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ASCA, Linguistics Abstracts, and Social Science
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1990 VOLUME 28-6 [310]

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Catapults and pendulums: the mechanics of language acquisition

JANET H. RANDALL

Abstract

Learners' overgeneralization of lexical rules has been a longstanding puzzle in language-acquisition research since it poses the problem of 'retreat'. How do learners, without the benefit of negative evidence, find out that a rule they have formulated is overly general; and once they do, how can they be sure to reformulate it correctly? The first problem is addressed by the catapult hypothesis, which proposes that each overgeneralization is resolved by a catapult: a combination of a principle If A then not B, and information A. The outcome, not B, tells learners that their assumption that B was part of the language is incorrect, leading them to tighten their early overgeneralizations. Catapults have the property that the principles they use are assumed to be a part of the grammar, independently required. This obviates the need for external counting mechanisms, or other grammar-external machinery often proposed in order to deal with this acquisitional puzzle. The second problem, how the learner manages to reformulate the generalization correctly, is also considered. Having overshot the correct generalization in one direction, the retreating learner can overshoot it in the other direction and retreat too far. To avoid a pendulum problem, perpetually swinging between competing overgeneralizations and never settling on a rule of the right size, we propose a domain condition. Like the principles used in catapults, the domain condition is part of the grammar: the domains into which the grammar is divided — lexicon, syntax, and so on — provide lines inside which generalizations may fall. Learners revise their grammars accordingly, and (as with the catapult) without additional learning machinery.

1. Introduction

Consider the problem that the learner faces in acquiring the rules of the lexicon. Unlike the syntax, where rules are general, the lexicon harbors
partial generalizations and idiosyncratic facts. Take two nearly synonymous verbs, \textit{eat} and \textit{devour}. The lexical classes they belong to are not the same. While both belong to the transitive class, only \textit{eat} may occur without an object. \textit{Fred ate} but \textbf{*Fred devoured}.

(1) a. eat NP devour NP \\
b. eat \emptyset *devour \emptyset

In the face of such bewildering facts, the learner’s most reasonable strategy, as Baker (1979) pointed out, would be to make no generalizations at all, but to take a conservative route: assign each lexical item only the properties it exhibits in the input. Each word’s lexical representation would then be built up independently and overgeneralization errors would be avoided.

The logic for a conservative route is compelling, yet learners don’t follow it. Their rule-constructing tendencies are radical and lead them to generalize beyond the data that they hear. This is clear from their overgeneralization errors, cases like (2).

(2) Overgeneralizations 
   a. *foots, *singed 
   b. *The mailman delivered me a package. 
   c. *I let it spilled. 
   d. *Button me the rest.

Eventually, the learner must replace her overgeneral lexical rules by a set of rules of the right size. Somehow, she must be able to retreat. But what retreat routes are available? One, we know, is closed. Correction, or ‘direct negative evidence’, is not in the input. The forms of learners’ utterances are seldom corrected; in the rare instances when they are, learners resist making changes to their grammars.\textsuperscript{1} And occasional correction is not enough anyway; what is needed is guaranteed and systematic correction, and this learners certainly don’t get. The problem has been called the ‘no-negative-evidence’ problem (see Bowerman 1987, 1988). Given ‘no negative evidence’, learners must retreat from their overgeneralizations some other way.

Another possible retreat route is reviewed and illustrated in the next section: ‘The catapult hypothesis’ (Randall i.p.). What makes this proposal different from others is its parsimony. It limits the mechanisms available to the learner to just two elements, both of which, crucially, are available anyway: primary linguistic data and principles of universal grammar. These elements then serve double duty, in the grammar and in the learning device, and no additional mechanisms need to be ‘flown in’ just for work in...
the catapult hypothesis (Randall i.p.)

A catapult is a machine built from two elements. The first is a principle, with the form in (3a) or equivalently (3b). (Since they are logical equivalents, we will concentrate for now on only one of them, [3b]).

\begin{align*}
\text{(3a)} & \quad \text{either A or B but not both} \\
\text{(3b)} & \quad \text{if A then NOT B}
\end{align*}

The second element is 'A'. As shown in (4), combining (3b) with A leads to the conclusion NOT B. The syllogism is a familiar one; its classical name, less familiar, is modus ponendo tollens.

\begin{align*}
\text{(4)} & \quad \text{Modus ponendo tollens} \\
& \quad \text{if A then NOT B} \\
& \quad \text{A} \\
& \quad \text{\therefore NOT B}
\end{align*}

With a negative outcome, modus ponendo tollens acts like a 'catapult' (Figure 1). An incorrect form sitting on the low end will be ejected by an
incoming piece of data landing on the high end. The two cannot cooccur.\textsuperscript{2}

Given their structure, catapults are ideally suited to the retreat problem. A principle of the grammar (If $A$ then not $B$) and a fact available from the primary data ($A$) are all that are needed. Although they have not been discussed in these terms, several accounts of retreat in language acquisition have used catapults. The overgeneralizations in (2), above, provide four such examples. We will look carefully at each of them below. But for a brief introduction to how catapults work, consider the first one, (2a): *foots, *singed.

Each of these ungrammatical forms corresponds to a $B$ in Figure 1. The principle needed to eject them is the uniqueness principle, (5).

\textbf{Uniqueness principle:} in the unmarked case, each deep structure is realized as one and only one surface structure (Wexler and Culicover 1980).

Essentially, the uniqueness principle prohibits a language from containing two forms with the same meaning.\textsuperscript{3} Applied to noun inflections, it allows each noun only one plural form. Foot may have either feet or foots, but not both. In formulaic terms, (5) applies as in (6), forcing the incorrect foots to be replaced by the correct feet.

\begin{equation}
\text{if feet then not foots.}
\end{equation}

Like all cases of ‘not B’, this outcome is what we might call ‘indirect’ negative evidence. Here, the negative evidence concerns a single lexical item. The learner gathers that one of them is ruled out because the other one is in. There are other instances, which we will see below, where $A$ and $B$ are not lexical items but facts about linguistic structure. There the negative evidence is more general, holding of more than a single lexical item. We will leave this example for now, but return to it later in order to compare it with competing proposals and to answer some questions that we are finessing for the moment.

Suppose we pursue the idea of resolving overgeneralizations with catapults. We can formulate the hypothesis in (7).

\textbf{The catapult hypothesis:} for every overgeneralization that learners make, the grammar provides a catapult.

The catapult hypothesis claims that catapults are the general solution to the overgeneralization problem. This is the idea that we will pursue throughout this paper.

To sum up, although direct negative evidence is not available to learn-
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The two cannot cooccur. They are ideally suited to the retreat problem, since not B and a fact available from natural accounts of retreat in language. overgeneralizations in (2), above, are needed. Although they have notional accounts of retreat in language, look carefully at each of them below. catapults work, consider the first one.

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Let us now return to foots and singed. First, notice that the uniqueness principle account given here bears a strong resemblance to other accounts in the literature (Kuczaj 1977; Bybee and Slobin 1982; Pinker 1984). They all cluster around the idea of substitution. As soon as the learner understands that there are forms in the primary data like feet or sang which function exactly like her own rule-generated forms, she substitutes those forms for hers. But notice in order to get substitution and not just addition, some kind of uniqueness principle is required. Otherwise both forms could coexist in the learner's lexicon without either one dislodging
the other. Other principles which do the same job have been proposed, for instance, the principle of contrast (Clark 1987) and the unique-entry principle (Pinker 1984). We adopt the uniqueness principle because it is intended explicitly as a principle of grammar.\(^6\)

An apparent challenge to the uniqueness-principle solution (and to the others as well) comes from learners who seem to allow two plural or past-tense forms simultaneously, for instance, both *goed* and *went*. *Went* should preempt *goed* if the principle is operative. But what if the two surface forms were not both mapped onto the same deep-structure form, in other words, if *goed* and *went* were not both simultaneously understood as past tenses of the verb *go*? Then this would not constitute counterevidence; the uniqueness principle could still be in force. Evidence that this is in fact what is going on comes from the existence of an additional form, *wented*. *Wented* shows that *went* is actually analyzed as a present tense form, and that *goed* is the learner’s past tense of *go* (Kuczaj 1977; Clark, personal communication). Each present tense has a unique past-tense form, exactly as required.\(^7\)

We still have not solved the pendulum problem that we noted in the last section. We will hold off discussing it until later, when we have seen other cases where it arises. To sum up so far, retreat from overgeneralizations of inflectional rules can be accomplished with a simple catapult using a principle of the ‘If A then not B’ shape and data A. Nothing more is needed.

3.2. *The mailman delivered me a package*

Consider the second case in (2), an overgeneralization of the rule that relates *to* datives to double-object datives. While in the adult grammar the rule applies to *give*, as in (8), it does not apply to *deliver* as in (9) or to other verbs of that class, *recite, describe, explain, report*.\(^8\)

(8) a. gave the package to Mary  
   b. gave Mary the package  
(9) a. delivered the package to Mary  
   b. *delivered Mary the package

In the learner’s grammar, the rule has incorrectly applied to both classes, resulting in the representations in (10). (The incorrect form is indicated in italics.)

(10) a. give NP\(_{do}\) PP\(_{lo}\) deliver NP\(_{do}\) PP\(_{lo}\)  
   b. give NP\(_{lo}\) PP\(_{do}\) deliver NP\(_{lo}\) NP\(_{do}\)
do the same job have been proposed last (Clark 1987) and the unique-entry uniqueness principle because it is of grammar.\(^6\)

If grammar. 6

If grammar. 6

s the existence of an additional *went* is actually analyzed as a present perfect tense of *go* (Kuczaj 1977; each present tense has a unique past-
dulum problem that we noted in the sing it until later, when we have seen up so far, retreat from overgeneraliz-
accomplished with a simple catapult form not B‘ shape and data A. Nothing

\[ \text{The mechanics of acquisition 1387} \]

Getting rid of the incorrect deliver NP\(_{io}\)NP\(_{do}\) form is a different problem from the substitution cases we just looked at. There, the positive data supplied the learner with a substitute to replace — and drive out — each incorrect form; here no substitute exists. There is simply a gap in the paradigm. We need a different sort of catapult; but again, it will be a combination of a principle plus primary data.

To see the data that are relevant, consider the two verbs in (8) and (9) more closely. They differ not only on their compatibility with a double object, but also on their compatibility with a single NP object. The *give* class does not allow one, while the *deliver* class does.\(^9\)

*Cressida sent a poem.
*Hamlet lent this book.
*Gertrude showed the recipe.
*Cordelia told the news.

b. Romeo delivered the posies.
Cressida recited a poem.
Hamlet described this book.
Gertrude explained the recipe.
Cordelia reported the news.

These grammatical single NP forms in (11b) are crucial; they will provide the ‘A’ in the catapult. The ‘If A then not B’-shaped principle is (12), a principle of the X-bar system.\(^10\)

(12) The order principle: in a maximal projection, optional elements are attached outside of obligatory elements (that is, \(\ast V (X) Y\)).

Restated in the appropriate form, the order principle becomes (13).

(13) The order principle:
if A (A: element X is optional)
then not B (B: X is attached inside of obligatory elements)

Now stipulates that A (an element being optional) precludes B (the element is attached inside of an obligatory element).

(13) now stipulates that A (an element being optional) precludes B (the element is attached inside of an obligatory element).

(13) if A (A: element X is optional)
then not B (B: X is attached inside of obligatory elements)

\[ A \ldots \text{not } B \]

Now, from data like *Romeo delivered the posies*, the first case in (11b), the learner can surmise that the indirect object for *deliver* is optional, the
fact that we have called ‘A’. This fact can be registered on (10), with the result in (14). The optional objects are put in parentheses.

\[
\begin{align*}
(14) & \quad \text{give } NP_{do} PP_{io} \quad \text{deliver } NP_{do} (PP_{io}) \\
& \quad \text{give } NP_{io} PP_{do} \quad \text{deliver } (NP_{io}) NP_{do}
\end{align*}
\]

But the second deliver case now turns into a case of B, an optional element attached inside an obligatory element. Since A is true, B cannot be; it must be dropped.

\[
\begin{align*}
(15) & \quad \text{give } NP_{do} PP_{io} \quad \text{deliver } NP_{do} (PP_{io}) \\
& \quad \text{give } NP_{io} NP_{do}
\end{align*}
\]

The learner’s representation is now identical to the adult’s. Verb by verb as data are encountered, the illicit pieces of the learner’s lexical entries can be thrown out. The result is retreat from all of her overgeneralizations.\(^{11}\)

To sum up, ungrammatical double-object datives are not replaced by substitute forms. The catapult which dislodges them is a general principle governing the proper form of lexical entries: an optional element may sit only in certain positions in a phrase. Given this, the information that an element is optional carries with it restrictions on the positions in which it can appear.

There are three points to address before we proceed. One is a possible challenge to the catapult solution proposed here. The trigger (the ‘A’) is data illustrating that a verb allows a single NP object. Yet these data are available to the learner from the start. Wouldn’t they prevent overgeneralizations from occurring in the first place? This objection assumes one of two things, either that all data are available simultaneously, which is certainly wrong; or that verbs are available in the data with a single NP object before a NP-PP sequence, which is no doubt true for some verbs, but not all. Exactly those verbs whose single NP context is heard after its NP PP context are the verbs at risk. In other words, we don’t expect all learners to overgeneralize all verbs of the deliver class and await rescue for each one by a single-NP context. But those verbs which a learner has not heard in this context are potential sources of that learner’s overgeneralizations, and it is the single NP context for that verb which will allow her to curtail them. Our assumption about the data, then, is that they are nonsimultaneous and noninstantaneous. Further, they are not ‘ordered’, where ‘ordered’ means that a certain piece of data always precedes another certain piece. They are arbitrarily ordered: they don’t all appear at once, but we don’t know in exactly what order they will appear.

A second challenge to the catapult solution comes from apparent counterexamples to the order principle. Read has a double-object form but also a single-NP existence of the single-

We will put off showing that it poses no challenge until

This is the looming no less than it did in the


takes A, the information not only to deliver but of the give class as we
double-object forms in verbs in the give class, retreat poses no prob-
data with their double subsequent problem. The basis of another over-
allows a double objec-
tion would take her back to being a single NP for deliver and so on, back and forth.

Having now seen that we can better address it.

4. Solving the pendulum

4.1 *The mailman

A way around the petitions is for the learn-
single-object deliver would pose an order-
entry. If there were generalizing to other
and no pendulum proble-
A condition with a what separates the rules apply across me
where subcategories.
There are also dom-
ology, phonetics. This
and, here, principles.

\[
(16) \quad \text{The domain can}
\]

Principles apply...
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The mechanics of acquisition 1389

4. Solving the pendulum problem

4.1. *The mailman delivered me a package

A way around the pendulum problem in the case of dative overgeneralizations is for the learner to act conservatively, applying the data about single-object deliver to that verb alone. Then only this one lexical item would pose an order-principle violation and require a change in its lexical entry. If there were a general condition which kept the learner from generalizing to other verbs in cases like this, overretreat would be avoided, and no pendulum problem would arise.

A condition with just this effect already holds in the grammar. It is what separates the grammar into domains: a syntactic domain, where rules apply across members of a syntactic category, and a lexical domain, where subcategories and individual lexical items are the targets of rules. There are also domains we are not discussing here: logical form, phonology, phonetics. This ‘domain condition’ limits how all rules, operations, and, here, principles apply.

(16) The domain condition: Principles apply by domain.
Principles which specify lexical properties are limited by the domain condition to apply lexically. Catapults that use these principles will be similarly limited. For the deliver and give cases above, this means that the learner cannot assume that deliver’s occurrence with a single NP indicates a general property of a verb class. The argument structure of a lexical item is a clear lexical property. Therefore, it may figure only in the representation of this one verb. The domain condition restricts retreat from an overgeneral dative rule to the lexical domain; it will therefore never turn into overretreat and affect verbs in the give class. The pendulum will never start to swing.

Now let’s return to the other problem we put off in the last section, posed by verbs like read, which appear to tolerate both a double-NP and a single-NP form. Our story so far predicts that single-NP data (17b) will drive out the double-NP possibility (17a), since it will force the NP containing the kids into parentheses, in violation of the order principle.

(17) a. Grandpa read the kids a fairy tale.
 b. Grandpa read a fairy tale.

Suppose, in fact, that this does happen. The learner’s lexicon will be adjusted; (18a) will turn into (18b) and then, into (18c).

(18) a. read NP io NP do
 b. *read (NP io) NP do
 c. read NP do

More double-object cases will occur in the input, though. What does the learner do with these? Adding a double-object line to (18c) is one possibility. This entry would then be ‘marked’ with respect to the order principle. However, a more reasonable possibility, and the one that we will pursue here, is that the violation is taken as evidence that two different verbs are involved, requiring two separate entries. Under this assumption, the learner leaves (18c) as one lexical entry and creates a new one. Her lexicon then contains two reads, (19a) and (19b).

(19) a. read_1 NP do
 b. read_2 NP io NP do

But two questions arise. First, what evidence is there that these two reads are actually two different verbs? Second, and perhaps more importantly, when does a new argument structure for a verb signal a new verb and not just the same verb with an extra argument structure?

To answer the first question, consider a parallel case, load, to which Rappaport and Levin (1985; 1988) give a two-verb analysis.

(20) a. load the cart
 b. load cart

Their principal argument is understood as shown. However, when this partially affected requires the truck to carry a meaning independent with the other argument.

Applying this analysis has been often criticized. The object verb ‘is the direct object – at least for the period (1971; 21–22). This without a PP. A conflict represented in the order principle.

(21) a. read_1 NP do
 b. read_2 NP do

The answer to this question is, in fact, a conflict between the represented together be reasonable to an existing lexical entry or if they do, we will evidence above.

To sum up: the catapults can be advantageous. To answer the problem for our first question, consider a parallel case, load, to which Rappaport and Levin (1985; 1988) give a two-verb analysis.
properties are limited by the domain conditions. The principles that use these principles will apply to give cases above, this means that the role of the verb is limited by the domain conditions. Therefore, it may figure only in the lexical domain; it will therefore be a single-NP class. The pendulum problem we put off in the last section is, in fact, a nonproblem. Our proposed solution, the domain condition, takes advantage of the fact that the grammar is divided into domains. If catapults can apply only within the proper domain, then lexical retreat must proceed lexically, item by item, and overretreat and the ensuing pendulum problem will be avoided. We showed how the domain condition worked in the dative case, and we then turned to another apparent problem for our dative solution, putative counterexamples like read. We argued that these verbs are not in fact counterexamples but must be analyzed as having two separate lexical entries. Their principal argument is a semantic one. In (20a) the goal is understood as ‘wholly affected by the action denoted by the verb’. However, when this argument is realized as the object of a preposition, a partially affected interpretation is also possible. So, whereas (20a) requires the truck to be full of cartons, (20b) does not. Since one form carries a meaning component lacking in the other, the two must be independent with separate lexical representations. Applying this argument to read is straightforward. A semantic difference has been often noted between the double-object and prepositional-dative forms. The indirect object in read NPio NPdo or any other double-object verb ‘is the direct recipient of or benefits from the possession of the direct object — the indirect object “gets to keep” the direct object, at least for the period of time under consideration in the sentence’ (Fischer 1971: 21–22). This is not true either of read NP do to-NP io or of read NP do without a PP. Accordingly, the double-object form is given a separate entry from the other two, which could be represented together in the same entry. There the PP would be in parentheses but would not cause an order principle violation. (19) would be revised to (21).

To sum up: this section began by showing that the pendulum problem is, in fact, a nonproblem. Our proposed solution, the domain condition, takes advantage of the fact that the grammar is divided into domains. If catapults can apply only within the proper domain, then lexical retreat must proceed lexically, item by item, and overretreat and the ensuing pendulum problem will be avoided. We showed how the domain condition worked in the dative case, and we then turned to another apparent problem for our dative solution, putative counterexamples like read. We argued that these verbs are not in fact counterexamples but must be analyzed as having two separate lexical entries.

(20) a. load the truck with cartons
   b. load cartons into the truck

The answer to the second question is more a speculation than an answer at this point. The revision in the learner's lexicon resulted from a conflict between two verb structures. Both possibilities could not be represented together without violating a principle of grammar. It would be reasonable to propose that optional arguments are licit members of an existing lexical entry unless they cause violations of principles. Where they do, we will probably find additional evidence (like the semantic evidence above) that two entries are involved.12

To sum up: this section began by showing that the pendulum problem is, in fact, a nonproblem. Our proposed solution, the domain condition, takes advantage of the fact that the grammar is divided into domains. If catapults can apply only within the proper domain, then lexical retreat must proceed lexically, item by item, and overretreat and the ensuing pendulum problem will be avoided. We showed how the domain condition worked in the dative case, and we then turned to another apparent problem for our dative solution, putative counterexamples like read. We argued that these verbs are not in fact counterexamples but must be analyzed as having two separate lexical entries.
4.2. *foots and *singed

With the domain condition solving the pendulum problem for deliver- and give-class verbs, let us now return to inflections to see if it will also work there. Recall what sort of catapult operated for those cases. A form from the primary data, feet, was taken as a substitute for foots, since the uniqueness principle prevented the two forms from existing side-by-side in the learner's lexicon. Our worry was that the learner could instead take the new form as the basis of a new rule, and produce *reet, *heed, and *beek (as plural forms for root, hook, and book). A rule based on sang would lead to *brang, *stang (and, correctly), rang, and sprung (for past tenses of bring, sting, ring, and spring). But further data would lead to new generalizations, and the undoing of old ones. Brought would trigger *sought, *stought, *rought, *sprought; stung would lead to *sung, *brung, *rung, *sprung. Sang, sprang, or rang would bring the learner back to the original errors.

The domain condition solves this problem, however, too. Since inflection is a lexical operation, the catapult is restricted to operate lexically. Only one change can be made at a time, and only in response to a specific piece of positive data. This means that sang can lead only to sang, and *brang, *stang, rang, and sprung cannot be created.

There is an apparent problem with this account. Everyone has heard learners using brang. If this form doesn't arise through the overgeneralization of the sing--sang rule, then how DOES it come about? Notice, first, that if brang were a result of the domain condition failing to apply, then other forms, like stang, would also arise. And we would also find the rebound forms noted above: sought (parallel to brought) for sang, for example, which we do not find. More likely, in this one case, the learner creates brang on analogy with sang and rang in a moment when she can't remember brought but does remember that bringed isn't right. Analogy is neither a necessary nor a predicted element in this theory of language acquisition, but it may be used during the language-acquisition process, by learners in a pinch. When the rarer irregular brought is heard enough times to be remembered, it will take over and the analogy will no longer be used. The brang problem is not a counterexample to the domain condition, then. The condition stands as a check on the pendulum problem for inflections.

The domain condition is predicted to work in the opposite way for syntactic retreat. After we see one more example of conservative lexical retreat, we will see a case where the domain is the syntax and radical retreat is correctly predicted.

5. Two further cases

5.1. S complements

A solution to our (2c), is offered in uninflected S complements which take inflected

(22)  a. I let it
Make him
b. I hope (f) said (b)
c. I forced I persuaded

What the learner
uninflected forms

(23) *I let it spill
 *Make him
As in the inflected
substitution. The then not B', give
(24) Uniqueness
realized as
c. not let

Notice, however,
ing to prevent an correctly, that such classes, though -- effect on let and a would be incorrect

(26) I let it spill
Make him
*I hope it
*I forced h

Positive data wo
at the same time,
Two further catapults and how they avoid the pendulum problem

5.1. S complements: *I let it spilled

A solution to our third overgeneralization problem, *I let it spilled in (22c), is offered in Hyams (1985). Verbs like let and make, (22a), take uninflected S complements; they differ from the verbs in (22b) and (22c) which take inflected and infinitival S complements, respectively.

(22) a. I let it spill.
   Make him laugh.
 b. I hope (that) it spills.
   I said (that) it broke.
 c. I forced her to leave.
   I persuaded her to laugh.

What the learner does, suggests Hyams, is to substitute the correct uninflected forms like (22a) for the overgeneralizations (23).

(23) *I let it spilled.
   *Make him laughs.

As in the inflection case, here the catapult uses simple form-for-form substitution. The data in (23), 'A', plus the uniqueness principle, 'If A then not B', give the correct result.

(24) Uniqueness principle: in the unmarked case, each deep structure is realized as one and only one surface structure.

(25) if let S_{-infl} then not let S_{+infl}
    let S_{-infl}
    not let S_{+infl}

Notice, however, that the domain condition must implicitly be operating to prevent any leeway in how the catapult applies. Hyams assumes, correctly, that substitution applies verb by verb. If it applied to larger classes, though — say, to all verbs taking S complements — then the effect on let and make would be correct, but the effect on hope and force would be incorrect, as (26) shows.

(26) I let it spill.
   Make him laugh.
   *I hope it spilled.
   *I forced her leave.

Positive data would then supply other substitutes to force out (26) but, at the same time, to force out the just-corrected let and make.
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(27)  I hope (that) it spills.
     I forced her to leave.
     *I let it spilled.
     *Make him laughs.

And back and forth ad infinitum.
Under the domain condition, the learner operates conservatively. Since
A and B are lexical elements — subcategories of verb complements —
the catapult must operate verb by verb and the swings are avoided.

5.2.  Adjuncts: benefactive for PPs

The final overgeneralization in (2), (2d), provides a case where the domain
is the syntax, and the learner's revisions should apply across members of
a whole lexical category. (2d) is repeated in (28b) with others of the same
type.

(28)  a. Bake a cake for me.
       I'll draw a picture for you.
    b. Bake me a cake.
       I'll draw you a picture.

(29)  a. Button the rest for me.
       I'll brush his hair for him.
       Mummy, open the door for Hadwen.
    b. *Button me the rest.(=2d)
       *I'll brush him his hair.
       *Mummy, open Hadwen the door (from White 1985).

Here the dative for alternation in (28) is being extended to benefactive
for phrases. In White's (1985) analysis, the learner's error is to treat both
types of for phrases as arguments of the verb, with the structure in (30):

(30)  a.  
        V'   V'
        V   NP   NP   V   NP   PP
       bake   [me]_DAT a cake   bake a cake [for me]_DAT
       *button [me]_BEN the rest   button the rest [for me]_BEN

The two types are quite different, however. Benefactive for me means
'on my behalf'; dative for me means, roughly, I am to get the outcome.
Some verbs go both ways, but the double-object form is allowed only
with the dative reading. Bake in Jae
bake a cake for the detailed discussion
Benefactive for.
This difference in st
inside the X' level, X', inside X". This

(31)

Benefactive and d

(32)

How does the learn
from (30) to (32)?
A catapult will pr
the attachment pr
(33)  The attachm
its head by a

The triggering da
separated from it locative phrase or
benefactive for ph
The learner operates conservatively. Since categories of verb complements — verb and the swings are avoided.

(28b) provides a case where the domain should apply across members of the same class as in (28b) with others of the same form (from White 1985).

If a learner is extending to benefactive for me that a benefactive noun phrase or time adverbial, an indisputable adjunct, precedes a benefactive for phrase.

However, Benefactive for me means roughly, I am to get the outcome. Benefactive-object form is allowed only with the dative reading and not with the benefactive 'on my behalf' reading. Bake in John baked me a cake cannot mean, 'I was supposed to bake a cake for the bake sale but John baked it for me'. (For a more detailed discussion see Randall i.p.)

Benefactive for, in the adult grammar, are not arguments but adjuncts. This difference in status means a difference in structural position. According to another X-bar principle, the attachment principle, arguments attach inside the X' level, as sisters of the head X; adjuncts attach as sisters of X, inside X". This difference is shown in (31), where VP = V':

(31)

Benefactive and datives, then, must be attached as adjuncts and arguments, respectively, as shown in (32).

(32)

How does the learner figure out that benefactives are not attached in the same place as datives but rather outside V'; that is, how does she move from (30) to (32)?

A catapult will put these two attachment sites into conflict. Notice that the attachment principle can be restated in an 'If A then not B' form; (33) provides an informal version.

(33) The attachment principle: if a constituent C can be separated from its head by an adjunct, then C is not an argument.

The triggering data that provide A (that is, that show constituent C separated from its head by an adjunct) are cases like (34), in which a locative phrase or time adverbial, an indisputable adjunct, precedes a benefactive for phrase.
(34) a. John washed the car [in the driveway] [for Fred] (= White's [27]).
b. John's in charge of making the kids their breakfast, but Mary makes them breakfast [sometimes] [for him].
c. John buttoned the rest [five minutes ago] for Mary.

These adjunct phrases, which must hang outside V′, are attached between the head and the benefactives. The for benefactives, therefore, must also hang outside V′ and must therefore be adjuncts, not arguments. Moreover, since lexical argument-shifting rules like the dative alternation cannot apply to adjuncts, then benefactives cannot be affected by these rules. In sum, once a learner discovers that benefactives hang outside V′, her ungrammatical benefactives inside V′ are catapulted out of her grammar and the possibility for additional benefactive double-object forms disappears.14

The domain question now arises: how conservatively or radically does this catapult function? White assumes that it works verb by verb. But if it did, then for a certain period of time the learner would attach benefactives in two different places, depending on whether a particular verb happened to have appeared in the data so far. We predict the contrary: conservative retreat is not justified. Where benefactives attach isn't a lexical fact but a syntactic fact about PPs, and it holds regardless of a particular verb's argument structure. In contrast to White, the domain condition, repeated here, predicts radical retreat.

(35) The domain condition:
Principles apply by domain.

Thus, one piece of data like (34) will indicate that for all verbs — not just wash, make, or button — benefactive for phrases attach outside V′.

It's useful to contrast this radical retreat story with the conservative retreat we saw earlier for deliver-class verbs in (11b). As (36a) illustrates, what the learner surmises from the primary data about deliver is a lexical fact, that a certain verb's argument is optional. The domain must be the lexicon and retreat is conservative.

(36) a. deliver *(NPio) NPdo
    b. [makes them breakfast 0]v [sometimes] [for him]ben

But for for benefactives, what the learner discovers is a syntactic fact about the attachment site of a kind of PP. What she initially thought was part of argument structure is not. This nonlexical fact allows her to reanalyze her structures en masse, for all cases where benefactives occur.
And what about the pendulum problem? Here there is none. The new generalization is not too large for the target, and once it is made, it is made for all cases. It is not undone either for individual verbs or for a whole class because no data where adjuncts violate the attachment principle will be heard for any verb. The pendulum problem does not arise when the domain of generalization is the syntax, so when retreat is caused by a catapult in this domain, it holds.

6. Necessity and sufficiency: what mechanisms do we need?

Throughout our discussion of catapults, we have been stressing two properties. The first is their 'minimalism'. A catapult requires two elements: a principle and a piece of primary data. Nothing additional is needed. The second important property of catapults is their deductive structure. Given a principle of grammar and a piece of primary data, the outcome is retreat. No choice is involved. In this section we will contrast these two properties with the properties of other proposed theories of retreat. We will argue that the catapult theory is desirable on theoretical grounds, and we will suggest how to find out whether it is also desirable on empirical grounds. We will also take up the domain condition once again, in order to compare it to another principle which has been proposed to operate in language acquisition, the subset principle.

6.1. Catapults versus criteria

The minimalism of catapults is due to the fact that they link the task of learning the grammar to the grammar itself. Half of each catapult is a grammatical principle, supplied by universal grammar and, therefore, accessible to learners without their having to learn it. The other half is data, automatically supplied by the environment. The deductive way in which these two halves interact gets around the need for any 'external' learning mechanisms or additional assumptions about how the learner or the data function.\(^{15}\)

A good example of a contrasting view can be seen in accounts where the possibility for retreat depends on learners' ability to register 'negative' properties of the data that they hear. For example, the accounts given by Pinker (1984, 1987) and Mazurkewich and White (1984) for how learners curb overgeneral lexical rules attribute to these learners the ability to notice that a large number of verbs of a certain class fail to undergo an expected alternation. In other words, they notice that a certain rule does not apply to these verbs. They conclude that the rule...
is hampered by a ‘rule condition’ (Mazurkewich and White) or a ‘criterion’ (Pinker) which discriminates, we might say, the players from the verbs on the bench. They then use the criterion to tighten their original rule; and as a consequence, their overgeneralizations disappear.\textsuperscript{16}

One justification given for the ‘criterion approach’ is that children appear to be sensitive to criteria in experimental tasks (Gropen and Pinker 1986). But there is a logical leap between showing sensitivity to a criterion and showing that that criterion serves as a learning mechanism, especially if using it as such means gathering negative information about nonparticipation in a rule. A second problem for criteria approaches is how learners figure out which of the vast number of features displayed by each lexical item are potentially relevant as criteria on rules that the item might (or might not) participate in. Number of syllables and phonological structure are supposedly relevant for one alternation, while the affectedness of the direct object is supposedly relevant for another. How does the learner figure out which of these criteria to try and for which rules? Without a theory to limit the criteria or tie them to individual rules, the learner would have no clue.\textsuperscript{17} Third, the learner is expected to count and keep track of the number of items that don’t participate in a rule since, presumably, one exception to a rule wouldn’t justify a criterion. This raises the question: how many items are sufficient for making up a criterion? Perhaps a less compelling, but still relevant, fourth reason to prefer catapults to criteria is that the purported criteria don’t always hold. Bowerman (1987) cites embarrassing cases of the criteria not doing their job and letting rules apply where they shouldn’t. These counterexamples, the criteria — at least the ones that have been suggested — are not yet reliable enough ingredients to include in a theory of retreat.

An alternative to a criteria approach is an account of rule tightening which does not require learners to gather negative information (that certain verbs do not undergo a rule) but only to notice positive facts, for example, that certain verbs do undergo a rule. The features of these verbs can then be compared, and ‘positive criteria’ can be formulated, extracted, and imposed (as Braine proposed in 1971). But this explanation also falls prey to the ‘vast number of features’ objection raised for the negative-criteria approach. And these accounts also need to explain why a tighter rule is better, when the learner’s perfectly good original rule would have continued to do just fine.\textsuperscript{18} Again, an external mechanism is lurking.

In the catapult account there is no tallying of either negative or positive features, and no registering of the extent of generalizations, negative or positive. If there are partial generalizations to be noticed, nothing prevents learners from noticing them, but then, nothing requires them to either.
6.2. The domain condition and the subset principle

Another mechanism which has been proposed to operate in language acquisition is the subset principle (Berwick 1982; originally suggested by Dell 1981). Like the domain condition, the subset principle is designed to allow the learner to choose between competing grammars. But given this, we should consider how much the two constraints overlap. Are they both necessary?

The subset principle is stated in (37).

(37) Subset principle: given two languages in a subset relation, L and L', both compatible with the data, choose the smaller language.

It is usually assumed that the subset principle predicts no overgeneralization, since it forces the learner to formulate the rules that lead to the smallest language motivated by the data, the 'least general' set of rules. This would mean that if the subset principle were at work, the learner would not overgeneralize in the first place.

To see how the subset principle might operate, consider what the 'least general set of rules' would be for generating past-tense forms in English. It would be a set of rules which correspond one to one with the learner's attested singular-plural forms: the singular-plural pairs that the learner has heard. Call this set of rules Grammar 1, G1 in (38). The language it produces is the set of forms on the two sides of the arrows. Call this language L1.

(38) $G_1$

- foot $\rightarrow R_1 \rightarrow$ feet
- hat $\rightarrow R_2 \rightarrow$ hats
- beet $\rightarrow R_3 \rightarrow$ beets
- etc. (for all attested pairs)

Notice that $G_1$ contains as many rules as there are pairs of singular-plural forms in L1; and indeed, there is no overgeneralization. The problem with positing this 'least general' grammar, however, is that at least at a certain stage in acquisition, it is incorrect, since overgeneralizations like foots do occur. At this stage, the subset principle cannot be operating: the learner has projected a larger language than the one she has encountered since her data presumably did not include foots.

An alternative account is (39): the learner has one rule, applying to all plural forms. This rule, $R_1$, is more general than the rules in $G_1$ and produces a larger language, L2, which includes the unattested plural forms that the child has invented.
Does the subset principle have a role to play here? Although, for whatever reason, it does not keep the learner from choosing the overgeneral $G_2$, can it be used at this point in the story to allow her to retreat? The answer is no. We know that learners retain the ‘overgeneral’ $R_1$ in their grammars, maintaining regular forms until they register the evidence that an irregular version exists. At this point, the uniqueness principle forces the irregular form to replace the regular form. But recall that here is where the domain condition entered this procedure: it requires that when the learner replaces the incorrect forms, she do so one by one rather than en masse. The subset principle cannot have the same effect; it limits the learner’s choice of a grammar only when the resulting languages differ in size, preferring the smaller one. Here, the languages are the same size: there will be only one plural form for each singular form, regardless of how many plurals simultaneously switch from regular to irregular. So the domain condition is still necessary; the subset principle has nothing to say.

Whether the subset principle even operates at all in acquisition is an open question. Fodor and Crain (1987) question its plausibility as an acquisition principle, raising the same kind of objection to it as we raised to ‘external’ learning mechanisms, above. They doubt that a learner could actually do the computation needed to apply it: compute the languages that two or more grammars generate and decide whether they stand in a subset relation. As they note,

Sometimes the computation is straightforward, as for example in the case of a choice between bounding node A and bounding nodes A and B. But what of the choice between A and C? Or between an addition to the bounding nodes and a restriction of landing sites, etc.?

The subset principle, then, is questionable as a principle of acquisition.

6.3. **Timing**

We have already discussed one timing issue. In the catapult model, there is no assumption that the data are timed. However, they are ‘staggered’ in two ways. First, they occur in different, arbitrary, orders in each learner’s input. Second, a ‘intake’ (Corder 1967; Whiten properly recognize or interpret they have occurred. Staggered, why overgeneralizations occur. It also accounts for learners don’t all overgeneralize.

In contrast to the data, model uses, we assume, as in the ‘continuity’ and others. The ‘continuity’ that certain principles mat Wexler (1987), and Felix (As we saw above, no learners’ retreat schedules principles mature. But she (or all) principles, this Catapults need either starvation. We are assuming the first.

In fact, the catapult hypothesis continuity accounts, in the for a moment. And assume will be triggered as each overgeneralizations over the other phenomena fall. For instance, if retreat is were guided by the natural reflexes of the attachment that benefactive retreat is that the principle must be the trigger. The question reveal insights.

7. **Conclusion**

We have seen four cases where a principle of grammar the learner with negative lexical overgeneralizations) but their syntactic adjuncts). Moreover, w
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learner's input. Second, a learner's 'input' is not always the same as her
'intake' (Corder 1967; White 1981, 1982). That is, learners do not always
properly recognize or interpret the available data, despite the fact that
they have occurred. Staggered data explains why retreat is noninstantan-
eous, why overgeneralizations are not catapulted out as soon as they
occur. It also accounts for differences between learners: why it is that
learners don't all overgeneralize and retreat on exactly the same forms.

In contrast to the data, the grammatical principles that the catapult
model uses, we assume, are not timed but are available from the outset,
as in the 'continuity' models of Clahsen (1989, i.p.), Weissenborn (i.p.),
and others. The 'continuity' view contrasts with the 'maturational' view
that certain principles mature, advocated by Gleitman (1981), Borer and
Wexler (1987), and Felix (1986).

As we saw above, noninstantaneous acquisition and differences in
learners' retreat schedules can be explained without the assumption that
principles mature. But should it turn out that maturation is true of some
(or all) principles, this is still compatible with how catapults operate.
Catapults need EITHER staggered input OR staggered principles, OR BOTH.
We are assuming the first and not the second. But it might be otherwise.

In fact, the catapult hypothesis might allow us to test maturation versus
continuity accounts, in the following way. Assume the maturation view
for a moment. And assume, further, that all data are available. Catapults
will be triggered as each principle matures. This predicts that retreat from
overgeneralizations governed by a certain principle will happen just as
the other phenomena falling under the same principle click into place.
For instance, if retreat from benefactive for-phrase overgeneralizations
were guided by the maturation of the attachment principle, then all other
reflexes of the attachment principle would emerge at exactly the moment
that benefactive retreat happens. If they don't coincide, then we know
that the principle must already be present and staggered data must be
the trigger. The question is an empirical one; longitudinal studies may
reveal insights.

7. Conclusion

We have seen four cases where learning is accomplished by a CATAPULT,
where a principle of grammar in tandem with positive evidence provides
the learner with negative evidence. Catapults cure not only learners'
lexical overgeneralization errors (inflection and errors on argument struc-
tures) but their syntactic errors, too (attachment of arguments and
adjuncts). Moreover, we claimed that the learner can decide what the
negative evidence she derives is negative evidence about if a domain condition holds, which divides grammatical labor into a syntactic domain and a lexical domain. The domain condition — already a property of the grammar and not a special condition posed on the acquisition system — ties the learner’s decision about how to interpret the evidence to the domain in which the change is being made. The condition gets her around the pendulum problem, swinging perpetually between overgeneralizing and retreating from rules whose domains are not clear.

The catapult theory has the advantage that learning — in particular, unlearning — can happen without an appeal to ‘external’ learning mechanisms. It is ‘grammar-internal’, driven solely by grammatical principles and the data in the learner’s linguistic experience. The notion that the grammar is responsible for the learning ‘of itself’ is not as paradoxical as it sounds. What accomplishes the task are the catapult’s ‘either/or’ principles and the assumption that the data are staggered. (We also showed that the opposite assumption would also work: ever-present data but maturing principles.)

If mechanisms of language acquisition can be reduced to linguistic principles and data, then answers to questions about language acquisition will coincide more with the answers to our questions about linguistic structure. Linguistics and language acquisition will truly inform one another, as we have always been saying they do.

Received 18 July 1988
Northeastern University
Revised version received
31 January 1990

Notes

* This article has benefitted from discussions with many generous colleagues. I would like to thank Melissa Bowerman, Jill Carrier, Janet Fodor, John Frampton, Lila Gleitman, Howard Lasnik, Steve Pinker, Tom Roeper, Virginia Valian, Jürgen Weisssenborn, Ken Wexler, and an anonymous reviewer. I am also grateful to audiences at the Boston University Conference on Child Language, the University of Connecticut, and the Max Planck Institute for Psycholinguistics, where earlier versions of this research were presented. I gratefully acknowledge support from Northeastern University, for a Research and Scholarship Development Fund grant and a Junior Research Appointment, and from the Max Planck Institute. Correspondence address: Linguistics Program/406 Holmes Hall, Northeastern University, 360 Huntington Avenue, Boston, MA 02115, USA.

1. Anecdotes like this one are familiar by now:
   Child: My teacher held the baby rabbits and we patted them.
   Mother: Did you say your teacher held the baby rabbits?
   Child: Yes.
   Mother: What did she hold?
   Child: She held the baby rabbits.
   Mother: Did you say she held the baby rabbits?
   Child: No, she held the baby rabbits.

2. As is clear from a mechanical device, an acrobat landing on the object.

3. When two forms with or without is a rule have applied structures. For example, the WH word either.

4. Another proposaling (PDP) account be found in Pinker.

5. As a reviewer pointed out, uniqueness principle grammatical, for in fact, it is unlike.

6. Although I am interested, based on.

7. At first glance, the elsewheress and essentially that is.

8. Although I am interested, based on.

9. At first glance, the elsewheress and essentially that is.

10. Although I am interested, based on.


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Child: Yes.
Mother: What did you say she did?
Child: She holded the baby rabbits and we patted them.
Mother: Did you say she held them tightly?
Child: No, she held them loosely (Cazden 1972, cited in Aitchison 1983).

2. As is clear from the figure, I am talking not about a war machine, but about the mechanical device, often used by acrobats, consisting of a long board on a fulcrum. An acrobat landing on the high end of the board propels a second acrobat (or whatever is sitting on the other end) into the air.

3. When two forms are understood as having the same meaning, it must be assumed that a rule has applied to derive one from the other, thereby resulting in two distinct surface structures. For example, the possibility of embedded clauses in English occurring either with or without that points to a rule deleting the complementizer. WH questions with the WH word either initial or in situ points to a WH-movement operation.

4. Another proposal is Rumelhart and McClelland's (1987) 'parallel distributed processing' (PDP) account. I will not offer arguments against this approach here; several can be found in Pinker and Prince (1987).

5. As a reviewer points out, there are some English verbs which seem to disconfirm the uniqueness principle, in that both the regular and irregular past tense forms are grammatical, for example dived and dove, learned and learnt, dreamed and dreamt. But in fact, it is unlikely that the two forms in each pair are used by the same speaker interchangeably. More likely, the speaker ordinarily uses one but, when confronted with another speaker who uses the other, switches. However, if it could be shown that an individual speaker's dialect contains both forms, then one might claim that the uniqueness principle is the child's default assumption, suspendable when data from the input demand it. But this requires that the child be able to analyze the two words as meaning the same thing, despite their different forms, something the uniqueness principle should prevent. It would also require that she keep close track of the input, something which I will argue against below. In fact, I believe that the child does not suspend the uniqueness principle in these cases. Rather, we acquire the second forms for these words more or less in adult life, as marked cases.

Dreamt and learnt are, for many speakers, part of the learned vocabulary, acquired in school in a literary context. They are interesting indicators of language change, of substitution on the diachronic level.

6. The 'elsewhere condition' (Kiparsky 1973, 1982) could also do the job here. It states essentially that when two rules or forms are in competition, the more specific one — the 'special' rule — takes priority over the general rule. Here the specific irregular past-tense rule is preferred over the more general regular one. Lasnik (1981) uses this condition in acquisition to account for how the English verbal auxiliary system is acquired.

7. Pinker (1984) gives an alternative account of how two simultaneous forms could coexist, based on the learner's limited processing capacity.

8. Although I am dealing explicitly with to datives here, a similar argument is made for for datives in Randall (i.p.).

9. At first glance, this generalization seems to be false. We find to give blood, to show a film, to bring dessert, to read a story. However, it can be shown that in these cases the verb is being used in one of three noncanonical ways, either (a) idiomatically, with a small number of permitted NP objects; (b) with an ellipsed goal PP; or (c) as a separate two-argument verb, with a different meaning. (a) and (b) are discussed in detail in Randall (1987); (c) is discussed below; see Randall (i.p.).
This account was first proposed in Randall (1985). See Randall (1987, i.p.) for more detailed accounts.

Notice that if the learner accidentally assumes that give also takes a single NP (hearing sentences in which ellipsis has occurred, like Sally gave $10 or idioms like give a damn) there is no problem. The NP NP cases may be temporarily discarded but they will be reinstated when the learner encounters them in the data later, by which time, presumably, she will understand the single NP give cases as special.

In Randall (i.p.) arguments along the same lines are made for verbs of other classes, for dative cases like draw, and 'spray/load' class verbs, such as spray.

See Roeper (1987) for an interesting discussion of the difference between theory and process in language acquisition. On the difference between analogy and rule in language acquisition, see Bowerman (1983) and Maratsos and Chalkley (1980).

The uniqueness principle might also be seen as applying here. Each phrase type is attached at a single level; therefore, if benefactives attach outside V', they do not attach inside V', and vice versa. The information that benefactives are attached outside V' triggers this either-or (if A then not B) principle, and the incorrectly placed benefactives are forced out.

If benefactive for phrases hang outside V' then they don't hang inside V'. Benefactive for phrases hang outside V' Benefactive for phrases do not hang inside V'.

See Roeper (1987) for a discussion of deduction in language acquisition.

Pinker's (1984, 1987) and Mazurkewich and White's (1984) accounts are aimed at the dative alternation; Pinker's (1987) proposal also encompasses the causative, passive, and locative alternations. These accounts are essentially versions of the indirect-negative-evidence approach (Chomsky 1981).

See Bowerman (1987) for a further critique. She notes that this problem also constitutes an argument against connectionist theories such as Rumelhart and McClelland (1987).

As evidence from adults as well as children in 'wug' tests indicates (Berko 1958).

References


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The mechanics of acquisition


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**Abstract**

German and Dutch clauses, however, placement in main how children find Clahsen and M have claimed that related to the agreement. Corre the use of verb for I present an a verb fronting is not there are distrib between verbal e minimal overlap.

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**Introduction**

In Dutch (D) group is right auxiliaries, (2) with nonfinite

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