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# Verb Phrase Ellipsis with Nominal Antecedents

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## Abstract

This paper brings new theoretical and experimental evidence to bear on the classical question of whether Verb Phrase Ellipsis requires a syntactically identical antecedent. We focus on the less studied case of nominal antecedents and argue that they are always grammatical but that the discourse conditions on VPE, namely that it requires a salient alternative in the discourse model, are such that they can only be met by nominal antecedents in those special cases where a noun can express such an alternative. Specifically we focus on the case of ‘polar nouns’ which we show can function as a previously unnoticed type of concealed question, making a polar alternative salient. We provide experimental evidence, based on online acceptability judgments, showing (i) that VPE is judged more acceptable than *do it* when there is a salient polar alternative in the context, whether it is expressed by a verb or a noun; (ii) that nominal antecedents are judged slightly less acceptable than verbal antecedents in such cases, a difference that can be partly explained by the fact that (iii) nouns are judged less acceptable than verbs when they are forced to express a polar alternative, independently of the ellipsis, suggesting that coercion is involved. In conclusion, we suggest that VPE simply requires accessing an antecedent satisfying the discourse constraints within the discourse model but that the heuristic strategies of the parser make use of all available evidence, including syntactic structure in short term memory, making syntactically identical antecedents easier to find and hence more acceptable.

## 1 Introduction

The question of whether Post-Auxiliary Ellipsis (PAE)<sup>1</sup> is licensed by syntactic or semantic identity of the ellipsed material with the antecedent has been under debate since the earliest discussions of the topic in the context of generative grammar (see among many others, Hankamer and Sag 1976, Sag 1976, Sag and Hankamer 1984, Dalrymple et al. 1991, Hardt 1993, Fiengo and May 1994, Johnson 2001, Kehler 2002, Dalrymple 2004, Merchant 2008, Kertz 2010, Culicover and Jackendoff 2012, Kertz 2013, Merchant 2013). Though early generative studies assumed that syntactic identity was necessary, it was shown as early as Sag’s thesis, but especially in the later references cited, that there are attested examples of various mismatches

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<sup>1</sup>We use the name suggested by Ivan Sag in his thesis (1976) rather than the more usual ‘Verb Phrase Ellipsis’ (VPE) because it is descriptively much more adequate: PAE always occurs behind an auxiliary (see Levine 2012 for evidence that *to* is an auxiliary, see Hankamer and Sag 1976 for evidence that elliptical VPs after other verbs are cases of Null Complement Anaphora); and, after auxiliaries *be* and *have*, what is ellipsed does not have to be a VP, nor does it even have to be a constituent.

between the syntax of the antecedent and the ellipped material. In particular active/passive mismatches have been much discussed. There has also been much discussion within the psycholinguistics literature, particularly concerning the processing of ellipses, e.g. Murphy 1985, Malt 1985, Tanenhaus and Carlson 1990, Arregui et al. 2006, Kertz 2010 Kim et al. 2011, Grant et al. 2012, Kertz 2013, Phillips and Parker 2014. This paper is centered on PAE with nominal antecedents, a case which remains much less understood and for which there are far fewer attested examples in the literature. Most of these come from Hardt 1993:34-36, who provides four attested examples, namely those cited here in footnotes 13, 24, as well as example (25a).

The central dilemma in the debate on whether syntactic or semantic identity is necessary has been the following: if one assumes syntactic identity, then it is difficult to understand why mismatches exist at all; on the other hand, if one assumes semantic identity then one cannot explain why most cases of mismatches seem so unacceptable.<sup>2</sup>

Three central types of solutions have been proposed in the literature to account for the variety of acceptability judgments that arise in the case of PAE with mismatched antecedents. Kehler 2000, 2002 and Kertz 2010, 2013, have proposed that mismatches are always grammatical. However they further suggest that there are discourse conditions on the use of PAE and that unacceptability results when these conditions are not respected. Kim et al. 2011 suggest that mismatches are grammatical but that they induce additional processing difficulties leading to reduced acceptability (this is made plausible by the large literature showing that parallelism in general—and in particular independently of ellipsis—facilitates processing, see e.g. Frazier et al. 1984, Frazier et al. 2000, Frazier and Clifton 2001, Dubey et al. 2005.) The latter position is compatible with the first and is in fact accepted by Kertz 2013, who suggests that lack of parallelism can intervene as a second factor reducing acceptability beyond the effect of the violation of discourse constraints. The present paper adopts this combined perspective and shows how it can explain acceptability patterns for PAE with nominal antecedents. A third position, the ‘recycling hypothesis’, which will be discussed in section 7, has been defended in a series of papers by Frazier and her collaborators, see e.g. Arregui et al. 2006. They claim that PAE requires a syntactically identical antecedent and that any mismatch leads to ungrammaticality. They develop a theory of repairs to such ungrammatical structures that explains why they can be felt to be more or less acceptable in some cases.

Though the debate has usually been framed in terms of syntactic vs. semantic identity, as we have done up to now, it is in fact not clear at all that any type of *linguistic* identity is required. Following the ideas of Sag and Hankamer 1984 (though they limit this to deep anaphors and do not consider PAE as a deep anaphor) and Cornish 1999, one might assume that all that is necessary is that an appropriate antecedent be accessible in the mental discourse model, which Cornish 1999:5 defines as “a coherent representation of the discourse being evoked via the co-text and its context in terms of the speaker’s or writer’s hypothesized intentions”. The discourse model is thus a mental representation which coherently combines information from the text (linguistic or nonlinguistic utterance acts) and from the nonlinguistic context. Under this view, it is important to distinguish the antecedent (defined by Cornish as the discourse-model representation making interpretation of the anaphor or ellipsis possible) from the antecedent-trigger, which Cornish defines as the actual segment of text that makes the antecedent accessible in the case of a linguistically evoked antecedent). For simplicity, we will continue to refer to the antecedent-trigger by the term ‘antecedent’ when there is no possible ambiguity, but will

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<sup>2</sup>Some analyses defending syntactic identity make assumptions about syntactic structure such that, for instance, the active and passive VPs are identical at the relevant level of structure, see e.g. Fiengo and May 1994, Johnson 2001, Merchant 2008, Merchant 2013. Such analyses run into exactly the same problem as those based on semantic identity, since they predict that all cases of mismatch should be acceptable; see Kertz 2013 for discussion.

make the distinction when it leads to greater clarity.

The classical evidence from split antecedents (where the antecedent-trigger does not form a constituent, cf. Webber 1979) and exophoric uses (cf. Schachter 1978) suggests that this is the only tenable position. This is corroborated by Miller and Pullum 2013 who argue, on the basis of a corpus study, that there are no special constraints on exophoric PAE. Simply the discourse conditions on PAE (which we will discuss in section 2 below) are much more difficult to satisfy in exophoric cases. But when they *are* satisfied the result is perfectly acceptable. A crucial point made in that paper is that in such cases, typically, *do it* is not acceptable.

The main hypothesis put forward in the present paper stems from an example of PAE with a nominal antecedent found in the COCA (Davies 2008-):<sup>3</sup>

- (1) Mubarak's survival is impossible to predict and, even if he does [survive], his plan to make his son his heir apparent is now in serious jeopardy. [COCA: CBS Evening News]

This example seems strikingly natural and raises the question of why it sounds so much better than randomly constructed nominal antecedent cases. The current proposal builds on previous work on the discourse conditions constraining PAE (see Miller 2011 and Miller and Pullum 2013). The key insight proposed in those papers is that there has to be a salient alternative in the context and the purpose of the utterance containing the ellipsis must be to choose one branch of this alternative. What is special about (1) is that the noun *survival* can express a concealed question of a type that has not been previously noticed. Specifically, the first clause in (1) means something close to 'It is impossible to predict whether or not Mubarak will survive', in which the indirect polar interrogative makes a polar alternative salient. The following *even if* conditional clause, containing the PAE, selects one branch of this alternative, as required. Thus the unusual lexical semantics of the noun in this context allows it to satisfy the discourse constraints on PAE in this particular use, making PAE acceptable. The rest of this paper will present the relevant discourse conditions on PAE; examine more closely the lexical semantic properties of the relevant class of nouns; show how these two combine to explain the acceptability of certain cases of PAE with nominal antecedents; provide evidence from psycholinguistic acceptability experiments in favor of the analysis; briefly discuss other attested types of nominal antecedents; and finally discuss the consequences of our data and analysis for psycholinguistic and theoretical linguistic work on PAE.

## 2 Discourse conditions on PAE and *do it*

Generative studies of PAE and verbal anaphors such as *do so* or *do it/this/that* have never addressed the discourse conditions on these constructions. In fact, it has been tacitly assumed that there is no difference in their uses beyond those resulting from some version of the deep/surface distinction of Hankamer and Sag 1976 and the fact that *do* in *do so* and *do it/this/that* is the main verb. Kehler 2000, 2002 and Kertz 2010, 2013, were the first to discuss how certain general discourse conditions could apply to PAE and to propose that the reduced acceptability found in certain mismatches could be attributed to violations of these conditions. Miller 2011

<sup>3</sup>In order to make the examples easier to read, the antecedent is underlined and the elliptical auxiliary is double underlined. In some examples we strike out the putatively ellipted material in the elliptical position. This is a mere expository device intended to clarify interpretation. It is never a suggested syntactic analysis.

and Miller and Pullum 2013:12 build on this work and propose discourse conditions bearing specifically on the felicity of PAE. Following Kertz 2008, they make a distinction between two central uses of PAE, which they call Aux-choice and Subj-choice and propose the following conditions on them.<sup>4</sup>

- (2) a. **Type 1: Auxiliary Choice**  
 FORMAL CHARACTERISTICS: The subject of the antecedent is identical with the subject of the PAE construction and the auxiliary is (at least weakly) stressed, signaling a new choice of tense, aspect, modality, or (in the most overwhelmingly frequent case) polarity.  
 DISCOURSE REQUIREMENT: A choice between the members of a jointly exhaustive set of alternative situations must be highly salient in the discourse context, and the point of the utterance containing the PAE is strictly limited to selecting one member of that set.
- b. **Type 2: Subject Choice**  
 FORMAL CHARACTERISTICS: The subject of the antecedent is distinct from the subject of the PAE construction, and stressed if it is a pronoun.  
 DISCOURSE REQUIREMENT: A particular property must be highly salient in the discourse context, and the point of the utterance containing the PAE must be strictly limited to identifying something or someone possessing that property.

These two types of PAE are illustrated in (3) (SMALL CAPITALS indicate stress):

- (3) a. A.—Does he shop in women's? B.—He DOESN'T/He DOES. [Aux-choice]  
 b. A.—Does he shop in women's? B.—#He DOES to find things his size. [Aux-choice]  
 c. A.—He shops in women's. B.—He DOESN'T/He DOES. [Aux-choice]  
 d. A.—The guy who shops in women's was here today. B.—#He DOESN'T/#He DOES. [Aux-choice]  
 e. A.—Mark shops in women's. B.—ANDY does too. [Subj-choice]

In (3a) we see a typical Aux-choice usage: the subject of the antecedent is coreferential with that of the PAE construction, the auxiliary is stressed and signals a choice of polarity. A's polar question sets up the proposition  $p$ , 'he shops in women's', as the maximal element of QUD (the ordered set of Questions currently Under Discussion, see Ginzburg 2012, Roberts 1996) and makes the alternative  $p \vee \neg p$  highly salient.<sup>5</sup> B's answer is limited to choosing one branch of the alternative, conforming to the final clause of (2a). On the other hand, (3b) is intuitively felt to be less felicitous. This is because adding the adjunct *to find things his size* makes B's answer go beyond choosing between the branches of the alternative and resolving the maximal QUD,

<sup>4</sup>It should be noted that there are cases which combine subject and object choice, e.g. A.—*Mark shops in women's*. B.—*Andy doesn't*. These mixed cases are far less frequent: Miller 2011 reports that his sample of 126 cases of PAE from the COCA contained 83% of Aux-choice cases and 17% of Subj-choice, but none of the mixed cases. The properties of the mixed cases remain to be investigated in detail. It appears that in general one of the choices is subordinate to the other, as indicated by greater prosodic prominence on either the subject or the auxiliary.

<sup>5</sup>Malt 1985 is a precursor on the use of PAE in discourse. Her experimental results can be taken to provide evidence that PAE prefers an antecedent that is the maximal element of QUD.

and thus violates the final clause of (2a).<sup>6</sup> Example (3c) shows that asserting a proposition  $p$  makes it the maximal QUD, ensuring that the alternative  $p \vee \neg p$  is salient, and allowing either contradiction or confirmation by PAE. In (3d) we see a case where the content of a proposition  $p$  is not asserted, but introduced as commonground information that is not under discussion (in this specific case, within a relative clause). As a consequence, the alternative  $p \vee \neg p$  is not made salient and  $p$  is not added to QUD. In such cases contradicting or confirming  $p$  using PAE is much less felicitous, because it requires major accommodation on the part of the addressee to access the alternative. Finally, (3e) illustrates Subject Choice PAE: the subjects are distinct, the property ‘shops in women’s’ is salient in the discourse context and the purpose of the PAE utterance is to identify someone who possesses this property.<sup>7</sup>

Let us now turn briefly to discourse conditions on the verbal anaphor *do it*. Though these are not as well understood as those bearing on PAE, Miller 2013 suggests that *do it* is dispreferred in cases where there is a salient alternative and the purpose of the utterance is limited to choosing one branch of the alternative. Its preferences in usage are thus complementary to those given in (3), as shown in (4). *Do it* is dispreferred as a simple answer to a polar question (4a) or as a confirmation or contradiction of a previous statement (4c), but is preferred if the point of the utterance is not simply to choose one branch of the alternative, as shown in (4b) where an adjunct is present.<sup>8</sup>

- (4) a. A.—Does he shop in women’s? B.—#He DOESN’T DO IT/#He DOES IT.  
 b. A.—Does he shop in women’s? B.—He DOES IT to find things his size.  
 c. A.—He shops in women’s. B.—#He DOESN’T DO IT/#He DOES IT.

### 3 A new class of concealed questions

It has been known since Baker 1968 and Grimshaw 1979 that certain NPs, known as ‘concealed questions’, can have question type meanings when placed in an interrogative context. Classical examples include:

- (5) a. Kim knows the price of this book. (*≈ Kim knows what the price of this book is.*)  
 b. Kim told me the answer to the question. (*≈ Kim told me what the answer to the question is.*)

The crucial properties of concealed questions are (i) they have a question type meaning;<sup>9</sup> (ii) they can occur in most typical indirect question contexts (see Frana 2010:13 for a discussion);

<sup>6</sup>The acceptability of (3b) is markedly improved if the adjunct is separated by a comma in writing and prosodically detached in speech, because it is then interpreted as an afterthought, and the main content of B’s answer is limited to choosing one branch of the alternative. See footnote 14 below for further discussion.

<sup>7</sup>Frazier et al. 2007 provide some support for our condition (2b). They examine cases of what we are calling Subject-choice PAE and give experimental evidence in favor of the idea that the presence of an L+H\* pitch accent on the subject of a VP in the discourse preceding a case of PAE makes the VP in question a preferred candidate for resolving the ellipsis. Clearly, any theory of focus will predict that the contrastive focus on the subject marked by the L+H\* pitch accent makes the open proposition expressed by the VP highly salient in the discourse context.

<sup>8</sup>Souesme 1985:51 notes that *do it* is often modified by an adjunct and Levin 1986:3 notes that PAE is almost never followed by an adjunct.

<sup>9</sup>The precise semantics necessary to account for them is at the heart of most of the recent literature, the main proposals being that they denote individual concepts (Romero 2005 and Frana 2010) or propositions (Nathan 2006).

and (iii) they have the distribution of noun phrases rather than that of a clausal complement (as demonstrated at length by Grimshaw), specifically, for instance, they can be inverted with an auxiliary (6):

- (6) Does [<sub>NP</sub> your answer to the question] depend on who asks?

Nathan (2006:21) claims that “insofar as a concealed question denotes a question, that question is an *identity* question, i.e. one of the form *who X is* or *what X is*.” A brief review of the literature suggests that this is the current received position (Nathan specifically argues against Baker on this point). It turns out, however, that there is an apparently unnoticed class of nouns that are somewhat similar but can have polar question type meanings. These are illustrated in the following examples:

- (7) a. The outcome of the negotiations largely depends on Anna’s participation in the talks. (Compare: ... *depends on whether or not Anna participates in the talk*)  
 b. I am not sure of the committee’s approval of the new guidelines. (Compare: *I am not sure whether or not the committee will approve the new guidelines*)  
 c. It is impossible to predict the witness’s cooperation with the police. (Compare: ... *to predict whether or not the witness will cooperate with the police*)

Other nouns that allow this kind of use include *acceptance, approval, attack, consent, cooperation, escape, participation, recovery, resignation, surrender, survival, victory, withdrawal* (this list was compiled through a combination of introspection and searches for patterns which might provide them in the COCA). For convenience, we will call nouns that have this property ‘polar nouns’ ( $N_{\text{polar}}$ ). As illustrated in (7), these nouns can appear in certain indirect question contexts with a meaning similar to that of an indirect question.<sup>10</sup> However the range of contexts in which they can appear with such a meaning is far more restricted than for classical concealed questions.<sup>11</sup> It is beyond the scope of this paper to investigate the proper semantic analysis of polar nouns when they are used in these contexts. Given their restricted distribution, it is likely that they do not in fact denote questions. However it is clear that when they are used in question contexts, they make a polar alternative salient. It is important to note that the question type interpretation only appears in contexts allowing indirect interrogatives. In other contexts polar nouns are interpreted as denoting facts and do not allow *whether*-based paraphrases like those in (7), as illustrated in the following examples:

<sup>10</sup>Note that in (7a,c) the nouns *participation* and *cooperation* can also be understood as classical concealed questions: they allow a constituent question interpretation in terms of manner and/or degree, i.e. they also allow paraphrases of the type ‘depends on {the way in which/the degree to which} Anna participates in the talks’ (though these are less accessible as shown by the paraphrase judgment norming study discussed below in section 5.2). Nathan 2006 would claim that such interpretations are in fact identity interpretations, i.e. ‘the {way in which/degree to which} she participates’ could be reduced to ‘what her participation is’. It is beyond the scope of this paper to decide whether such a reduction is the best analysis.

<sup>11</sup>If one considers Karttunen 1977’s typology of indirect question contexts, it seems that they cannot appear, for instance, after verbs of retaining knowledge (*#I don’t know his participation*), verbs of acquiring knowledge (*#I found out his participation*), verbs of communication (*#I told them his participation*). On the other hand, as will appear in the examples provided, they are possible with at least certain verbs of prediction, certain inquisitive verbs, certain verbs of relevance and of dependency.

- (8)
- a. Anna's participation in the talks annoyed us. ( $\neq$  *Whether or not Anna participated in the talks annoyed us*; = *The fact that Anna participated . . .* )
  - b. The committee's approval of the new guidelines enthralled the staff. ( $\neq$  *Whether or not the committee approved the new guidelines enthralled the staff*; = *The fact that the committee approved . . .* )
  - c. John resented the witness's collaboration with the police ( $\neq$  *John resented whether or not the witness collaborated with the police*; = *The fact that John resented . . .* )

We will suggest below that the factual interpretation of polar nouns is basic, and that the polar interpretation is obtained by coercion, requiring extra processing effort. This is made plausible by the results of Harris et al. 2008, who provide evidence from eye-tracking and MEG studies showing that processing classical concealed questions requires accommodation by the addressee, similar to that found in classical cases of aspectual or complement coercion (see Harris et al. 2008 for references). This is evidenced by the fact that interpreting an NP used as a concealed question requires more processing time and involves higher brain activation than when the same NP is used in a non question environment.

## 4 PAE with nominal antecedents

We are now in a position to understand why our initial example of PAE with a nominal antecedent, repeated in (9a), is so intuitively acceptable.

- (9)
- a. Mubarak's survival is impossible to predict and, even if he does [survive], his plan to make his son his heir apparent is now in serious jeopardy. [COCA: CBS Evening News]
  - b. Whether or not Mubarak will survive is impossible to predict and even if he does [survive], his plan [. . .]

Indeed, *survival* is one of the polar nouns discussed above. It appears in an indirect question type context, as evidenced by the fact that it can be replaced by an indirect polar interrogative, as shown in (9b). In this context, its meaning is coerced into a polar question type meaning, as the paraphrase relation between (9a) and (9b) makes immediately clear. Thus, both the NP *Mubarak's survival* and the clause *Whether or not Mubarak will survive* make the polar alternative  $\{Mubarak \text{ will survive} \vee Mubarak \text{ will not survive}\}$  salient and the purpose of the elliptical clause is limited to selecting one branch of the alternative, satisfying the discourse condition on Aux-choice PAE given in (2a). Consequently, both the N and the V can serve as antecedents for PAE.

Further constructed examples of the same type are given in (10) to show the robustness of the phenomenon:

- (10)
- a. The integrity of the Senate depends on her participation. If she does, [. . .] (compare: *depends on whether or not she participates*)
  - b. Since they don't have anyone to replace her with, her resignation is in doubt. If she does, [. . .] (compare: *it is in doubt whether or not she will resign*)
  - c. The release of this information on the user's part depends on his consent. If he does, [. . .] (compare: *depends on whether or not he consents*)



Furthermore, as shown by the following examples, trying to use *do it* in the same contexts intuitively reduces acceptability, both with nominal and verbal antecedents:<sup>12</sup>

- (11) a. The integrity of the Senate depends on {her participation/whether or not she participates}. #If she does it, [...]
- b. Since they don't have anyone to replace her with, {her resignation is in doubt/it is in doubt whether or not she will resign}. #If she does it, [...]
- c. The release of this information on the user's part depends on {his consent/whether or not he consents}. #If he does it, [...]

This should be compared to the intuitively degraded acceptability of *do it* in answers to polar questions, illustrated in (4) above.

It is important to note that most nouns cannot be coerced into polar question type meanings. Some can occur as classical concealed questions, receiving identity question type meanings (or manner/degree type meanings, see footnote 10), as in (12a,b). For many nouns, no question type interpretation is easily available at all, as illustrated in (12c). In all such cases, no polar alternative is made salient and PAE is infelicitous.

- (12) a. That depends on her answer. ( $\approx$  *That depends on what her answer is*;  $\neq$  *That depends on whether or not she answers*)  
#If she does [...]
- b. When Francis leaves her, his decision is unclear. ( $\approx$  *It is unclear what his decision is*;  $\neq$  *It is unclear whether or not he decides*)  
#If he does [...]
- c. #That depends on her destruction of the evidence ( $\neq$  *on what her destruction of the evidence is*;  $\neq^2$  *on whether or not she destroys the evidence*;  $\neq^3$  *on how she destroys the evidence*).  
#If she does [...]

It is also crucial to remember that it is not the  $N_{\text{polar}}$  nouns as such which can serve as antecedents to PAE. This is only the case if they are in an environment that makes an alternative salient. Otherwise, acceptability is expected to be degraded. Thus, if the antecedent appears in a context where its basic factive interpretation is possible, the proposition denoted will be understood to be part of the common ground, and not in QUD. PAE is consequently felt to be infelicitous and *do it* is more acceptable, as illustrated in (13).

- (13) a. We were annoyed by her participation in the proceedings. ( $\approx$  *by the fact that she participated/by the manner in which she participated*)  
We wondered why he #did / Ok: did it.
- b. His friends were annoyed by his cooperation with the police. ( $\approx$  *by the fact that he cooperated /by the manner in which he cooperated*)  
They wondered why he #did / Ok: did it.

<sup>12</sup>Replacing *do* by *do it* in (9) intuitively leads to a stronger decrease in acceptability for the independent reason that *survive/survival* do not denote sufficiently actional events to make good antecedents for *do it* in this context (see e.g. Culicover and Jackendoff 2005:284). Note however that adding a means complement (see Souesme 1985:41) enhances agentivity and makes *do it* more acceptable: *People were intrigued {by the hiker's survival/that the hiker survived}. They couldn't understand how he did it.* In experiments 2 and 3, discussed below, the three items based on *survive/survival* were similarly constructed with a means complement, to avoid independent decrease in acceptability due to lack of agentivity.

Before closing this section, it is worth mentioning that the discourse condition on subject-choice PAE (2b) is very difficult to satisfy with a nominal antecedent. Consider the following examples:

- (14) a. Peter's participation surprised us and #John did participate too.  
 b. Only/Even Peter's participation surprised us although John did too.

The NP *Peter's participation* in (14a) cannot make salient the open proposition 'x participated'. The variants in (14b) appears to be somewhat more acceptable. The presence of *only* or *even* suggests a choice among a set of individuals and contributes to making the property 'x participated' a bit more accessible in the context. This makes it easier to accommodate the discourse condition on Subj-choice PAE given in (2a) above, and results in an intuitively more acceptable sentence.<sup>13</sup>

## 5 Evidence from acceptability experiments

In order to provide empirical evidence for the hypotheses made in the previous sections, a number of acceptability experiments were run on Amazon's mechanical turk using the Ibex platform for online experiments. Experiment 1 will provide evidence for our hypothesis that PAE is preferred to *do it* in strict answers to yes/no questions. We will then present a norming study verifying that the polar nouns we will use in Experiments 2 and 3 actually have a salient polar question type reading in the relevant contexts. In Experiment 2, we will investigate the acceptability of PAE and *do it* for verbal and nominal antecedents in contexts providing a salient alternative or not. In Experiment 3, we will present acceptability judgments for the first sentences of the sentence pairs investigated in Experiment 2 in order to see whether verbal and nominal antecedents are judged differently in contexts making an alternative salient or not independently of the anaphorical or elliptical sentence.

### 5.1 Experiment 1: Acceptability of PAE and *do it* as answers to polar questions

Recall that an underlying assumption of our hypotheses is that PAE is more acceptable than *do it* in strictly *yes/no* answers to polar questions. On the other hand adding an adjunct goes beyond a strict *yes/no* answer, which violates the discourse requirement on PAE given in (2a), making *do it* more acceptable than PAE. Experiment 1 was run to compare the acceptability of *do it* vs. PAE with *do* as answers to polar questions with and without adjuncts. A typical item in its four conditions is presented in (15). Figure 1 shows a typical stimulus in the experiment.

<sup>13</sup>In this discussion of subject-choice cases, it is interesting to consider the following example from Hardt 1993:35, his (118), provided to him by Gregory Ward.

- i. [Many Chicago-area cabdrivers] say their business is foundering because the riders they depend on — business people, downtown workers and the elderly — are opting for the bus and the elevated train, or are on the unemployment line. Meanwhile, they sense a drop in visitors to the city. Those who do, they say, are not taking cabs. (*Chicago Tribune*, 2/6/92)

This example is a case of joint subject-choice (the visitors who don't come are contrasted with those who do) and aux-choice (change of polarity). The conditions on these mixed cases have not yet been explored and are left for a further study.

**A:** Did Peter dance with you at the party?

**B:** Yes, he did.

How natural is B's response?

(not at all natural)        (perfectly natural)

Figure 1: A typical stimulus for Experiment 1 using the Ibex platform

	Estimate(SE)	t-value
adj1	-0.18(0.05)	-3.34
PAE1	0.39(0.07)	5.92
adj1:PAE1	0.47(0.06)	8.20

Table 1: Model estimates, standard errors (in brackets) and t-values for the fixed factors Adjunct and PAE

- (15) A—Did Peter dance with you at the party?
- B—Yes, he did. [–Adj, Do]
- B—Yes, he did it. [–Adj, Do it]
- B—Yes, he did to make me happy. [+Adj, Do]
- B—Yes, he did it to make me happy. [+Adj, Do it]

## Design and methods

20 items were distributed across 4 lists following a Latin Square design, randomly mixed with 60 distractors. 80 participants judged acceptability (explained in terms of naturalness of the answer in the context of the question) on a 7 point scale. 7 self-reported non-native speakers were excluded from the analyses as well as two further participants who systematically judged all items as perfectly natural without making any distinctions. We furthermore excluded judgments with reaction times lower than 500 ms. Since all our stimuli had more than 10 words, reaction times of less than 500ms would mean less than 50ms per word which makes reading for understanding highly improbable. This affected 1.3% of the observations of the remaining 71 participants. Note that excluding observations based on the standard “means  $\pm$  2 standard deviations” rule is not applicable here. Reaction times in web-based acceptability judgment experiments without any incentive for speeded judgments are far too variable to make this measure useful.

## Results

Condition means for Experiment 1 are given in Figure 2 (error bars indicate confidence intervals). Model estimates with standard errors and t-values are given in Table 1. Estimates correspond to deviations from the general mean in this analysis as in all following analyses.

The data were analyzed using R (R Development Core Team 2009) and the R packages lme4 (Bates et al. 2009) and languageR (Baayen 2008, 2009). Mixed effect models were fitted to the

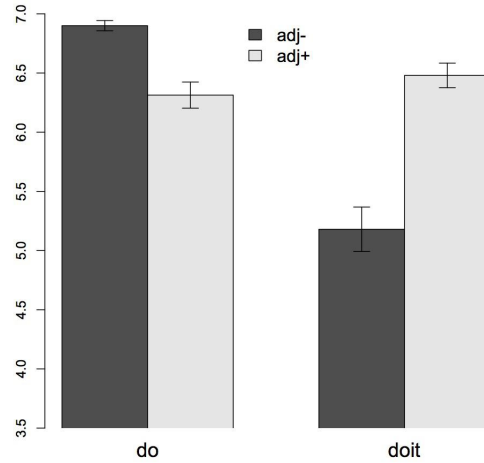


Figure 2: Acceptability of PAE vs. *do it* in polar questions

data with the fixed factors Adjunct (+,–) and PAE (*do* vs. *do it*), the random factors Participant and Item including random slopes of the fixed effects. Maximal structure models were used in all experiments where possible (see Barr et al. 2013). Exceptions due to non-convergence of the models will be mentioned in the respective descriptions of the results. To assess the validity of the mixed effects analyses, we performed likelihood ratio tests comparing the full models with all fixed effects to reduced models. Planned comparisons were carried out by fitting a simple LME model with random intercepts for participants and items to data for one level of a condition. P-values for planned comparisons were calculated using Markov Chain Monte Carlo (MCMC) sampling.

The interaction is highly significant (Chisquare(1)=34.919,  $p < .001$ ): the absence of an adjunct significantly increases the acceptability of *do* ( $t=11.49$ ,  $p < .001$ ) and significantly reduces the acceptability of *do it* ( $t=-14.4$ ,  $p < .001$ ). Moreover, *do* is generally more acceptable than *do it* (6.61 vs. 5.83, Chisquare(1)=5.2324,  $p < .03$ ). There is no significant main effect for the presence/absence of an adjunct ( $p > .10$ ).

## Discussion

The results corroborate the hypothesis that PAE with *do* is strongly preferred to *do it* as an answer to a polar question, when the answer is limited to choosing one branch of the alternative. They also provide weak support in favor of the idea that the acceptability of PAE is reduced when the answer goes beyond simply choosing one branch of the alternative.<sup>14</sup>

<sup>14</sup>One might wonder why the choice of PAE in the +Adj case is not more strongly degraded (as opposed to the choice of *do it* in the –Adj case). We tentatively propose that this is due to the presence of *Yes* in initial positions of the answers in the test materials illustrated in (15). This clearly indicates that the central purpose of the answer is to choose one branch of the alternative and may lead to interpreting the adjunct as a type of afterthought. Indeed, examples of PAE with an adjunct intuitively seem much more acceptable if they are pronounced with a pause between *do* and the adjunct and subjects may have read them as such, despite the absence of a comma. In any case, the statistical interaction as well as the simple effects fully confirm our hypothesis. Future studies will be carried out to test this particular interpretation of the data in more detail. These considerations may also be the reason for the main effect that *do* is generally more acceptable than *do it*.

## 5.2 Norming study: Possible interpretations for polar nouns

A norming study was run to ensure that polar nouns do in fact allow polar question type readings and that they differ in this respect from more typical deverbal nouns. We tested 18 nouns using a metalinguistic task in which participants were asked to judge closeness in meaning between an initial sentence and two or three proposed paraphrases.

### Design and methods

Participants saw the initial sentence and the two or three proposed paraphrases at the same time on the screen. Each of the paraphrases was accompanied by a rating scale from 1 to 7.<sup>15</sup> Participants were asked to judge the closeness in meaning of the proposed paraphrases to the initial sentence. Among the paraphrases there was always a polar paraphrase and either a manner paraphrase or an identity paraphrase, depending on which seemed intuitively most plausible. Furthermore, if a degree paraphrase seemed at all plausible, it was also included. (16) provides an example of the test materials with three paraphrases and Figure 3 shows a typical stimulus with two paraphrases.

- (16)
- a. The outcome depends on Kate's participation. [initial sentence]
  - b. The outcome depends on how Kate participates. [manner paraphrase]
  - c. The outcome depends on how intensely Kate participates. [degree paraphrase]
  - d. The outcome depends on whether Kate participates. [polar paraphrase]

For each noun, three initial sentences were constructed with the nouns respectively as complements of *depends on*, *regardless of*, and *unsure of* (all three of which can govern an indirect interrogative complement), as illustrated in (17), giving rise to three items of type (16) for each noun and 54 items in all. These three versions were distributed across three lists following a latin square design. No effect of the specific sentence context was expected or found empirically.

- (17)
- a. The outcome depends on Kate's participation.
  - b. I intend to hold the meeting, regardless of Kate's participation.
  - c. We are still unsure of Kate's participation.

60 participants judged 18 of the 54 items in a latin square design among 18 distractors.

### Results

Table 2 provides the results of the norming study.<sup>16</sup> Clearly, the thirteen intuitively identified polar nouns (from *acceptance* to *withdrawal*) strongly favor a polar interpretation over a manner/identity interpretation. On the other hand, *answer* and *decision* strongly prefer an identity reading. (Discussion of the last three nouns is beyond the scope of this paper).<sup>17</sup>

This norming study thus leads us to expect that the thirteen nouns that allow polar interpretations should be able to serve as antecedents for acceptable PAE when they are in a context that forces the polar reading. The following subsection discusses the experiments that were run to test this prediction.

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<sup>15</sup>We chose not to apply the technique proposed by Ford and Bresnan 2013, who asked participants to distribute points (out of 10) between different constructions, because their technique does not permit one to distinguish

**The outcome of the championship depends on The Lakers' victory.**

*For each of the following sentences tell us how close it is in meaning to the previous sentence:*

(1) The outcome of the championship depends on how The Lakers win.

Completely different meaning    ☐ 1    ☐ 2    ☐ 3    ☐ 4    ☐ 5    ☐ 6    ☐ 7    Exactly the same meaning

(2) The outcome of the championship depends on whether The Lakers win.

Completely different meaning    ☐ 1    ☐ 2    ☐ 3    ☐ 4    ☐ 5    ☐ 6    ☐ 7    Exactly the same meaning

Continue

Figure 3: A typical stimulus in the paraphrase study using the Ibex platform

Noun	Manner/Identity	Polar	Intensity
acceptance	3.46(±.61)	6.35(±.39)	
approval	4.31(±.63)	6.60(±.24)	3.73(±.52)
attack	4.27(±.55)	5.58(±.53)	3.73(±.52)
consent	3.71(±.63)	6.46(±.30)	2.92(±.51)
cooperation	4.59(±.57)	6.41(±.32)	3.63(±.54)
escape	2.94(±.47)	5.60(±.51)	
participation	3.71(±.53)	6.60(±.21)	3.56(±.52)
recovery	4.94(±.56)	5.82(±.43)	4.15(±.57)
resignation	2.85(±.51)	6.4(±.30)	
surrender	2.56(±.48)	5.40(±.61)	
survival	3.00(±.53)	6.46(±.29)	
victory	2.52(±.53)	6.6(±.25)	
withdrawal	3.21(±.51)	6.35(±.34)	2.52(±.48)
answer	6.02(±.46)	3.27(±.55)	
decision	6.58(±.31)	3.37(±.59)	
solution	5.39(±.52)	4.98(±.44)	2.65(±.50)
arrival	2.35(±.48)	5.94(±.46)	
destruction	3.33(±.58)	6.29(±.34)	3.81(±.56)

Table 2: Average judgments of quality of paraphrases in the norming study

### 5.3 The choice between PAE and *do it* with nominal and verbal antecedents

Two related experiments (Experiments 2 and 3) were run to determine the acceptability of PAE and *do it* with polar nouns and corresponding verbs as antecedents, depending on whether the context made an alternative salient or not.

#### Experiment 2

The purpose of Experiment 2 was to investigate the acceptability of PAE with *do* and the verbal anaphor *do it*, with nominal or verbal antecedents, taking into account whether the context made an alternative salient or not.

#### Design and methods

Materials were constructed on the basis of three binary factors: (i) Nominal vs. verbal antecedent (N/V); (ii) Alternative vs. Non Alternative context (+Alt/–Alt); (iii) *Do* vs. *do it* (Do/Do it). For the nominal antecedents the thirteen polar nouns confirmed by the norming study were used. It should be recalled that the norming study shows that the similarity to a polar paraphrase was judged to be very high for these nouns (the mean is 6.2 on a 7 point scale, where 7 points was explained as ‘exactly the same meaning’). This gives us eight conditions per item. A typical item is shown in (18) with its eight conditions.

- (18)
- DO
    - 1. Everyone was annoyed by **Andrew’s participation** in the chess tournament. His fans could not understand why he **did**. [N/–Alt]
    - 2. It is impossible to predict **Andrew’s participation** in the chess tournament. He is sure to win if he **does**. [N/+Alt]
    - 3. Everyone was annoyed that **Andrew participated** in the chess tournament. His fans could not understand why he **did**. [V/–Alt]
    - 4. It is impossible to predict whether **Andrew will participate** in the chess tournament. He is sure to win if he **does**. [V/+Alt]
  - DO IT
    - 5. Everyone was annoyed by **Andrew’s participation** in the chess tournament. His fans could not understand why he **did it**. [N/–Alt]
    - 6. It is impossible to predict **Andrew’s participation** in the chess tournament. He is sure to win if he **does it**. [N/+Alt]
    - 7. Everyone was annoyed that **Andrew participated** in the chess tournament. His fans could not understand why he **did it**. [V/–Alt]
    - 8. It is impossible to predict whether **Andrew will participate** in the chess tournament. He is sure to win if he **does it**. [V/+Alt]

interpretations which are all equally close or all equally distinct paraphrases of the original sentence.

<sup>16</sup>Means are followed by the confidence interval in parentheses.

<sup>17</sup>It appears that *arrival* and *destruction* allow polar interpretations. However, it was impossible to use these nouns in experiments 2 and 3. *Arrival* raises problems with *do it* because it is insufficiently agentive (cf. fn. 12) and *destruction* was interpreted as passive, leading to PAE with *be* (*We are still unsure of the city’s destruction. If it is/\*does...*) and making any alternation with *do it* impossible. As for *solution*, it is unclear to us why the polar interpretation was judged to be so close in acceptability to the identity interpretation.

	Estimate(SE)	t-value
DoDoit	-0.05(.04)	-1.33
Antecedent	-0.23(.03)	-9.27
Alt	-0.05(.05)	-1.08
DoDoit:Antecedent	-0.14(.02)	-8.03
DoDoit:Alt	0.37(.02)	20.68
Antecedent:Alt	-0.04(.02)	-2.30
DoDoit:Antecedent:Alt	0.02(.02)	1.07

Table 3: Model estimates, standard errors (in brackets) and t-values for the fixed factors DoDoit, Antecedent Type (Noun, Verb) and Context(+/-Alt)

The +Alt conditions always involved the three contexts given in (19):

- (19)
- a. It is impossible to predict {NP/S[whether]}
  - b. NP depends on {NP/S[whether]}
  - c. NP is still unsure {of NP/S[whether]}

The -Alt conditions involved items of the types given in (20):<sup>18</sup>

- (20)
- a. NP was annoyed/embarrassed/exasperated/preoccupied/irritated/disgusted/enraptured/amused/fascinated {by NP/S[that]}
  - b. NP resented {NP/S[that]}
  - c. NP was aware {of NP/S[that]}

40 items<sup>19</sup> were constructed and distributed across eight lists following a Latin Square design and were mixed with 56 distractors. In order to maximize the dispersion of the acceptability judgments, distractors were chosen so as not to contain anything strongly unacceptable. 177 self-identified native speakers judged the acceptability of the second sentence in the context of the first. Cases with reaction times less than 500ms were excluded from the analyses. 0.4% of the observations were affected by this procedure.

Analyses were realized using Mixed Linear Models with individual random slopes for main effects for participants and items. To avoid non-convergence of the models, we had to exclude interactions in the random slopes. For estimating p-values for planned comparisons, we used Markov Chain Monte Carlo (MCMC) sampling, as in the previous experiments. Table 3 provides the results.

## Results

Overall results per condition are given in Figure 4.

<sup>18</sup>Though all the contexts mentioned in (20) are factive contexts, not all factive contexts assign background status to the same degree. A factive predicate such as *was surprised at NP/that S* makes an alternative much more accessible by the very nature of what it is to be surprising: if  $p$  is surprising, then  $\neg p$  is likely, and stating that  $p$  is surprising makes the  $p \vee \neg p$  salient. An initial version of Experiment 2 had not paid sufficient attention to this, leading to less clear results than those reported here. We thank Anne Jugnet (p.c.) for helping us clarify this issue.

<sup>19</sup>As we have 13 polar nouns, using each of these in the three contexts of (19) leads to 39 items. To complete our list of 40, a fourth example using *resignation* in the *depends on* context was added.



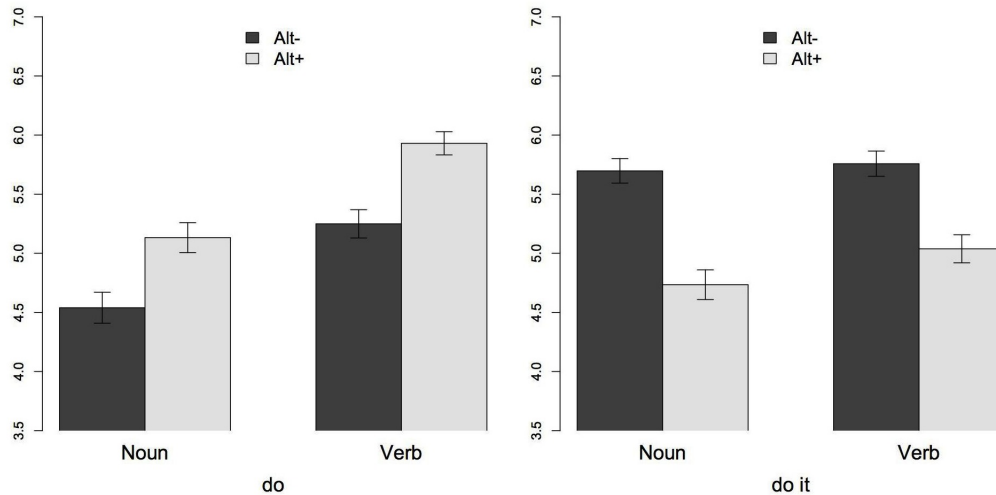


Figure 4: Experiment 2: PAE vs. *do it* with NP vs. VP antecedents in +Alt vs. –Alt contexts

Among the major results one can note strong corroboration of the hypothesis according to which PAE with *do* is more acceptable when there is a salient alternative in the context while *do it* is more acceptable when the antecedent is not under discussion. This is shown in Figure 5 and evidenced by the highly reliable interaction of Do/Doit and +/-Alt which is confirmed by likelihood ratio tests (Chisquare(1)= 255.16,  $p < .001$ ). PAE was most acceptable in +Alt contexts (Chisquare(1)= 35.618,  $p < .001$ ) while the opposite was true for –Alt contexts (Chisquare (1)= 43.673,  $p < .001$ ).

It also turns out to be true, as expected, that *do* in PAE is judged more acceptable with a verbal antecedent than with a nominal antecedent (Chisquare (1)= 17.151,  $p < .001$ ). But as shown in Figure 6, this seems to be true for *do it* too, though to a lesser extent (Chisquare (1)= 5.0207,  $p < .04$ ; but see Discussion of Experiment 3). Those differences lead to a reliable interaction (Do/Doit by Antecedent: Chisquare(1)= 36.768,  $p < .001$ ).<sup>20</sup>

Looking more closely at the average acceptability of the various conditions of Experiment 2, as shown in Figure 4, it is worth pointing out the following facts. First, the condition “Do/N/+Alt” is rated at 5.15 (out of 7), a surprisingly high rating in view of the N vs. V mismatch involved. To put this into context, the average acceptability rating for the whole experiment, including fillers, was 4.73. This should be compared to the condition “Do/V/+Alt”, which was rated most acceptable at 5.94. Also of interest is the fact that compared to the condition “Do/N/+Alt” (5.15), the condition “Do it/N/+Alt” was rated significantly lower at 4.77 ( $t = -3.02$ ,  $p < .05$ ). The condition “Do it/V/+Alt” was rated numerically but not reliably ( $p > .20$ ) lower than condition “Do/N/+Alt” at 5.07, but significantly higher than the condition “Do it/N/+Alt” ( $t = 2.62$ ,  $p < .05$ ). In sum these data discredit the idea that *do it* should system-

<sup>20</sup>These results should be compared to those of Tanenhaus and Carlson 1990’s experiment 2, in which they use a ‘make sense’ task to investigate differences between PAE and *do it* with verbal and nominal antecedents. They found that reaction times were similarly increased in the mismatch cases, both for PAE and *do it*, which conforms well with the reduced acceptability of nominal antecedents in both cases evidenced here in Figure 5. It should be noted that they found a significant difference in the results for the make-sense task, in the case of mismatch, between *do it* and PAE (respectively judged to be ‘sensible’ in 86% and 71% of cases). We would interpret this result as due to the fact that the discourse conditions on PAE are not satisfied in their nominal antecedent cases. Consider for instance their example (9): “The mention of her sister’s name always annoys Sally. However, Tom did (it) anyway out of spite.” Note that two factors contribute to making PAE far less acceptable than *do it*: (i) the event of mentioning is backgrounded by the nominalization and (ii) there is an adjunct after the anaphor.

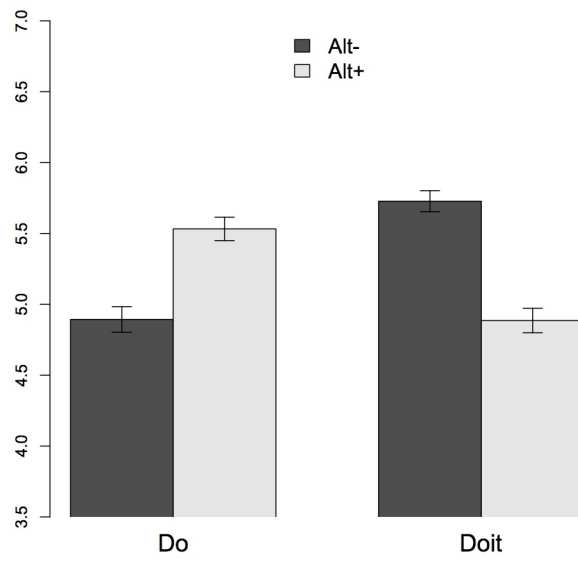


Figure 5: Experiment 2: PAE vs. *do it* in +Alt vs. -Alt contexts

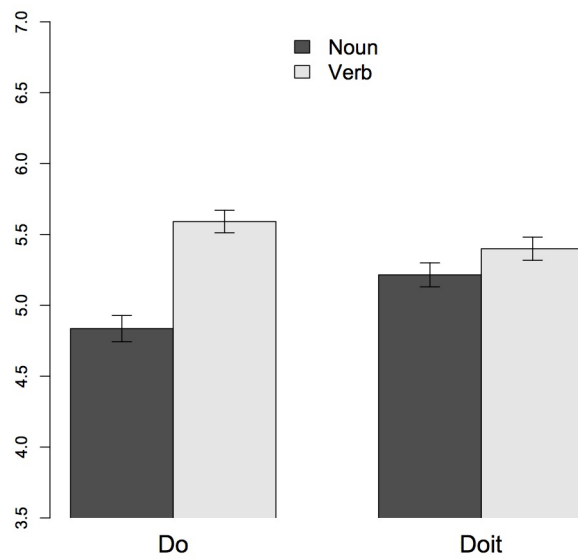


Figure 6: Experiment 2: PAE vs. *do it* and V vs. N

atically be judged better with nominal antecedents than PAE.<sup>21</sup>

We thus believe that it becomes very difficult to claim that the condition “Do/N/+Alt” is ungrammatical (we will come back to this in section 7). But we still need to account for the fact that the nominal antecedent cases are judged .79 less acceptable than the verbal antecedent cases. What can explain this difference if it is not due to a difference in grammaticality? To answer this question, it is worth returning to the results of Harris et al. 2008, mentioned above, which showed that NPs require longer processing time when they are interpreted as classical concealed questions, due to the need for accommodation. This suggests that polar nouns might require accommodation when they express a polar question and consequently be more difficult to process, which would affect their acceptability judgment. In order to address this question, we ran Experiment 3.

## Experiment 3

### Design and methods

Experiment 3 used as materials the antecedents of Experiment 2 *without* the following anaphoric or elliptical sentence (the stimuli of Experiment 2 were intentionally constructed to make this possible). This leaves us with two binary factors, N/V and +Alt/–Alt. A typical item in its four conditions is given in (21):

- (21)
- a. Everyone was annoyed by **Andrew’s participation** in the chess tournament.  
[N/–Alt]
  - b. It is impossible to predict **Andrew’s participation** in the chess tournament.  
[N/+Alt]
  - c. Everyone was annoyed that **Andrew participated** in the chess tournament.  
[V/–Alt]
  - d. It is impossible to predict whether **Andrew will participate** in the chess tournament. [V/+Alt]

10 out of 80 participants were excluded as self-reported non-native speakers. Observations with reaction times lower than 500ms were excluded from the analyses. 1% of the observations were affected by this operation.

### Results

Mixed effect models with Antecedent and Alternative as fixed factors and Participant and Items as random factors as well as random slopes for participants and items were fitted to the data. Interactions were not included in the random slopes to avoid nonconvergence. Ratings per condition are given in Figure 7. Table 4 shows the statistical analysis.

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<sup>21</sup>Though this is only anecdotal evidence, it is also worth pointing out that for two out of forty items the condition “Do/N/+Alt” was actually judged better than the condition “Do/V/+Alt”, and for three items the condition “Do/N/+Alt” was judged only .1 or less worse than the condition “Do/V/+Alt”. The following example provides the data and ratings from one of the items which was judged on average (by 20 subjects) to be more acceptable with the nominal variant of the antecedent.

i. We have talked about a possible adoption, but we are still unsure of her consent. [Do/N/+Alt]

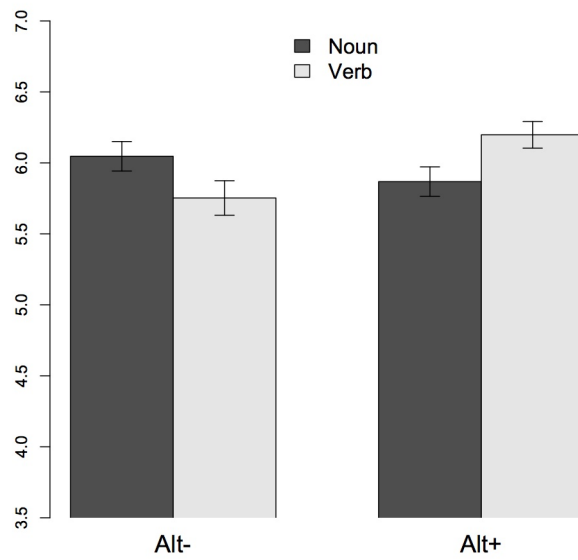


Figure 7: Experiment 3: Antecedents

	Estimate(SE)	t-value
Antecedent	-0.01(.03)	-0.42
Alt	0.34(.25)	1.37
Antecedent:Alt	0.15(.0 26)	5.68

Table 4: Model estimates, standard errors (in brackets) and t-values Antecedent Type (Noun, Verb) and Context (+/-Alt)

The interaction between antecedent type and alternative is significant (Chisquare(1)=32.286,  $p < .001$ ). Verb antecedents were more acceptable than noun antecedents in +Alt ( $t = -4.571$ ,  $p < .05$ ). Noun antecedents are more acceptable in –Alt ( $t = 3.58$ ,  $p < .05$ ).

## Discussion

In the Alt condition, we find that the verbal stimuli are rated at an average of 6.19, whereas the nominal stimuli are rated 5.86. Thus a difference in rating of .33, almost half of the .79 difference noted in the corresponding ellipsis case. It is interesting to note that there is a symmetric effect for the –Alt environment, where verbs are judged less acceptable than nouns. This suggests that polar nouns are indeed harder to process when they have a question type meaning than when they have a fact type meaning, supporting the idea that some form of coercion might be required.

In order to neutralize the effects of the acceptability of the antecedent sentence (as provided by Experiment 3) on the acceptability judgments for the elliptical sentence in the context of the antecedent (as provided by Experiment 2), we established ‘ellipsis-only’ ratings by calculating the residuals of the linear regression between the ratings of the antecedents and ratings of the ellipsis in each context.<sup>22</sup> Figure 8 shows the results for the residuals and Table 5 gives the fixed effects of the linear regression model that we fitted to these data.<sup>23</sup>

As before, we excluded interactions from the random slopes such that the models were identical to those of Experiment 2. Contrary to the uncorrected ratings, no significant main effect of Antecedent was found for the residuals. Using likelihood ratio tests, we did however establish statistically reliable interactions of Do/Do it and Antecedent on the one hand (Chisquare(1)=34.261,  $p < .001$ ) and Antecedent and Alternative on the other hand (Chisquare(1)=245.62,  $p < .001$ ). For PAE, +Alt contexts are more acceptable than –Alt contexts (Chisquare(1)=34.325,  $p < .001$ ), for Do it, on the other hand, –Alt contexts are more acceptable than +Alt contexts (Chisquare(1)=30.607,  $p < .001$ ). Noun antecedents are moreover less acceptable than verbal antecedents for PAE (Chisquare(1)=14.381,  $p < .001$ ) while they are more acceptable for Do it (Chisquare(1)=13.013,  $p < .001$ ). The mean difference between Noun and Verb Antecedents in +Alt contexts is strongly reduced for the residuals (.34), but still statistically reliable (Chisquare(1)=8.1522,  $p < .01$ ; the equivalent model comparison yielded Chisquare(1)=43.098,  $p < .001$  for the .79 difference in ratings of ellipses in context in Experiment 2).

This leads us to the following hypothesis. In Experiment 2, part of the .79 difference in acceptability between verbs and nouns in contexts providing salient alternatives may be due to the fact that the antecedent is harder to process. Though participants were told to judge the second (elliptical) sentence in the context of the first, it is plausible that processing difficulties with the first sentence would lead to decreased acceptability in the judgment of the second. However

- 
- We have talked about a possible adoption, but we are still unsure whether she will consent. [Do/V/+Alt]  
 ii. It will be better for the baby if she does. N:5.74; V:5.26

<sup>22</sup>Since there are a variety of possible ways to calculate residuals which may each under- or overestimate the role of the context, the following line of argumentation can only provide a first indication of how to disentangle effects of context and target sentences. Acceptability judgments only provide a single measure for all components of complexity in the two-sentence texts in our experiments. We are currently preparing eyetracking reading studies to arrive at a more detailed picture of the processes under investigation and to check the degree to which the decrease in acceptability is due to processing difficulties.

<sup>23</sup>Note that effects for the residuals will be negative when the judgments are lower than can be expected from the first sentence alone and positive when the judgments are higher than what can be expected from the first sentence alone.

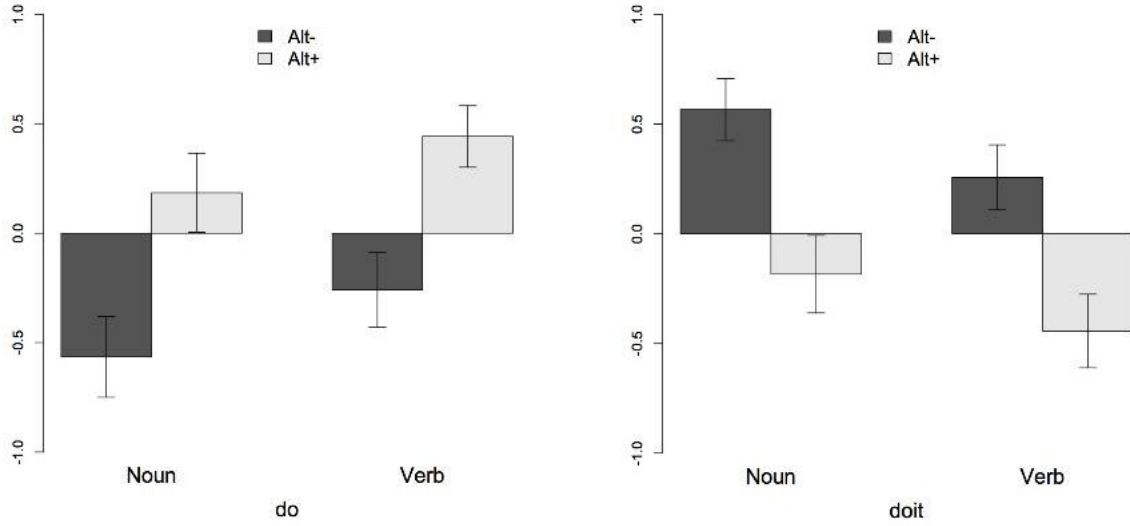


Figure 8: Residuals of the data from Experiment 2 taking into account the context plausibility

	Estimate(SE)	t-value
DoDoit	0.02(.10)	0.197
Antecedent	-0.065(.56)	-0.117
Alt	-0.012(.40)	-0.031
Antecedent:Alt	0.012(.73)	0.016
DoDoit:Antecedent	-0.154(.02)	-6.393
DoDoit:Alt	-0.408(0.2)	-16.958
DoDoit:Antecedent:Alt	0.00(.02)	0.111

Table 5: Model estimates, standard errors (in brackets) and t-values for the fixed factors Do/Doit, Antecedent Type (Noun, Verb) (and Context (+/-Alt)

the remaining significant difference for residuals shows that this cannot account for the full difference found. To account for the remaining difference, we follow Kertz 2013 in adopting a proposal by Kim et al. 2011. They argue that cases of mismatch with PAE are grammatical but less acceptable because they violate heuristic parsing strategies. They assume a deletion under syntactic identity analysis of PAE, but their proposal can be modified to fit in with an analysis in terms accessible antecedents. In a nutshell, we suggest that it is easier to access an antecedent if there is a syntactic representation of the antecedent (i.e. an antecedent-trigger, in the terms of Cornish 1999) still active in short-term memory. More precisely, speakers search for an antecedent fulfilling the discourse requirements when coming across a PAE. The heuristics for establishing possible candidates makes use of all linguistic structure currently available, including the syntactic structure. Syntactically identical antecedents are thus easier to find, similarly to first mentioned antecedents in pronoun resolution (see Gernsbacher and Hargreaves 1988) without making non-identical linguistic antecedents (or exophoric antecedents, see Miller and Pullum 2013) ungrammatical. This approach predicts (consistent with Murphy 1985) that the advantage of syntactically identical antecedents should diminish with increased distance.

## 6 Other cases of nominal antecedents

In this section, we will briefly review two other types of attested cases of PAE with nominal antecedents that have been reported in the literature and which are not based on polar nouns. We will show that there are specific factors in each of these which help satisfy the discourse condition on Aux-choice PAE given in (2a), namely factors which help make an alternative salient.

### 6.1 Indefinite deverbal nouns in the scope of a modal possibility operator

Consider first the following example from Kehler 2000:549(26), which he credits to Gregory Ward:

- (22) This letter deserves a response, but before you do, ...

It should be noted that *response* is not a polar noun. As with the case of the previously mentioned *answer* it prefers an identity question interpretation when placed in a question context (*That depends on his response*  $\approx$  *That depends on what his response is*). Note the similar constructed examples with *answer* and *decision*.

- (23) a. I don't expect an answer from her, but if she does answer, ...  
 b. Knowing their attitude, a decision is unlikely, but if they do decide, ...

These examples appear to be quite natural (though experiments would be necessary to get a more precise understanding of their acceptability). However it should be noted that they have very specific properties which distinguish them from the cases discussed here. Specifically, the NP that they head does not appear in an indirect question context (as shown by the ungrammaticality of (24a,b)) and they require an indefinite article (as shown by the infelicity of (24c,d)):

- (24)
- a. \*I don't expect whether she will answer.
  - b. \*Knowing their attitude, whether they will decide is unlikely.
  - c. #I don't expect her answer, but if she does answer, ...
  - d. #Knowing their attitude, their decision is unlikely, but if they do decide, ...

In (22) and (23), the NPs refer to a possible future response, answer, or decision. This is linked to the possibility modality inherent in the predicates *deserve*, *expect*, and *unlikely*, which clearly sets up a salient alternative (e.g. for (23a) *He will answer* ∨ *He won't answer*). The discourse condition on Aux-choice PAE is thus satisfied, and the examples are acceptable.<sup>24</sup>

## 6.2 Agentive *-er* nominals

A second case involves agentive *-er* nominals as antecedents. Hardt 1993:34 provides the attested example (25a) and proposes (25b) as a similar constructed example.

- (25)
- a. David Begelman is a great laugher, and when he does, his eyes crinkle at you the way Lady Bretts did in *The Sun Also Rises*. (p. 90, *You'll Never Eat Lunch in This Town Again*, Julia Philips) (Hardt 1993:34, his (111))
  - b. Harry used to be a great speaker, but he can't anymore, because he has lost his voice. (Hardt 1993:34, his (114))

Intuitively, the attested example is much more acceptable than the constructed one. With the discourse conditions on PAE in mind, it is possible to explain why this might be the case. The adjective *great* can be interpreted as a frequency modifier (see e.g. Gehrke and McNally ms) when modifying an appropriate nominal in an appropriate context. This is the case in (25a), where *great laugher* can be interpreted as a person who laughs frequently. On the other hand, *great speaker* in (25b) does not allow a parallel frequency modification interpretation: a great speaker is someone who makes excellent speeches, not someone who speaks often. Thus, in the case of (25a), the antecedent sentence makes salient an alternative over times when there are occurrences of the event 'David Begelman laughs', and the universal quantification expressed in the following sentence with PAE selects one of them, satisfying the discourse constraint. No parallel alternative is made salient in (25b), explaining its intuitively reduced acceptability. The following examples provide intuitive corroboration of the relevance of the frequency adjective in these cases.

- (26)
- a. Newshour is a great program. I am an occasional listener, and when I do, I'm never disappointed.
  - b. #Newshour is a great program. I am a listener, and when I do, I'm never disappointed.

<sup>24</sup>The following example cited by Hardt 1993:35, his (116), and provided to him by Bonnie Webber, is similar. *We should suggest to her that she officially appoint us a committee and invite faculty participation. They won't of course, ...* (UPENN e-mail message). Note that although *participation* is a polar noun, it does not appear in an indirect question context here and cannot be replaced by an indirect interrogative (*\*invite whether faculty will participate*). This is consequently a case of an indefinite deverbal noun in the scope of a modal possibility operator, contained here in the verb *invite*: the faculty members may or may not participate. Another example cited by Hardt 1993:35, his (117), and provided to him by Ellen Prince, is of the same type. *Today there is little or no OFFICIAL harassment of lesbians and gays by the national government, although autonomous governments might* (b-board msg). Asserting that there is little or no harassment of lesbians and gays leads to the inference that such harassment is unlikely. Note that this examples combines Aux-choice and Subj-choice, leading to complications that are beyond the scope of this paper. We plan to investigate these in future research.



- (27) a. Jack is a frequent drinker and every time he does he manages to get into some sort of trouble.
- b. #Jack is a drinker and every time he does he manages to get into some sort of trouble.

In both (26) and (27) the a. variant has a frequency modifier on the deverbal noun (*occasional* and *frequent*), making them similar to the attested example (25a). PAE is clearly felt to be much more acceptable with these than the b. variants, where the frequency modifier is absent.

This analysis of agentive nominals as antecedents for PAE explains the observation (made by Jason Merchant, p. c.) that they are far less acceptable when the nominal is not in predicative position, as illustrated in (28a), which can only be understood as a sort of pun, and in the variants on (26), (27) given in (28b) and (28c) respectively. Intuitively, nominals in predicative position with a frequency modifier are better than nominals in predicative position without one, and the latter are better than nominals in argument position: (26a)/(27a) > (26b)/(27b) > (28a), (28b,c). Note furthermore that when the nominal is in argument position, even the addition of a frequency modifier doesn't improve acceptability. This effect is limited to predicative position.

- (28) a. A laugher walked in to the room where the coffin was. #Luckily he didn't.
- b. A listener called. #He said that when he does, he's never disappointed.
- c. I met a drinker. #When he does, he always gets very drunk.

This follows from the fact that when the nominal is in an argument position, as in (28c), the proposition 'x drinks' is completely backgrounded and it would require tremendous accommodation on the part of the addressee to get it into QUD and make the alternative salient. In predicate position without a frequency modifier, as in (27b), asserting that Jack is a drinker makes it marginally possible to get the proposition 'Jack drinks regularly' into QUD by accommodation and thus to make the alternative over occasions of drinking salient.

To conclude we propose that there is no difference in grammaticality between nominal and verbal antecedents in PAE. The reason most cases of PAE with nominal antecedents are judged to be unacceptable is that they do not satisfy the discourse condition on Aux-choice PAE, namely they do not make an alternative salient. When the noun can do this, as is the case for polar nouns as well as for the two cases discussed in this section, then PAE is almost as acceptable as with a verbal antecedent. The difference in acceptability can be accounted for in terms of, first, processing difficulties due to the accommodation required by the use of the noun to express an alternative and, second, easier access to the antecedent in the case of syntactic identity.

## 7 Comparison with other psycholinguistic studies

As was just pointed out, we adopt a position very similar to that of Kim et al. 2011 and Kertz 2013 and we agree with them in rejecting the recycling theory of Arregui et al. 2006. The latter propose that PAE requires a syntactically identical antecedent and that any mismatches lead to ungrammaticality. However, in some cases an ungrammatical string can be judged to be acceptable (or at least marginally acceptable) because the addressee can use repair strategies to build an appropriately identical antecedent from the actual, mismatched antecedent. They call this the 'recycling hypothesis'. A central assumption they make is that the degree of unacceptability is a function of the number of operations required to repair: the more repair operations

are needed, the more the example will be judged unacceptable. The cases with polar nouns that we have been discussing in this paper raise a significant challenge for this theory, for two reasons. First, a noun like *participation* should require the same number of operations to repair, independently of the discourse context it appears in. Hence the difference in acceptability between the +Alt and the –Alt contexts is not accounted for. If the proponents of the recycling hypothesis were to take into account the specific lexical semantics of polar nouns and adopt the discourse condition proposed here, suggesting that satisfying discourse conditions facilitates repair, it would become much harder to distinguish between the two theories.

However, it seems to us that the plausibility of the recycling hypothesis is crucially linked to the relatively low acceptability ratings reported by Arregui et al. 2006 for nominal antecedents. Specifically, in their Experiment 3, they request an online binary judgment of acceptable or unacceptable and they find that PAE was judged acceptable 35% of the time with nominal gerunds,<sup>25</sup> as antecedents (as in (29a)) and 58% of the time with verbal gerund as antecedents (as in (29b)). It is of course difficult to compare the results of their very different experimental protocols (online binary judgments) and materials (verbal and nominal gerunds) with those reported on here. However, in the light of the preceding discussion, it is plausible to attribute these much lower acceptability results to the fact that their stimuli do not at all respect the condition on Aux-choice PAE.<sup>26</sup> Consider for instance the examples they use to illustrate their materials:

- (29)     a.    Tomorrow night's slow singing of the arias will be difficult/ but Maria will.  
              [Nominal gerund]
- b.    Singing the arias slowly tomorrow night will be difficult/but Maria will. [Verbal  
              gerund] (Arregui et al. 2006:238, their (14b,d))

Clearly, whether or not the arias will be sung tomorrow night is not at all at stake in the antecedent. The maximal QUD is the difficulty of singing the arias, the fact that they will be sung is taken for granted and is not in QUD. Thus acceptability can be expected to be low, regardless of the category of the antecedent and a further penalty for the mismatched nominal gerund is to be expected.

To conclude, it is obvious that the recycling theory seems more appealing when stimuli are only judged acceptable 35% of the time than when they are judged to have an acceptability of 5.15 on a 7 point scale, as was the case in Experiment 2. Recall furthermore that the overall mean acceptability rating (including fillers, none of which were strongly unacceptable) for Experiment 2 was 4.73. In this light it seems to us that the recycling theory becomes less plausible as an analysis for mismatched antecedents in PAE on general grounds of theoretical parsimony ('Ockham's razor'): since putatively repaired sentences are judged as acceptable as clearly grammatical sentences, there is no longer any reliable means to distinguish the two statuses and it is hard to see what might be gained by saying that some equally acceptable sentences are grammatical while others are ungrammatical but repaired.<sup>27</sup> This of course is not

<sup>25</sup>There is much terminological variation for these forms. In Huddleston et al. 2002:80ff, for instance, verbal gerunds are called 'gerunds' and nominal gerunds are called 'gerundial nouns'.

<sup>26</sup>This probably goes a considerable way in explaining that verbal gerunds were only judged acceptable 58% of the time. When the discourse conditions on PAE are met, verbal gerunds appear to be completely acceptable antecedents, e.g. *The success of tonight's performance depends on her singing the aria slowly. If she does, there won't be any problems* (this should be contrasted with their example cited here as (29a)). This is not surprising given that the verbal gerund clearly combines with its complements and adjuncts to form a VP, see Pullum 1991.

<sup>27</sup>More generally, a systematic dispreference for certain antecedents, e.g. non-topics, clefted antecedents in within sentence pronoun resolution (see Colonna et al. 2012, De la Fuente and Hemforth 2013), or negated an-

meant to imply that the recycling hypothesis is irrelevant in general. There may very well be other cases where explaining acceptability on the basis of a theory of repairs is the best option.

There is one more reason why the recycling hypothesis is hard to reconcile with our data: if we accept that encountering a case of PAE first triggers a search for a syntactically identical antecedent and only takes into account various semantic strategies in the repair process, there is no reason to assume that the discourse requirements should exert any effect on verbal antecedents. However, in our experiments, contexts with salient alternatives increased acceptability for verbal antecedents as much as they did for nominal antecedents. This effect is clearly not predicted by the recycling hypothesis.

Interestingly, in more recent work within the recycling hypothesis framework, Grant et al. 2012 propose that what they call ‘Non-Actuality Implicatures’ (NAIs), conveyed by non-epistemic modals like *should*, facilitate processing of ellipsis in general, and specifically in cases of voice mismatches. As Grant et al. do not study nominal antecedents, the details of their results are not directly comparable to ours. But it is important for us to discuss their study further as the analysis they propose, involving alternatives and QUD, is clearly related to the hypotheses defended here. Consider, for instance, the sentences in (30a) and (30b), both taken from the test materials of their Experiment 1 (Grant et al. 2012:329, their (8a) and (8b)). These respectively illustrate a simple passive-active mismatch and a passive-active mismatch with a NAI (due to the presence of *should*).

- (30)      a.    This information was released but Gorbachev didn’t.  
             b.    This information should be released but Gorbachev didn’t.

They suggest that the improvement linked to the presence of an NAI is due to the fact that NAIs introduce an alternative (between a desired and actual state of affairs). This triggers a potential QUD and ellipsis is claimed to be easier when the ellipsis clause comments on the QUD. Though this may seem somewhat similar to the discourse conditions given above in (2), it is in fact very different. Indeed, the improvement effect linked to the presence of an NAI is not presented as specific to PAE, but rather as applying in general to anaphor resolution. They claim, for instance, that “The NAI hypothesis predicts that mismatch ellipsis will be more acceptable when there is an NAI, because the alternatives introduced by the NAI will implicitly focus the antecedent making the antecedent easier to identify and therefore repair” (Grant et al. 2012:328). Though this general idea may initially appear rather natural, it should be noted that anything that makes an “antecedent easier to identify” should facilitate anaphor resolution in general, whether the anaphor is elliptical or not. Thus it is predicted that the presence of an NAI should also facilitate the resolution of *do it* with mismatched antecedents. However, our Experiment 2 (discussed in section 5.3 above), shows that this is not true at all. More specifically, Grant et al. 2012 propose that strict non-actuality, in the sense of counterfactuality, is crucial to the improvement effect. On the other hand, we claim that it is alternatives in general that specifically favor the choice of PAE over any other verbal anaphor, whether or not one branch of the alternative is presented as counterfactual. It is quite unclear, for instance, how the preference for PAE as an answer to a polar question, which is corroborated by our Experiment 1, could be linked to their NAI hypothesis. Neither branch of the alternative involved is presented as counterfactual.

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tededents within or across sentences (Shuval and Hemforth 2008) has usually been taken as evidence for reduced accessibility or prominence of the antecedent but never as evidence for ungrammaticality, even though preferences clearly depend on language specific options in the grammar (Hemforth et al. 2010). We consider that the slightly reduced acceptability of nominal antecedents (when opposed to verbal antecedents in a favorable context) should be seen in a similar way.

It is clear, however, that Grant et al. 2012 have independently discovered a subcase of the more general discourse condition on PAE proposed by Miller 2011 and Miller and Pullum 2013 and cited above in (2a). What they call NAIs are clearly a subset of what are generally known as alternatives. We can thus safely assume that the improvement in acceptability of passive/active mismatches that they find in their experiments can in fact be explained by the more general conditions provided in (2a) above.

Before closing this section, we should also mention the recent eye-tracking study of Roberts et al. 2013 who argue that PAE requires more computation at the ellipsis site than *do it* in the case of voice mismatches and nominal antecedents. However, their results are difficult to interpret because their stimuli typically do not satisfy the discourse conditions on PAE. Consider for instance, their (12c): *The robbery at Citibank was an act of desperation. The police haven't figured out who did.* Very clearly, the first sentence presents the fact that Citibank was robbed as backgrounded information, and not a QUD. Thus the greater processing times they find are probably simply due to the fact that no antecedent satisfying the discourse conditions on PAE is accessible.

## 8 Conclusion: PAE and identity

What are the consequences of the above discussion for the general question of the type of identity that is required for PAE? If one accepts even the weak lexicalist hypothesis, according to which derivational morphology is invisible to syntax, (see Chomsky 1970, Lapointe 1985(1980)), then it is impossible to maintain a syntactic identity condition on PAE. This is all the more true in theories which accept the strong lexicalist hypothesis (e.g. HPSG, LFG, CG, Simpler Syntax). On the other hand, if one refuses the lexicalist hypothesis, as is done in current Chomskian theory, accepting abstract functional projections and movement of morphemes, it is of course possible to set up one's syntax so that the nominal antecedent and the ellipted constituent are identical at the relevant level of structure. Specifically, as suggested by Johnson 2001 and van Craenenbroek 2013, one could adapt the analysis proposed by Fu et al. 2001 for *do so* with nominal antecedents and assume that there is a verbal projection within the noun phrase that is syntactically identical to the ellipted material at the relevant level of representation. This would lead to a claim similar to that made here (as well as by e.g. Kim et al. 2011, and Kertz 2013) viz. that all cases of PAE with a nominal antecedent are well-formed.

However, there is a price to be paid for such a position, as Chomsky himself convincingly argued in his 1970 "Remarks on Nominalization", and as was further developed in numerous subsequent publications. Indeed it means that morphological idiosyncrasy must be dealt with in the syntax. For instance, in the case of *do so*, as pointed out by Kehler and Ward 2007, the semantic transparency of the derived nominal antecedent is a crucial determinant of its acceptability as an antecedent, as illustrated by the contrast between (31a) and (31b):

- (31)     a.     One study suggests that almost half of young female smokers do so [= smoke] in order to lose weight. (Kehler and Ward 2007, attested example, their (18))
- b.     #Most professors will do so [=profess] for hours even when no one is listening. (Kehler and Ward 2007, their (22))

It is hard to see how this can be captured in the analysis proposed by Fu et al. 2001, where there is no difference in the syntax of the nominals that could be linked to their degree of semantic transparency.

If one nevertheless decides to adopt such a framework, the question becomes how to account for the differences in acceptability that we have found between nominal and verbal antecedents and between alternative and non alternative contexts. Indeed, if the surface NPs are in fact VPs at the relevant level of structure, it is a priori unclear why there should be any difference in acceptability judgments at all. Though a minimalist account could adopt the discourse conditions proposed here (possibly attempting to encode them syntactically, through a specific functional projection for polarity, that might be considered as a licenser for PAE (As is done, for instance, by Martins 2005 for Portuguese.)), it would still have trouble accounting for the details of the acceptability data for several reasons.

First, as we have shown, even when the discourse conditions on PAE are satisfied, there appears to remain a penalty for mismatched antecedents, which we have attributed to the fact that the presence of a syntactically identical antecedent-trigger makes it easier to access the antecedent, given the heuristic strategies of the parser. If the surface NP antecedent is in fact verbal at the relevant level of structure, then there is no relevant difference between nominal and verbal antecedents, and it is hard to see why such a penalty should be expected.

Second, we have seen that only a limited subclass of nouns are polar nouns, allowing polar question type readings. Yet all derived nominals will be assumed to have a verbal head. It is thus unclear how such an analysis can distinguish acceptable from unacceptable derived nominal antecedents. If one claimed that a polarity head, or some such distinctive syntactic property is present in polar nouns, the problem is not yet solved: At this point, we do not yet understand the specific lexical semantic properties which explain that a noun has a possible polar interpretation (assuming that this is not a completely idiosyncratic property). But in any case it seems pretty clear that the property is linked to the nouns themselves and not to their verbal bases (verbs can be used in polar questions irrespective of whether their nominalizations are polar nouns or not). Any non-lexicalist approach will consequently have to paradoxically provide some sort of syntactic account for what are clearly lexical properties.

Third, we have seen that it is not polar nouns as such which allow PAE, but only polar nouns when used in an environment that makes their polar reading available. Any theory that claims that derived nominals have verbal heads will have to provide some means of distinguishing whether those heads are in a context which allows them to take on a polar reading.

Fourth, it is unclear that all polar nouns are deverbal nouns. Though 12 of the 13 polar nouns mentioned in Table 2 are clearly synchronically deverbal, *victory* can be argued not to be.<sup>28</sup> In order to treat *victory* along the lines suggested, one would have to assume that an underived noun can have an internal VP, certainly not a step one would want to take lightly.

Fifth, a central difficulty for non lexicalist analyses is the fact that, as shown in Experiment 3, the polar interpretation of the relevant nouns is dispreferred and requires accommodation, even when it is possible. If it were simply the case that these nouns include a verb inside of them one would have no explanation for the processing difficulties linked to accommodation which are evidenced by Experiment 3.

Sixth, and last, it is very hard to see how a non lexicalist approach could distinguish between the acceptable and unacceptable cases of PAE with nominal antecedents discussed in section 6. Once again, there is no reason to assume that nouns like *answer* or *decision* contain an underlying verbal head in some cases but not in others. Therefore, nominal antecedents should

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<sup>28</sup>It is implausible to treat *victory* as a nominalization of *vanquish*, as the latter verb is approximately 100 times less frequent than *victory* in the COCA and has a much narrower range of uses. It is natural to talk about *the Laker's victory over the Wolves* but quite unnatural to say *The Lakers vanquished the Wolves*. Very clearly, *victory* is in competition with the converted noun *win* as a nominalization of the verb *win*.

be expected to be acceptable very generally, which is clearly not the case.

Obviously, we are not claiming that these problems could not be dealt with at all in a non-lexicalist framework where ellipsis is constrained by some form of syntactic identity. Discourse properties could be built into the syntactic structure through functional projections, distinctions could be made between various classes of nominals as to whether they contain a VP or not, etc. However it seems to us that the approach we are advocating provides a much simpler analysis. As suggested by e.g. Culicover and Jackendoff 2005, combining a simpler syntactic structure with an appropriate understanding of discourse conditions allows a much simpler linguistic theory overall.

To conclude, the nominal antecedent cases of PAE significantly reduce the plausibility of any analysis based on syntactic identity. But beyond this, when we take into account other well known cases in the literature, such as split antecedents (see Webber 1979, Hardt 1999, and Elbourne 2008 for an opposing view) and exophoric uses (see Miller and Pullum 2013), it can be argued that any kind of *linguistic* identity constraint is untenable. PAE simply requires accessing an antecedent that satisfies the relevant discourse constraints. The heuristics for establishing possible candidates makes use of all the information available in the discourse model as well as available syntactic structure. Syntactically identical antecedents are thus easier to find and are consequently typically more acceptable. In this perspective, one might speculate about the reasons for which syntactic identity is so much more frequent for PAE than for *do it* in actual usage. We suggest that this results from a combination of two factors. First, syntactically identical verbal antecedents are much more frequent because nominal antecedents only rarely fulfill the discourse requirements on PAE (the same is true for argument structure mismatches as shown by Kertz 2013). Second, PAE requires a more accessible ('in focus' in the terminology of Gundel et al. 1993) antecedent than *do it*, as shown by Miller 2011. As a consequence, when the antecedent is inferred from an antecedent-trigger in the preceding discourse, it is much more likely that the antecedent-trigger will still be active in short term memory in the case of PAE than in the case of *do it*. Taken together, these two factors entail that searching for a syntactically identical antecedent is a more dependable heuristic for PAE than for *do it* because it leads to success more often.

We speculate that this is what has led PAE to be identified as a surface anaphor, requiring syntactic identity, as opposed to *do it*. If the heuristic strategies involved in recovering antecedents give more weight to syntactic structure in the case of PAE than in the case of *do it*, all other thing being equal the absence of a syntactically identical antecedent will reduce acceptability more strongly for PAE than for *do it*. This idea is corroborated by the fact that *do so* also requires an in focus antecedent (see Miller 2011) and that it has also been identified as a surface anaphor, requiring syntactic identity, despite sharing the presence of main verb *do* with *do it*, contrary to the auxiliary *do* of PAE.

Finally, one might wonder why attested examples of PAE with nominal antecedents are so rare (six such cases are cited in this paper, and we do not know of any others). Might this not be a strong argument in favor of syntactic identity? We claim that this paper shows exactly the opposite. The problem with nominal antecedents is not a problem of syntax, but rather a problem of discourse constraints. PAE with nominal antecedents is rare because it is only under very specific circumstances and with restricted classes of nouns that the discourse constraints on PAE can be satisfied.

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## Appendix A: Test materials for Experiment 1

1. A.—Did Kim go home? B.—Yes, she did because she was tired.  
A.—Did Kim go home? B.—Yes, she did it because she was tired.  
A.—Did Kim go home? B.—Yes, she did.  
A.—Did Kim go home? B.—Yes, she did it.
2. A.—Did Emma eat the sandwich? B.—Yes, she did (it) (because she was very hungry).
3. A.—Did Jim manage to solve the problem? B.—Yes, he did (it) (on Tuesday).
4. A.—Did Alex finish his paper? B.—Yes, he did (it) (on Tuesday).
5. A.—Did Ann plant tulips in her garden? B.—Yes, she did (it) (with great care).
6. A.—Did Lily rake up the leaves? B.—Yes, she did (it) (with great care).
7. A.—Did James bake a cake? B.—Yes, he did (it) (for me).
8. A.—Did Juan make lasagna? B.—Yes, he did (it) (for me).
9. A.—Did Joan clean up the kitchen? B.—Yes, she did (it) (in less than an hour).
10. A.—Did Chloe wash the dishes? B.—Yes, she did (it) (in less than an hour).
11. A.—Did Kurt write up the report? B.—Yes, he did (it) (without any problems).
12. A.—Did Casper correct the spreadsheets? B.—Yes, he did (it) (without any problems).
13. A.—Did Claire chair the meeting? B.—Yes, she did (it) (very professionally).
14. A.—Did Abigail explain the new procedures to the team? B.—Yes, she did (it) (very professionally).
15. A.—Did Peter dance with you at the party? B.—Yes, he did (it) (to make me happy).
16. A.—Did Louie help you with the kids? B.—Yes, he did (it) (to make me happy).
17. A.—Did Jenny file the complaint? B.—Yes, she did (it) (this morning).
18. A.—Did Sophia review the file? B.—Yes, she did (it) (this morning).
19. A.—Did Carl buy a new car? B.—Yes, he did (it) (just to show off).
20. A.—Did Ryan post his vacation photos on facebook? B.—Yes, he did (it) (just to show off).

## Appendix B: Test materials for Norming Study

1. The outcome depends on Kate's participation.  
The outcome depends on how/how intensely/whether Kate participates.
2. I intend to hold the meeting, regardless of Kate's participation.  
I intend to hold the meeting, regardless of how/how intensely/whether Kate participates.
3. We are still unsure of Kate's participation.  
We are still unsure how/how intensely/whether Kate will participate.
4. Tina's success depends on her constituents' approval.  
Tina's success depends on what/how strongly/whether her constituents approves.
5. Tina will continue, regardless of her constituents' approval  
Tina will continue, regardless of what/how strongly/whether her constituents approves.
6. We are still unsure of her constituents' approval.  
We are still unsure what/how strongly/whether her constituents will approve.
7. The outcome of the investigation depends on Peter's consent to the study.  
The outcome of the investigation depends on how/how strongly/whether Peter consents to the study.
8. We will go ahead with the marriage, regardless of my father's consent.  
We will go ahead with the marriage, regardless of how/how strongly/whether my father consents.
9. We are still unsure of Cathy's consent to the transfer.  
We are still unsure how/how strongly/whether Cathy will consent to the transfer.
10. Our victory in the elections depends on the current chairman's resignation.  
Our victory in the election depends on how/whether the current chairman resigns.
11. I will not step in to help, regardless of the current chairman's resignation.  
I will not step in to help, regardless of how/whether the current chairman resigns.
12. We are still unsure of the chairman's resignation.  
We are still unsure how/whether the chairman will resign.
13. Jill's success depends on Grant's withdrawal.  
Jill's success depends on how/how intensely/whether Grant withdraws.
14. Jill will continue, regardless of Grant's withdrawal.  
Jill will continue, regardless of how/how intensely/whether Grant withdraws.
15. We are still unsure of Grant's withdrawal.  
We are still unsure how/how intensely/whether Grant will withdraw.
16. The outcome of the negotiations depends on the kidnapper's surrender.  
The outcome of the negotiations depends on how/whether the kidnapper surrenders.
17. I will not stop the fight, regardless of our opponent's surrender.  
I will stop the fight, regardless of how/whether our opponent surrenders.
18. We are still unsure of the kidnapper's surrender.  
We are still unsure how/whether the kidnapper will surrender.
19. The outcome of the project depends on Carter's cooperation.  
The outcome of the project depends on how/how intensely/whether Carter cooperates.
20. The case is at a standstill, regardless of the captive's cooperation.  
The case is at a standstill, regardless of how/how intensely/whether the captive cooperates.
21. We are still unsure of Carter's cooperation.  
We are still unsure how/how intensely/whether Carter will cooperate.
22. The outcome of the peace process depends on the her acceptance of the new plan.  
The outcome of the peace process depends on how/whether she accepts the new plan.
23. I do not trust her, regardless of her acceptance of the new plan.  
I do not trust her, regardless of how/whether she accepts the new plan.

24. We are still unsure of her acceptance of the new plan.  
We are still unsure how/whether she will accept the new plan.
25. The outcome of the experiment depends on the hiker's survival.  
The outcome of the experiment depends on how/whether the hiker survives.
26. We will not mount a rescue operation, regardless of the hiker's survival.  
We will not mount a rescue operation, regardless of how/whether the hiker survives.
27. We are still unsure of the hiker's survival.  
We are still unsure how/whether the hiker will survive.
28. The success of our mission depends on the prisoner's escape.  
The success of our mission depends on how/whether the prisoner escapes.
29. We will not hunt him down, regardless of his escape.  
We will not hunt him down, regardless of how/whether he escapes.
30. We are still unsure of the prisoner's escape.  
We are still unsure how/whether the prisoner will escape.
31. The outcome of the operation depends on Nelson's attack.  
The outcome of the operation depends on how/how intensely/whether Nelson attacks.
32. We will not give in, regardless of Nelson's attack.  
We will not give in, regardless of how/how intensely/whether Nelson attacks.
33. We are still unsure of Nelson's attack.  
We are still unsure how/how intensely/whether Nelson will attack.
34. The outcome of the championship depends on The Lakers' victory.  
The outcome of the championship depends on how/whether The Lakers win.
35. We will get first place in the overall ranking, regardless of The Lakers' victory.  
We will get first place in the overall ranking, regardless of how/whether The Lakers win.
36. We are still unsure of The Lakers' victory.  
We are still unsure how/whether The Lakers will win.
37. The outcome of the procedure depends on the patient's recovery.  
The outcome of the procedure depends on how the patient recovers.
38. I am pessimistic about the outcome of the procedure, regardless of the patient's recovery.  
I am pessimistic about the outcome of the procedure, regardless of how the patient recovers.
39. We are still unsure of the patient's recovery.  
We are still unsure how the patient will recover.
40. The outcome depends on Tania's answer.  
The outcome depends on what Tania answers.
41. I will hold the meeting, regardless of Tania's answer.  
I will hold the meeting, regardless of what Tania answers.
42. We are still unsure of Tania's answer.  
We are still unsure of what Tania will answer.
43. The outcome of the project depends on Kimberly's decision.  
The outcome of the project depends on what/whether Kimberly decides.
44. I will hold the meeting, regardless of Kimberly's decision.  
I will hold the meeting, regardless of what/whether Kimberly decides.
45. We are still unsure of Kimberly's decision.  
We are still unsure what/whether Kimberly will decide.
46. The outcome of the experiment depends on Vanessa's solution.  
The outcome of the experiment depends on how/whether Vanessa solves the problem/on what Vanessa solves.

47. I will hold the meeting, regardless of Vanessa's solution.  
I will hold the meeting, regardless of how/whether Vanessa solves the problem/of what Vanessa solves.
48. We are still unsure of Vanessa's solution.  
We are still unsure how/whether Vanessa will solve the problem/what Vanessa solved.
49. The possibility of holding the meeting depends on the chairman's arrival.  
The possibility of holding the meeting depends on how/whether the chairman arrives.
50. I will not open the door, regardless of the chairman's arrival.  
I will not step in to help, regardless of how/whether the chairman arrives.
51. We are still unsure of the chairman's arrival.  
We are still unsure how/whether the chairman will arrive.
52. The outcome of the war depends on the city's destruction.  
The outcome of the war depends on how/how intensely/whether the city is destroyed.
53. They will go on with the attacks, regardless of the city's destruction.  
They will go on with the attacks, regardless of how/how intensely/whether the city is destroyed.
54. We are still unsure of the city's destruction.  
We are still unsure how/how intensely/whether the city will be destroyed.

## Appendix C: Test materials for Experiments 2 and 3

1. It is impossible to predict Andrew's participation in the chess tournament. He is sure to win if he does (it).  
Everyone was annoyed by Andrew's participation in the chess tournament. His fans could not understand why he did (it).  
It is impossible to predict whether Andrew will participate in the chess tournament. He is sure to win if he does (it).  
Everyone was annoyed that Andrew participated in the chess tournament. His fans could not understand why he did (it).
2. The outcome of the negotiations largely depends on Anna's participation in the talks. It will help our side if she does (it).  
People from the other departments were embarrassed by Anna's participation in the talks. They were annoyed that she did (it).  
The outcome of the negotiations largely depends on whether Anna participates in the talks. It will help our side if she does (it).  
People from the other departments were embarrassed that Anna participated in the talks. They were annoyed that she did (it).
3. Despite all our efforts, we are still unsure of Adele's participation in the proceedings. Things are sure to go well if she does (it).  
After all our efforts, I was exasperated by Adele's participation in the proceedings. I wondered why she did (it).  
Despite all our efforts, we are still unsure whether Adele will participate in the proceedings. Things are sure to go well if she does (it).  
After all our efforts, I was exasperated that Adele had participated in the proceedings. I wondered why she did (it).
4. It is impossible to predict Betty's withdrawal from the race. Her fans will be disappointed if she does (it).  
Betty's teammates were irritated by her withdrawal from the race. They didn't know why she did (it).  
It is impossible to predict whether Betty will withdraw from the race. Her fans will be disappointed if she does (it).  
It irritated Betty's teammates that she had withdrawn from the race. They didn't know why she did (it).

5. The outcome of the peace talks depends on the fleet's withdrawal from the neighboring system. There will definitely be an improvement if they do (it).  
The general resented the fleet's withdrawal from the neighboring system. He couldn't figure out why they did (it).  
The outcome of the peace talks depends on whether the fleet withdraws from the neighboring system. There will definitely be an improvement if they do (it).  
The general resented that the fleet had withdrawn from the neighboring system. He couldn't figure out why they did (it).
6. Jackson's fans are still unsure of her withdrawal from the competition. Cooper is sure to win if she does (it).  
Jackson's fans were disgusted by her withdrawal from the competition. They wonder why she did (it).  
Jackson's fans are still unsure whether she will withdraw from the competition. Cooper is sure to win if she does (it).  
Jackson's fans were disgusted that she had withdrawn from the competition. They wonder why she did (it).
7. It is impossible to predict the chairman's resignation. We can't hold the meeting if she does (it).  
Everyone felt threatened by the chairman's resignation. It was very unclear why she did (it).  
It is impossible to predict whether the chairman will resign. We can't hold the meeting if she does (it).  
Everyone felt threatened that the chairman had resigned. It was very unclear why she did (it).
8. The success of our plans depends on the CEO's resignation. Everything will go smoothly if she does (it).  
The committee was preoccupied by the CEO's resignation. There was a lot of finger-pointing after she did (it).  
The success of our plans depends on whether the CEO resigns. Everything will go smoothly if she does (it).  
The committee was preoccupied that the CEO had resigned. There was a lot of finger-pointing after she did (it).
9. At this point, we are still unsure of Diane's resignation. Things will not be the same if she does (it).  
At that point, we were amused by Diane's resignation. We knew exactly why she did (it).  
At this point, we are still unsure whether Diane will resign. Things will not be the same if she does (it).  
At that point, we were amused that Diane had resigned. We knew exactly why she did (it).
10. It is impossible to predict the fugitive's surrender. He will get a reduced sentence if he does (it).  
Everyone was preoccupied by the fugitive's surrender. The police were unsure why he did (it).  
It is impossible to predict whether the fugitive will surrender. He will get a reduced sentence if he does (it).  
Everyone was preoccupied that the fugitive had surrendered. The police were unsure why he did (it).
11. The life or death of the hostages depends on the hostage-taker's surrender. The families will be relieved if he does (it).  
The media were fascinated by the hostage-taker's surrender. The families were expecting the worst when he did (it).  
The life or death of the hostages depends on whether the hostage-taker surrenders. The families will be relieved if he does (it).  
The media were fascinated that the hostage-taker had surrendered. The families were expecting the worst when he did (it).
12. Despite the ongoing negotiations, they are unsure of the soldier's surrender. It will make things easier if he does (it).  
Given the ongoing negotiations, they resented the soldier's surrender. No one could get why he did (it).  
Despite the ongoing negotiations, they are unsure whether the soldier will surrender. It will make things easier if he does (it).  
Given the ongoing negotiations, they resented that the soldier had surrendered. No one could get why he

did (it).

13. It is impossible to predict the Chairman's approval of the proposal. The members will be relieved if he does (it).  
The protestors were irritated by the Chairman's approval of the proposal.. They staged a demonstration just after he did (it).  
It is impossible to predict whether the Chairman will approve the proposal. The members will be relieved if he does (it).  
The protestors were irritated that the Chairman had approved the proposal.. They staged a demonstration just after he did (it).
14. The survival of the company depends on the FDA's approval of the new drug. It will be good news for the shareholders if it does (it).  
Most of the medical staff were disgusted by the FDA's approval of the new drug. The doctors could not understand why they did (it).  
The survival of the company depends on whether the FDA approves the new drug. It will be good news for the shareholders if it does (it).  
It disgusted most of the medical staff that the FDA had approved the new drug. The doctors could not understand why they did (it).
15. I am not sure of the committee's approval of the new guidelines. It will be a great relief if they do (it).  
I was aware of the committee's approval of the new guidelines. But I couldn't understand why they did (it).  
I am not sure that the committee will approve the new guidelines. It will be a great relief if they do (it).  
I was aware that the committee had approved the new guidelines. But I couldn't understand why they did (it).
16. It is impossible to predict our father's consent to the marriage. My sister will be delighted if he does (it).  
My sister was exasperated by our father's consent to the marriage. She was almost in tears after he did (it).  
It is impossible to predict whether our father will consent to the marriage. My sister will be delighted if he does (it).  
My sister was exasperated that our father had consented to the marriage. She was almost in tears after he did (it).
17. The patient's survival depends on her consent to the procedure. The operation is almost sure to go well if she does (it).  
The family felt threatened by the patient's consent to the procedure. They couldn't figure out why she did (it).  
The patient's survival depends on whether she consents to the procedure. The operation is almost sure to go well if she does (it).  
The family felt threatened that the patient had consented to the procedure. They couldn't figure out why she did (it).
18. We have talked about a possible adoption, but we are still unsure of her consent. It will be better for the baby if she does (it).  
After all her doubts, we were preoccupied by her consent to the adoption. We were afraid she would be depressed after she did (it).  
We have talked about a possible adoption, but we are still unsure whether she will consent. It will be better for the baby if she does (it).  
After all her doubts, it preoccupied us that she had consented to the adoption. We were afraid she would be depressed after she did (it).
19. It is impossible to predict the witness's cooperation with the police. They will be relieved if she does (it).  
The police inspectors were amused by the witness's cooperation. They knew exactly why she did (it).  
It is impossible to predict whether the witness will cooperate with the police. They will be relieved if she

does (it).

The police inspectors were amused that the witness had cooperated. They knew exactly why she did (it).

20. The criminal's sentence depends on his cooperation with the authorities. He may get a suspended sentence if he does (it).

The judge was indifferent to the criminal's cooperation with the authorities. It didn't mean anything to him that he did (it).

The criminal's sentence depends on whether he cooperates with the authorities. He may get a suspended sentence if he does (it).

The judge was indifferent that the criminal had cooperated with the authorities. It didn't mean anything to him that he did (it).

21. Despite all our efforts, we are still unsure of their cooperation in the project. Our rivals will be furious if they do (it).

Bruce is a real loner: he was annoyed by their cooperation in his project. It upset him that they did (it).

Despite all our efforts, we are still unsure whether they will cooperate in the project. Our rivals will be furious if they do (it).

Bruce is a real loner: he was annoyed that they had cooperated in his project. It upset him that they did (it).

22. It is impossible to predict the director's acceptance of the new policy. But I will not be surprised if he does (it).

Some members felt threatened by the director's acceptance of the new policy. They organized a protest after he did (it).

It is impossible to predict whether the director will accept the new policy. But I will not be surprised if he does (it).

Some members felt threatened that the director had accepted the new policy. They organized a protest after he did (it).

23. The outcome of the negotiations depends on the rebels' acceptance of the terms of the treaty. The ambassador will be greatly relieved if they do (it).

The ambassadors were upset by the rebels' acceptance of the terms of the treaty. They couldn't figure out why they did (it).

The outcome of the negotiations depends on whether the rebels accept the terms of the treaty. The ambassador will be greatly relieved if they do (it).

The ambassadors were upset that the rebels accepted the terms of the treaty. They couldn't figure out why they did (it).

24. The chairman is still unsure of the committee's acceptance of the resolution. He may actually resign if they do (it).

The chairman was annoyed by the committee's acceptance of the resolution. He threatened to resign after they did (it).

The chairman is still unsure whether the committee will accept the resolution. He may actually resign if they do (it).

The chairman was annoyed that the committee had accepted the resolution. He threatened to resign after they did (it).

25. It is impossible to predict the government's survival. Political commentators will not understand if it does (it).

The leader of the opposition was preoccupied by the government's survival. He couldn't understand how they did (it).

It is impossible to predict whether the government will survive. Political commentators will not understand if it does (it).

The leader of the opposition was preoccupied that the government had survived. He couldn't understand how they did (it).



26. The rescue team's reputation depends on the victim's survival. They will be greatly honored if she does (it).  
 The rescue team was aware of the victim's survival. It was puzzling to them how she did (it).  
 The rescue team's reputation depends on whether the victim survives. They will be greatly honored if she does (it).  
 The rescue team was aware that the victim had survived. It was puzzling to them how she did (it).
27. We are still unsure of the lost hiker's survival. It will puzzle outdoors specialists if he does (it).  
 People were intrigued by the lost hiker's survival. They wondered how he did (it).  
 We are still unsure whether the lost hiker will survive. It will puzzle outdoors specialists if he does (it).  
 People were intrigued that the lost hiker had survived. They wondered how he did (it).
28. It is impossible to predict the prisoner's escape. The prison authorities will not understand if he does (it).  
 The prison authorities were annoyed by the prisoner's escape. They held a special security meeting after he did (it).  
 It is impossible to predict whether the prisoner will escape. The prison authorities will not understand if he does (it).  
 The prison authorities were annoyed that the prisoner had escaped. They held a special security meeting after he did (it).
29. The outcome of our plans depends on the soldier's escape from captivity. Things should work out if he does (it).  
 The newsrooms were fascinated by the soldier's escape from captivity. People could not understand how he did (it).  
 The outcome of our plans depends on whether the soldier escapes from captivity. Things should work out if he does (it).  
 The newsrooms were fascinated that the soldier had escaped from captivity. People could not understand how he did (it).
30. We are still unsure of the victim's escape from the kidnapper's hideout. Her family will be relieved if she does (it).  
 The media were enthralled by the victim's escape from the kidnapper's hideout. Everyone wondered how she did (it).  
 We are still unsure whether the victim will escape from the kidnapper's hideout. Her family will be relieved if she does (it).  
 The media were enthralled that the victim had escaped from the kidnapper's hideout. Everyone wondered how she did (it).
31. It is impossible to predict the fleet's attack against the enemy stronghold. International protest is likely if they do (it).  
 Patriots were thrilled by the fleet's attack against the enemy stronghold. Everyone felt joyful after they did (it).  
 It is impossible to predict whether the fleet will attack the enemy stronghold. International protest is likely if they do (it).  
 Patriots were thrilled that the fleet had attacked the enemy stronghold. Everyone felt joyful after they did (it).
32. The outcome of the war depends on the Navy's attack against the enemy's power supply. We are sure to win if they do (it).  
 People were dazzled by the Navy's attack against the enemy's power supply. Everyone wondered how they did (it).  
 The outcome of the war depends on whether the Navy attacks the enemy's power supply. We are sure to win if they do (it).  
 People were dazzled that the Navy had attacked the enemy's power supply. Everyone wondered how they did (it).

33. We are still unsure of the hackers' attack against our security system. We may lose precious data if they do (it).  
 We were preoccupied by the hackers' attack against our security system. We were not sure how they did (it).  
 We are still unsure whether the hackers will attack our security system. We may lose precious data if they do (it).  
 We were preoccupied that the hackers had attacked our security system. We were not sure how they did (it).
34. It is impossible to predict our team's victory in the volleyball tournament. We will be very happy if they do (it).  
 Everyone was thrilled by our team's victory in the volleyball tournament. No one is quite sure how they did (it).  
 It is impossible to predict whether our team will win the volleyball tournament. We will be very happy if they do (it).  
 Everyone was thrilled that our team had won the volleyball tournament. No one is quite sure how they did (it).
35. The Blue Jays' ranking depends on their victory against the Detroit Tigers. They will end up first if they do (it).  
 Fans were enthralled by the Blue Jays' victory against the Detroit Tigers. There was a huge party after they did (it).  
 The Blue Jays' ranking depends on whether they win against the Detroit Tigers. They will end up first if they do (it).  
 Fans were enthralled that the Blue Jays had won against the Detroit Tigers. There was a huge party after they did (it).
36. We are still unsure of our troops victory against the enemy. There will be scenes of joy if they do (it).  
 People were dazzled by our troops victory against the enemy. Specialists cannot understand how they did (it).  
 We are still unsure whether our troops will vanquish the enemy. There will be scenes of joy if they do (it).  
 People were dazzled that our troops had vanquished the enemy. Specialists cannot understand how they did (it).
37. It is impossible to predict the patient's recovery from the disease. Most doctors will be surprised if she does (it).  
 The family was thrilled by the patient's recovery from the disease. The doctors can't quite understand how she did (it).  
 It is impossible to predict whether the patient will recover from the disease. Most doctors will be surprised if she does (it).  
 The family was thrilled that the patient had recovered from the disease. The doctors can't quite understand how she did (it).
38. Further developments depend on Elizabeth's recovery from her state of partial paralysis. The medical community will be very intrigued if she does (it).  
 The medical staff were enthralled by Elizabeth's recovery from her state of partial paralysis. They couldn't figure out how she did (it).  
 Further developments depend on whether Elizabeth recovers from her state of partial paralysis. The medical community will be very intrigued if she does (it).  
 The medical staff were enthralled that Elizabeth had recovered from her state of partial paralysis. They couldn't figure out how she did (it).
39. We are still unsure of the President's recovery from his heart attack. The whole nation will be relieved if he does (it).  
 People were thrilled by the President's recovery from his heart attack. Everyone was wondering how he did (it).  
 We are still unsure whether the President will recover from his heart attack. The whole nation will be

relieved if he does (it).

People were thrilled that the President had recovered from his heart attack. Everyone was wondering how he did (it).

40. The outcome of the election depends on the Senator's resignation. We have a small chance if she does (it).  
Opponents were amused by the Senator's resignation. They had a good idea why she did (it).  
The outcome of the election depends on whether the Senator resigns. We have a small chance if she does (it).  
Opponents were amused that the Senator had resigned. They had a good idea why she did (it).