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Two interpretive systems for natural language?

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What are the desiderata for a theory of interpretation during language processing? They might include the following, at least:

- explaining how humans compute the meaning of novel sentences, including implausible ones
- characterizing the incrementality of interpretation
- accounting for how interpretation processes relate to conscious awareness
- explaining the existence and nature of widespread context effects
- characterizing the complexity profile of interpretation, e.g. why Downward Entailing (DE) context are more complex than non-DE contexts
- accounting for semantic illusions

Although at present there is to my knowledge no theory that satisfies any of the above criteria, there is interesting psycholinguistic research on several aspects of interpretation, including in the domain of coercion (e.g., Schumacher, 2013), compositional interpretation (e.g., Bemis and Pykkänen, 2011), the role of context effects (e.g., Van Berkum, 2004), an organized body of work on scalar implicatures (e.g., Sauerland and Yatsushiro, 2008) and emerging work on processing presuppositions (e.g., Schwarz and Tiemann, 2013), to name only a few areas. There is thus considerable cause for optimism with respect to developing a theory of language processing that actually pairs a particular syntactic form with an appropriate meaning.

One might distinguish two extreme views of interpretation: one claiming the operation of a largely bottom-up, de-contextualized grammatical composition system at least in the early stages of comprehension, and the other claiming instead that language interpretation rests on context and situation knowledge, in addition to grammar, from the very earliest stages of comprehension. The present proposal is that there are two systems for pairing form and meaning – the familiar compositional system characterized in the grammar, and a system that includes implicit knowledge of the performance system and situation knowledge, in addition to grammatical rules of composition.

In joint work, Chuck Clifton and I have been pursuing the hypothesis that some sentences that sound perfectly acceptable or that appear to have a particular meaning actually involve

^aTo convince this man is necessary (to us).

^bThis man is necessary. (Note the lack of relation between a and b.)

more than just grammatical analysis or grammatical interpretation: they may involve repair, using the same operations required for repairing garden-path sentences (Fodor and Ferreira, 1998). In the present proposal, the idea is that some utterances that are technically speech errors can be corrected and assigned the interpretation of the originally intended utterance. In some cases, these utterances are also acceptable, suggesting the existence of a somewhat automatic speech error reversal system. The proposed analysis implies that in addition to acceptable and unacceptable grammaticality and unacceptable ungrammaticality, a fourth option is needed, namely, acceptable ungrammaticality (see Langendoen and Bever, 1973, Bever, 1976, Otero, 1972, Haider, 2009, for a similar point).¹

For many years now, Chuck Clifton and I have been developing a theory of processing ellipsis. Focusing on the types of ellipsis that may cross sentence boundaries, Verb Phrase Ellipsis, Sluicing and Fragment Answers to questions, we have pursued the hypothesis that the grammar requires the elided constituent and its antecedent to match syntactically, apart from certain morphological features (Williams, 1978, Sag, 1976 though see also Sag and Hankamer, 1984 for a different view).

However, examples of ellipsis without a matching antecedent have been attested, see (1).

- (1) This information could have been released by Gorbachev, but he chose not to.
(Daniel Shorr, NPR, 10/17/92, reported by D. Hardt)

They raise two problems for the approach advocated here. One problem is to explain why listeners and readers tend to accept certain examples like (1) if indeed such examples are ungrammatical, and the other problem is to explain why speakers equipped with a grammar prohibiting ‘mismatch ellipsis’ sentences like (1) would produce them anyway. In what follows, I will argue that the solutions to these two problems are related: speakers utter mismatch ellipsis examples as speech errors and listeners repair such errors, using the same operations implicated in repairing garden path sentences. The repaired utterances are relatively acceptable when they are easy to repair (few operations are needed, with lots of evidence for them, producing a plausible meaning), they sound like a form the human language production system would produce (i.e., like an error humans might be likely to make), and the repaired meaning is plausible and fits with presumed intent of the speaker.

The structure of the paper is as follows. It will be assumed that the grammar requires syntactic matching between antecedent and elided constituent (see Frazier and Clifton, 2005 for some evidence). Section 2 will present evidence that repairs are involved in mismatch ellipsis. Examples will be drawn from our earlier work on Verb Phrase Ellipsis (VPE) and from recent work on fragment answers to questions. We will then turn to evidence suggesting that mismatch ellipsis is a speech error – essentially a syntactic blend, that can be repaired by the processor. However, the ability to repair an input form is not sufficient to

¹‘Acceptable ungrammaticality’ is a theoretical notion whereby the best theory of grammar and best theory of processing conspire to account for how an utterance not generated by the grammar nevertheless tends to be accepted by native speakers at least under some conditions. One reviewer wondered if this notion might be related to the Good Enough processing hypothesis (Ferreira and Patson, 2007) which claims that processing is very shallow, i.e., comprehenders assign only as much structure and interpretation as required given the task demands. In principle, some examples of acceptable ungrammaticality might arise due to shallow processing. However, the claim of the present paper is that comprehenders reverse natural speech errors, not that they process shallowly.

explain why some such examples are also relatively acceptable, and others not. For this, we must take up what is known in general about acceptability judgments, and their determinants, and show how these same factors apply in the case of mismatch ellipsis. Section 3 will move beyond ellipsis. It will be argued that reversing predictable speech errors is not tied to ellipsis but also occurs in other domains. Section 3 will also explore the nature of the error reversal system, addressing questions about whether accepting mismatches – and other repaired utterances – is tied to modality or register. It will also examine the relation between the proposed performance pairing of form and meaning (error reversal) and research on ‘noisy channels’ (e.g., Gibson and Bergen, 2012) as well as the relation to ‘good enough’ processing (Ferreira and Patson, 2007). Section 4 concludes by contrasting the grammatical pairing of form and meaning with ‘performance pairing’ (the latter implicating implicit knowledge of the grammar plus implicit knowledge of the systematic properties of the production system).

2. Acceptable ungrammaticality: mismatch ellipsis

2.1 Mismatch ellipsis implicates repair

There are various reasons to assume that sentences containing mismatch ellipsis are ungrammatical. Although several specific arguments will be noted as we progress, one general argument is that most speakers seem to find the simplest most unadorned cases of mismatch ellipsis to be worst of all, e.g., *The bathroom was cleaned and the janitor did*. This is expected if the structure is not grammatical.

In any case, Arregui et al. (2006) proposed that the processor repairs the antecedent when it does not match the elided constituent. This hypothesis predicts that sentences requiring more repairs should be less acceptable. They tested sentences like those in (2) in a self-paced acceptability judgment study, where readers read each sentence clause by clause and then decided whether the sentence was a good sentence of their language or not.

- (2)
- a. None of the astronomers saw the comet, /but John did. (Available verb phrase)
 - b. Seeing the comet was nearly impossible, /but John did. (Embedded verb phrase)
 - c. The comet was nearly impossible to see, /but John did. (Verb phrase with trace)
 - d. The comet was nearly unseeable, /but John did. (Negative adjective)

In (2a), there is an acceptable VP antecedent for the elided VP after *did*; in (2b) there is a VP embedded inside the nominal; in (2c) there is a trace after *see* in the antecedent clause but it must be replaced by its ultimate binder to produce the desired antecedent *see the comet*; in (2d) the desired VP antecedent would need to be built from scratch, using a verb that is available only by de-constructing the adjective *unseeable*. In short, sentence (2a) requires no repair to arrive at a matching antecedent (*see the comet*) for the elided VP after *did*. In (2b) the processor must in effect undo the nominalization, assuming that the subject nominal phrase contains a VP inside it. In (2c) to create a matching antecedent, the trace after *see* must be bound by an empty operator which is itself related to its ultimate binder *the comet*. The trace must be replaced by *the comet*. In (2d) a matching antecedent could only be created by ripping the verb *see* out of the word *unseeable* and creating a VP headed by *see*. Thus on a repair approach to ellipsis, acceptability should drop systematically from a to d, reflecting the number of operations the processor must perform. The results confirmed the

prediction, with 83% acceptable responses for a, dropping to only 17% for d, with each pairwise contrast being significant.

In subsequent studies, Arregui et al. showed that the results could not be due to the antecedent alone, and they presented further findings, e.g., showing that VP ellipsis examples with verbal gerundive antecedents were more acceptable than ones with nominal gerundive antecedents, as expected if examples requiring more repairs are less acceptable than ones needing fewer repairs.

We turn now to an argument from fragment answers to questions. Fragment answers to questions such as (3a) involve ellipsis. Merchant (2004) argued that the answer is fronted to a focus phrase, and the rest of the sentence is elided.

- (3) Speaker A: What did John deny?
 Speaker B: a. That he had lied.
 b. *He had lied.

- (4) a. That he had lied, John denied.
 b. *He had lied, John denied.

This explains why (3a) is an acceptable fragment answer and (3b) is not, because, as shown in (4), a clause may front when it has an overt complementizer (3a,4a) but not when it does not (3b,4b). Since only constituents move, as illustrated in (5a), Merchant's analysis predicts that only constituents can be fragment answers, as illustrated in (5b).

- (5) a. *And sour-I, John likes the sweet ____-I combo.
 b. Speaker A: Does John like the sweet and spicy combo?
 Speaker B: *No, and sour.

Movement is not generally permitted out of an island, as illustrated in (6a), and thus fragment answers implicating movement out of an island is not permitted, as in (6b = Merchant's (87)).

- (6) a. *Who does Abby speak the same Balkan language that __ speaks?
 b. Speaker A: Does Abby speak the same Balkan language that Ben speaks?
 Speaker B: *No, Charlie.

In languages lacking Preposition-stranding in overt movement, such as German (7b), fragment answers implicating Preposition-stranding should be ungrammatical, as in (7d).

- (7) a. Speaker A: Mit wem hat Anna gesprochen?
 with who(m) has Anna spoken?
 b. Speaker A: *Wem hat Anna mit gesprochen?
 who has Anna with spoken?
 c. Speaker B: Mit dem Hans. with the Hans ('With Hans.')

- d. Speaker B: ?? Dem Hans. the Hans ('Hans.')

Merchant, Frazier, Clifton and Weskott (2013) tested the prediction that Question-Answer pairs like that in (8) should be ungrammatical.

- (8) Speaker A: What did Kylie concede?

- Speaker B:
- a. That she took the keys.
 - b. She took the keys.

In a written acceptability judgment study, (8b) received significantly lower acceptability ratings (3.73) than (8a), which received a mean of 4.25.² As predicted by Merchant (2004), an elided answer ('direct fragment answer') is fully acceptable only when the answer is a constituent that grammatically fronts to the beginning of the sentence.

One might wonder whether some simpler theory of fragment answers might be possible. For example, one might propose that the answer need only be constrained by being a well-formed constituent that MIGHT in principle be expanded into a full (non-elided) direct answer to the question. But notice that it is not sufficient to say that the answer is acceptable just in case it is a fragment that might be expanded into a full grammatical answer because the *that*-less replies in the English study discussed in connection with (8) also would satisfy such a constraint.³

Frazier and Clifton (submitted) report an eye movement recording study of Question-Answer pairs like (9), crossing the presence/absence of the complementizer with the presence/absence of ellipsis.

- (9)
a.	Ellipsis+that:	Speaker A:	What did Meg infer about school recitals?/
		Speaker B:	That/ she should go to school recitals/ whenever she can./
b.	Ellipsis-that:	Speaker A:	What did Meg infer about school recitals?
		Speaker B:	She should go to school recitals whenever she can.
c.	No ellipsis+that:	Speaker A:	What did Meg infer about school recitals?
		Speaker B:	She inferred that she should go to school recitals whenever she can.
d.	No ellipsis-that:	Speaker A:	What did Meg infer about school recitals?
		Speaker B:	She inferred she should go to school recitals whenever she can.

The predicted penalty for no complementizer fragment answers (9b) was observed in first pass data in the region *she should go to school recitals*, and the number of fixations in this region, as well as in later measures. This result suggests that readers detect the ill-formedness of mismatch pairs as they process the sentence, not just in some later deliberative judgment task.

Having presented evidence about the structure of fragment answers, we can now turn to a study of fragment answers that implicates repair in the analysis of ungrammatical fragment answers such as (10b,d). In this study, the fragment answer contained a Negative Polarity

²Indirect replies, which do not fully answer a question but only comment on it, are also possible in principle as in (I), but they are not sensible in our materials (see original paper).

(I) Speaker A: Who left?
Speaker B: Harry's jacket is gone.

³Similarly, an alternative account claiming that a fragment answer must only be a well-formed constituent and supply the missing information requested by the question will not suffice as an account of fragment answers: in a study of German fragment answers, a DP answer such as (7d) to a PP question was rated as significantly less acceptable than a PP answer, despite satisfying the potential alternative account (see Merchant et al. for details).

Item (the NPI *any* or *ever*) in half the a and b forms, but a non-NPI indefinite in the c and d forms.

(10) What would Brian deny?

- a. That Tim should hire any help.
- b. Tim should hire any help.
- c. That Tim should hire some help.
- d. Tim should hire some help.

In a written judgment study (Clifton and Frazier, in progress), the expected penalty for not having an overt complementizer was observed, as may be seen in Table 1. However, the forms containing an NPI were slightly **better** in the fragment answers than the forms not containing an NPI, though the interaction was only marginal. Since the NPI is only licensed if indeed the answer is interpreted as a fragment answer, and hence under the scope of the negative verb in the elided clause, the very presence of the NPI may have served as more evidence that a repair was needed, i.e., that indeed the speaker intended a fragment answer even though she failed to include an overt complementizer. In general the difficulty of repairs depends on the number of repairs needed, and the amount of evidence for the repairs (Fodor and Ferreira, 1998, Frazier and Clifton, 1998) and thus no new principles are required to explain the result.

In short, in both VP ellipsis and fragment answers, there is evidence that acceptability depends on repair, i.e., the number of repairs that must be made to restore grammaticality, or the amount of evidence for those repairs.

2.2 Mismatch ellipsis as a speech error: syntactic blends

There is a small but interesting literature on syntactic blends (Fay, 1982, Cohen, 1987, Coppock, 2006, Cutting and Bock, 1997, Kawachi, 2002, Paglia, ms., Bock, 2011). Although estimates of the frequency of blends varies, blends may make up approximately 20% of syntactic errors, and 4% of all speech errors (at least in Kawachi, 2002, with higher estimates from the Frankfurt corpus and Paglia, and lower estimates in work on blended idioms, Cutting and Bock, 1997).⁴ In any case, what matters for present purposes is not whether syntactic blends are particularly frequent but whether ‘anything goes’ when two utterances are blended together. Very clearly, the answer is ‘no’. Coppock (2006) proposes a syntactic alignment analysis of blends where they result from two utterances competing for the same syntactic slots. She tests it on 2,000 blends collected by Cohen and shows that her syntactic alignment system can correctly distinguish actual blends from non-occurring mixtures of the same sources with 85% accuracy. This argues persuasively that blends are structured and two source utterances do not combine randomly to produce a blend.

⁴Estimates of how many utterances adults hear per year seem to hug the million mark. This suggests that even relatively infrequent events may occur with sufficient regularity to influence the performance system. Hart and Risley (1995) found that children hear an average of 340 utterances per waking hour. In recent discussions of acquisition, ‘poverty of the stimulus’ arguments have come under attack because even rare utterances are probably heard a few times a day or week Pullum and Scholz (2002).

Returning to the case of mismatch ellipsis, the question is why speakers would ever produce such examples if indeed they are ungrammatical? The proposal here is that they are produced as speech errors, specifically, syntactic blends. If they are produced as errors, then we might expect passive-active mismatches to be more acceptable than active-passive ones, since people misremember passives as actives more often than the reverse (Mehler, 1963). Arregui et al. tested this prediction in a written acceptability rating study using sentences like those in (11), varying the order of mismatch ellipsis (passive-active vs. active-passive).

(11)	a. The dessert was praised by the customer after the critic did already.	3.34
	b. The dessert was praised by the customer and the critic did.	1.55
	c. The customer praised the dessert after the appetizer was already.	1.97
	d. The customer praised the dessert and the appetizer was.	1.39

The study also looked at whether the presence of a presupposition trigger (already in (11)) would increase acceptability, as it should if indeed mismatch ellipsis is ungrammatical, and therefore facilitated by the presence of an implied context where a grammatical antecedent might be found. Both predictions were confirmed. For alternative theories of voice mismatches, see Kim et al. (2011), Merchant (2013) and San Pietro, Merchant and Xiang (2012).

If mismatch ellipsis is produced as a speech error, then it might be expected to be particularly common in cases where the speaker is systematically confronted with more than one way to syntactically formulate a given message, as in the case of active-passive variants. Conjunction is another such case. When a speaker wants to predicate two properties of a referent, typically it would be possible to use either conjoined VPs, as in (12a), or conjoined clauses with co-referential subjects, as in (12b). In this sense, conjoined VP sentences and conjoined clauses with co-referential subjects are systematic alternatives. Thus, we might expect speakers to utter an antecedent clause in one form, forget which form had been adopted, and use an elided form even when it was not licensed, i.e., when it was only **licensed by the unchosen structure**.

Examples like those in (12 a,b) were investigated in order to test this prediction. In a self-paced reading study, sentences like those in (12) (12c,d were included for independent reasons) were tested.

(12)		
	% Conjoined antecedent	
a.	Ian travels in winter and stays home in summer. George does too.	84%
b.	Ian travels in winter and he stays home in summer. George does too.	86%
c.	Ian travels in winter. He stays home in summer. George does too.	55%
d.	Ian used to travel in winter. He stays home in summer. George does too.	32%

Each sentence was followed by a question, e.g., *What did George do?* with two paraphrases indicating possible answers (Frazier and Clifton, 2011b). Not surprisingly, for examples containing conjoined VPs, the conjoined VP answer was selected 84% of the time. But, in the conjoined clause examples (12b), conjoined VP answers were selected equally often, even though no conjoined VP antecedent was present. This suggests that readers could easily repair forms like (12b), recognizing that the VP ellipsis is actually licensed by the

unchosen conjoined VP form. Of course, an account of ellipsis not requiring a syntactically matching antecedent might also account for this result, but it would fail to explain why mismatches are tolerated particularly in cases where the production system has systematic alternative syntactic formulations to choose from but not in cases like (12c,d).

2.3 Acceptability judgments

Recognizing that an input is an utterance that might have been the erroneous output of the human language production system, and being able to repair the error, is not sufficient to explain why certain ungrammatical utterances seem to be relatively acceptable, e.g. (1). To understand why some repaired forms sound acceptable and others don't, it's necessary to understand what influences acceptability judgments.

The familiarity of a form influences judged acceptability. Luka and Barsalou (2005) reported five experiments, in which participants read grammatical sentences first and then rated novel sentences. Mere exposure to a sentence, or to a sentence structure with different words, resulted in higher ratings. E.g., *Egor lugged Dr. Frankenstein the corpse* was rated higher after reading semantically and lexically unrelated sentences that had a double object structure; *What the pharmacist recommended is to read the directions* was rated higher after reading sentences that had a pseudo-cleft structure.

An utterance is rated as more acceptable if it corresponds to a natural speech error than if it does not (Frazier 2008a). In a two-item experiment with Chuck Clifton, we tested examples like (13a), an actual speech error heard on National Public Radio, and (13b).

- (13)
- a. If you think this is going to solve the terrible problems in Najaf, we're deluding ourselves.
 - b. If we think this is going to solve the terrible problems in Najaf, you're deluding yourself.

In (13a), spoken during an interview, it was clear that the interviewer got to the main clause subject and substituted *we* for *you* in order to avoid insulting his guest. In (13b), however, the same mismatched subjects appear as in (13a), but (13b) would only be produced if the speaker went out of his way to insult his guest. Consequently (13b) is not a natural speech error. In a written acceptability judgement study, (13b) was rated significantly less acceptable (3.37) than (13a), which received a rating of 4.05 (on a scale from 1 to 5 where 5 is perfectly acceptable).

Question Under Discussion (QUD) and 'Non-actuality implicatures'—If it is true that naturally attested mismatch ellipsis examples are syntactic blends, which are strictly speaking ungrammatical, then we might expect the acceptability of such forms to be increased by properties that draw attention away from syntactic form (and to be judged worse in circumstances that draw attention to linguistic form such as formal register, see below). In a series of experiments, Grant, Clifton and Frazier (2012) showed just such effects. Introducing a 'non-actuality implicature' using items like *wants to X*, *should X*, *needs to X*... which imply that the state of affairs described, X, does not hold in the actual world (see Giannakidou 1998, 1999 for discussion of the class of items that induce non-veridical environments), and invites the question 'Is X the case?'. Grant et al. suggest that this implicit question focuses attention on the answer to the question, e.g., John wanted to quit (and/but he did/didn't), and they show that the presence of a non-actuality implicature

trigger did indeed increase the acceptability of mismatch ellipsis. Further, the facilitation effects due to the presence of a non-actuality implicature trigger in mismatch ellipsis may be observed online during the reading of the (mismatch) ellipsis clause. In short, mismatch ellipsis improves under conditions where attention is directed away from linguistic form.

The repair results in a plausible meaning/is tied to the speaker's intention—

Garnham and Oakhill (1987) found that mismatch ellipsis answers were given by participants only when the analysis would result in a plausible interpretation. Participants read normal (*child*) or 'misleading' (*nurse*) discourses like (14) and answered questions about the ellipsis clause.

- (14) It had been a busy morning in the hospital. The elderly patient had been examined by the doctor. The child/nurse had too.

Participants at times gave incorrect answers for misleading subject examples (*The nurse had too*), interpreting the nurse as the agent rather than the patient of examine, but they didn't give any such interpretations to the 'normal' (*child*) examples. The results indicate that participants assigned the interpretation that goes with a repaired input only when that interpretation was plausible.

In this section, it has been shown that the acceptability of an ungrammatical form depends on its likelihood or naturalness as a speech error, on the ease of repairing the error, on plausibility, and on whether attention is directed to form. These factors determine whether an input that can be repaired sounds acceptable.

3. Beyond ellipsis

Speakers are regularly confronted with systematic alternative ways to formulate an utterance, and blend the alternatives. Some examples I've collected appear in (15).

- (15)
- a. "is sufficient enough for"
 - b. "pales next to comparison of"
 - c. "She can't afford to be able to do it."
 - d. "their lack of inexperience"
 - e. "I'm going to get some bed." I'm going to go to bed/to get some sleep.
 - f. "I want to hear you about" ("I want you to hear about/ I want to tell you about)
 - g. "Don't let them in if they are have a forehead tattoo" if they are Charles Manson/if they have a forehead tattoo
 - h. "Israel and Palestine are much more shakier"
 - I. (Obama and Cameron) "will look at each other in the eye and say"
 - j. "He didn't do enough to stop this tragedy being averted" on BP Gulf oil crisis--Tina Brown

Reversing predictable speech errors is not tied to ellipsis

In a language like English, speakers must choose between using a determiner quantifier (*everyone, nobody*) or an adverbial quantifier (*always, never*). Sometimes both show up in the same (blended) utterance, as in (16).

- (16) Doubled quantifiers in attested blends

- a. “Many people often thought that you use whipped cream pie” (National Public Radio, discussion of clowns and pie throwing)
- b. “Typically when I meet people I often ask people what they would talk about if this wasn’t a job talk” (Introduction to a University of Massachusetts colloquium, 3-22-10)
- c. “...and it might not require scientific research to infer that the majority of sarcasm one encounters is usually spoken.” (Undergraduate paper, University of Massachusetts, Spring, 2010)

Frazier and Clifton (2011a) investigated the interpretation of sentences with doubled quantifiers in a written interpretation study using examples like (17), and counterparts using *all-ever*, *few-seldom* or various forms of doubled negation.

(17) Many students often turn in their assignments late.

What did that mean?

- A. The number of students who turn in their assignments late is large.
- B. The number of students who frequently turn in their assignments late is large.

The results are shown in Table 2.

Another example of speech error reversal, pointed out to us by Greg Carlson, involves sentences like (18). People fail to notice the grammatical interpretation of the sentence, where the mother kills the child by preventing her from almost drowning.

(18) Mother saves child from nearly drowning.

(19) Prevent X from happening/X almost happened

- a. Mother saved the child from nearly drowning.
- b. Mother saved the child from drowning.

In a written study (Clifton and Frazier, in progress) where participants indicate whether sentences were “o.k., acceptable” sentences, overwhelmingly people accepted sentences like (19a) as well as sentences like (19b) (see (21) below for data). This result like the quantifier undoubling result suggests that comprehenders reverse common or natural errors, assigning interpretations that would be ungrammatical if the reversal did not take place.

It’s possible that acceptable ungrammatical sentences, such as mismatch ellipsis or prevent-near-culmination sentences on the present analysis, are more common in spoken language and perhaps more generally in informal registers whether spoken or written than they are in formal especially edited language. In formal registers, however, it is expected that the producer (speaker or author) will do the work rather than the comprehender. As a result, we might expect that mismatch ellipsis and other ungrammatical blends will be rated as more acceptable in informal registers that encourage repairs than in formal registers where perhaps comprehenders may be less inclined to undertake repairs. Chuck Clifton and I have recently begun to test this hypothesis using mismatch ellipsis sentences, quantifier doubling and prevent–near–culmination sentences (18). In order to manipulate register, filler items were marked for either a formal or for an informal register as illustrated in (20) in a between subjects design (in order to test identical sentences in either a formal or informal ‘setting’).

(20) Formality manipulation examples

- a. In the US, a doctor must pay for his or her education./US doctors gotta go into debt to pay for their education.

- b. The professor typically lectured in a formal style./The prof usually lectured pretty formally.

We tested whether the acceptability of acceptable ungrammatical sentences is higher in an informal register. At present, despite testing 30 participants in the informal register condition, the study containing fillers that are marked for an informal register, and testing 30 participants in the formal register condition, with fillers marked for a more formal register, the crucial interaction where the blended form benefits more from an informal register than does its unblended counterpart, was not significant. However, the numerical effects went in the predicted direction: when there was a difference between registers it was larger numerically for blended examples than for their unblended controls. The study also showed that reversal of the prevent-near-culmination blend was robust: as shown in (21), the blended forms like (21a) were accepted 98% of the time in the informal register condition. As expected they were accepted somewhat less often (88% of the time) in the (written) formal register condition.

(21)

	Informal	Formal
a. A mother saved her child from nearly drowning.	98%	88% yes(=acceptable)
b. A mother saved her child from drowning.	98%	96%

Together with Chuck Clifton and Katy Carlson, the experiment was re-run in the auditory domain, this time using both the nature of the fillers and phonetic cues to manipulate register (primarily whether voiceless stops were released or not). The results were comparable to what was found in the visual study in finding very high acceptance for the blended sentences.

In a separate written acceptability judgment study, two sets of sentences were tested, each based on an actual speech error. One set of 12 sentences was based on a blend between a possessive pronoun (*his car*) and a clausal alternative based on a verb of possession (*the car he has*), as illustrated in (22a).

(22) “his X that he has”

- a. Because the his extraordinary vision that he has, he wins.
- b. Because of his extraordinary vision that he hides, he wins.
- c. Because of the extraordinary vision that he has, he wins.

The blended form was compared to a minimal pair involving a non-possessive verb (22b) and a minimal pair lacking the possessive pronoun (22c). In a counterbalanced design, 42 participants rated written sentences. Mean ratings on a scale of 1–5 where 5 is fully acceptable showed that the blended form (22a), which received a mean rating of 2.35, did not differ from the verb-replaced form (22b), which received a mean rating of 2.30, but it was rated as significantly less acceptable than the pronoun-replaced form (22c), which received a rating of 2.84. The results suggests that blends in general, not just in the case of ellipsis, tend to be rated as being relatively acceptable. However, in the same study, eight (*except not*) examples like (23a), based on an actual blend observed by Chuck Clifton, were tested, along with the expected grammatical form (23b).

(23) “except not”

- a. Everyone left except not Harry.
- b. Everyone left except Harry.

In this case, the blended sentences like (23a) received a mean rating substantially and significantly lower (0.86) than the unblended counterpart (4.14), indicating that participants in this case (the same participants as rated (22)), did not find the blended utterance acceptable at all. Like the doubled negation quantifier examples, participants were not fooled into accepting doubled negation. We suspect, that this is because students are taught in school not to use double negatives. It is interesting that, apart from examples involving negation, the acceptability ratings for sentences with natural speech errors show little or no acceptability penalty relative to grammatical controls. In the present paper, the focus has been primarily on syntactic blends, but others types of errors, such as local plural errors, seem to show similar behavior (Perlmutter, Garnsey and Bock, 1999, Wagers, Lau and Phillips, 2009 among many others).

The speech error reversal system proposed in Section 2 based on mismatched ellipsis data is clearly not restricted to the domain of ellipsis. Predictable speech errors seem to be reversed generally, at least when they do not involve negation. Non-ellipsis examples tested to date include doubled quantification, prevent-near-culmination examples, and ‘his X that he has.’

Additional evidence that input is likely to be repaired and accepted in particular in cases where the speech production system regularly faces a choice between two or more ways of syntactically formulating the same message comes from a pilot study⁵. Acceptability ratings of individual examples of actual blends, those in (24) and their corrected counterparts, were rated in a written acceptability judgment study, using a scale of 1–5 (5 = “good”).

(24)

Systematic competitors –predicted small penalty:		(Rating)	Penalty
a.	Three pounds is sufficient enough for many loaves of bread. is sufficient for...	(2.94)	0.65
b.	That insult pales next to comparison of what Jesse said. ...pales next to what...	(2.32)	1.75
Non-systematic competitors –predicted larger penalty:			
c.	I’m going to get some bed. ...get some sleep.	(1.69)	3.22
d.	I want to hear you about Mr. Chilton. ...want to tell you about	(1.64)	3.30

38 participants were tested. The question was whether ratings would be higher for forms involving systematic competitors between alternatives as in (24a,b) vs. examples without clear systematic alternatives for the same message (24c,d). (Only ‘systematic competitors’ will generally permit the alternative syntactic formulation independent of the particular lexical terminals.) The mean for each example is presented after the example in (24), which also provides the penalty for the blend, i.e., the difference between the mean rating for the blend and the mean for its grammatical counterpart (given under each example in (24)).

⁵Thanks to Andrew Weir for collecting these data.

Specifically, the question was whether the penalty for syntactic blend, would tend to be smaller when the blend involved syntactic formulations that are systematic competitors. For example, ‘is sufficient to/for X’ and ‘is enough to/for X’ provide alternative ways of formulating a message, independent of the content of X. Similarly, ‘Y pales next to X’ and ‘Y pales in comparison with X’ compete regardless of the particular complement (the particular X). By contrast, ‘I’m going to X’ and ‘I’m going to get some X’ are not systematic competitors; when X is replaced by ‘water’ for example, or most nouns, the two forms no longer correspond to competing formulations of the same message. The prediction that the systematic competitors (24a,b) would result in a smaller penalty than the non-systematic ones (24c,d) was confirmed in the pilot data, providing a bit of suggestive evidence from a domain beyond ellipsis that repairing systematic errors is easier – or at least accepting the output is more likely – than with less common or less systematic errors.

4. Relation to other work

Many investigators have proposed a role for the language production system in language comprehension. Gennari and MacDonald (2009) argued that in circumstances where speakers might passivize a clause, and thus not produce an object gap relative clause, object gap relative clauses are particularly hard to parse (i.e., in sentences with an inanimate theme, and an experiencer verb, as in (25)).

- (25) The director that the movie pleased received a prize.

This picture of sentence comprehension suggests an important influence of production choices on the comprehension of sentences. Pickering and Garrod (2013) argued that normal comprehension involves simulation of one’s own production of language, with forward predictions drawn at each level of representation and matching of the input with prediction. Garrett (2000) argued that the language production system acts as a filter on comprehension: lexical items and basic phrase structure identified by the recognition system, along with context, are fed to the production system for identification of candidate sentence structures. Like the present work, all of these proposals emphasize that understanding how the human production system works will be essential to a full understanding of language comprehension.

Another set of findings that may be closely related to the speech error reversal system proposed here concerns the ERP effects that have been observed with reversal of stereotypical arguments. For example, Kim and Osterhout (2005) found a P600, a component also found in sentences containing syntactic garden-paths, in (26a). On the other hand, (26b), which contains a semantic anomaly, only showed the expected marker of semantic anomalies (the N400).

- (26) a. The hearty meal was devouring the kids.
b. The dusty tabletops were devouring

If the stereotypical arguments in (26a) are taken as evidence that the speaker intended a plausible sentence in which the kids devoured the hearty meal, it is not surprising on the present view that the processor responds to the sentence in a manner similar to sentences in need of repair. (Whether this is indeed the right analysis of the result is a highly

controversial issue. See Kaan and Swaab, 2003, Brouwer, Fita and Hoeks, 2012, and Phillips and Lewis, this volume, for relevant data and discussion.)

Various recent studies of language comprehension have been based on the idea that language involves a noisy channel, where the input, or the perceiver's encoding of it, cannot be trusted completely (Levy, 2008). Gibson and Bergen (2012) presented data suggesting that participants are more likely to accept an interpretation of an input when it involves a small likely deviation from the input, e.g., a deletion is more likely than an insertion, and an insertion is more likely than both a deletion and an insertion. (See also Doyle and Levy, 2012.)

Although it might appear that this work completely dove-tails with the current proposal, the Gibson and Bergen proposal, at least, does not rely on the properties of the human production system. Thus, on their view, all deviations from the input should be ‘symmetric’. E.g., the Najaf example in (13) above should not differ depending on whether it is the first-clause subject or the second clause subject that avoids *you*. Also, the naturalness or systematicity of a speech error, or the plausibility of the intended message, should not matter on the Gibson and Bergen proposal. On the other hand, it is not surprising on a speech error-based proposal, like the present one, that an interpretation requiring fewer repairs, or easier repairs, should be more likely to be accepted than an interpretation requiring more repairs or harder repairs.

To sum up, various sources of evidence suggest predictable speech errors involving a blend of two competing forms are repaired by listeners. The interpretation that goes with the repaired utterance is only accepted as a possible interpretation when it is a plausible interpretation. This stands in stark contrast with unrepaired utterances that are paired with their meanings by the compositional semantic interpretation of the actual utterance. In other words, the performance based pairing of form and meaning is token-based, and it relies on the performance systems (competing morphological or syntactic forms in production, comprehension repair mechanisms based in part on knowledge of the speaker's probable intent) together with the compositional semantics to pair form and meaning. In the case of mismatch ellipsis, the repair involves licensing of a later form based on the unselected form of the antecedent clause, as illustrated in (27).

- [illegible]

Given a particular message, two forms are available for expressing the message (active-passive; conjoined VP-conjoined clause). The speaker chooses one form but a later (ellipsis) clause is licensed only by the unchosen form. By hypothesis, it is implicit knowledge of human language performance systems that allows the comprehender to repair the form, as if 'reading through' the error.

Error reversal repair is NOT a form of sloppy or 'good enough' processing

Ferreira and Patson (2007) among others have argued that the processor assigns only as much structure or interpretation to a sentence as is required for a particular task (see Frazier, 2008b, for a critique). The sentence in (28) is not likely to be produced as a speech error if

the intended meaning is ‘*the girl kicked the table*’ because normal sentence production mechanisms favor conceptually accessible phrases, such as those that are given, human and imageable, and thus normal production mechanisms would not tend to anticipate *table* or make *table* the subject in an utterance like (28).

(28) The table kicked the girl.

If sloppy interpretation rather than error reversal is at work, then sloppy interpretation should apply in (28) to produce a plausible interpretation. However, if reversal of a natural speech error is implicated, (28) should just be assigned an implausible meaning.

In a pilot study, 10 undergraduates were asked to rate how likely various sentence forms are to be produced with a particular intended meaning (on a scale from 1 = never to 5 = very likely). Example (28) was always rated as “never” in terms of being a likely error given the intended meaning the girl kicked the table. In a separate paraphrase selection pilot study with 10 different participants, all but one response indicated that the table was the agent of an event of kicking the girl. Clearly, comprehenders are not just treating sentences like word salad or normalizing them in an unsystematic fashion.

Why care?

‘Performance pairing’ of forms and meanings has distinct properties from the pairing imposed using the grammar alone. The grammar-alone system is type based, it produces plausible and implausible interpretations, specific knowledge of the speaker’s intent is unnecessary, and there is no need for competing forms, no need to direct attention away from form.

(29)

Grammatical pairing	Error reversal (‘performance pairing’)
-type based	-token based
-plausible and implausible	-plausible only
-speaker’s intent unnecessary	-speaker’s intent is crucial
-no need for competing forms	-most likely with competing forms
-directing attention to form ok.	-best when attention is not directed to form
-limited individual & register variation	-considerable variation

In contrast, performance pairing of form and meaning is token-based, it delivers plausible meanings only, and the speaker’s intent is crucial. It is most likely with blends involving forms that systematically compete as alternative formulations of a message, and is most acceptable when attention is directed to content, not form. (There also may be considerable variation with respect to the operation of this system, and possibly its availability across individuals, registers and other sociolinguistic circumstances.)

Recognizing the existence of acceptable ungrammaticality, such as the acceptable errors discussed here, means that certain attested utterances are explained outside the grammar proper, thereby permitting a much simpler grammar than would otherwise be possible. The present approach also offers a more nuanced account of the data explaining why only particular tokens of a structure (or interpretation) may be acceptable.

It has been argued here that alongside the type based grammatical system for pairing form and meaning, we must recognize the existence of a token based system that allows certain utterances to be patched up before they are interpreted. The resulting view of language is one that is more dynamic than one that abstracts away from systematic properties of the performance system: in principle the output of the token-based ('performance pairing') system might influence the grammar itself⁶, e.g., giving rise to grammatical concord (see Zeijlstra, ms.) or more generally to 'double' exponence (Harris and Samuels, 2011). Further, in principle, the performance-based system might also anchor explanations of those diachronic 'cycles' that apparently proceed in only one direction, e.g. from pronoun to agreement to elimination altogether if features on a doubled pronoun behave like the quantificational doubling examples discussed above.

A fuller picture of language, and systematic language variation, may emerge when analysis of the acceptability and interpretation of sentences recognizes that not all data involving structure and interpretation need to be explained in the grammar itself. The present proposal offers some promise of reconciling conflicting data (mismatch ellipsis is acceptable, and it's not) and providing a richer view of where there is potential for language change.

Returning to the desiderata for a theory of language interpretation laid out in the introduction, the current proposal in some ways complicates the picture and, at the same time, in some ways simplifies it. In explaining how humans compute the meaning of novel sentences, including implausible ones, the present proposal really only adds a second system for pairing form and interpretation - what might be conceived as a second route through the performance systems. With respect to characterizing the incrementality of interpretation, it suggests that the existence of a system that may recognize the speaker's intent and anticipate the intended (indirect) mapping from the actual input to intended meaning. The performance system may be fast and jump to a likely intent when considerable evidence supports the performance pairing of form and meaning, i.e., when the speaker's intent is clear and the actual form is just what the human production system would tend to produce. The pairing provided by the grammar, the compositional system, presumably requires bottom up composition from the most deeply embedded constituent and therefore the compositional system presumably cannot jump ahead in quite the same way as the performance pairing system. Put differently, the compositional system is de-contextualized by definition and it requires bottom-up input.

In terms of accounting for how interpretation processes relate to conscious awareness, the error reversal system implicitly offers an account for how humans can know what the

⁶Indeed Bolinger (1961) anticipated this point and suggested in his critique of Lee's classic analysis of adjectives (Lees, 1961) that constraints on certain adjectival constructions implicate blends (two sources, not one). if this was in fact the source of *tough*-constructions then they were grammaticized imperfectly since counter-examples are easy to construct.

- i. This place is dangerous to explore.
 - a. To explore this place is dangerous.
 - b. This place is dangerous. (Note the relation between a and b.)
- ii. *This man is necessary to convince.

grammatical meaning of an input is **and not know** (assign an ungrammatical one) at the same time. This is likely to be essential in offering an explanation of semantic illusions.

With respect to explaining the existence and nature of widespread context effects, it has already been noted that the ‘performance pairing’ needn’t de-contextualize the input. The fact that it is a token-based system, rather than a type-based system, allows evidence to be gleaned from various sources including situational information that may only come in during pragmatic processing of the compositional meaning. As a consequence, there is unlikely to be only one complexity profile for interpreting a given sentence type.

In conclusion, recognizing an intended path not taken in production (e.g., a systematic competitor form not actually produced) may speed repairs in comprehension by providing evidence for what has gone wrong and for what can fix it.

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Table 1

Mean acceptability ratings on a scale from 1–5 (where 1= bad and 5 =good)

A 4.81	That...Any
B 3.66	No that...Any
C 4.88	That...Some
D 3.41	No that...Some

Table 2

Percentage Choices of Undoubled Paraphrases, by Item Set (with SE in Parentheses) Item Set

Many (many-often)	universal (every-always)	negation (no-never)	few (few-seldom)
77	64	36	73