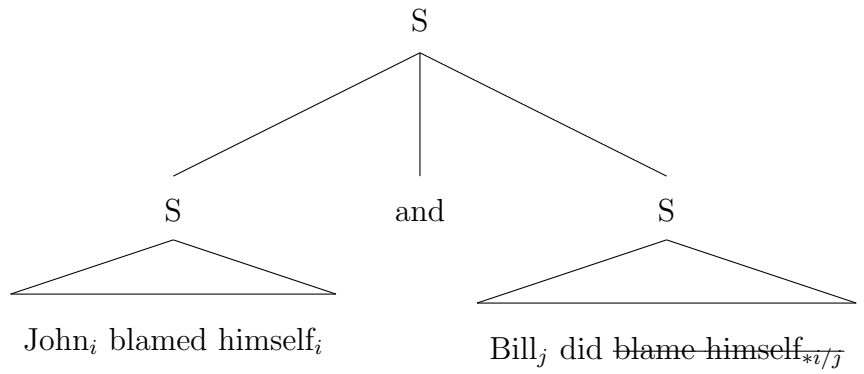


or an asymmetric structure which is headed by the conjunction itself, as in



For Hestvik's approach either view is acceptable. What matters is the position of the second clause relative to the *subject* of the first. In this sense, for subordinate structures the second clause sits below the subject of the first but for parallel clauses it does not. E.g.





3.2 Reflexives and binding theory

In order to explain why subordinate structures license strict readings but parallel structures do not Hestvik proposes two analyses, both of which assume a copy account of VP-ellipsis as opposed to a deletion account (cf. Sag 1976). Hestvik's first account is couched in a DRT framework (see Kamp 1981, Heim 1982, Kamp and Reyle 1993), in which reflexives receive their interpretation by undergoing movement at LF out of the VP in order to establish the necessary equational condition for the DRS (discourse representation structure). The movement essentially creates λ-abstraction which leads to the bound variable interpretation. Thus

(28) John defended himself. $\rightarrow$ [$_S$ John [$_\alpha$ himself$_i$ [$_{VP}$ defended t$_i$]]].

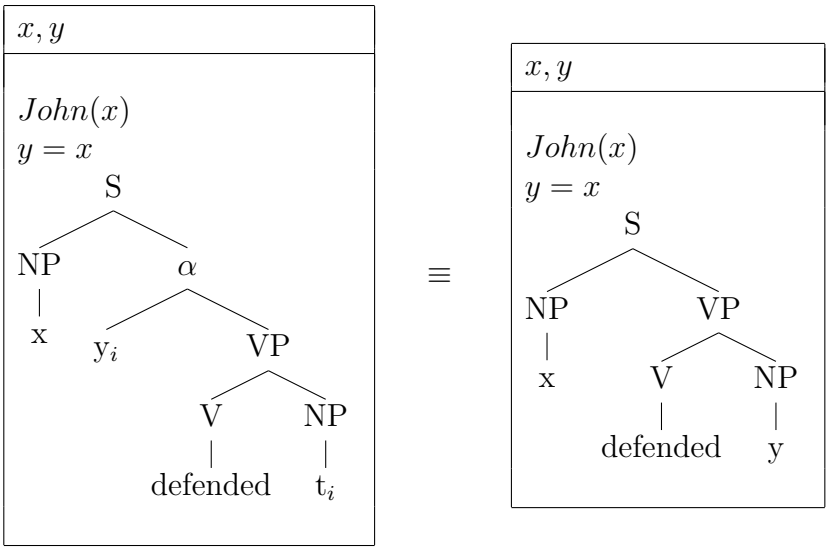


Table 2: The DRT account of reflexives (from Hestvik 1995)

(See Figure 2) Such proposals about movement of reflexives can also be found in Chomsky 1986 and Lebeaux 1983, among others.

The derivation of strict and sloppy readings then essentially comes from competing orders between the LF copying of the VP material to the ellipsis site and the raising of the reflexive. If raising happens before copying, both the trace in the source VP and that of the elided VP are governed by a single reflexive, giving the strict reading. If raising happens afterward, the trace at the ellipsis site is governed locally within its own clause, giving the sloppy reading.

For example, the derivation for the sloppy reading of 'John blamed himself because Bill did' would proceed along the following three steps:

(29) John $[_{VP}$ blamed himself] because
Bill e

(30) John $[_{VP}$ blamed himself] because
Bill $[_{VP}$ blamed himself]

(31) John $[_{\alpha}$ **himself**$_i$ $[_{VP}$ blamed $\mathbf{t}_i]]$ because

Bill $[_{\alpha}$ **himself**$_j$ $[_{VP}$ blamed $\mathbf{t}_j]]$

Since reflexives only get their interpretation by which NP they move under at LF, in (30) no binding has taken place. Only after copying in (31) does variable binding take place, allowing *Bill* to serve as the antecedent to the reflexive in the elided VP.

However the derivation for the strict reading proceeds from first raising the reflexive and then copying:

(32) John $[_{VP}$ blamed himself] because
Bill e

(33) John $[_{\alpha}$ **himself**$_i$ $[_{VP}$ blamed $\mathbf{t}_i]]$ because
Bill e

(34) John $[_{\alpha}$ **himself**$_i$ $[_{VP}$ blamed $\mathbf{t}_i]]$ because
Bill $[_{VP}$ blamed $\mathbf{t}_i]$

Crucially, the structure is licit because both traces $\mathbf{t}_i$ are bound by the reflexive **himself**$_i$. This is because the *because* clause sits below the subject of the source clause.

When we try to follow the same derivation for the strict reading of the parallel configuration, a problem arises:

(35) John $[_{VP}$ blamed himself] and
Bill e

(36) John $[_{\alpha}$ **himself**$_i$ $[_{VP}$ blamed $\mathbf{t}_i]]$ and
Bill e

(37) John $[_{\alpha}$ **himself**$_i$ $[_{VP}$ blamed $\mathbf{t}_i]]$ and
Bill $[_{VP}$ blamed $\mathbf{t}_i]$

Since the subject of the source clause does not c-command the elided clause, the trace $\mathbf{t}_i$ there ends up being unbound and incurs an ECP violation.

One interesting issue Hestvik mentions in passing regards the effect of negation on the Causality Effect and will be the focus of Experiment 2. He observes that when the source clause is negated strict readings become more accessible even in contrastive clauses involving *but*:

(38) John didn't blame himself, but Bill did.

Such an observation seems unaccounted for under the simple version of the syntactic account, since negation heads a phrase above the VP and should not impact the binding theory arguments above. If syntactic structure was the primary determiner of strict/sloppy bias, sentences like (38) should behave like ones without negation, or even

(39) John didn't blame himself, and Bill did. (emphasis required on *did*)

But (39) seems like its counterpart with no negation in disallowing strict readings. As Experiment 2 will show, this phenomenon is likely due to the discourse effect of contrast with negation rather than any structural properties special to *but*-clauses.

4 The discourse-theory account

An alternative explanation for the Causality Effect comes from a particular version of discourse theory developed by Andrew Kehler (see Kehler 2000, 2002). It sets up only three basic discourse relations, **Resemblance**, **Cause-Effect**, and **Occasion**, each with different 'subtypes'. For example,

(40) Bill likes to play golf. Al likes surfing the net. (Resemblance: Parallelism)

(41) John supports Clinton, but Mary opposes him. (Resemblance: Contrast)

(42) Bill was about to be impeached. He called his lawyer. (Cause-effect: Result)

(43) Bill was about to be impeached, but he didn't call his lawyer. (Cause-effect: 'Violated expectation')

Generally, a Resemblance relationship between S_1 and S_2 requires a one-to-one correspondence between the set of entities mentioned in S_1 and the set of entities in S_2, as well as some salient property P common to both sets.

For Cause-Effect relationships however, one need only have an implicational relationship between sentences at the propositional level. Here 'implicational' is defined in terms of plausability and not the stricter sense of classical logical inference. Thus if P is inferred from S_1 and Q from S_2, the Result relation is obtained if $P \rightarrow Q$. If $Q \rightarrow P$, we have explanation, while if $P \rightarrow \neg Q$, we have Violated expectation.

What is crucial in Kehler's theory is that for VP-ellipsis, *Resemblance relations require syntactic identity while Cause-Effect relations require identity only at the 'propositional level'*. Such a distinction is meant to capture a myriad of observations about the acceptability of various perturbations to typical examples of VP-ellipsis. For instance, Kehler argues that in voice-mismatch examples like

(44) In March, four fireworks manufacturers asked that the decision to be reversed, and on Monday the ICC did. (from Dalrymple 1991)

the mismatch between *be reversed* in the source clause and *reverse* in the target clause is licensed by the Cause-Effect relation. Such acceptability is to be contrasted with a Resemblance relation as in the sentence below (from Kehler 2002):

(45) #This problem was looked into by John, and Bob did too. (cf. ?This problem was looked into by John, because Bob did)

Another area where Cause-Effect relations seem to loosen syntactic restrictions is in Condition C effects. For instance, in

(46) #Sue defended John$_i$ but he$_i$ didn't ~~defend John$_i$~~.

the sentence is presumably bad on the grounds that there is reconstructed material in the ellipsis site. However a sentence like

(47) Sue defended John$_i$ because he$_i$ couldn't.

is better on the grounds that only the proposition 'John couldn't defend John' is inferred from the causality relationship.

Kehler makes the same sort of observation about Condition A effects, where Cause-Effect relations license strict readings much better than Resemblance relations. Implicit in Kehler's view of syntactic reconstruction is an absence of more complicated movement or copying analyses like Hestvik's. Thus

(48) John$_i$ defended himself$_i$ because his lawyer did.

admits the strict reading on the (perhaps contextual) grounds that 'John's lawyer defended John' implies 'John defended himself'. Other examples of Cause-Effect relations and licit strict identity of reflexives is

(49) John$_i$ defended himself$_i$ even though Bill didn't. (Denial of Preventer)

(50) John$_i$ defended himself$_i$ and so Bill did too. (Result)

(51) John$_i$ defended himself$_i$ but nevertheless Bill didn't. (Violated expectation)

5 Implicit Causality Verbs

In addition to the possible syntactic and discourse effects on the Causality Effect, the third remaining aspect considered in this paper is the lexical contribution of the verb.

Such a question requires us to introduce the notion of *implicit causality* (McKoon et. al. 1993, Garvey and Caramazza 1974, Rohde 2008) . Several decades ago, it was observed in the psycholinguistics literature that certain verbs strongly bias pronoun resolution in minimal pairs like

(52) John disappointed Bill because he stole the book.

(53) John scolded Bill because he stole the book.

Readers of (52) strongly prefer to resolve the pronoun *he* to the subject of *disappoint* rather than the object, whereas in (53) the opposite is true. The strength of the preference is so strong that Garvey and Caramazza 1974 have proposed it follows from the idea that verbs like *disappoint* and *scold* imply as part of their root meaning an underlying causal event involving either the subject or object. Thus in 'John disappointed Bill', John must have done something to make Bill disappointed in him. For 'John scolded Bill', Bill must have done something to make John scold him. Verbs in the class of *disappoint*, such as *amaze*, *infuriate*, and *frighten* have been dubbed IC1 verbs. Those in the class of *scold*, such as *thank*, *fear*, and *hate*, are known as IC2 verbs.

The notion of implicit causality has sometimes been cast in terms of initiation and emotional effect. That is, IC1 verbs are ones where the subject initiates an action that leads to an emotional state in the object, while for IC1 the object initiates an action that leads to an emotional state in the subject (see McKoon 1993, Kasof and Lee 1994). Such a view distinguishes IC verbs from ones like *hit*, since there is no emotional effect involved, as well as *like*, in which no subject or object initiated action is involved.

What is significant about IC verbs is the possibility that they may trigger the Causality Effect in a way akin to discourse connectives like *because* or *even though*. That is, they induce a weakening of the requirement for structural parallelism that

IC1	IC2
aggravate, amaze, amuse, annoy, apologize, bore, charm, cheat, confess, deceive, disappoint, exasperate, fascinate, frighten, humiliate	assist, blame, comfort, congratulate correct, detest, envy, hate jeer, notice, pacify, praise, reproach

Table 3: List of IC verbs (from McKoon 1993)

Kehler's model predicts for Cause-Effect type relations. With such weakening, the elided VP can function like a deep anaphor in the sense of Hankamer and Sag 1976 and can get its interpretation with reference to the source clause (recall the Copy Account from Table 1, repeated below).

PF		DS		LF
John blamed himself	$\leftarrow$	John [blamed himself]	$\rightarrow$	John [blamed himself]$_i$
Bill e		Bill e		Bill PRO$_i$

Table 4: Anaphoric reference for VP-ellipsis induced by IC verb.

As the choice of verb is independent from the type of discourse connective used, we predict that the Causality Effect induced from IC verbs should appear above and beyond whether *and*-type or *because*-type connectives are used to join source and target clause. Thus even *and*-type sentences should witness an uptick in strict readings when IC verbs are present.

This prediction served as the motivation for Experiment 3, whose results are reported in Section 8.

6 Experiment 1

6.1 Reflexives and if-then clauses

As a first step toward deciding whether Hestvik's syntactic account or Kehler's discourse-theory account better explains the Causality Effect, an experiment was

designed that varied the relative c-command relation between the *subject* of the source clause and the elided VP on the one hand, while preserving the discourse relation between the two clauses on the other. Specifically, the two configurations used were conditional sentences where the antecedent appeared either sentence initially or sentence final. For example,

(54) If Ann voted for herself, Mary did too. (if-then sentence)

(55) Mary voted for herself, if Ann did too. (then-if sentence)

If-then sentences have the structure in Figure 1, where the if-clause occupies a position higher than the main clause subject.

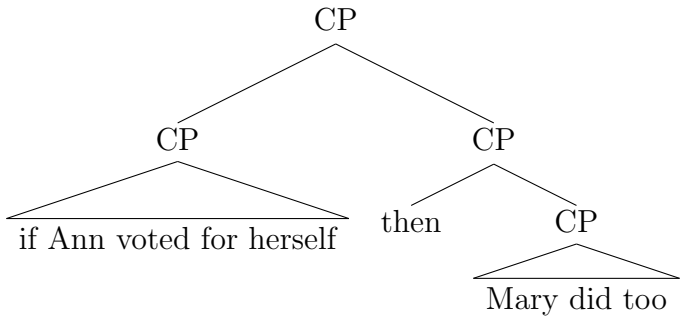


Figure 1: Structure of an if-then clause

This fact can easily be established via Condition C:

(56) If Mary$_i$ is hungry, she$_i$ yells.

On the other hand, when the if-clause comes last, it sits as an adjunct below the CP-level at the VP level (see Figure 2).

A number of tests show that a sentence final if-clause must sit below the subject of the matrix clause. These include Condition C effects:

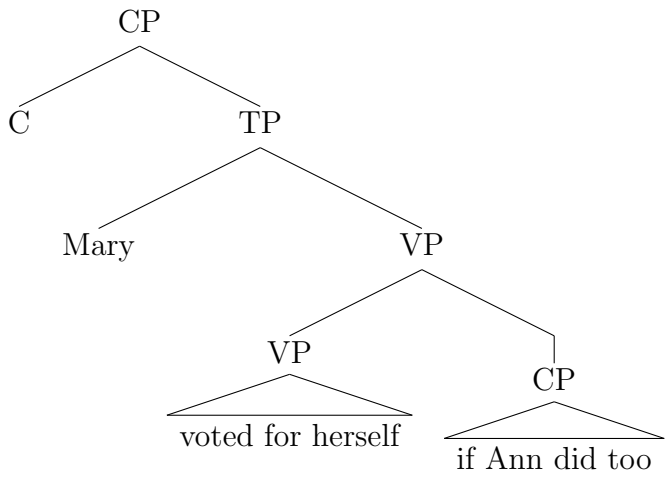


Figure 2: Structure of an then-if clause

(57) *She$_i$ yells if Mary$_i$ is hungry.

(58) Bill visits her$_i$ if Mary$_i$ is sick.

Also there is VP ellipsis and VP topicalization:

(59) VP ellipsis: I will leave if you do and John will [~~leave if you do~~], too.

(60) VP Topicalization: I told Peter to take the dog out if it rains, and [take the dog out if it rains] he will. (Iatridou 1991)

According to Hestvik's arguments, conditionals with the if-clause coming first should only allow sloppy readings of reflexives since strict readings require the subject of the source clause to c-command the elided VP. However both strict and sloppy readings should be possible when the if-clause appears in sentence final position. On the other hand, Kehler's coherence account predicts that both strict and sloppy readings should be possible for both sentence-final and sentence-initial if-clauses since the cause-effect relationship between the if- and then-clauses is preserved regardless of linear order. The two different predictions are captured by Table 5.

	Structural account	Coherence account
If P then Q	sloppy (only)	strict & sloppy
Q if P	strict & sloppy	strict & sloppy

Table 5: Predictions for readings in conditional sentences

6.2 Method

The experiment consisted of a 2 × 3 design that combined source and target clauses via 3 connectives (*and*, *if-then*, and *so*) versus relative order between the two clauses. That is, for the *if-then* connective, sentence-initial and sentence-final if clauses were used as a condition, while for *and* and *so* clauses the difference in order amounted to a dummy condition. A full set of conditions is thus represented by Table 6:

EARLY & IF	If Ann voted for herself	Mary did too.
LATE & IF	Mary voted for herself	if Ann did too.
EARLY & AND	Ann voted for herself,	and Mary did too.
LATE & AND	Mary voted for herself,	and Ann did too.
EARLY & SO	Ann voted for herself,	so Mary did too.
LATE & SO	Mary voted for herself,	so Ann did too.

Table 6: A full set of conditions for Experiment 1

The *so*-condition was included because the experiment was partly designed as a comparison to similar work in Kim and Runner 2009. That experiment consisted of a 2 × 2 design which compared Resemblance and Cause-Effect discourse relations in intra- and inter-sentential configurations. A full set of conditions is given in Table 7.

Although the overall aim of Kim and Runner 2009 was to see if inter- vs. intra-sentential relations affected strict and sloppy readings for reflexives, the manipulation of Resemblance and Cause-Effect relations was repeated in our experi-

INTRA-SENT. & RESEMBLANCE	Ann voted for herself	and Mary did too.
INTRA-SENT. & CAUSE-EFFECT	Mary voted for herself	so Ann did too.
INTER-SENT. & RESEMBLANCE	Ann voted for herself.	Mary did too.
INTER-SENT. & CAUSE-EFFECT	Mary voted for herself.	So Ann did too.

Table 7: A full set of conditions for Kim and Runner 2009, Experiment 3

ment and served as a check on robustness of their results. Many of the verbs were reused in both experiments.

In addition to the early vs. late and connective-type conditions, the verbs were chosen to be a mixture of implicit causality and non-causality verbs in order to see whether implicit causality (in either direction) had any effect on strict vs. sloppy readings in any one of the conditions. In particular, 9 IC1 verbs were chosen, 18 IC2's, and 21 NONIC's. The list of these verbs is given in Appendix A.3.1.

The participants were given a binary choice task between strict vs. sloppy readings in the context of a 'detective story' as follows. They were asked to interpret elliptical statements made by a concise detective investigating various circumstances. They would first see a display of the form

(61) The detective states: 'If Ann voted for herself, Jane did too.'

You take this to mean either:

(a) If Ann voted for herself, Jane voted for Ann.

(b) If Ann voted for herself, Jane voted for Jane.

and were required to choose between the strict and sloppy interpretation. This set-up was chosen in order to ensure participants would not be confused by the conditional sentences in resolving the ellipsis. That is, if the task had simply been framed as *Who did Jane vote for? (A) Ann or (B) Jane*, participants may have expected the consequent clause to reflect an established fact, whereas the conditional only reflects a causal relationship between the antecedent and consequent.

31 UCSC undergraduates served as participants for course credit.

6.3 Results and discussion

6.3.1 Descriptive summary

The raw counts for the experimental conditions (fixed effects) are shown in Table 8 and Figure 3.

Condition	Strict	Sloppy
EARLY & AND	90	158
LATE & AND	82	166
EARLY & IF	88	160
LATE & IF	78	170
EARLY & SO	85	163
LATE & SO	83	165

Table 8: Raw Counts for Experiment 1

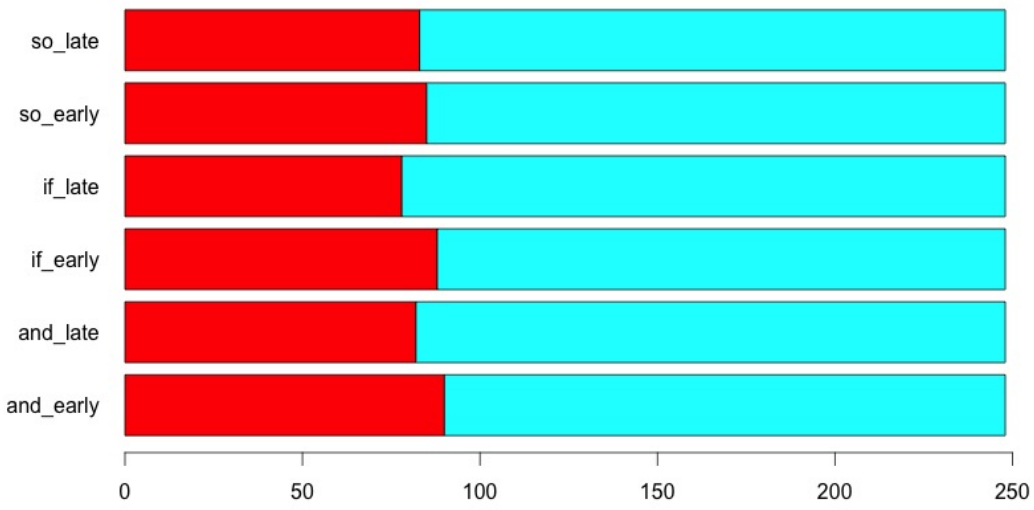


Figure 3: Raw counts of strict readings for Experiment 1 (Red=strict, Blue=sloppy)

At a first glance, there are three things which one should note from the table and graph.

1. The relative evenness of all conditions.

2. The non-trivial proportion of strict readings for all conditions, particularly the AND condition.

3. The divergence between these results and the results of the similar experiment from Kim and Runner 2009.

1) illustrates that the probability of having a strict reading is roughly constant across all conditions. This is particularly significant for the IF-conditions, as the order of the if-clause appears not to make a difference. Such a result supports Kehler's coherence account because Hestvik's account would predict a significant difference between the EARLY & IF and LATE & IF conditions.

2) shows that, contrary to what one might expect from isolated intuitive judgments, participants fairly readily chose the strict reading for all types of clauses, even *and*-clauses.

3) shows that the experiment here and that in Kim and Runner 2009 tend toward different conclusions about the impact of Cause-Effect relations on strict vs. sloppy readings in VP ellipsis. In Kim and Runner 2009, what they labeled as Cause-Effect relations showed a markedly higher tendency ($> .70$) toward strict readings, while their Resemblance relations showed a strict probability similar to ours.

Equally significant is the data coming from the breakdown of strict probabilities arranged by IC type, which shows the lexical contribution to the Causality Effect. The raw data is in Table 9.

From this table two things are obvious:

1. The proportion of strict readings for IC1 is lower compared to IC2 and NONIC.

Condition	IC1	IC2	NONIC
EARLY & AND	13/32	38/55	39/71
LATE & AND	9/39	36/57	37/70
EARLY & IF	15/32	37/56	36/72
LATE & IF	12/34	30/63	36/73
EARLY & SO	15/31	32/61	38/71
LATE & SO	10/37	37/56	36/72

Table 9: Raw counts (strict/sloppy) for Experiment 1 according to IC type

2. The proportion of strict readings for IC2 is higher compared to IC1 and NONIC.

This imbalance between IC1 and IC2 will be taken up in the discussion section.

6.3.2 Statistical analysis

To provide greater support for the above conclusions, statistical analysis was done on the data using a mixed-effects logistical regression model with random effects for subjects and items. This was done in a Bayesian framework where uninformative priors were used to compute a full posterior distribution on the relevant coefficients, from which the relevant means and confidence intervals could be calculated. More details on this are found in Appendix A.1.

Figure 11 and Table 10 show the mean strict probabilities for conditions in the experiment.

Condition	Mean probability
EARLY & AND	0.31
LATE & AND	0.26
EARLY & IF	0.29
LATE & IF	0.24
EARLY & SO	0.28
LATE & SO	0.27

Table 10: Mean probabilities for strict readings in Experiment 1

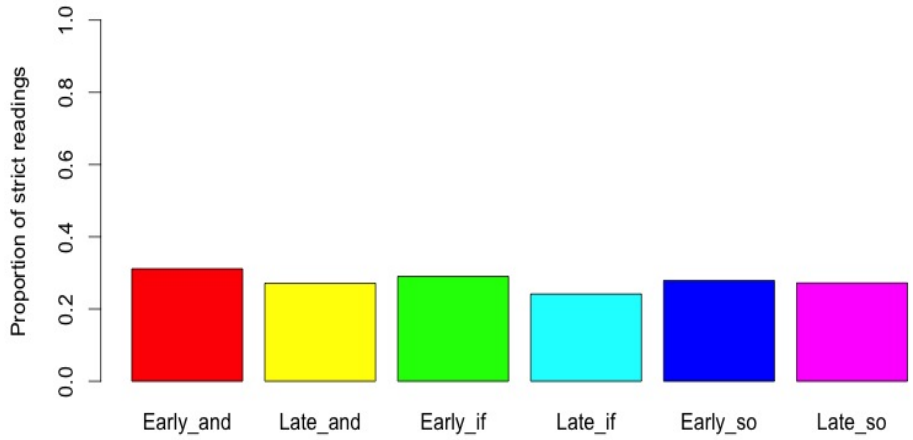


Figure 4: Mean probabilities for strict readings in Experiment 1

At a bird's-eye level these means lead to the same observations 1), 2), and 3) as the raw counts data above, above all else the relative evenness of probabilities across all conditions. To illustrate the full power of Bayesian analysis, it is possible to compute the difference of means distributions for all relevant pairs of conditions in order to show that there is no statistically significant difference.

Figure 5 shows the 6 pair-wise difference distributions for the 4 most relevant conditions (AND (both EARLY and LATE), EARLY & IF, LATE & IF, and SO (both EARLY and LATE)), represented in logits.

The fact that the means are close to zero confirms the above assertion that the mean probabilities for all conditions are about the same. Moreover, the fact that the 95% confidence intervals encompass the zero point shows that the existence differences are not statistically significant. The advantage of stating these confidence intervals in Bayesian terms is that we can interpret the negligible difference as a statement of beliefs (95% certain there is no difference) rather than simply

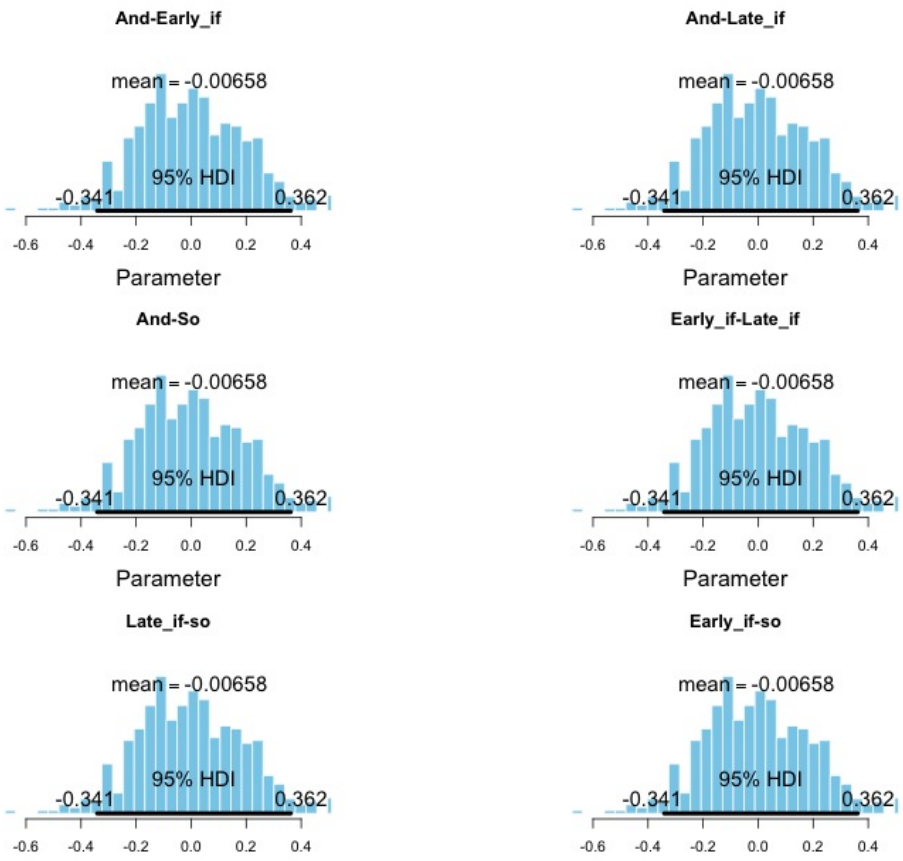


Figure 5: Pairwise differences for coefficients of the posterior distribution (code based on Krushke 2011)

failing to reject the null hypothesis.

The same mixed-effects logistical regression model was applied to the data according to the IC breakdown. Table 11 and Figure 6 provide the summary.

6.3.3 Discussion

We already mentioned above that the lack of a statistically significant difference in strict probabilities between EARLY & IF and LATE & IF conditions provided support for Kehler's model over Hestvik's. If, according to Hestvik, syntactic considerations were the dominant factor in the Causality Effect, we would expect

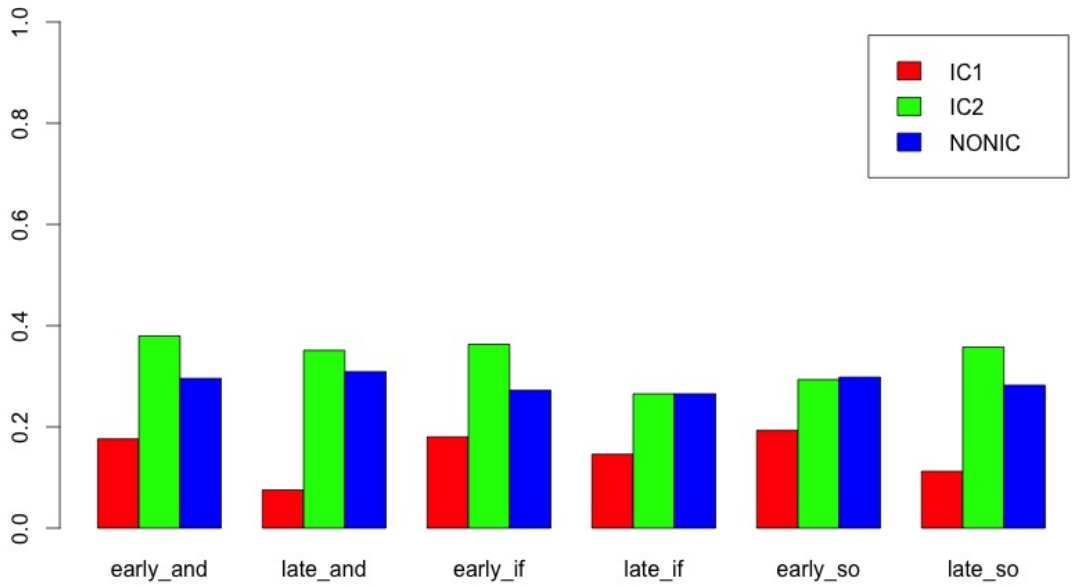


Figure 6: Probabilities for Experiment 1 according to IC type

Condition:IC1	Mean	Condition:IC2	Mean	Condition:NONIC	Mean
Early & and	0.18	Early & and	0.38	Early & and	0.30
Late & and	0.08	Late & and	0.35	Late & and	0.31
Early & if	0.18	Early & if	0.36	Early & if	0.26
Late & if	0.14	Late & if	0.26	Late & if	0.26
Early & so	0.19	Early & so	0.29	Early & so	0.30
Late & so	0.11	Late & so	0.36	Late & so	0.28

Table 11: Mean probability of strict readings in Experiment 1 according to IC-type.

a significant difference in these two conditions. Instead, the lack of difference is exactly what Kehler's model predicts since both positions of the if-clause preserve the Cause-Effect relation.

One potential criticism should be dispelled at the outset. Most of the IC2 verbs are performatives or behabitives such as *criticize*, *condemn*, and *congratulate* whereas many of the IC1 verbs are psych verbs such as *disappoint* and *scare* (see Table 12). One may hypothesize that the difference lies in a behabitive/psych predicate distinction rather than implicit causality. It seems clear, for instance,

that a person can criticize himself and have another person criticize him at the same time. Whether, on the other hand, a person can scare himself and have another person scare him simultaneously may be less clear.

IC2	IC1
Performative/behabitive: condemn, congratulate, apologize for, comfort, criticize, praise defend, berate, disparage, laugh at, correct	Performative/behabitive: encourage(?), motivate(?) reassure(?), fool(?)
Psych verbs: value, be disappointed with, have confidence in, respect, doubt	Psych verbs: amuse, disappoint, scare humiliate(?), disgrace(?)
Neither/ambiguous: blame, be hard on	Neither/ambiguous:

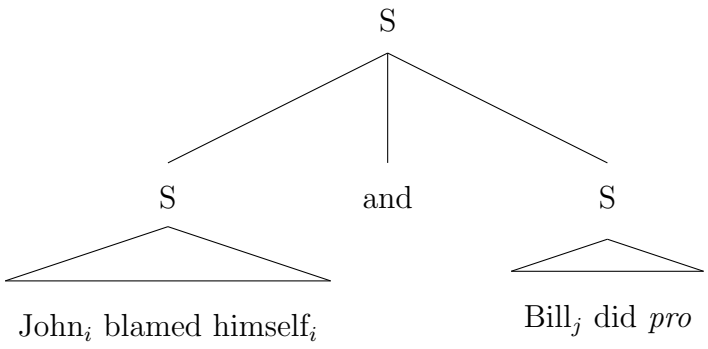
Table 12: Categorization of IC verbs

The difficulty is that the psych IC1 verbs pattern closer to the performative/behabitive IC1 verbs than the psych IC2 verbs, in terms of bias toward strict readings. IC1 psych and performative verbs showed a mean strict probability of .35 and .30, respectively, while IC2 psych and performatives had means .5 and .29, respectively. In connection with this data see Section A.2.1, which lists the raw counts broken down by verb.

One aspect of the data which is not predicted by Kehler's model however is the relatively low proportion for the SO conditions (and even the IF conditions). We would expect a higher proportion given that all of them signal Cause-Effect relations and should allow for both strict and sloppy in equal variation (or at least higher strict readings compared to the AND conditions). As it is, we cannot tell if these depressed readings are the result of experimental artifice (strategizing by subjects based on seeing the AND conditions) or if in fact *so* and *if* do not signal Cause-Effect relations in the way other connectives like *therefore* and *nevertheless* do (in relation to this, compare the data for these connectives in Experiment 2,

Section 7).

As they were outlined in Sections 3 and 4, neither the syntactic account nor the discourse-theory account predicts the non-trivial strict probabilities for AND conditions. For both of them, Resemblance-relations signaled by *and* lead to syntactic reconstruction and binding restrictions. This is not to say that these authors have not offered proposals for this unexpected result. Hestvik 1995 argues that elided VP's in *and*-clauses can be reinterpreted 'off-line' as deep anaphora in the sense of Hankamer and Sag 1976, and thereby get their referent from the source clause:



He bases this argument on work by Chao 1987, who argued that VP-ellipsis can involve either reconstruction at LF or deep anaphora, with the latter sometimes being blocked by syntactic considerations. In particular, there is a prohibition against vacuous *wh*-operators that forces reconstruction. Such a forced reconstruction renders a strict reading impossible in conjoined clauses involving reflexives and *wh*-words, while that reading is possible for subordinate structures. This is illustrated by the following triplet (from Hestvik 1995).

(62) ?John defended himself against the accusations, and Bill did too. (under strict reading)

(63) *I know what John defended himself against, and what Bill did.

(64) I know what John defended himself against before Bill did.

The possibility of deep anaphora is meant to capture this 3-way distinction.

Kehler 2002's response to this highlights the importance discourse parallelism plays in VP-ellipsis and is more consonant with our own approach. Kehler argues that VP-ellipsis does not involve reinterpretation from syntactically reconstructed material to deep anaphora. Rather, it is always anaphoric in the sense of Lakoff 1968 and Jackendoff 1972, getting as its referent the semantic content of the source clause. For Cause-Effect relations this is enough. However for Resemblance-relations the further step of syntactic reconstruction is necessary to set-up the correspondence between arguments in the source and target clauses. Thus the process essentially happens in reverse.

To us, this seems to be a better explanation: the ability to get strict readings in *and*-clauses results from a backing off of the maximal parallelism constraints in Resemblance-relations based on contextual factors, which translates into a lack of syntactic reconstruction. Such a stance would argue that (63) may not only be a result of the need to prevent vacuous *wh*-operators, but also a contextually enforced parallelism. Such parallelism could be weakened, for instance, by a different *wh*-phrase:

(65) ?I know why John defended himself against the accusations, and why Bill did too.

Or more radically by the choice of verb and its arguments.

(66) I know what year Mitt Romney voted for himself, and what year his son did, too.

This view about the anaphoric nature of VP-ellipsis may also help explain the more surprising find from the experimental data, namely the different effects

the IC classes have on the strict vs. sloppy bias. Recall that IC1 verbs have a depressing effect on strict readings while IC2 has a raising effect (relative to NONIC's). This holds for all connective types and clause orders, suggesting that the phenomenon is at least partially independent of discourse relation.

If VP-ellipsis is foremost anaphoric at the level of properties (i.e. a semantic level) with syntactic requirements being imposed on top of that according to discourse relation, then the anaphor can be drawn to, or influenced by, particularly salient antecedents despite default tendencies (just as with regular pronouns, which can refer to salient entities contrary to considerations of grammatical parallelism, thematic roles, etc. See Rohde 2008). IC-verbs provide particular salience by their implicit causality in the sense that they supply an underlying causal event involving their verbal arguments. The anaphoric VP has a tendency to incorporate this cause as part of the information necessary to resolve its antecedent. Thus for the sentence 'John blamed himself and Bill did PRO too', the VP-anaphor PRO is resolved to λx *blame(x,j)* because John is associated with the blaming event inherent in the meaning of PRO's antecedent (blame).

blame	$\rightarrow$	$\lambda e \lambda y \lambda x$ *blame(x,y,e)* $\wedge$ **Cause(y,e)**
John blamed himself	$\rightarrow$	λx *blame(x,*α*,e)(j)* $\wedge$ **Cause(j,e)** $(\alpha = j)$
Bill did PRO	$\equiv$	Bill did $\text{PRO}_{verb} \wedge \text{PRO}_{cause}$
Resolve:		$\text{PRO}_{verb} = \lambda x$ *blame(x,*α*,*e'*)*,
		PRO_{cause} = **Cause(j,**$\mathbf{e'}$**)** $(\alpha = j)$

Table 13: Anaphora resolution for 'John blamed himself and Bill did too.'

where α resolves to j because of the salience of the **Cause** predicate.

This would explain why IC2 verbs promote strict readings relative to IC1's and NONIC's: the argument that is elided is the same as the one involved in the causal event floating in the discourse. For IC1's, on the other hand, the explanation may be more complicated. One possible argument is as follows. There is a competing factor which works against the influence from the underlying causal event, namely

the salience of the subject. According to the Salience Hypothesis of Kasof and Lee 1994, IC verbs can be divided into 4 classes depending on the thematic roles of their participants: Stimulus-Experiencer (SE) verbs like *frighten*, Experiencer-Stimulus (ES) verbs like *admire*, Agent-Patient (AP) verbs like *cheat*, and Agent-Evocator (AE) verbs like *criticize*. The SE and AP verbs would be what we call IC1, while ES and AE are IC2. For Kasof and Lee, SE and AP verbs involve high salience of the subject while ES and AE verbs involve high salience of the object. In our situation then, for a sentence like 'John frightened himself and Bill did PRO too', PRO's tendency to incorporate John as the causer of the event underlying *frighten* conflicts with the tendency for the most salient entity of the target clause (here the remnant subject) to be the same as the causer. In effect, the alignment of grammatical salience (explicit subject) with semantic salience (causer) overrides the Causality Effect.

amuse	$\rightarrow$	$\lambda e \lambda y \lambda x$ *amuse(x,y,e)* $\wedge$ **Cause(x,e)**
John amused himself	$\rightarrow$	λx *amuse(x,*α*,e)(j)* $\wedge$ **Cause(x,e)** (α = j,x)
Bill did PRO	$\equiv$	Bill did PRO$_{verb}$ $\wedge$ PRO$_{cause}$
Resolve:		PRO$_{verb}$ = λx *amuse(x,*α*,*$e^{'}$*)*,
		PRO$_{cause}$ = **Cause(x,**$\mathbf{e^{'}}$**)** ($\alpha = x$)

Table 14: Anaphora resolution for 'John amused himself and Bill did too.'

See Table 14. There, α resolves to b in the final equation because of the salience of the subject Bill.

In order to be more certain that the bias shown in the data is a result of an IC1/IC2 distinction and not coincidence, another experiment was conducted which focused specifically on implicit causality as a condition (see Experiment 3).

7 Experiment 2

7.1 Motivation

Having provided evidence in favor of Kehler's coherence account of the Causality Effect, we next designed an experiment that broadened the type of discourse connective and examined the interaction between them and negation. The original motivation was the observation in Hestvik 1995, pg. 216 that coordinating structures involving *but* and negation have improved strict readings:

(67) John didn't blame himself, but Bill did.

Hestvik accounts for this phenomenon within his syntactic framework by arguing that *but*-structures can sometimes involve subordination. However the argument against this is the same as that for the unlikelihood that *and*-clauses can be subordinated. Namely, neither can be fronted as other clearer cases of subordinating conjunctions:

(68) *but Bill blamed himself, John didn't blame himself.

(69) *and Bill blamed himself, John didn't blame himself.

(70) Because Bill blamed himself, John blamed himself.

Given that discourse relations seem to be the main factor in influencing strict vs. sloppy readings, it is worth asking what impact *but* + negation makes on them. Is it primarily negation? Is it contrast? Can this bias be repeated for other discourse connectives other than *but*?

In introducing Kehler's discourse model we laid out 3 basic types of relations: **Resemblance**, **Cause-Effect**, and **Occasion**. We briefly noted that these basic types contain various subtypes that reflect the various possibilities for entity to entity correspondence (in the case of Resemblance) and logical entailment (for

Cause-effect). In general there is not a one-to-one correspondence between connective and discourse relation. Thus for the Cause-Effect relation the two propositions can be related in 4 different ways, each signaled by different connectives (see Table 15).

Relation	Presuppose	Conjunction
Result	$P \rightarrow Q$	and therefore
Explanation	$Q \rightarrow P$	because
Violated Expectation	$P \rightarrow \neg Q$	but
Denial of Preventer	$Q \rightarrow \neg P$	even though

Table 15: Cause-Effect relations (from Kehler 2002)

Given Kehler's coherence account of the Causality Effect, we expect the bias toward strict and sloppy readings of reflexives to be modulated by the discourse relation between source and target clauses, regardless of whether they sit in a syntactically subordinating relation or not. In particular, to the degree that *but* (and perhaps *and* can signal *Cause-effect* relations when combined with negation, we expect an uptick in strict readings for such combinations.

7.2 Methods

To test this theory, a $2 \times 4 + 1$ experiment was designed that crossed 4 discourse connectives (*and*, *but*, *(and) therefore*, and *(but) nevertheless*) plus presence of negation in either the first or second clause. The final condition was *and* with no negation. A full set of conditions is given below.

The same items from Experiment 1 were recycled for this experiment, which thus included the same partition into IC1, IC2, and NONIC verbs. The method of presentation also remained the same.

Condition	First clause	Second clause
noNeg	John blamed himself	and Bill did too.
Early & and	John didn't blame himself	and Bill did.
Late & and	John blamed himself	and Bill didn't.
Early & but	John didn't blame himself	but Bill did.
Late & but	John blamed himself	but Bill didn't.
Early & TF	John didn't blame himself	and therefore Bill did.
Late & TF	John blamed himself	and therefore Bill didn't.
Early & NTL	John didn't blame himself	but nevertheless Bill did.
Late & NTL	John blamed himself	but nevertheless Bill didn't.

Table 16: Full set of conditions for Exp. 2 (TF = therefore, NTL = nevertheless

7.3 Results and discussion

7.3.1 Descriptive summary and statistical analysis

Table 17 and Figure 7 show the raw data of the experiment. Figure 8 and Table 18 summarize the findings from the Bayesian model.

Condition		Condition	
noNeg	63/103		
early & and	48/117	late & and	47/115
early & but	66/100	late & but	47/119
early & therefore	104/63	late & therefore	99/66
early & nevertheless	81/85	late & nevertheless	66/99

Table 17: Raw counts (strict/sloppy) for Experiment 2

Condition	Mean	Condition	Mean
noNeg	0.36		
early & and	0.27	early & therefore	0.64
late & and	0.26	late & therefore	0.61
early & but	0.39	early & nevertheless	0.49
late & but	0.26	late & nevertheless	0.38

Table 18: Mean probabilities of strict readings for Experiment 2

The data breakdown down according to IC-type is shown in Figure 9.

The red bars show the probabilities for IC1, green for IC2, and blue for NONIC.

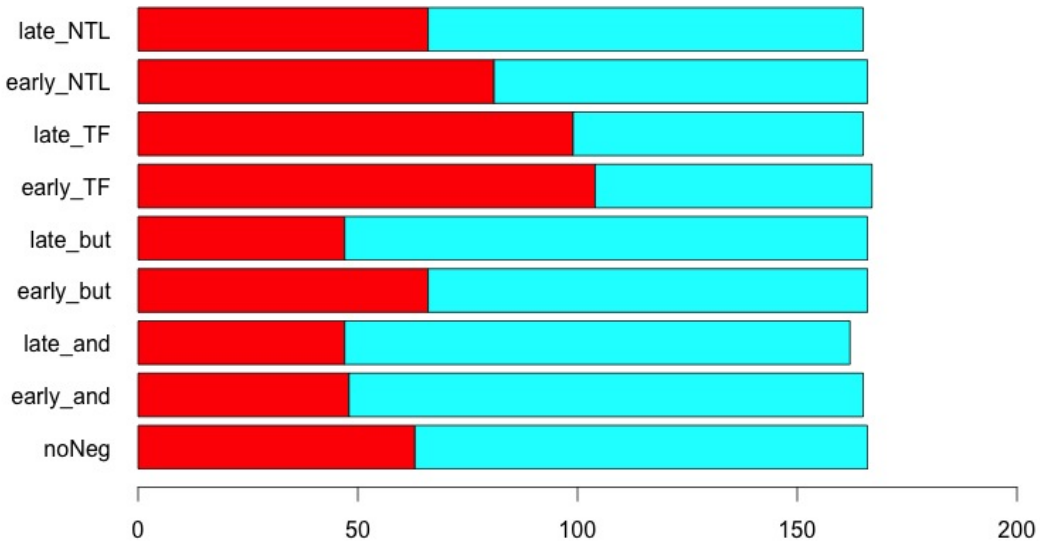


Figure 7: Strict readings for Experiment 2 (TF=therefore, NTL=nevertheless).

7.3.2 Discussion

A number of things are evident. First, the *therefore* and *nevertheless* conditions are all significantly higher than either the *and* or *but* conditions ($p < .001$). This is further support for the coherence account since it is not clear that clauses headed by *therefore* or *nevertheless* are subordinate to their conjunct, which we would expect if they easily allowed for strict readings. Rather, they clearly signal Cause-Effect relations regardless of position of the negation.

Secondly, for *and*-clauses the proportion of strict readings is on par with the data from Experiment 1. This indicates reproducibility in results. It is also consistent with the claim that even with negation, the simple *and*-clauses used here strongly enforce a Resemblance-type relation.

Finally (and most interestingly), the presence of negation in the first conjunct lead to significantly ($p < .02$) more strict readings than when in the second conjunct. Although this happened across all clause types, it was most salient for

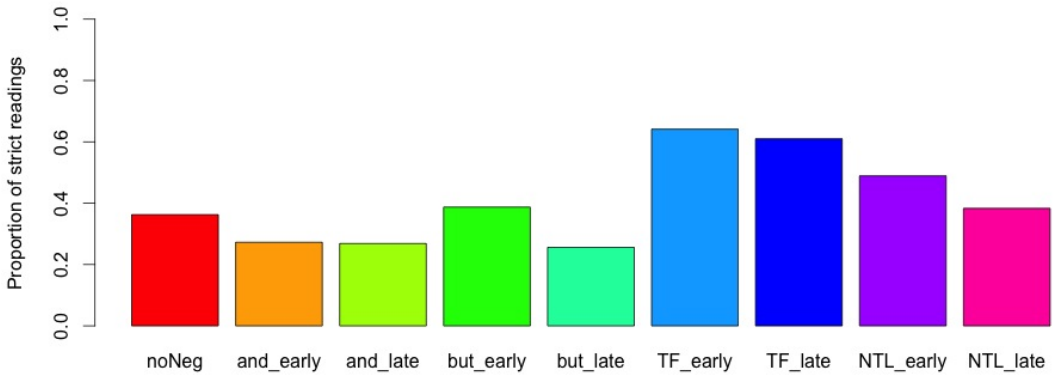


Figure 8: Raw counts of strict readings for Experiment 2 (Red=strict, Blue=sloppy, TF=therefore, NTL=nevertheless).

but-clauses. We mentioned before that *but* can signal either Resemblance and Cause-Effect relations. It is possible that the early negation condition can more easily signal a Violated-Expectation relation than a late negation condition. Thus for a sentence like

(71) John didn't blame himself for the disaster, but Bill did.

the first conjunct can lead to the expectation that since John didn't blame himself, no one should blame him. That expectation is violated by Bill's blaming him.

An alternative explanation fits in with the general distinction between *but* in its *contrastive* function on the one hand, and its *corrective* role on the other (see Vicente 2010). Corrective *but* involves explicit denial of the proposition expressed by the first conjunct plus a related alternative proposition expressed by the second. It is thus a propositional, Cause-Effect-type relation which requires negation in the first conjunct. E.g.

(72) John didn't go to the park, but (rather) he went to the library.

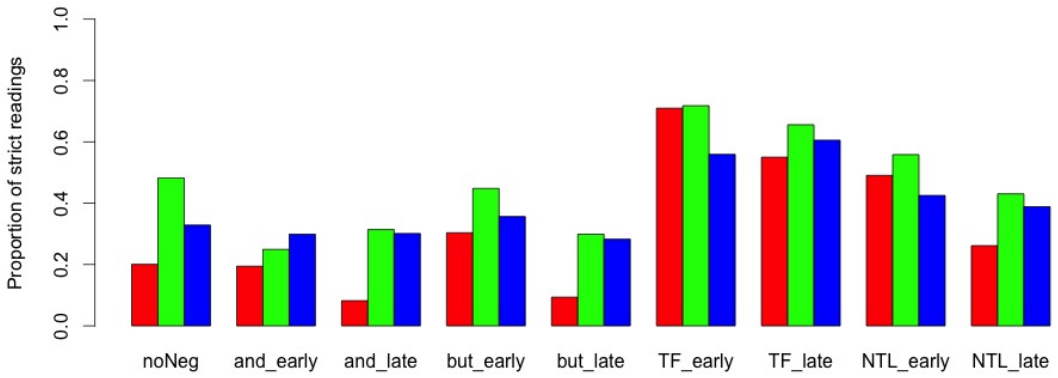


Figure 9: Strict readings for Exp. 2 according to IC-type (Red=IC1, Green=IC2, Blue=NONIC)

Contrastive *but* may signal either a Resemblance relation ('Contrast' in Kehler's sense) or a Violated expectation relation, neither of which requiring negation. An example of the Violated expectation type would be

(73) Randy is a taxi driver, but he has a truck driver license. (from Vicente 2010)

while a clear example of Resemblance would be

(74) Gephardt supported Gore, but Armey supported Bush. (from Kehler 2002)

The propensity of (71) toward strict readings relative to its late negation counterpart may result from the ambiguity of the latter between Cause-Effect and Resemblance relations.

This explanation about the differing effects of Cause-Effect vs. Resemblance relations is also reasonable given that there is a relatively large difference in *but nevertheless* conditions between early and late negation, whereas there is only a very small difference with *and therefore* in early and late negation. That is, the

difference in means for *but nevertheless* was about .11 whereas for *and therefore* it was only .03. The difference may arise because *and therefore* is the strongest signal of a propositional level operator and hence is less influenced by the potential contrasting effect of sentential negation. On the other hand, *but nevertheless* is weaker in this regard and can be interpreted as either Cause-Effect or Resemblance. Here early negation is the stronger signal of a propositional relation compared to late negation. The sentences below illustrate these relations.

(75) John didn't blame himself, but nevertheless Bill did. (Probability=0.49)

(76) John blamed himself, but nevertheless Bill didn't. (Probability=0.38)

(77) John didn't blame himself, and therefore Bill did. (Probabilty=0.64)

(78) John blamed himself, and therefore Bill didn't. (Probability=0.61)

For most conditions there was a statistically significant difference ($p < .02$) between the probabilities for IC1 and IC2, with NONIC in between. The only exceptions were the EARLY & THEREFORE and EARLY & NEVERTHELESS conditions, where the relationship between IC1 and NONIC was reversed, and the EARLY & AND condition, where IC2 and NONIC were reversed. The explanation for these reversals is not clear, since we would need to come up with a reason why the bias toward strict readings switches between (a-b) and (a'-b').

(a) John didn't amuse himself, and Bill did.

(b) John didn't photograph himself, and Bill did.

(a') John didn't amuse himself, and therefore Bill did.

(b') John didn't photograph himself, and therefore Bill did.

The data shows that the observed effect of implicit causality from Experiment 1 is not nullified by negation. Instead, the dampening effect of IC1 is strongest for connectives *and* and *but*, cases where parallel interpretations are generally accessible. Such a large disparity in parallel clauses relative to causal clauses should be seen as an independent contribution by lexical causality to the strict/sloppy bias which is swamped by the higher order discourse relations signaled by *but nevertheless* and *and therefore*.

8 Experiment 3

8.1 Motivation

In order to examine the effects of implicit causality specifically, apart from negation and idiosyncratic choice of verbs, a third experiment was conducted which expanded the number of IC1 and IC2 verbs while eliminating NONIC's. This experiment treated implicit causality as an explicit condition rather than a simple covariate. The synonym classes of both types were expanded and since Experiment 1 favored Kehler's discourse-theory framework for the Causality Effect the number of connective types pared down to just *and* and *so* without regard for considerations of syntactic structure.

8.2 Methods and materials

A 2 × 2 experiment was conducted that crossed IC-type (IC1 vs. IC2) and connective type (AND vs. SO). The IC verbs from Experiment 1 and 2 were reused along with a number of new verbs which rounded out the items to 24 IC1 verbs and 24 IC2 verbs. The list of verbs is Table 19.

IC1	IC2
amuse, disappoint, scare, humiliate, disgrace, encourage, motivate, reassure, fool, calm, inspire, embarrass, confuse, please, shock, startle, let down, flatter, amaze, discourage, astonish, cheat, surprise	hate, pity, like, dislike, thank, help, condemn, apologize, comfort, value, criticize, blame, berate, disparage, laugh at, correct, be disappointed with, disgust, have confidence in, praise, doubt, respect, defend, be hard on, congratulate

Table 19: List of verbs for Experiment 3

8.3 Results and discussion

8.3.1 Descriptive summary and statistical analysis

The raw counts for the experiment are in Table 20 and Figure 10. The results of the Bayesian model are in Figure 11.

Condition	Strict/sloppy	Condition	Strict/sloppy
IC1 & AND	39/213	IC1 & SO	61/191
IC2 & AND	71/181	IC2 & SO	88/164

Table 20: Raw count for Experiment 3

8.3.2 Discussion

The overall impression from the raw counts and Bayesian model confirms the results from the IC portion of Experiments 1 and 2. IC1 verbs overall have a depressing effect on strict readings while IC2 raises them. This effect is on top of the effect of discourse connective and should be seen as independent. The possible reasons for the effect of implicit causality were discussed in Section 6. To recap: VP ellipsis at its basic level is an anaphoric process. When implicit causality verbs are used, part of the anaphor resolution involves finding an argument for the underlying causer of the event. For IC2 verbs, the subject of the first clause

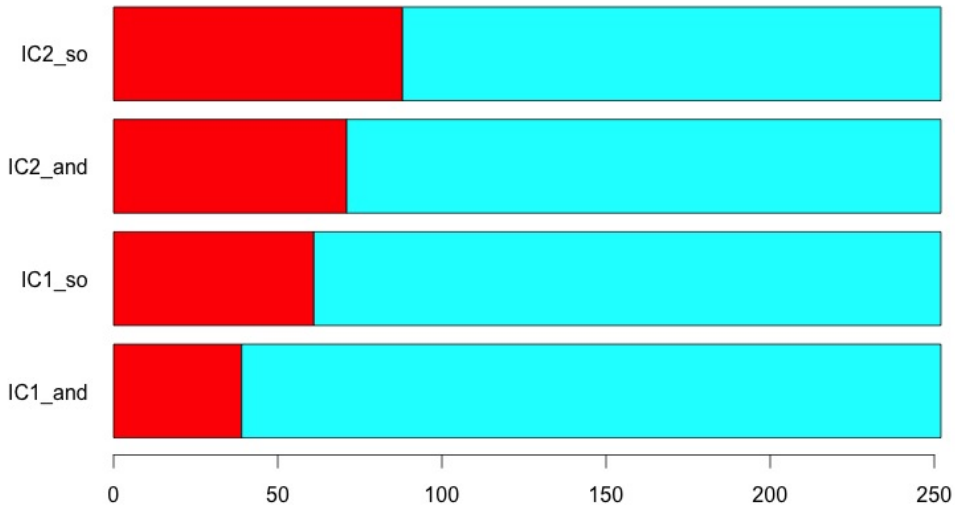


Figure 10: Raw count for Experiment 3

naturally fits the bill and gives rise to strict readings. However for IC1 verbs the required heightened salience of the subject of the elided VP competes with the subject of the source clause in resolving the underlying causer.

The same question from Experiment 1 persists however, regarding the relatively low proportion of strict readings for the SO conditions. We would expect higher proportions if *so* really signaled a Cause-Effect relation in the way *therefore* and *nevertheless* did in Experiment 2. The possibility that it does not, or that experimental design led to a depressive influence from the AND conditions, is a question that should be resolved in follow up studies.

9 Conclusions

The overall theme of this paper has been that discourse relations can play a significant role in the reading of reflexives in VP ellipsis. This is above all true for relations that involve the notion of causality. This influence follows from the way

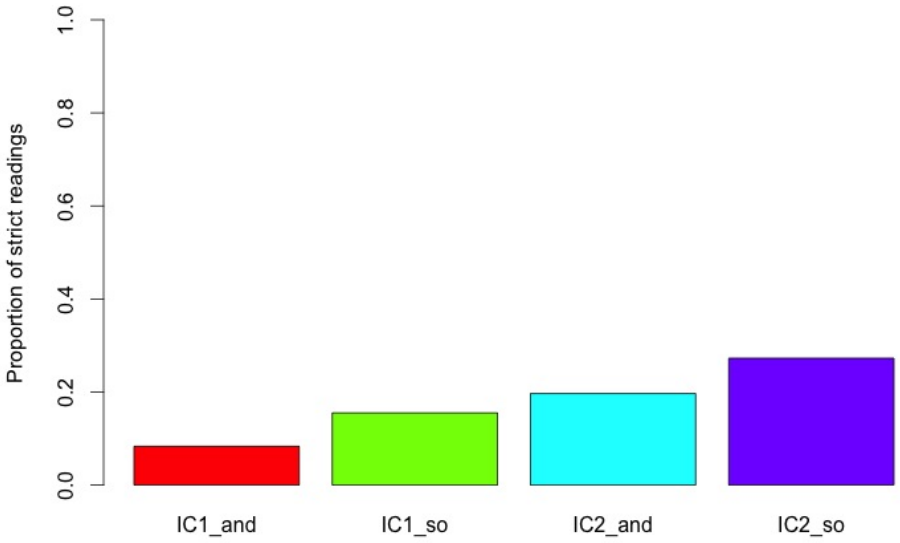


Figure 11: Strict readings for Experiment 3

that causality connects the source and target clause. Resemblance type relations impose structural congruence on verbal arguments that bring in the expected restrictions from binding theory. Cause-Effect relations on the other hand require no such parallelism and relate only the semantic content of the VP's, which is probably the best way to read Kehler's statement that Cause-Effect relations relate clauses 'at the propositional level'.

We have seen that the relevant source of causality can come from at least three sources: the specific discourse connective, the position of verbal negation, and the semantics of the verb itself. While this paper framed the first two factors in terms of two competing theories (Hestvik's and Kehler's) that were grounded in syntax and discourse theory, respectively, the results overall are more interesting and complex than a single side-by-side comparison may warrant. Indeed, while the preponderance of the evidence sides with Kehler's theory, not all of the data can be explained by it (mostly the data coming from *so* in the first and third experiments). The third factor regarding implicit causality is not explicitly ad-

dressed by either theory as well. Thus we have tentative support for a discourse analysis of the Causality Effect plus an interesting side issue that deserves its own investigation, namely how much of the lexical influence can truly be attributed to implicit causality as opposed to a mix of other factors. Given the relatively small number of IC1 verbs used and overall limited semantic range of IC verbs, the lexical contribution may be a confound with other issues related to , say the ability or non-ability to reflexivize various items. Such a question would be an interesting follow up to this research.

A Appendix

A.1 Details of the models

In all 3 experiments a Bayesian model was used to come up with the graphs in the results sections, alongside more traditional point-based estimates for the mean statistics. Both of these will be described for each experiment.

A.1.1 Experiment 1

The mixed effects logistical regression model used for this experiment was as follows. Fixed effects were GAP POSITION (reference level EARLY), CLAUSE TYPE (reference level AND), and VERB TYPE (reference level IC1). Random effects were for subjects and items intercepts. The maximum likelihood estimates are provided in Table 21.

The Bayesian counterpart of the above model assumed uninformative priors for the fixed effects. Each of them was assumed to come from a normal distribution $N(\mu = 0, \sigma^2 = 100)$. The random effects from subjects and items were also assumed to come from a normal distribution $N(0, \sigma^2)$, with σ itself coming from

Random Effects		std. dev.		
	SUBJECTS	0.64		
	ITEMS	1.24		
Fixed Effects		estimate	std. err.	p-value
	INTERCEPT	-1.27	0.36	< 0.001
	GAP POSITION-LATE	-0.15	0.12	0.22
	VERB TYPE-IC2	0.70	0.32	0.03
	VERB TYPE-NONIC	0.48	0.31	0.12
	CLAUSE TYPE-IF	-0.12	0.15	0.44
	CLAUSE TYPE-SO	-0.07	0.15	0.64

Table 21: Coefficients for frequentist model used in Experiment 1 (in logits)

a uniform hyperdistribution $U(0, 100)$. Table 22 gives the estimates of the means, standard deviations, and 95% credibility intervals (CRI) for the fixed and random effects (in logits). [1]

Random Effects		mean	std. dev.	95% CRI
	σ_{subj}	1.37	0.20	(1.04, 1.81)
	σ_{items}	0.73	0.10	(0.56, 0.95)
Fixed Effects		mean	std. dev.	95% CRI
	EARLY & AND	-0.77	0.31	(-1.41, -0.19)
	LATE & AND	-0.99	0.32	(-1.63, -0.34)
	EARLY & IF	-0.87	0.32	(-1.46, -0.24)
	LATE & IF	-1.13	0.31	(-1.71, -0.54)
	EARLY & SO	-0.94	0.30	(-1.54, -0.39)
	LATE & SO	-0.98	0.31	(-1.64, -0.41)

Table 22: Coefficients for the Bayes model used in Experiment 1 (in logits)

A.1.2 Experiment 2

The mixed effects logistical regression model used for this experiment was as follows. Fixed effects were NEG POSITION (reference level NONEG), CONNECTIVE TYPE (reference level AND), and VERB TYPE (reference level IC1). Random effects

[1] Details of the MCMC chain are: 3 chains, 1000 iterations per chain, 500 burn in, 1 thinning.

were for subjects and items intercepts. The maximum likelihood estimates are provided in Table 23.

Random Effects		std. dev.		
	SUBJECTS	0.35		
	ITEMS	0.66		
Fixed Effects		estimate	std. err.	p-value
	INTERCEPT	-0.89	0.27	< 0.001
	NEG POSITION-EARLY	-0.29	0.22	0.17
	NEG POSITION-LATE	-0.58	0.22	0.008
	CONNECTIVE TYPE-BUT	0.25	0.18	0.15
	CONNECTIVE TYPE-TF	1.50	0.17	< 0.001
	CONNECTIVE TYPE-NTL	0.74	0.17	< 0.001
	VERB TYPE-IC2	0.56	0.22	.01
	VERB TYPE-NONIC	0.27	0.21	0.21

Table 23: Coefficients for frequentist model used in Experiment 2 (in logits)

The Bayesian counterpart of the above model assumed the same uninformative priors as in Experiment 1. Table 24 gives the estimates of the means, standard deviations, and 95% credibility intervals (CRI) for the fixed and random effects (in logits).

Random Effects		mean	std. dev.	95% CRI
	σ_{subj}	0.72	0.12	(0.50, 0.95)
	σ_{items}	0.44	0.08	(0.29, 0.61)
Fixed Effects		mean	std. dev.	95% CRI
	NONEG	-0.58	0.21	(-0.97, -0.15)
	EARLY & AND	-1.01	0.22	(-1.45, -0.61)
	LATE & AND	-1.03	0.24	(-1.47, -0.59)
	EARLY & BUT	-0.48	0.23	(-0.92, -0.02)
	LATE & BUT	-1.09	0.24	(-1.50, -0.57)
	EARLY & THEREFORE	0.55	0.22	(0.14, 1.03)
	LATE & THEREFORE	0.44	0.22	(0.03, 0.89)
	EARLY & NEVERTHELESS	-0.09	0.22	(-0.54, 0.31)
	LATE & NEVERTHELESS	-0.49	0.23	(-0.92, -0.05)

Table 24: Coefficients for the Bayes model used in Experiment 2 (in logits)

A.1.3 Experiment 3

The mixed effects logistical regression model used for this experiment was as follows. Fixed effects were VERB TYPE (reference level IC1) and CONNECTIVE TYPE (reference level AND). Random effects were for subjects and items intercepts. The maximum likelihood estimates are provided in Table 25.

Random Effects		std. dev.		
	SUBJECTS	1.48		
	ITEMS	0.55		
Fixed Effects		estimate	std. err.	p-value
	INTERCEPT	-2.30	0.39	< 0.001
	VERB TYPE-IC2	0.84	0.23	< 0.001
	CONNECTIVE TYPE-SO	0.55	0.17	0.001

Table 25: Coefficients for frequentist model used in Experiment 3 (in logits)

The Bayesian counterpart of the above model assumed the same uninformative priors as in Experiment 1. Table 26 gives the estimates of the means, standard deviations, and 95% credibility intervals (CRI) for the fixed and random effects (in logits).

Random Effects		mean	std. dev.	95% CRI
	σ_{subj}	1.67	0.33	(1.08, 2.26)
	σ_{items}	0.60	0.13	(0.34, 0.85)
Fixed Effects		mean	std. dev.	95% CRI
	IC1 & AND	-2.42	0.47	(-3.42, -1.59)
	IC1 & SO	-1.70	0.44	(-2.57, -0.84)
	IC2 & AND	-1.41	0.44	(-2.28, -0.55)
	IC2 & SO	-0.98	0.44	(-1.81, -0.13)

Table 26: Coefficients for the Bayes model used in Experiment 3 (in logits)

A.2 Individual verb counts

Listed in this section are the raw counts for strict readings according to individual verbs.

A.2.1 Experiment 1

IC1		IC2	
humiliate	2	disparage	6
disgrace	3	apologize for	7
amuse	6	correct	7
disappoint	6	condemn	8
fool	7	defend	10
encourage	11	berate	10
reassure	12	doubt	10
motivate	13	blame	10
scare	14	congratulate	13
		be hard on	10
		comfort	13
		laugh at	13
		value	13
		criticize	14
		have confidence in	14
		praise	15
		respect	16
		be disappointed with	21

Table 27: Raw counts out of 31

A.2.2 Experiment 2

IC1		IC2	
disappoint	5	disparage	7
fool	5	be hard on	11
amuse	9	doubt	12
humiliate	9	respect	12
disgrace	9	criticize	13
scare	14	have confidence in	13
encourage	14	blame	14
motivate	16	berate	14
reassure	17	praise	14
		apologize for	15
		value	15
		be disappointed in	15
		condemn	16
		correct	16
		comfort	17
		laugh at	17
		defend	18
		congratulate	20

Table 28: Raw counts out of 31

A.2.3 Experiment 3

IC1		IC2	
humiliate	1	apologize for	2
disgrace	1	disparage	2
embarrass	1	help	3
fool	2	condemn	3
inspire	2	doubt	3
shock	2	dislike	5
amuse	3	criticize	5
encourage	3	comfort	6
disappoint	4	hate	6
motivate	4	correct	6
startle	4	value	7
amaze	4	congratulate	7
discourage	4	berate	7
cheat	4	hard on	7
reassure	5	have confidence in	7
confuse	5	praise	7
let down	5	pity	8
astonish	5	defend	8
scare	6	be disappointed in	9
disgust	6	respect	9
surprise	6	like	10
please	7	blame	10
flatter	7	laugh at	10
calm	9	thank	12

Table 29: Raw counts out of 21

A.3 Items

A.3.1 Experiment 1

Items are reported only for the EARLY & AND condition. Replace the connective and clause order to get the other conditions.

IC1 items

1. Kevin amused himself by telling funny stories and Mike did too.
2. Ann disappointed herself at the performance and Michelle did too.
3. Keith scared himself at the Halloween party and Harry did too.
4. Judy humiliated herself at the company picnic and Sara did too.
5. Andy disgraced himself at the family reunion and Eric did too.
6. Abby encouraged herself to do good work and Christie did too.
7. Danny motivated himself with apt words of encouragement and Kirk did too.
8. Anna reassured herself with words of comfort and Candy did too.
9. Daryl fooled himself with unrealistic promises and Bert did too.

IC2 items

1. Jane condemned herself at the opening hearing and Ann did too.
2. Sean congratulated himself at the award ceremony and Brian did too.
3. Julie apologized for herself at the public inquiry and Allison did too.
4. Sally comforted herself at the family funeral and Clara did too.

5. Sarah valued herself as a loyal employee and Amy did too.
6. Jenny criticized herself in the annual report and Julie did too.
7. Cathy blamed herself for the disaster and Sally did too.
8. Hannah berated herself at the disciplinary hearing and Candace did too.
9. Jill disparaged herself in front of everyone and May did too.
10. Keith laughed at himself during the comedy routine and Aaron did too.
11. Stephanie corrected herself while speaking and Brianna did too.
12. Jason was disappointed with himself for getting poor grades and Mel was too.
13. Mary was hard on herself at the company evaluation and Annie was too.
14. Charlie had confidence in himself during the music recital and Kirk did too.
15. Joanne praised herself for getting all the test questions correct and Andrea did too.
16. Michael defended himself in front of the parole board and Joe did too.
17. Danielle doubted herself in terms of programming skills and Jill did too.
18. William respected himself and Harvey did too.

NONIC items

1. Janice heard herself on the radio and Julie did too.
2. Janet considered herself perfect for the new job and Ann did too.
3. Mike recommended himself to the cabinet position and John did too.

4. Elizabeth promised herself that the team would win the championship and Louise did too.

5. Walter photographed himself in front of the museum and Carl did too.

6. Anne referred to herself as a liberal at the rally and Ellen did too.

7. Susan spoke up for herself at the town hall meeting and Beth did too.

8. Kevin put pressure on himself to get good grades and Charles did too.

9. Danielle saw herself on the video and Dolores did too.

10. William made great demands of himself for the development report and Harvey did too.

11. Samantha voted for herself in the election and Becky did too.

12. Brian compared himself to the other game show contestants and Sam did too.

13. Rachel bought herself a present for Christmas and Sarah did too.

14. Robbie sent himself a reminder about the project deadline and Jack did too.

15. Jill expected herself to graduate in four years and Kristen did too.

16. Paul ranked himself as the number one player in the survey and Jim did too.

17. Abby anticipated herself being on time for the weekly meeting and Megan did too.

18. Becky told herself not to worry and Jane did too.

19. John sketched himself in art class and Bob did too.

20. Sarah mailed herself a postcard from Europe and Amy did too.

21. Robbie accepted himself for who he was and Jack did too.

A.3.2 Experiment 2

The items for this experiment were the same as for Experiment 1.

A.3.3 Experiment 3

The IC1 and IC2 items from Experiments 1 and 2 were reused for this experiment. Additional items are included below.

IC1 Items

1. Kevin calmed himself after the earthquake and Bob did too.

2. Jane inspired herself with eloquent words and Jill did too.

3. Jack embarrassed himself and George did too.

4. Arthur confused himself with the bad directions and Bill did too.

5. Janet pleased herself with her choice of wardrobe and Joy did too.

6. Andy shocked himself with a brazed outburst and Rudy did too.

7. Janice startled herself with her actions and Rachel did too.

8. Alex let himself down and Robert did too.

9. Clara flattered herself with words of praise and Anna did too.

10. Mike amazed himself with a feat of strength and William did too.

11. Brianna discouraged herself from applying to college and Karen did too.

12. Jake disgusted himself with his behavior and Ben did too.

13. Ashley astonished herself with her bold actions and Susan did too.

14. Ken cheated himself out of an easy victory and Gilbert did too.

15. Kate surprised herself with her rash decision and Abby did too.

IC2 Items

1. Karl hated himself and Nate did too.

2. Page pitied herself and Natasha did too.

3. Matt liked himself immensely and Ben did too.

4. Anny disliked herself and Cathy did too.

5. Adam thanked himself for his foresight and Peter did too.

6. Sarah helped herself to do well on the test and Kate did too.

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