

## The Said and the Unsaid: Learnability in the English Passives\*

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Working with Tom is to be constantly reminded of the rich complexity of language and the tough analytical puzzles it presents. This has always kept me honest, ever since I was a graduate student when Tom kindly took me under his wings. The present note evolved from a recent email exchange, one of the many over the past twenty years, which concerns the English past participles and their ability to appear attributively in a pre-nominal position:

- (1) a. \*the read book  
      \*the told story  
      \*the debated resolution  
      \*the mentioned *bisque*
- b. the unread book  
         the untold story  
         the carefully debated resolution  
         the previously mentioned *bisque*

### 1. Projecting Said to Unsaid

What is the source of the robust contrast in (1)? The traditional approach in generative linguistics is to seek structural constraints that distinguish the grammatical and ungrammatical expressions. The question then turns to the nature of such constraints: Are they properties of Universal Grammar, which hold invariantly across languages (e.g., Merge and hierarchy; Berwick and Chomsky 2016), or are they properties of particular languages, which children acquire on the basis of the primary linguistic data? If they are combination of both, what is the proper division of labor (Yang 2002, Chomsky 2005)?

To get to the bottom of these issues, we not only need concrete claims about Universal Grammar but also precise learning models for the Projection Problem (Peters 1972, Baker 1979): How does the child “project” the grammar from a finite amount of primarily linguistic data? In particular, how do children acquire the *unsaid*, i.e., knowledge of ungrammatical expressions such as (1a) that they never hear, from the *said*, i.e., grammatical expressions such as (1b) that they do hear in the input albeit only a very small sample?

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There have been no shortage of false starts but perhaps the most persistent is the unprincipled appeal to indirect negative evidence and its many variants; see Pinker (1989) for a critical review. That is, unattested linguistic forms are regarded as ungrammatical. At this point it is useful to remind ourselves that the absence of evidence is not evidence of absence. Just as no one had heard of the *wug* before Berko (1958), its plural form *wugs* is available to even young children: the infinity of language derives from the productivity of the rule “add -s” despite some exceptions (e.g., *sheep-sheep*, *mouse-mice*, *child-children*). The modern, probabilistic, instantiations of indirect negative evidence does not fare better, contrary to some recent claims (e.g. Xu and Tenenbaum 2007, Boyd and Goldberg 2011). Thanks to the statistical sparsity of linguistic distributions, it is generally impossible to distinguish ungrammatical sentences, which would never appear in the input, from grammatical ones which just happen not to be sampled even in very large corpora (Yang 2015, 2017).

It is important, however, to recognize cases where not hearing a form in the input *does* imply its ungrammaticality. The most straightforward and striking example has to be infelicitable gaps. For most English speakers, the past participle of the verb *stride* does not exist as both *I have strode* and *I have stridden* sound awful. Similarly, the past tense of the verb *forgo* seems: both *forgoed* or *forwent* are avoided (Pullum and Wilson 1977, Pinker 1999). Ever since Halle (1973)’s landmark study, it has been recognized that gaps arise in the unproductive corners of morphology where no (productive) default form exists; see Gorman and Yang (2018) for a modern take. Here speakers must rely on the input to learn the inflected forms of words; if they are not attested, lexical gaps will appear.

Taken together, a satisfactory solution to the Projection Problem must have the following attributes:

- (2) a. The learner must identify productive rules (e.g., “add -ed”) which can apply to unattested data (e.g., *googled*) even though these rules may have exceptions.
- b. The learner must also identify unproductive or lexicalized rules which can only apply to the attested data (e.g., *stride*) but do not extend beyond.

Note the absence of evidence *does* become evidence of absence albeit only in the case of (2b); *after* the unproductivity of a rule has been established independently, and critically *not* via the absence of evidence!

In reflection, the problems outlined in (2) have been a source of controversy from the very beginning of generative grammar. In Lakoff’s formulation (1965, 1), (2a) refers to “major” rules which “apply in normal cases, but do not apply to exceptions” and (2b) refers to “minor” rules which “apply only to exceptions, but do not apply in normal cases”. A thorough consideration of these issues is beyond the scope of this paper and Lakoff’s challenges were never fully resolved but it is interesting to view them under the Minimalist light and the division of labor between UG and learning and other cognitive factors (Chomsky 2005, Yang et al. 2017).

I suggest that a successful solution to the problem in (2) provides a satisfying account for the contrasting distribution in (1). The solution is the Tolerance Principle developed over the years (Yang 2005, 2016), which I will simply state as follows:

- (3) Let a rule  $R$  be defined over a set of  $N$  lexical items.  $R$  is productive if and only if the number of lexical items not supporting  $R$  does not exceed  $\theta_N$  where

$$\theta_N = \frac{N}{\ln N}$$

The intuition behind the Tolerance Principle is straightforward. For a rule to generalize beyond direct experience, it must receive sufficient evidential support (Aronoff 1976, Plunkett and Marchman 1991). If there are 10 examples and all but one (9/10) support a rule, generalization ought to ensue. But no one in their right mind would extend a rule on the basis of 2/10: the rule is thus unproductive and the two supporting examples are just memorized. The Tolerance Principle provides a precise threshold of productivity, which has received considerable support from quantitative and experimental studies of language acquisition and change (Yang 2016, Schuler et al. 2016). As I will explain, the Tolerance Principle yields the following conclusions concerning the data in (1):

- (4) a. Adjectival passive formation is an unproductive process: the ungrammaticality of (1a) is because the participles are never used as adjectives.  
b. The *un-* prefix is also unproductive and thus the grammaticality of (1b) is because the *un-* forms are in fact attested as adjectives, or there are other distributional contexts that independently sanction their appearance as adjectives.

## 2. English Adjectival Passives Formation is Unproductive

Since Wasow (1977), the distinction between English verbal and adjectival passives has played an important role in the theory of syntax and its interface with morphology and semantics. For the present study, I am not concerned with how adjectival passives are formed or represented — in the “syntax” or “lexicon” (e.g., Marantz 1997) — but only aim to characterize their productivity. By claiming adjectival passives as unproductive, I mean that the learner must rely on positive evidence to learn, or “lexicalize”, which verb has an adjectival passive form.

Following Anderson (1977), an influential approach to adjective passive formation (APF) assumes that the passivization of theme arguments results in an adjectival passive (Wasow 1980, Williams 1981, Bresnan 1982). This readily accounts for the contrast in (5) where the adjectival passive attributively modifies the theme but the goal (from Levin and Rappaport 1986):

- (5) a. a recently offered deal; \*a recently offered customer  
b. a recently rented apartment; \*a recently rented tenant  
c. a recently given medal; \*a recently given winner

However, Levin and Rappaport (1986) note that the theme analysis fails to account for the data in (6), where the theme (*cereal*) cannot be modified by the passive yet the goal (*baby*) can:<sup>1</sup>

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<sup>1</sup>Levin and Rappaport’s original discussion uses *unfed* to demonstrate the adjectival status of *fed*. This assumes the use of the *un* prefix as a diagnostic for adjectives, which is argued to be problematic in Section 3.

- (6) a. I fed the baby some cereal.  
b. the recently fed baby; \* the recently fed cereal

Levin and Rappaport (1986, 631) proceed to propose an alternative condition dubbed the Sole Complement Generalization (SCG):

- (7) An argument that may stand as the sole NP complement to a verb can be externalized by APF.

which accounts for both (5) and (6):

- (8) a. I offered a deal. \*I offered a customer.  
I rented an apartment. \*I rented a tenant.  
I gave a medal. \*I gave a winner.  
b. I fed the baby. \*I fed some cereal.

The SCG provides an elegant theory for the dative verbs, the primary concern of Levin and Rappaport's analysis. It is also highly desirable from a learnability perspective: if (7) is true, then an English-learning child only needs to encounter distributional data such as (8) to learn the adjectival passives in the language. Unfortunately the SCG runs into difficulties with Tom's observations:

- (9) They read a book.  
They told a story.  
They mentioned an example.  
They debated the resolution.

But the single complement NPs in (9) cannot be modified by the passive as shown in (1).

Furthermore, when we turn to new verbs that only recently entered into English, we see that the SCG does not appear to capture the distribution of their passive forms (data from teenagers):

- (10) a. I googled the topic.  
\*the googled topic.  
the carefully googled topic.  
b. I friended my neighbor.  
\*the friended neighbor.  
the recently friended neighbor.  
c. Drake dropped an album.  
\*the dropped album.  
the quietly dropped album.

If APF is unproductive, as I claim, then the English speaker must have learned so during language acquisition. According to the Tolerance Principle, the generalization in the form of the SCG (7) must be unproductive. That is, suppose that a child has learned  $N$  verbs in the passive form, an insufficiently many of them — fewer than  $(N - \theta_N)$  to be precise — would be positively and unambiguously attested in adjectival usage, e.g., attributively as in

*spilled coffee* and *fried chicken* while the predicative form (*the coffee was spoiled* and *the chicken was fried*) is inconclusive. To establish this claim, we turn to English corpora and consider how children learn the syntactic and morphological rules of their language.

I first examined a five-million-word corpus of child-directed North American English from the CHILDES database (MacWhinney 2000), which roughly represents a year worth of input data (Hart and Risley 2003). While this is not substitute for child-specific data, it does give us a ballpark measure of the input young learners receive. I extracted the 100 most frequent transitive verbs, which all would have a single complement NP according to the SCG. An important property of the Tolerance Principle is that the smaller  $N$  is, the easier for a productive rule to be established, due to the fact that the threshold  $\theta_N$ , the number of items *not* supported for the rule in question, decreases sharply as a proportion of  $N$  as  $N$  gets larger. One hundred transitive verbs are probably a reasonable estimate for a young English learner's vocabulary (Fenson et al. 1994, Hart and Risley 2003): if a productive rule is not established then, it is virtually impossible for it to be established later in language acquisition as  $N$  will inevitably increase. Note that I do not assume that these verbs are exactly the first verbs children learn, but only assume that their high frequency, and their distributional profile, provide a reasonable account of children's early linguistic experience.

The input data was processed with a part-of-speech tagger (GPoSTTL) to extract the past participles that have been identified as adjectives. Although the tagger is by no means perfect, the data is sufficiently clear to withstand any reasonable margin of error. Very few of the top 100 transitive verbs have an unambiguous adjectival passive form in the child-directed data: participles following an auxiliary are of course ambiguous, and so are those that follow *get* which functions like auxiliaries in the passive construction (Huddleston and Pullum 2001). In effect, only attributive use in noun phrases, and a very few instances that follow verbs such as *seem* (assuming that children know this property of them), provide clear evidence for the participle's adjectival status. There are only five out of the top 100: *baked*, *chopped*, *fried*, *drunk*, and *squashed*. There is no way to support the productive application of APF under the SCG.

By contrast, the verbal passive is completely productive for English transitive verbs. The search is also a bit rudimentary: I only included past participles immediately following *be* as an instance of passive. Even so, 85 out of the top 100 transitive verbs have at least one verbal passive counterpart in the child-directed English corpus, easily clearing the sufficiency threshold of 78, as  $\theta_{100} = 22$ .

Taken together, a distributional learner armed with the Tolerance Principle can establish the following generalization about the English grammar:

- (11) A transitive verb (i.e., one with an external argument) can productively form a verbal passive but cannot productively form an adjective passive.

We can say *fried chicken*, *fossilized bones*, and *limited ability* because we hear these participles in adjectival usage. Because APF is not productive, the ungrammatical data in (1) are unaccounted for.<sup>2</sup>

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<sup>2</sup>Why do some verbs have adjectival passives but others don't? I have nothing interesting to say other than

At this point, let me emphasize that in the current approach to learning, generalizations such as the SCG (7) needn't be stated as a principle of UG but may be something that the learner can conjecture from, and subsequently evaluate against, language-specific data. Of course, the "primitives" with which generalizations such as the SCG need to be stated must still be available to the child learner but this represents a simplification over previous approaches that presuppose innate linking rules (e.g., Pinker 1989). Furthermore, it is possible, and in fact likely, that subclasses of transitive verbs do allow APF productively. For instance, the manner-of-cooking verbs such as *fried*, *grilled*, *sauteed*, *boiled*, *baked*, etc. frequently feature as adjectival passives, and it seems that even novel cooking methods readily lend to adjectival passive forms: *a sousvided steak* seems acceptable. This is analogous to the constraints in the English dative constructions: even though the entire set of transferred-possession verbs does not productively participate in the double object construction, some subclasses do. These are demarcated by additional semantic (e.g., "telecommunication verbs"; Levin 1993) and phonological (e.g., monosyllabic) constraints, which are in fact learnable from the distributional data by recursive applications of the Tolerance Principle (Yang 2016, section 6.3). The research program for language acquisition, then, signals a return to the abductive learning framework laid out in *Aspects* (Chomsky 1965; see also Chomsky 1968): the learner forms hypotheses based on data and then evaluates, and possibly revises, these hypotheses on further data.

### 3. The *un*-prefix is Unproductive

Traditionally, *un*-prefixation has been used as a diagnostic for adjectival passives (Wasow 1977, Levin and Rappaport 1986). This may have been the source of the puzzling data (1): if *read* is not an adjectival passive (*\*read books*), how come *unread* is one (*unread books*)? Here I argue that the *un*- prefix is also unproductive but can only lexically select *read*, *told*, etc. because they are attested in the adjectival form.

Like the discussion of the verbal and adjectival passives in Section 2, the status of *un*- must be distributionally learnable on purely quantitative grounds. I first analyzed the five-million-word corpus of child-directed English. There are 64 *un*-prefixed adjectives identified by the tagger. Interestingly, 54 attach to a morphologically derived stem (e.g., *uncomfortable*, *unpacked*, *unstuck*, etc.) and only 10 are morphologically simplex: *unhappy*, *unusual*, *uneven*, *unfair*, *untrue*, *unreal*, *unpleasant*, *undead*, *unstable*, *unsafe*, and *unable*. The following generalization is warranted because 10 falls below the threshold of  $\theta_{64} = 15$  and can thus be memorized as exception without invalidating it:

- (12) *Un*- only attaches to morphologically complex stems (as a necessary condition).

This immediately accounts for the ungrammaticality of *unred*, *unnice*, *unquick*, etc.

Similar conclusions can be arrived at by examining other corpora. For instance, the English Lexicon Project (ELP) corpus (Balota et al. 2007) provides about 40,000 morphologically segmented words. Focusing on words whose frequency exceeds once per million,

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pointing to contingencies: someone said it and it caught on. Why did *that* someone innovate, and why did *that* specific form catch on? In some cases the Tolerance Principle does make concrete predictions; see Yang (2016) and Ringe and Yang (2017) for case studies.

which can be regarded as familiar to most English speakers (Nagy and Anderson 1984), we can find 426 *un*-prefixed adjectives, of which only 49 are morphologically simplex. Thus, the generalization in (12) can be upheld:  $\theta_{426} = 70$ .

For the purpose of the present paper, I focus on whether *un*- can productively attach to adjectival passives. In other words, *if* a past participle has already been established as adjectival — which must be attested as such because APF is unproductive (11) — can it be prefixed with *un*- for the purpose of forming a negative? In quantitative terms: suppose that there are  $N$  adjectival passives, are there at least  $(N - \theta_N)$  *un*-prefixed forms in the primary linguistic data?

The answer: Not even close. Here we need to step beyond the child-directed corpus which is too sparse for our purposes. Again using the ELP corpus, I first extracted past participles that have been annotated as adjectives (often in addition to other parts-of-speech), about 1,000 in all. Even focusing on the top 50 more frequent ones, only 16 have an *un*-prefixed counterpart. I should stress again that although we do not take unattested words to be impossible, the learner must have sufficient evidence in the attested data to justify productive word formation. If this can't be done for the top 50 words, then it'd never be done. Thus we have *advanced* but not *\*unadvanced technology*, *missed* but not *\*unmissed opportunity*, *recommended* but not *\*unrecommended hotel*, *split* but not *\*unsplit bill*, *noted* but not *\*unnoted scholars*, etc.

Likewise, an *un*-prefixed adjectival passive does not necessarily have an *un*-prefixed — pun intended — stem: in fact, only 18 of the top 50 most frequent *un*-prefixed adjectival passives do, nowhere near the requisite threshold for productivity. Thus we have *unexplained* but not *\*explained reasons*, *untapped* but not *\*tapped resources*, *unanswered* but not *\*answered questions*, etc. For *unread*/*\*read books* and *untold*/*\*told stories* in (1), that is because we hear *unread* and *untold*, but not *read* and *told*, as adjectives, and because APF is unproductive.

Which brings us the remaining data in (1): Why can we say *a carefully debated resolution* but not *\*a debated resolution*, *the previously mentioned bisque* but not *\*mentioned bisque*? My suggestion is again one of distributional learning. When used in noun phrases, manner adverbs such as *previously*, and *carefully*, which typically modify VPs, always select a past participle (e.g., “a hastily read book”), making it distributionally like an adjective. Presumably this is what we do when we heard *the frequently bick/bicked student will be punished*: *bick* is a novel word and we can't help but treat it as an adjective or a verb and start to infer its meaning from the context. This, of course, the core idea behind the distributional learning approach to syntactic categories known as *syntactic bootstrapping* (Gleitman 1990).

#### 4. Conclusion

Although the current approach to the passives is squarely situated in the study of language acquisition, it does provide an alternative to the purely structurally based analysis more familiar in theoretical linguistics. Presumably both the child and the linguist need to identify significant generalizations about language: what the Tolerance Principle offers is a benchmark for what counts as significant, the chief among which is the infinite productivity of

language. This is of course not to say that the unproductive corners of language are not interesting: even the English irregular verbs are organized (and learned) in systematic ways (Yang 2002) rather than simply memorized by fiat (e.g., Pinker 1999). But this does mean that there is no “deep” reason why these forms are not possible once the linguistic process has been assessed as unproductive. As linguists, we don’t need theories to rule them; as speakers, we won’t say them simply because we don’t hear them.

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