Introduction

On the surface, the sentence pairs in (1) and (2) are structurally identical. In both cases, the first sentence is intransitive, and the second transitive:

(1)  a. Luke ate.
    b. Luke ate the eggs.

(2)  a. The door opened.
    b. Thora opened the door.

However, this outward similarity hides a fundamental difference. In (1), the subjects of both the intransitive and the intransitive sentence play the role of agent in the eating events denoted. In (2), only the subject of the transitive sentence plays this role; the subject of the intransitive is the patient of the opening event, and shares this role with the object of the transitive. These four sentences exemplify four constructions: the Intransitive Active in (1a), the Transitive Active in (1b), the Intransitive Inchoative in (2a), and the Transitive Causative in (2b). By hypothesis, the lexical semantic properties of verbs determine the range of constructions they can be used in (Levin, 1993). The causative alternation (Levin & Rappaport Hovav, 1995) is the lexical semantic relation that holds between the Intransitive Inchoative (2a) and the Transitive Causative (2b) constructions.

Bowerman (1974) noted that children overgeneralize the causative alternation: they make causative alternation errors. Diary studies of children (Bowerman, 1974, 1982; Lord, 1979; Eve V. Clark, 1993, p.c.)¹ have documented some of these uses (other studies include Bowerman, 1996; Berman, 1982; Figueira, 1984; Hochberg, 1986; Pinker, 1989; Gropen et al., 1996). For instance, the verbs in (3) are erroneously used as Transitive Causatives in causative errors:

(3)  a. Don't _giggle_ me. (Eva 3;0)
    b. I'm _singing_ him. (Christy 3;1)
    c. First I want to _resquirt_ him and then I'll _hop_ him onto the side (Damon 3;6)
    d. You can _drink_ me the milk. (Jennifer 3;8)
    e. The tiger will come and eat David and then he will be _died_ and I won't have a little brother any more. (Hilary 4;x)

¹The Damon errors are from Clark’s unpublished diary data; the Jennifer and Benjy errors from Lord (1979); and the rest from Bowerman (1974, 1982).
Note that (3d) is an erroneous ditransitive use of a transitive verb; I subsume such examples under the term Transitive Causative for expository purposes. Note also the passive use of transitive *die* in (3e). Lord (1979), especially, found errors in the opposite direction, with strictly transitive verbs used as Intransitive Inchoatives in *inchoative errors*:

(4) a. Maybe it's a building building up. (Damon 2;9)
b. I wanna take it out so it can't put on my nose. (Jennifer 2;10)
c. Come and see what Jenny got today. *Pull. Pull!* (Benjy 3;1)
d. They didn't throw in! (Damon 3;4)
e. You keep on talking to her! And that makes me bother! (Benjy 3;11)

The context of (4c) *pull* makes it clear that an inchoative is intended: the child is pulling on his reluctant mother and demanding that she come along. And notice that inchoative *bother* in (4e) is the complement of the verb *make* in the *Periphrastic Causative* construction.

In Marcotte (2005), I gathered causative alternation errors from diary studies, both published (Lord, 1979; Bowerman, 1982) and not (Eve V. Clark, p.c.), and undertook to find more errors through an exhaustive search of the CHILDES archive (MacWhinney, 2000) for the various forms of 175 verbs. Table 1 compiles the results of that effort.

<table>
<thead>
<tr>
<th>Source</th>
<th>Inchoative</th>
<th>Causative</th>
<th>Total</th>
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</thead>
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<tr>
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<td>126</td>
</tr>
<tr>
<td>Total</td>
<td>79</td>
<td>224</td>
<td>303</td>
</tr>
</tbody>
</table>

Table 1: Distribution of causative alternation error types among data sources.

Analyses of children's causative alternation errors in English have either failed to account for their bidirectionality (Bowerman, 1982) or their lexical semantics (Lord, 1979; Hochberg, 1986; Braine et al. 1990), or they have posited innate grammatical knowledge to account for both, and explain recovery (Pinker, 1989). My goal in this paper is to show that the bidirectionality of causative alternation errors, their lexical semantics, and children's recovery can in principle be accounted for without innate grammatical knowledge. More precisely, I show how the innate grammatical knowledge central to the account of Pinker (1989) can instead be seen to emerge from the fact of language use, given the lexical semantic properties of English verbs, the properties of real-world events, and grammatical knowledge in the form of construction paradigms.

I begin by outlining the problem that has led researchers to posit innate grammatical knowledge for recovery from overgeneralization errors, and by describing the account Pinker (1989) specifically has argued is necessary both for explaining recovery from causative alternation errors, and for explaining the errors in the first place. I then briefly recapitulate my argument that the argument for innate grammatical knowledge is disarmed by a proper characterization of the acquisition task on the one
hand and a learning device to implement it on the other (Marcotte, 2005). I outline a constructional alternative to Pinker, then show how semantically restricted errors emerge in the manner I allude to above, and disappear through the intervention of the learning device.

The Problem

Like all overgeneralization errors, causative alternation errors have been at the heart of the debate on innate grammatical knowledge. The crux of the debate is the putative absence from children's learning environments of negative evidence, information about the sentences that are ungrammatical in the target language. If this supposition is correct, then children have no reason to stop believing that sentences like those in (3) and (4) are grammatical, or to stop using them. But children become adults who do find these sentences ungrammatical, so they must unlearn them somewhere along the way. This is the Logical Problem of Language Acquisition (LPLA; Baker, 1979; Baker & McCarthy, 1980; Marcus, 1993): absent negative evidence there needs to be some form of innate grammatical knowledge to explain children's errors and recovery. Two different solutions to the LPLA present themselves. First, children could acquire the knowledge to make errors, and be rescued from it by the intervention of innate knowledge. Second, children could be very conservative learners who would never make mistakes if they did not have innate knowledge, later set aside, that leads inexorably to the capacity to make mistakes.

Pinker (1989) adopts a mixture of these approaches, and goes on to propose a detailed theory of argument alternation errors with the causative alternation, the dative alternation, the locative alternation, and passive formation. I focus here exclusively on the causative alternation, but Pinker's notions of broad- and narrow-range lexical rules are central to the analysis of all these. Broad-range rules define bidirectional lexical semantic operations over large, semantically-coherent classes of verbs, and provide the necessary conditions a verb must meet in order to participate in an alternation. Narrow-range rules define non-exhaustive, semantically-coherent subclasses of the large classes defined by broad-range rules, and provide the sufficient conditions for a verb's alternation. For each alternation, this defines three sets of verbs: a first whose members do not meet the broad-range conditions and cannot participate in the alternation at all; a second whose members meet the broad-range conditions but not the narrow-range ones, and therefore meet necessary conditions but not sufficient ones; and a third set whose members meet both broad-range and narrow-range conditions, and thus meet both necessary and sufficient conditions for alternation. The first and second sets are complementary, and the second set includes the third one.

More specifically, with regard to the causative alternation, Pinker defines the broad-range rule as the following:

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2 I use the word “set” here in contrast with “class”. I understand the distinction to be the following: sets of verbs are not necessarily semantically coherent, but classes necessarily are. A class is a set, but the reverse does not necessarily obtain. Semantic coherence is defined relative to the representational framework adopted.
This rule states a correspondence between *dynamic* lexical semantic representations. In the representational framework adopted by Pinker, drawn mainly from Jackendoff (1983), these representations are those built around conceptual predicates like GO or ACT, denoted by verbs like *break, swim* and *cut*, but not those built around BE or HAVE, denoted by verbs like *exist* and *own*. The correspondence stated is that the intransitive *dynamic* lexical semantic structure of a verb like *swim* corresponds to a causative lexical semantic structure with that dynamic structure as its effect, enabling sentences like “I swam the doll”; and vice-versa for verbs like *cut*. Verbs denoting dynamic events can belong to the second and third sets of verbs mentioned above, but verbs denoting non-dynamic events are part of the first.

Narrow-range rules operate on more restrictive subclasses than the broad-range rule, simply by specifying more detailed inputs. For instance, a manner-of-motion verb like *roll* in (6a) fits in the narrow-range rule in (7), but a directed motion verb like *enter* in (6b) does not:

I represent (7) as unidirectional based on inference, since Pinker does not provide representations for narrow-range rules. The reasoning is as follows. One, Pinker provides representations for the classes of verbs defined by narrow-range rules. Two, all of those representations are for intransitive verbs. Three, if narrow-range rules are bidirectional, then they predict that verbs like *cut* have an intransitive inchoative form in adult speech, because the lexical semantic structure for that verb corresponds to a possible output for a narrow-range rule. Four, predicting that verbs like *cut* alternate is wrong. Five, hence Pinker does not mean to predict that verbs like *cut* alternate. Therefore, by *modus tollens* on three and five, Pinker does not mean for his narrow-range rules to be bidirectional.

Where do broad-range rules come from? (Pinker, 1989:326) seems to approve of a notion he attributes to Slobin (1985), that “children seek the linguistic means of
expressing certain kinds of conceptual gestalts”. In particular, the conceptual gestalts that verbs express are thematic cores. A thematic core is “a schematization of a type of event or relationship that lies at the core of the meanings of a class of possible verbs” (1989:73). As they acquire verbs, children notice that there is “a set of independently acquired verbs sharing the same root but differing in argument structures, each of which is associated with some thematic core” (Pinker, 1989:268). That is, individual stems are repeatedly associated with pairs of lexical semantic structures, such that the first is always an instance of a particular thematic core, and the other always an instance of another thematic core. To capture this regularity, children set up a lexical semantic operation “capable of deriving one thematic core from another” (1989:269). Thus the broad-range rule in (5) predicts that verbs whose lexical semantic structure has a dynamic intransitive thematic core also have a causative lexical semantic structure with a dynamic complement, and vice-versa.

Narrow-range rules are acquired in parallel as “minor bottom up generalizations of lexical entries” (Pinker, 1989:293). As children acquire narrow-range rules, they abandon the broad-range ones, and therefore stop making errors. Narrow rules on their own cannot explain children's errors, because the process that creates them is conservative. This hardly sounds like a nativist account at all, except that Pinker also assumes innate linking rules between the lexical semantic structures and argument structures of verbs, stated relative to lexical semantic structures that look suspiciously like thematic cores (this is not explicitly stated; see Pinker, 1989:194). The rules determine which elements of lexical semantic structures are expressed at argument structure, and thus how they are realized syntactically. These innate linking rules allow children, upon witnessing a verb used with a particular argument structure, to acquire a lexical semantic representation for it.

Representations acquired in this manner for verbs denoting dynamic events fit into the broad-range rule, itself acquired based on observing adults using the causative alternation. Hence children make causative alternation errors with verbs denoting dynamic events until they start using narrow-range rules. Because the overgeneral broad-range rule is bidirectional and semantically restricted, Pinker's account captures both these features of children's causative alternation errors. Because the correct, narrow-range rules are learned on a separate track from the broad-range rule, with a separate learning process, then the fact that children recover from their errors is not surprising. If children learned only narrow-range rules, not a broad-range one, they would not make mistakes since their rules would always be more restricted than adult rules, or equally restricted once they have reached the correct level of generalization. Broad-range rule explain the properties of children's errors; the conservative process that creates narrow-range rules explains recovery.

A notable problem with this, as Pinker himself points out, is that the innate linking rules seem not to be universal: syntactically ergative languages (Dixon, 1972; Comrie, 1978) violate them. It seems less than compelling that Pinker, in his own words, can merely “offer some remarks that make the phenomenon something other than a total mystery” (Pinker, 1989:251).

This is not the only problem. As Goldberg (1995) argues, using lexical rules to predict a verb's possible argument structures creates rampant polysemy, including a proliferation of implausible verb meanings like a caused-motion version of “sneeze” to
account for the grammaticality of “He sneezed the napkin off the table”. No such implausible senses are created by (5) or (7), but they still predict that verbs undergoing the causative alternation have at least two different lexical semantic structures. However, Levin & Rappaport Hovav (1995) argue that the causative alternation is best accounted for by assuming that the inchoative and causative versions of the verbs undergoing the alternation both have causative lexical semantic structures.

So it seems that two of the main features of the Pinker (1989) account – lexical rules and innate linking rules – are at odds with what is known about the lexical semantic properties of English. An alternative account that dispenses with these features would be desirable. For example, a verb-specific approach (Tomasello, 1992, 2003) permits a construction-based account of the causative alternation, in which the lexical semantic polysemy that Pinker attributes to alternating verbs becomes instead a construction-level generalization; constructions lend their meanings to the verbs they host. The conservative generalization process that Pinker postulates for the acquisition of narrow-range rules is less problematic: ergative argument linking could be acquired based on observed verb-specific patterns, eliminating the need to override innate rules. But then the question returns to why children make mistakes in the first place – semantically restricted ones to boot – and then recover from them. This paper represents an attempt at explaining the former problem of semantically restricted, bidirectional errors within a constructional framework. The solution I propose appeals to a learning device I have proposed elsewhere (Marcotte, 2005a, 2005b) in answer to the second problem, recovery. I describe this learning device in the next section, lay out the constructional framework I assume, then show how they interact to account for causative alternation errors.

Hypothesis-Testing and Acquisition

While arguments and evidence exist to support the claim that children have no access to negative feedback – parent replies to child utterances from which children know, or are able to can infer, that their utterance was ungrammatical – leaping from them to the conclusion that children receive no negative evidence at all requires studious avoidance of foundational assumptions about the nature of language.

Since at least Chomsky (1959), linguistic theory has explicitly made the representational assumption that “Explaining language mastery and acquisition requires the postulation of contentful mental states and mental processes involving their manipulation” (Cowie, 1999:154). In particular, this means that the sentences of a language, that is to say the sentences that are grammatical in that language, are pairs of form and meaning represented in the minds of humans. The grammaticality of a string depends crucially on the meaning it is intended to have. Sentences like “John is eager to please” and “John is easy to please” can be either grammatical or ungrammatical depending on whether “John” is interpreted as the subject or object of “please”. This means that children acquire knowledge of language consisting of a system for replicating adult use of pairs of form and meaning, which means in turn that children can learn nothing unless they receive data in the form of form/meaning pairs. Since adult utterances are nothing but patterns of sequential air pressure variation until they are interpreted by a
mind, some mind-internal work is absolutely required before children can use them as evidence of anything at all.

But the leap from “no negative feedback” to “no negative evidence” tends to gloss over the fact that positive evidence – information about which sentences are grammatical in the target language – requires mind-internal mechanisms; at the same time, the leap relies on the claim that negative evidence would only be available if such mechanisms existed, so that it is more parsimonious to assume no negative evidence. As Marcus (1993:58) writes: “positive evidence is simply the input, that is, the sentences children hear”, while negative evidence would be “information about which sentences have not appeared in the input [...] based on mechanisms internal to the child, rather than input external to the child” (Marcus, 1993:55n.1).

Firmly reasserting representationalism, I propose that both positive and negative evidence should be reconceptualized as mental objects, specifically as the output of a hypothesis-testing language acquisition mechanism (HLAM) (Marcotte, 2005). This mechanism allows children to compare an actual adult utterance with a hypothesis of what that utterance ought to have been in the context of its occurrence. In this conception,
later. Even if her grammar fails to assign a complete representation to the utterance, the child knows what the words Bob and box are intended to refer to, and uses the conceptual representation to infer what the meaning of the adult sentence must be. Here, the child's social-cognitive skills of intention-reading (Tomasello, 2001, 2003) are key. My assumption that the child knows or is able to infer the adult’s intended meaning may seem controversial, but as (Pinker, 1989:361) puts it: “most explicit theories of language acquisition” assume “that children can accurately encode from context the adult's intended meaning”.

The sentence parsed by the child is the data that feeds HLAM. The mechanism takes in the meaning of this sentence and conceptual information about the context in which the sentence was uttered, and uses the child’s grammar to generate a form for this meaning. The parsed meaning, paired with this child-generated form constitutes a hypothesis about the sentence just uttered by the adult, namely a hypothesis about the form this sentence would have taken if the child had uttered it instead. Because the child assumes that the adult utterance respects the conventions of the linguistic community, and the child is learning to speak like an adult, the parsed adult sentence is the benchmark by which the child’s expected sentence is judged.

In the particular case illustrated in Figure 1, the child hypothesizes a Transitive Causative sentence. This is because the event is one of intentional causation, and children, like adults, prefer to use the Transitive Causative to talk about direct or intentional causation events and the Periphrastic Causative to talk about indirect or unintentional causation events (Ammon, 1980; Wolff, 1999).

HLAM returns positive evidence if the form of the child's hypothesized, expected sentence matches the form of the parsed adult sentence, or negative evidence if, as in this case, the forms do not match. In the event of a match, HLAM picks out the grammatical objects and operations that were used to generate the expected sentence, and assigns them good marks. In the event of a mismatch, the repair process looks over the derivation, picks out the grammatical objects and operations that led to the mismatch, and flags them. In this case, the faulty knowledge is either the child's belief that there is a Transitive Causative version of fall, or her belief that the falling event required the use of a Transitive Causative verb form over a Periphrastic Causative. Only the former is wrong, but the child does not know that. However, because that is the case, the child's correct belief about contextual choice of constructions will sometimes be used to generate correct hypotheses, and be assigned good marks that mitigate the repeated flagging. On the other hand, the Transitive Causative option for fall will never be assigned good marks, and will eventually be purged from the grammar.

HLAM produces just the kind of evidence that children need to correct their hypotheses about the target language, at least in the case of the causative alternation. There is no Logical Problem of Language Acquisition: the fact that children recover from causative alternation errors is not evidence that they are endowed with innate grammatical knowledge, since children do receive negative evidence. This opens up the possibility that children commit causative alternation errors for some other reason than having innate linking rules that lead to the formation of broad-range rules. I suggest in the next section a constructional approach that effortlessly supports the alternative account I subsequently present.
A Constructional Approach

There are many ways to conceive of constructions (Goldberg, 1995; Sag, 1997; Croft, 2001; Tomasello, 2003). My conception of them, for present purposes, is as lexical items with syntactic structure. They are lexical items because they pair form and meaning, but they differ from words in that their form is syntactic, as opposed to morphophonological, in nature. In some cases, constructions may have a morphophonological reflex in addition to syntactic structure – for instance a passive construction would specify that the verb form it hosts should be a participle – but I consider no such cases here.

About the syntactic aspect of constructions I have little to say, except that I will use words like intransitive and transitive to describe the aspects of those structures that are relevant to my purposes. Thus a construction places valency requirements on sentences. It also places category requirements on the grammatical units that are allowed to satisfy those valency requirements. Above all, a construction requires the presence of a verb, and places requirements on the meaning of that verb in a manner that I will specify. Thus, Figure 2 contains no syntactic information except for category labels, co-indexed through numbered tags with elements of the construction's lexical semantic structure.

As far as this meaning half of constructions is concerned, I assume that it can be represented as a lexical semantic structure, like the ones used to represent verb meanings in Levin & Rappaport Hovav (1995) and Rappaport Hovav & Levin (1998), whose analysis of the causative alternation I adopt essentially wholesale, with some caveats that I will note as they come up.

Figure 2 illustrates these pairs of lexical semantic structure and valency/category requirements. Each construction is made up of two tiers: on top is the lexical semantic structure representing the construction's meaning, and on the bottom are the valency and category requirements imposed by the construction. The words used to satisfy these requirements have meanings of their own, which fit into the lexical semantic structure on top, as indicated by the numbered tags. Inserting a verb into the Intransitive Active construction, for example, means merging the verb’s lexical semantic structure with the

<table>
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<td><img src="image" alt="Intransitive Active Construction" /></td>
<td><img src="image" alt="Intransitive Inchoative Construction" /></td>
</tr>
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</table>

Figure 2: Selected relevant constructions.
one enclosed by the brackets marked by [1], which contain the ACT and its argument. Inserting a noun phrase into the same construction means substituting for x the noun phrase’s lexical semantic structure.

The lexical semantic structures I assume for the Intransitive Inchoative and Transitive Causative constructions are much like the structures proposed in Levin & Rappaport Hovav (1995). Under this analysis, both the inchoative and causative structures explicitly include the CAUSE predicate, which links a causing substructure to a result substructure. In the Transitive Causative construction, the causing substructure is a transitive action whose own structure is like that of the Transitive Active construction. The causing substructure of the Transitive Causative has its own articulated structure, but is existentially bound in the Intransitive Inchoative. Uses of the inchoative thus imply the presence of a causing substructure, without requiring that any of its participants be syntactically realized. The result substructures of the Intransitive Inchoative and Transitive Causative attribute a new property to the entity denoted by the argument of the <STATE> predicate.

Although I find explicit suggestions that there are relations among construction compelling (Goldberg, 1995; Sag, 1997), such relations play no role here.

The meanings of verbs are themselves represented as lexical semantic structures. For example, swim denotes an intransitive action with a more specific instance of the ACT predicate (8a), and break denotes a causative action with a specific result STATE (8b). Note that there are no coreference restrictions on the arguments of the predicates in these structures; the arguments are free to corefer in principle, but in practice restrictions are imposed by the constructions in which verb meanings are inserted. For instance, the Transitive Causative construction in Figure 2 states that the second argument of ACT is coreferent with the only participant argument of the result substructure.

\[(8)\]
\[
\begin{align*}
\text{a. } \text{swim: } & [x \text{ACT}_{\text{swim}}] \\
\text{b. } \text{break: } & [ [x \text{ACT } y ] \text{CAUSE } \text{BECOME } [z \text{<BROKEN> } ] ]
\end{align*}
\]

Constructions place requirements on the meanings of the verbs they host because the meanings of verbs have to be merged with the lexical semantic structures of constructions, as indicated by the numbered tags in Figure 2. Informally, there must be no conflicting information between the lexical semantic structure of a verb and that of a construction for the two to be compatible. A formal account of this might make use of unification as it is defined in one or another of the constraint-based approaches to generative grammar (Bresnan, 1982; Pollard & Sag, 1994; Dalrymple et al., 1995).

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3 This differs from Levin & Rappaport Hovav (1995), who assume that only the first argument of the causing subevent is existentially bound in the inchoative. I do not explore the consequences of this difference here.
break \quad \text{[ [ x \ \text{ACT} \ y ] \ \text{CAUSE} \ [ z \ (BROKEN) ] ]}

Transitive Causative \quad \text{[ [ x \ \text{ACT} \ y ] \ \text{CAUSE} \ [ z \ (STATE) ] ]}

swim \quad \text{[ x \ \text{ACT}_{(swim)} ]}

Figure 3: Verb-construction match-ups.

I put the matter visually in Figure 3. The brackets, predicates and variables of the construction meaning and the verb meaning have to match when the outer brackets of the verb meaning are lined up with the brackets indicated by numbered tags in the constructional representations of Figure 2. Thus break fits in the Transitive Causative construction because their features match when the verb meaning's outer bracket is lined up with the outer bracket of the construction, the brackets tagged $\text{[1]}$ in Figure 2; but swim does not fit in this construction because the outer brackets are mismatched: the matrix predicate of the construction is CAUSE, but that of the verb is ACT.

By hypothesis, as I stated at the outset, the lexical semantic properties of verbs and constructions determine which verbs can occur in which constructions; not all verbs fit in all constructions, and not all constructions welcome all verbs. Discovering the semantic regularities that determine which verbs fit in which constructions is a task for children (and lexical semanticists). But knowing those regularities is not necessary for correct speech, as long as one keeps to the combinations of verbs and constructions that one has heard proficient speakers use. I suggest that children keep a tally of the combinations of verbs and constructions they have heard, even as they seek to discover regularities to make this tally obsolete. This amounts to keeping track of construction paradigms: a tally of the constructions a verb has been observed in.\textsuperscript{4}

Figure 4 schematizes partial construction paradigms in a hierarchical lexicon (Ginzburg & Sag, 2001). At the bottom of the figure are the verb-specific argument realization patterns children initially acquire. These are specific verb meanings with argument realization information, akin to the verb islands of Tomasello (1992). In the

\textsuperscript{4} I choose this term over the equivalent term verb paradigms, a tally of the verbs a construction had been observed with. Adopting the perspective of the verb seems more natural to me since, intuitively, an arbitrary verb will be associated with fewer constructions than an arbitrary construction will be associated with verbs.
middle tier of the figure are the verbs and constructions into which children analyze these verb-specific patterns: argument realization information is removed from verb meanings and consigned to constructions. But the verbs and constructions remain linked to the verb-specific patterns from which they originate. Neither verbs nor constructions can be used on their own: they either occur combined in the patterns at the bottom of the figure, or not at all. The use of any particular verb-construction pair is motivated to the extent that there is evidence for it; the more frequent such a pair is in adult speech, the less discourse pressure is needed for children to actually use that pair.

From this perspective, causative alternation errors occur because children believe that verbs and constructions are linked in pairs that adults do not, and cannot, actually use. A good working hypothesis is that children analogize between construction paradigms based on the lexical semantic properties of verbs (Tomasello, 2003). We know by hypothesis that children are trying to acquire knowledge to make their construction paradigms redundant: lexical semantic knowledge that predicts precisely which verbs occur in which constructions. Erroneous analogies would be first stabs at using such lexical semantic knowledge; actual errors would be rare because hypothetical verb-construction pairs require more discourse pressure to surface than do observed pairs. In effect, children would notice that verbs with certain lexical semantic properties share significant parts of their construction paradigms, and reason that other verbs with those lexical semantic properties therefore also share those parts. Children engage in a process of analogical paradigm completion. The next section explores the possibility that a misalignment between conceptual and lexical semantic representations leads through such a process to causative alternation errors.

**Verbs, Event Prototypes, and Acquisition**

I assumed (see Figure 1 above) that conceptual and lexical semantic representations exist separately in children's minds, meaning to imply that they do so in adult minds as well. This is not an uncontroversial matter; for instance Jackendoff (1990, 2002) denies that there is a separation, though my assumption can be reconciled with his approach if linguistic representations are part of conceptual representations, understood as referring to other, non-linguistic parts of those representations.

In this light, consider Talmy (2000), who argues that transitive action verbs differ in how the agent's intention scopes over the action performed. Specifically, there is a cline in strength of the implicature that the agent intends to bring about a particular result by performing the action denoted by the verb in question. For verbs like verbs like *smash* and *assassinate*, there are necessary entailments of damage and death, respectively. As such, sentences like the following are contradictory and infelicitous:

(9) a. Pete smashed his guitar, but it remained undamaged.

b. The lone gunman assassinated the president, but the ERTs revived him.

At the other extreme, implicature is essentially absent in verbs like *kick* and *pull*. The verbs imply no particular results, because there is no contradiction in uttering sentences like:
(10)  a. Zinédine kicked the football, but it stayed in place.
    b. Kramer pulled the rickshaw, but it didn't budge.

Even speakers who think that “pull on” would provide a more natural description of the event in (10b) would presumably answer affirmatively if I asked them “Did Kramer pull the rickshaw?” after having described or depicted an event in which Kramer pulls on a rickshaw but fails to displace it. Neither kick nor pull necessarily denote displacement of the affected entity, only the exertion of some kind of force on that entity. In the representational framework I have adopted here, the distinction between verbs like smash and assassinate in (9) on the one hand and verbs like kick and pull in (10) on the other is best captured as in (11): the former verbs encode a result in their lexical semantic structures, but the latter do not:

(11)  a. smash:  [ [ x ACT y ] CAUSE [ BECOME [ z <SMASHED> ] ] ]
    b. kick:  [ x ACTkick y ]

Indefeasible, conventional implicatures arise with verbs like (10a) because the result substructure is essentially affirmed whenever the verb is used. In contrast, no result substructure is affirmed in (10b), and no implicature arises that a result necessarily occurs.

This is not to say that no uses of kick carry implicatures: “Zinédine kicked the football” strongly suggests that the football moved as a result of the kicking, even though it is perfectly possible that Zinédine, having forgotten his eyeglasses, was in fact aiming his foot at the depiction of a football in a trompe-l'oeil rendition of a pick-up game, failing to move the ball even an inch, even though he made solid contact with it. I suggest that those implicatures arise not from the meaning of the verb itself, but rather emerge from prototypicality effects triggered by the event concept KICK associated with the meaning of the verb kick, in tandem with the nature of the kicked object and real-world expectations of how such an object typically behaves when participating as the affected object in the event type in question. The act of kicking a wall, for instance, would not be expected to result in any displacement of the wall, but nevertheless remains an instance of KICK, albeit a non-prototypical one.

Here, then, is an example of misalignment between lexical semantic and conceptual representations: though the event concept KICK may prototypically involve a result, the verb kick that best expresses this concept does not encode the resulting state. Hence, any implicature of a result arising from an utterance of kick can be defeated, even for those actions that do involve a prototypical result.

In Marcotte (2005), I determined that adult speech to children in the CHILDES archive does indeed have the property I surmise: when speaking to children younger than 4, adults tend to use the intransitive verbs run, swim, and walk, as well as the transitive verbs kick, pull, push, and wash to talk about events in which a change of state or location occurs as a result of the action denoted by the verb.
Because of this prototypicality, children will tend to encounter utterances of kick that denote causative instances of kick. Nevertheless they must acquire a non-causative meaning for that verb: as schematized in the top half of Figure 5, children must discover that the adult, non-causative meaning of the verb kick refers to only the causing subevent of the event concept kick. On the other hand, as the bottom half of the figure illustrates, the causative meaning of break is coextensive with all instances of the concept break, since they necessarily involve a resulting state of brokenness.

\[ \text{KICK}_{\text{prototype}}: \quad [ [ x \ \text{ACT}(\text{kick}) \ y ] \ \text{CAUSE} [ \ \text{BECOME} [ y \langle \text{LOCATION} \rangle ] ] ] \]

Figure 5: The correspondence between concepts and verbs.

I contend that this is problematic because children are prone to assume isomorphic relationships between verb meanings and causative conceptual representations: children make a whole-event assumption (Clark, 1991, 1993), and furthermore find causative structures to be better wholes than their subparts. A child hearing kick used to denote the causative kicking event shown in the top half of Figure 5 prefers to assign the entire causative conceptual representation to the verb as its lexical semantic structure, rather than just the causing substructure of that conceptual representation. Children “seek the linguistic means of expressing certain kinds of conceptual gestalts” (Pinker, 1989:326), and treat causative events as better gestalts than the causing substructures of causative events. This leads them to acquire verb meanings that encode results, even when the adult meanings of those verbs do not.

This directly contradicts the accepted interpretation of Gentner (1978), who tested children on their understanding of the verbs stir, beat, shake and mix with the assumption that stir, beat and shake have a manner-of-action component to their meanings but no necessary result substructure, like kick in (11b); and that mix specifies no particular manner of action, but does denote a change from a heterogeneous state to a more homogeneous one, like smash in (11a) denotes the inception of smashedness.

Gentner presented 5-to-7 year-olds with a labeling task, asking “Am I stirring it?” or “Am I mixing it?” for all the verbs above as she performed actions on either a heterogeneous solution of salt and water, whose homogeneity could increase, and cream, whose homogeneity was fixed. The expectations were that children would acquiesce to the non-causative stir, beat and shake labels no matter what the substance being acted on, but only when the action was appropriate; and second that children would acquiesce to the mix label only when the salt and water solution was acted on, since only this substance could undergo the change in homogeneity described by that verb. The results seem to confirm these expectations, and Gentner concludes that “Children appear to learn the action components of the mixing verbs before they learn the change of state
components” (1978:994). This would refute my whole-event assumption if it did not vastly overstate the reported results.

First, Gentner only reports acceptance of stir, beat and shake relative to the actions being performed, and not to the results of those actions. We do not know, for instance, whether any of these labels were as likely to be accepted when there was a change of state (with the salt and water) as when there was none (with the cream), or whether acceptance rates differed. Thus, Gentner's account of her experiment only confirms that the verbs are specified for manner of motion, which the Intrusive Results Hypothesis does not exclude: verbs can be specified for both manner of motion and result. Hence, nothing can be concluded about whether the children understand those verbs as having results.

Conversely, acceptance of mix is only reported relative to the result of the actions being performed, and not to the actions themselves. We do not know whether mix was accepted equally readily as a label for stirrings, beatings and shakings. Notice that, if children do not acquire mix with a result component, as Gentner concludes, they must be acquiring it with a manner component, specifying some kind of generic agitation movement. But the experiment is not reported in a way that would lend support to this. In any case, a manner component of meaning for mix is also not excluded by my assumption; the issue of manner is in fact completely orthogonal to it.

Second, the formulation of the questions put to the children, with the verbs in the progressive, biases their responses in favor of actions over results. It is well known that verb inflection frequencies correlate with aspectual classes in adult speech, and that this is true of child speech as well (see among others Shirai & Anderson, 1995). Furthermore, children seem to go beyond tendencies, and restrict the use of certain verbal inflection to certain aspectual classes. In particular, the -ed suffix is constrained to telic verbs, and the -ing suffix to dynamic durative verbs (Olsen & Weinberg, 1999). The form of the questions in the Gentner study thus focuses the child's attention on the unfolding of the event, rather than on its termination, or on the event as a whole. Wittek (2002) argues the same line.

Moreover, even if children have in fact acquired those verbs with result components of meaning, they may not be willing to commit to the occurrence of that result before performance of the action is over. From the perspective of someone with causative meanings for those verbs, the questions were equivalent to asking whether the action, when completed, would produce a particular result. This could explain the chance performance on the use of mix with actions performed on salt and water: children were unwilling to commit to the eventual production of a result while the mixing action was ongoing, when only the occurrence of that result could determine whether a mixing event had in fact taken place. Again, Wittek (2002) makes a similar case.

Behrend (1990) replicates the Gentner (1978) results with a study that has the same failings and is equally inapplicable to my whole-event assumption, but Behrend's second experiment provides direct support for it. Subjects – including 3-year-olds, 5-year-olds and adults – were taught a novel word for a training event, after which they were asked whether this novel word could also be used to label test events, to determine just what meanings had been acquired. The training events were designed to each include an action and a result. The test events were designed to systematically differ from the training event: either the same action was performed leading to a different result, or a
different action was performed leading to the same result. After the presentation of each test event, the experimenter asked the children “Is she verbing this time, or is she doing something else?”

The results are telling: all age categories used novel verbs more readily to label test events in which the action had been changed than to label test events in which the result has been changed. This indicates that the meanings acquired by subjects for those novel verbs had more robust result components than action components. Notice that the experiment suffers from the same action bias as Gentner (1978), but in this case it works against the result obtained: the question has both progressive inflection and the generic action verb do, but subjects still prefer to categorize under the same label and meaning events with different actions than events with different results. This is strong evidence in favor of a preference for causative lexical semantic structures: if events denoted in adult speech by non-causative verbs have prototypical results, then children are likely to encode those results as part of their verb meanings.

The upshot is that verbs denoting events in which an entity undergoes a change of state or location are liable to be acquired by children with causative lexical semantic structures. Children will thus correctly acquire causative lexical semantic representations for causative alternation verbs (open, break) and causative non-alternating verbs (fall, cut), all of which necessarily denote causative events, but incorrectly acquire causative lexical semantic representations for verbs like swim, kick, and pull, which can denote causative events but do so only prototypically.

In Marcotte (2005), I hypothesized that children make causative alternation errors because they believe that all verbs with causative lexical semantic representations can alternate. Because causative verbs like open and break are linked in the lexicon to the Intransitive Inchoative and the Transitive Causative construction, other causative verbs like fall and pull must be linked to both of these constructions as well. I tested this hypothesis by comparing the causative alternation error rate of non-causative verbs – verbs that are not likely to denote causative events or be acquired as causative – with that of causative and prototypically causative verbs. The expected result was that the error rate would be higher with the latter than with the former.

The data I used to test this hypothesis was that which I extracted from the CHILDES archive in my search for the various forms of 175 verbs, including 60 inchoative errors and 66 causative errors (see Table 1 above). These verbs included all those for which causative alternation errors were known to exist because of diary data (giggle, throw, etc.), and other verbs thrown in because existing theories made predictions about their error potential (walk, judged a good candidate for error; like, judged a bad candidate; and so on). Using random samplings of the search results, I determined the number of occurrences for each sense of each verb – for instance, both shoelaces and football games can be tied – using the verb classes of Levin (1993) as senses. Then I determined which sense of the verb was in use in each of the 126 errors. Because the data was very sparse, with small numbers of errors for senses that have them and large numbers of senses without errors, I grouped verb senses in classes of verb senses, collapsing for each Levin class the number of occurrences of the verb senses within that class, and the number of errors with those senses. This made it possible to calculate an error rate for each verb sense class, with the expectation that non-causative
classes would have a lower error rate than causative and prototypically causative verb classes.

This expectation was met only partially: the overall error rate did not significantly differ for non-causative classes relative to causative and prototypically causative classes, nor did the rate of causativization error; however, the rate of inchoativization error was significantly higher for causative and prototypically causative classes than for non-causative classes.

I advanced above that shared causative meanings between verbs known to alternate and verbs not known to alternate motivate for children the hypothesis that the latter verbs alternate as well. This hypothesis survives the finding that only inchoative errors are sensitive to shared verb meaning causativity, but it must be supplemented by another motivation, not based on shared verb meaning causativity, for causativization errors. I suggest that this additional motivation for causativization errors is the acquisition of the Periphrastic Causative construction, because it affords children the opportunity to hear any intransitive verb used to talk about a causative event. For example, the two sentences in (12) are equally grammatical, though the first has the non-causative verb laugh in the complement of the periphrastic causative verb make, and the second has the causative verb open in the same position.

(12)  a. Thora made Isak laugh.
     b. Thora made the door open.

Recall that Ammon (1980) and Wolff (1999) have shown that adults and children prefer to use Periphrastic Causative sentences to describe indirect or unintentional causation, and Transitive Causative sentences to describe direct or intentional causation. But this preference is not absolute: in the experiments performed by these researchers, individual stimuli were liable to be described by either Periphrastic or Transitive Causative sentences. This means that the conceptual representations of these stimuli can be denoted by either the Transitive Causative or the Periphrastic Causative construction, and therefore that the lexical semantic representations of verbs paired with these constructions are sufficiently similar that they can be used to denote either direct or indirect, intentional or unintentional causation. Though significant preferences exist, Transitive Causative open in “Thora opened the door” and Periphrastic Causative open in “Thora made the door open” are close enough in lexical semantic representation that either can be used to denote an event in which Thora opens a door by pushing it with her hand, or an event in which she does so by pressing a button for wheelchair access. The Transitive and Periphrastic Causative function as alternative ways of talking about causative events, imputing different degrees of directness or intentionality to them.

But precisely because the Transitive and Periphrastic Causative forms of causative alternation verbs have such similar lexical semantic structures, the fact that all intransitive verbs have a Periphrastic Causative form can be used to infer that all intransitive verbs also have a Transitive Causative form similar in lexical semantic structure to this Periphrastic Causative form. In this case it is not causative lexical semantic structure shared between verb meanings that motivates the analogy, but causative lexical semantic structure shared between instantiated constructions – verb-specific argument realization patterns – represented in the hierarchical lexicon.
Meanwhile, there is no unrestricted alternative to the inchoative for effecting the syntactic realization of just the argument denoting the entity to which the result of a causative event applies. The requirements for such a construction are that it necessarily denote causative events, as grammatical inchoatives do (for example, “He fell” or “It broke”), that it be usable with otherwise transitive verbs that do not have causative lexical semantic representations, and that it realize syntactically only the causee of the causative event. It would then play to the inchoative the role that the Periphrastic Causative does to the Transitive Causative: it necessarily denotes causative events, is usable with non-causative intransitive verbs like laugh, and realizes both a causer and a causee. The closest construction that I can think of was offered by Bowerman (1974): the get-passive, as in “It got wet”, or “She got burned”.

But get-passive sentences do not necessarily denote causative events: they always mean that something happened, but not necessarily that something else happened as a result. A sentence like “John got kissed” means that someone touched John with their lips, but says nothing about whether some change in John was effected by the kissing. The only verbs with which get-passives do necessarily denote a result are verbs that are causative in the first place, like cut or kill; they also strongly imply a result with prototypically causative verbs like push or kick. The construction necessarily denotes causative events only when it is used with causative verbs. It follows that the construction itself is not causative, though the verbs that occur in it can be. If the get-passive was used as the basis for adding hypothetical links to the Intransitive Inchoative, only inchoative errors with necessarily or prototypically causative verbs would be expected: it is structural similarities that justify analogical mapping, and only get-passives with those verbs would have a causative lexical semantic structure in common with inchoative sentences like “It broke”. This would leave non-causative transitive verbs with no motivated hypothetical links to the Intransitive Inchoative, with the expectation that their occurrence in inchoative errors can only be coerced by rare, extreme discourse pressure. The consequence would be that inchoative error rates with non-causative transitive verbs would be lower than with necessarily or prototypically causative verbs, exactly the pattern I found in the CHILDES archive.

Conclusion

Three features of children's overgeneralizations with the causative alternation demand an explanation: their bidirectionality, their lexical semantics, and the fact that children recover and become adult speakers. Pinker (1989) explains all three features by appealing to innate grammatical knowledge. Innate linking rules allow children to acquire lexical semantic structure from which they acquire bidirectional broad-range lexical rules. These rules are semantically restricted, but still general enough that they enable errors to be made. Children recover because they abandon the broad-range rules in favor of narrow-range rules acquired through a conservative process of generalization operating on the lexical semantic structures of verbs. The Logical Problem of Language Acquisition (Baker, 1979; Baker & McCarthy, 1980) does not arise, because negative evidence is not needed to recover from errors: children need only stop using the broad-range rule, acquired thanks to innate knowledge. But this account has problems: its innate linking
rules are not universal and fail to account for syntactically ergative languages, and its lexical rules predict that alternating verbs have more lexical semantic structures than they appear to. Furthermore, the notion that knowledge needing to be set aside is attained thanks to innate grammatical rules seems unappealing, and better avoided if possible.

A construction-based approach (Goldberg, 1995; Tomasello, 2003) escapes these problems. The multiplicity of lexical semantic structures is folded into the notion of constructions, which host compatible verbs that flesh out their meanings. The absence of innate linking rules defuses the issue of syntactic ergativity. But the approach also requires some process that makes errors possible in the first place. This process is analogical paradigm completion, through which children try to anticipate the lexical semantic generalizations that will eventually make their construction paradigms redundant. But because of a misalignment between conceptual representations of events and lexical semantic representations of verb meanings in adult speech, children are prone to misacquire non-causative verbs that prototypically denote causative events as causative verbs, and to lump these verbs with causative alternation verbs on the basis of lexical semantic similarity. This motivates both causativization and inchoativization errors. But causativization errors are also motivated by the existence of a Periphrastic Causative form for every intransitive verb, which raise the possibility of an alternative Transitive Causative form for those verbs to parallel the Periphrastic and Transitive Causative forms of the causative alternation verbs. The outcome, as analysis of the CHILDES archive reveals, is that inchoativization errors are more common with causative and prototypically causative verbs than with non-causative verbs, but that causativization errors are no more common with either type.

The theory of children's causative alternation errors I advance above does not dispense with all kinds of innate grammatical knowledge. Though innate linking rules are not required to explain children's errors, I have assumed, following Tomasello (1992, 2003), that children represent their early grammatical knowledge in an item-based manner conducive to ulterior generalizations that create constructions, and perhaps ultimately some level of abstraction beyond them. In order to do this, children need a proper representational language. In some measure, this is provided by an innate conceptual language, but there may need to be more to it than that. I see no way around assuming that the learning mechanism itself is innate, though I venture no guess as to its language-specificity. The pervasiveness of HLAM-generated negative evidence obviates the need for innate grammatical knowledge to explain overgeneralization errors, but it does not address the putative problem of missing positive evidence that is a premise of the Argument from the Poverty of the Stimulus (Chomsky, 1980; Wexler, 1991; Pullum & Scholz, 2002), and the need for innate grammatical knowledge would be its consequence.

This theory makes crucial reference to properties of the English language. As such it makes the prediction that causative alternation errors in other languages may require different explanations, should those languages differ from English in relevant respects.

Lastly, the innate rules approach allowed Pinker, (1989) to present a cohesive and detailed account of the acquisition of not just the causative alternation, but also the dative alternation, the locative alternation, and passive formation. No alternative accounts have
this breadth of coverage and few have comparable depth, but perhaps the ideas I lay out above show the way forward.

This work has been enabled by a doctoral fellowship from the Social Sciences and Humanities Research Council of Canada (#752-2000-0417) and a Mellon Foundation dissertation year fellowship. I owe much to the Stanford linguistics community, especially Eve Clark and Beth Levin. Adele Goldberg, Dan Slobin, and audiences in Bristol and Christchurch also kicked the tires. Any remaining loose nuts are my sole responsibility.

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