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More overregularizations after all: new data and discussion on Marcus, Pinker, Ullman, Hollander, Rosen & Xu*

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ABSTRACT

Marcus, Pinker, Ullman, Hollander, Rosen & Xu (1992) claim that when the irregular past form of a verb is known, it is immediately known to be the correct form, such that overregularizations only occur as speech errors, not as a genuine grammatical alternative; as a result, they argue, overregularization rates are, when carefully inspected, very low. In the present paper: (1) it is shown that even if overregularizations are a genuine grammatical alternative, overall rates in samples would still be low for most children; (2) careful analysis shows evidence for substantial overregularization periods in three longitudinal subjects ages 2;5–5;2 (Abe), 2;3–5;2 (Adam) and 2;3–5;0 (Sarah); (3) Abe's much higher rates follow from general developments in his past tense acquisition, in ways not consonant with Marcus *et al.*'s formulations.

INTRODUCTION

Marcus, Pinker, Ullman, Hollander, Rosen & Xu (1992) have brought forth empirical evidence that contrary to much common belief overregularizations are never frequent in children's speech. The reason for this empirical finding, they argue, is that children observe a heuristic first stated as the *uniqueness principle* in Wexler & Culicover (1980): the child assumes that only one form expresses a grammatical function, unless direct evidence (something actually heard) shows there is more than one form. More particularly, if one form is actually heard, and the other only a deduction from a general rule, the directly experienced form will be assumed correct.

For the irregular past, presumably the child hears only the irregular form

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(from parents). So once the irregular form is learned through direct experience, the unheard regular past form will be immediately eliminated as a possibility. Unless the regular past operation were highly productive for months before irregular past forms began to be learned, overregularizations would thus be generally rare.

Marcus *et al*. call their hypothesis BLOCKING: knowledge of the irregular form blocks application of the past form. Previously other investigators have proposed other accounts of why the irregular past would be automatically preferred. Braine (1971) adopted from linguists the proposal that irregular rules are ordered before regular ones in rule application. Anderson (1976) proposed that lexically specific rules are always preferred over more general rules. Marcus *et al*.'s blocking proposal, however, certainly comprises the best known proposal, and discussion here will focus on it.

The blocking hypothesis opposes a group of COMPETITION HYPOTHESES. In competition proposals (e.g. Kuczaj, 1977; Rumelhart & McClelland, 1985), once regular past tensing is productive, and the irregular form of a particular verb is learned, the two forms are both initially acceptable alternatives. The (typical) choice of the irregular form is made because as the child experiences more input, only the irregular form actually appears. Gradually over time, the child's tendency to produce the regular past decreases, leaving the irregular past form as winner of the implicit competition. This hypothesised period during which the competition is carried out will be called the COMPETITION PERIOD in this paper.

Competition accounts, in Marcus *et al*.'s view, seem to predict relatively high overregularization rates. For presumably during the competition period, overregularizations will be reasonably common. But using a variety of cross-sectional and longitudinal data, Marcus *et al*. find that overall overregularization rates are generally low in children's samples from the preschool years. Marcus *et al*. favour an overall estimate of around 2–5%, though they also find that various data-analysing assumptions might give an overall estimate around 10% at the highest (for example, eliminating certain problematic irregular verbs from scoring; making sure that samples are limited to when it is certain the child has a productive regular past operation). They themselves favour the lower estimates, but suggest that all the available estimates give low rates, which they hold to favour blocking over competition.

They are aware, however, that one empirical phenomenon seems to falsify blocking. Longitudinal studies (Cazden, 1968; Kuczaj, 1977) show that individual children sometimes produce BOTH the irregular and regular past forms of the same irregular verb. They may produce both forms of the same irregular verb in the very same speech sample. This alternation among both forms may last for weeks to months in a child's samples. Blocking claims that once the irregular past is learned, the overregular form will be banished. So these findings seem to falsify blocking.

To respond to this difficulty, Marcus *et al*. add a memory-retrieval performance adjunct to blocking. When a child has just learned an irregular past form, they argue, the child's retrieval of the form may occasionally fail. This retrieval failure provides an opportunity for the regular past form to intrude itself as a default. Thus overregularizations may occur after learning of the irregular form. But Marcus *et al*. postulate that such memory retrieval errors are rare, and thus overregularizations will be rare. Furthermore, the child need not learn anything further from input for overregularizations to go away. Simple practice in retrieving the irregular form will eliminate retrieval errors, and thus eliminate overregularizations. Their hypothesis might thus more completely be called BLOCKING + RETRIEVAL ERROR.

The theoretical differences between blocking and competition accounts have intrinsic interest. But Marcus *et al*. also enlist the differences as part of a wider well-known theoretical dispute. Competition processes are amenable to representation by BOTH connectionist network models and symbol-based rule models. In contrast, Marcus *et al*. argue, ONLY rule-symbol representations can represent the clear, immediate, innate blocking mechanisms. So empirical support for blocking, they argue, also provides strong support for symbol-rule accounts of past tensing over non-symbol-rule accounts, such as connectionist models (e.g. Rumelhart & McClelland, 1985).

As will be seen shortly, in this discussion, arguments will be brought forth to: (1) weaken Marcus *et al*.'s case for blocking; (2) strengthen the case for competition. Marcus *et al*. have stated, in effect, that if blocking wins, rule-symbol representations win. Does this conversely mean that if competition wins, symbol-rule accounts lose? This counter-conclusion is unwarranted. Competition accounts are currently pointedly associated with parallel distributed models, which seek to eschew the use of ontologically abstract high-level symbols like Verb (e.g. Rumelhart & McClelland, 1985). But in fact, more traditional symbol-rule accounts can also implement competition accounts. So the probable theoretical situation is that support for blocking does comprise strong support for rule-symbol models. But, support for competition – at the broad level relevant in this discussion – favours NEITHER symbol-rule or distributed network accounts. It is important to keep in mind that the purpose of this paper is not to argue FOR distributed network accounts, even if its conclusions may weaken some support claimed for symbol-rule accounts.

Marcus *et al*. have made a genuine empirical contribution to the acquisition literature in showing that overall overregularization rates in the preschool years are indeed generally low, and for furthering a quantitative approach to what has often been an anecdote-dominated discussion (though see Slobin, 1971; Bybee & Slobin, 1982; or Marchman & Bates, 1991). In this paper, however, Marcus *et al*.'s conclusions will be disputed. First, it will be shown that under a range of reasonable initial assumptions, competition accounts

would also show low overall overregularization rates over extended samples (Marcus *et al*. also note this, but the discussion here will be more concrete and detailed, to aid later analysis).

Secondly, Marcus *et al*. themselves show that in the end, longitudinal records are central. It will be shown in this paper that when sampling considerations are carefully analysed, one primary longitudinal subject, Abe, provides data which contradict any plausible form of blocking. More surprisingly, internal analysis of the data will imply that even much lower-overall-rate overregularizers such as Adam and Sarah nevertheless very likely did have substantial overregularization rates during learning periods after they had acquired the irregular past form during which overregularizations were common. Thus, it will be argued, data from the richest three longitudinal samples on general record currently support competition accounts over blocking + retrieval error accounts.

Finally, discussion in the last section will look more closely at the question of why Abe overregularized so much more robustly than the other two subjects. These investigations will show that his higher rates were part of systematic, competence-based overall differences in his general morphological learning. They are not anomalous, or deficit-based. The nature of the differences will point to competition rather than retrieval error sources for his much higher rates, thus strengthening his special value as a clear counter-blocking subject.

Competition accounts and low overall rates

Marcus *et al*.'s blocking + retrieval error account predicts low overall overregularization rates. In contrast, they generally hold, competition accounts predict relatively high rates, either in overall overregularization for individual verbs, or detectable periods of high overregularization.

But in fact, current sampling problems may obscure or even conceal high overregularization periods, even in competition models. In these models, it will be recalled, overregularizations occur largely during a competition period, during which the input data are analysed and show a strong input bias towards the irregular. What will be shown here is that under reasonable ranges of assumptions about inputs, the competition period may be so comparatively brief, and our sample of it so sparse, that very little trace of it will show up in extended samples, except possibly for relatively low-frequency irregular verbs.

To make this argument at all, it is necessary to make some hypothetical stipulations and estimates. First, how many inputs would actually be required for a child's tabulation system to decide in favour of the irregular past form over the unheard regular past form? In reality, we have no good prior idea, and the actual figure (see later discussion) probably differs from

child to child. But just to have some basis for discussion, a score of 50 to nothing in favour of the irregular past seems like a pretty good inductive indication of an underlying one to nothing ratio, for a statistical inducer. So let us stipulate that the competition period must include 50 inputs after the learning of the irregular past form, during which (presumably) no regular past forms are heard.

As an adjunct to judging overall rate questions, some assumption is also needed about the overregularization rate during this 50-input period. Again for the sake of simplicity, it will be assumed that the child begins with no initial preference among the two competing forms, giving an initial overregularization rate of 50%. Then as irregular input accumulates during the competition period, there is a simple linear decline in overregularization rate, until the base rate reaches 0% at the end of the competition period. This process gives an overregularization rate of 25% during the competition period, followed by a rate of, effectively, near 0% afterwards.

Now the second question arises: what proportion of a total sampled time period would be taken up by the 25% rate competition period? This will vary from verb to verb. High-input verbs will reach the 50-input point faster in time than low-input verbs. So the competition period for high-input verbs would be shorter, and overall rates accordingly lower.

But how quickly could the input accumulate over time? Publicly available tabulations typically tell how often children produce various irregular past forms, not how often they hear them. Also, of course, all current data only give numbers for highly limited sampling periods of children's output.

Again, to be able to have a discussion at all, a simple heuristic guess will be made: adult input roughly matches children's output. That is, they are talking about the same kinds of events in roughly the same frequency, and children's production of irregular past forms roughly matches the number of input irregular past references that they process from adults. Then adult input can be estimated from children's tabulated output.

This heuristic can of course go wrong in various specific ways. For example, the sampled households may be child-centred in conversation, so that the children actually talk more than the adults, and adult input relatively lower. On the other hand, especially early on in development, children's productions may be restrained by various production problems, so that they actually process (comprehend) more adult irregular pasts than they produce. Indeed, there is very plausibly an initial comprehension-before-production period during which adult input goes on with no accompanying children's output. Misestimates in both directions are thus possible, and possibly work differently at different developmental periods.

Still, as a broad initial guess, the adult input = children's output has much to recommend it, even aside from simplicity. Children and adults are talking about similar events; very likely as the child's ability to refer to the past

increases, both linguistically and cognitively, adult usage probably increases in parallel. And as it will be seen, the general statistical conclusions drawn from extant data are robust over a wide range of probable assumptions.

In fact, using these (or comparable) inferential assumptions, it turns out that Competition Periods for frequent irregular past forms are likely to be very brief, as a proportion to the overall time period of speech samples. To illustrate this conclusion, let us look at a high-frequency verb for Adam. Such a verb was *see*. He produced his first sampled use of *saw* at the age 2;4. His samples show 104 past forms of *see* (all *saw*) from 2;4 through 5;2.

If his samples show 104 past forms of *see*, what was his actual total output likely to be over the whole period? Adam's 53 samples during this age period (Marcus *et al*., 1992) were typically 2 h long (Brown, 1973). A few samples were longer, however, because of the presence of interesting phenomena in his speech at the time (Brown, 1973). So the total sample might be estimated at 120 h overall, from 2;4 through 5;2. This means that during the three-year time period, he was sampled for an average of about 45 min a week.

But of course his total actual output comprised far more than 45 min a week. How much more? No one knows, but suppose Adam had an actual 'talk week' of 40 h a week (current labour standards). No middle-class parent known to the writer has objected to this estimate. Then his forty-five minutes a week would comprize about 1·8% of his actual total output, or about one-fiftieth of his total speech output. Then we would have to multiply his sampled output by about 50 times to estimate his actual output of past *see* for this period. By this logic, his actual output of past forms of *see* might have been 5200 outputs from 2;4 through 5;2. This gives an actual estimated output rate of 33 outputs a week. By our approximation above, this in turn implies an *input* rate of 33 inputs of *saw* per week. At this input rate, the period required to reach 50 inputs of *saw* would be just 1·5 wk.

Now in fact, if Adam had started to COMPREHEND inputs of *saw* a few weeks before he produced any forms of *saw* himself, then the competition period would have been over before he even started to produce *saw*, giving a zero rate of overregularization during the recording period. But let us assume, perhaps wrongly, that as soon as he had analysed *saw* in the input, he immediately started producing it, so that the effective input period is equivalent to the period of recorded output. Then Adam would have had a 25% overregularization rate during the competition period of 1·5 wk, out of a total sampled time period from 2;4 through 5;2, or roughly 99 wk total period. Then overregularization rates would be 25% for 1·5 wk, followed by about 95 weeks at an effective rate of 0% during the post-competition period. This would give an overall rate for the two-year sample period of – rounding off – zero percent.

See had one of the highest sample frequencies in Adam's data. But even for much more moderately frequent verbs, overall rates are prospectively quite

low. Marcus *et al*. argue (see later discussion) that only individual irregular verbs which are sampled 10 times or more in a total sample should even be taken seriously. So what might the situation have been for a verb SAMPLED 10 times over three years? The same kinds of projections as above indicate that for such a verb, Adam produced and thus perhaps heard 3·3 past forms a week. Under this assumption, the initial 50-input period would last about 16 wk. Suppose the total sample period that included initial processed inputs was again 95 wk. A period of 16 wk at 25% followed by a period of 79 wk at 0% gives an overall period rate of about 4% overregularizations. Thus overregularization rates for verbs sampled 10 times or more over two years would range from about zero to four percent.

Thus, under BOTH blocking + retrieval error and competition models, moderate-frequency verbs are likely to have rather low overall rates, and high-frequency verbs are likely to have very low rates (because input and practice both accumulate especially quickly for them). Furthermore, in the typical methods used to estimate overall estimates overregularization rates, the high-frequency verbs, which are particularly likely to have such low overall rates, have enormous statistical influence. In most computations of overall overregularization rates, (e.g. Kuczaj, 1977; Marcus *et al*., 1992), investigators pool together all the overregularization tokens from all of the irregular verbs, and divide by all of the irregular past tokens (correct irregular past forms + overregularizations) from all the verbs. The statistical result of this mass-token pooling process is that highly frequent verbs – the verbs with the lowest rates – will statistically dominate the overall rate. A verb sampled 104 times, for example, will contribute more responses than 10 verbs sampled 10 times each, and so have statistical weight equal to 10 such verbs in the overall rate. To make the matter more concrete, we can consider the following facts, from Abe's figures: Abe's most frequent past irregular verb was *say*, sampled 285 times, with a very low rate of 1% overall. In contrast, 40 of his 65 verb types were sampled fewer than 10 times each. These verbs had a very high overregularization rate, 58% (!). But their average sample was 3·9 responses, giving an overall token total of 155 responses. So in the computation of Abe's overall rates, the responses from one verb *say*, sampled 285 times, would by itself have almost twice as much statistical weight than ALL the data from the 40 different verb types sampled fewer than 10 times. So overall rate computations are highly dominated by small numbers of highly frequent verbs. Massed-token methods thus given enormous weight to those high-frequency verbs which both accounts predict will have very low rates.

Different assumptions could be tried out here: fewer number of inputs required in Competition Periods, or more; lower or higher 'talk weeks': and so on. But under wider ranges of assumptions, the basic logic will work the same way: overall sample rates for individual verbs, computed over whole

samples, are likely to be low under all accounts for most children, except perhaps for very infrequent verbs.

In the next section, these potential sampling considerations will be further applied to a consideration of Abe, Adam and Sarah's longitudinal records. These inferential analyses, reinforced by contributing internal analyses for each child, will indicate the existence of periods of substantial over-regularization that extend for tens or even hundreds of both adult inputs and child outputs for all three children. These analyses will thus indicate a lower plausibility for Marcus *et al*.'s version of blocking + response error, and a higher plausibility for Competition accounts in general.

Scoring decisions

First, however, it is necessary to say something about data scoring: in particular, the matter of which irregular verbs should be entered into the analysis. All investigators agree that scoring should include irregular main verbs for which the present and past stem have different forms. These include verbs such as *run* (past *ran*) or *eat* (past *ate*). For the other potentially scorable verbs, however, there is a surprising degree of disagreement; scoring here will largely agree with Kuczaj (1977). Other irregular verbs are excluded, for the reasons below:

(1) No-stem-change irregular verbs. Some irregular verbs have the same past and present stems, e.g. *hurt* or *put*. The problem with these verbs seems obvious. Suppose a child says, in a past context, 'I put it'. In such cases, no doubt the child often DID mean to express the past form of '*put*', and did so properly. But in many other cases, the child may have had no such intention, and was simply using the uninflected present stem of 'put.'

How could one tell? Marcus *et al*. simply scored ALL such no-change forms used in past context as correct past forms. This is inappropriate, especially given that children have initial sample periods during which even clear stem-change irregular verbs are not reliably inflected for past meaning. If obvious stem-change verbs are often not appropriately inflected, why should no-change verbs like *cut* assumed to be intended as grammatically past? No-change verbs are accordingly omitted from the present discussion.

(2) Forms of copula *be*. Marcus *et al*. score all past uses of copula *be*, such as *was*, *were*, as correct irregular past forms. But if *be* is a main verb at all, it is a remarkably odd one. For example, it can take negation like auxiliary verbs, in uses like *isn't* and *wasn't*, which main verbs cannot (one cannot say *eatn't*). It moves to the front of sentences in questions, as in 'was he happy?', which main verbs cannot. Linguists such as Chomsky (1965), Fillmore (1968), and Lyons (1968) have classified *be* either as its own special verb category, or a type of auxiliary verb. Children may well make similar internal decisions, in which case *be*-forms would not usually comprise candidates for

regular past tensing. As in Kuczaj (1977), data from *be* were not included for scoring here.

(3) *Do* and *have*. *Do* and *have* do sometimes function as main verbs, as in 'he did it'. But they also function as auxiliary verbs, as in 'did he go?' or 'has he eaten it?'. Kuczaj (1977) omits these two verbs from scoring because of this mixed character, which might again affect the child's analysis and use.

While this decision is more problematic than the decisions about no-change verbs and '*be*', Kuczaj's more conservative scoring practice is again followed here.

(4) Classification of *got* as a no-change verb. Kuczaj (1977) and Marcus *et al*. both score *get-got* as a stem-change irregular verb. But in colloquial usage, many uses of *got* are present tense: in everyday speech, 'I got it' often means the same as 'I have it'. It is often very difficult to tell whether 'GOT' is even intended as past or present in context.

In scoring Kuczaj's monthly transcripts for other analytic purposes, the present writer had frequent disagreements with Kuczaj's own guesses about the child's present or past intention. Disagreement ranged as high as 40% in one month, and high in many others. No other verb showed difficulties of this kind. The *get–got* alternation is therefore treated as a no-change verb, and omitted from analysis here.

These scoring decisions affect nothing central in the analyses to be reported here for Abe, Adam and Sarah. But Eve's sample period was by far the shortest of all these subjects (about a year, compared to three years), and included by far the smallest number of irregular verb past forms. When the exclusion criteria above are used, her corpus dropped from an already low 309 past forms to 157 such forms, and the decision was therefore taken to exclude it.

Thus, the remaining discussion focuses on data from Abe, Adam, and Sarah, the subjects with the richest irregular past samples. Only their clear stem-changing irregular main verbs are scored.

ANALYSES OF ABE, ADAM AND SARAH

Abe : a frequent and resilient overregularization

Abe, as discussed above, was an especially robust overregularizer. He was studied by S. Kuczaj, his father. He was recorded at home when he seemed more talkative, and when his father was at home. These recordings comprised 105 h in the period from 2;5 to 5;2, an average of about 45 min a week. The sample includes a total of 1942 past tokens from 65 different irregular verb types. Of the 1942 past tokens, 465 comprised overregularizations, for an overall sample rate of 24%. This is an extremely high rate for a two-and-a-half year sampling period, given the sampling considerations discussed

earlier. Indeed, if each verb is assigned its own rate, the median verb rate was much higher, 58%. A few high-frequency verbs are responsible for the massed-token rate having been 34% lower.

As was discussed earlier, even if different mechanisms are involved, both blocking and competition accounts predict that higher-frequency verbs should have lower overregularization rates, and lower-frequency verbs should have higher rates. In order to see Abe's verb-rates at different sample frequencies, his verbs were grouped into the following sample-frequency categories: verbs sampled 1–9 times, verbs sampled 10–49 times, verbs sampled 50–99 times, and verbs sampled 100 times or more. The lowest verb frequency category, 1–9 sampled uses, was chosen because Marcus *et al.* strongly divide verbs used fewer than 10 times from those used 10 times or more. The remaining frequency divisions were chosen somewhat arbitrarily to give an overall indication of the relation of rate to sample frequency. Within each frequency category, the individual-verb rates were averaged to give the category average overregularization rate, and these averages are printed in Table 1.

TABLE 1. *Overregularization rates for verbs of different sample frequencies*

	Sample = 1–9		Sample = 10–49		Sample = 50–99		Sample = 100+	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Abe	40	58%	14	45%	5	25%	6	18%
Adam	22	54%	12	1%	10	0%	7	1%
Sarah	33	29%	14	11%	5	5%	1	0%

Number = number of different irregular verb types in the relevant sample frequency class.

Of Abe's 65 verb types, 40 verbs (that is, most of them) were sampled one to nine times. The average rate for this group is a very high 58%. Again, these samples must represent verbs actually used far more often than one to nine times during the actual three-year period. As will be recalled, Abe's samples averaged about 45 min a week, out of perhaps 40 h of talking, about two per cent of the total output. Since Abe's father sampled Abe somewhat selectively, when Abe was more talkative (and his father was at home), perhaps these data represent a higher proportion of the output, somewhere around 4–5%. (Abe is reported to have been generally talkative (Kuczaj, personal communication)). Even this modified estimate means that when verbs were sampled one to nine times, they probably were actually used around 1–180 times during the total sample period; to the degree parental input was similar to Abe's output, they were also heard about that often. (Simple multiplication of the sample output by 20 times would give an estimated range of 20–180; but at the lower end, it is possible Abe used a verb

form just once, and that form happened to be caught in the sample. So in general, for estimating actual outputs from samples, 1 always comprises the lower end).

Thus these data imply that verbs which Abe used and heard about 1–180 times were overregularized about 58% of the time. This indicates long-lasting periods of high overregularization. In fact, even the 14 verbs sampled 10–49 times, corresponding to actual outputs and inputs of perhaps 200–980 responses, still had an average overregularization rate of 45%. This figure even more strongly implies that overregularization declined very slowly indeed, even as both output and input were reaching high cumulative totals. Only the 11 verbs sampled 50 times or more (each used perhaps 1000 times or more) had a substantially lower average rate of 23%. This rate is very high indeed for a possible two-to-three-year sampling period.

Both blocking and competition accounts may be consonant with rates dropping with higher use. But Marcus *et al.*'s blocking + retrieval error rate implies very low overregularization rates. Such high, resilient rates over periods probably lasting hundreds to thousands of total responses is obviously contrary to Marcus *et al.*'s low-rate account.

But these data by themselves are still inconclusive. Blocking only predicts rates will be low AFTER the irregular past tense has already been learned. As will be shown in later discussion, Abe achieved productive regular past tensing, compared to irregular past tensing, relatively earlier than Adam and Sarah. Perhaps this means that for a good many verbs, he had a productive regular past operation for months before he finally learned the irregular past form. Then overall verb rates might commonly be high, even if his rate dropped sharply as soon as the irregular past form was learned. It is necessary to see what verb rates look like AFTER he first used the irregular past form (which will be taken to indicate learning of the form).

For verbs sampled one to nine times, the average overregularization after the first appearance of the correct irregular past form was 45%. This is lower than 58%, but still very high. In fact, when one looks at the month-by-month records of these lower-frequency verbs, none looks for certain as though it has reached stable zero-rates by the end of the samples. Verbs sampled between 10 and 20 times also frequently showed high overregularization rates after the first sampled correct irregular past form. For example, *felt* comprised the first use of *fell* in the past. But of the remaining 15 past forms of *fell*, 11 were overregularizations. These verbs used 10–20 times also generally failed to show convincing convergence on zero-rates by the end of the sample.

But even for verbs sampled 10–20 times, the sample period spreads over many months, giving a relatively sparse a verb-over-time sample for each verb, probably too sparse to allow firm conclusions about the final state of the developmental trajectory.

The individual verb-over-time records are much richer for the 15 irregular verbs sampled more than 20 times. The richer data allow firmer general conclusions about each verb. When inspected, these developmental patterns fall into three major categories: there are eight verbs that decline convincingly to zero rates but only after about 30–40 sampled responses; three verbs that never show any convincing decline during the sample period; three verbs that never show any substantial overregularization at all. A last verb, *fall*, has its own unique pattern. A brief description of the relevant patterns is given in Marcus *et al*. A more detailed survey appears here (accompanied by different overall conclusions than those in Marcus *et al*.).

Most common were the eight verbs that did eventually decline to zero-rates, but only after a drawn-out learning period; figures 1–3 show the rates-

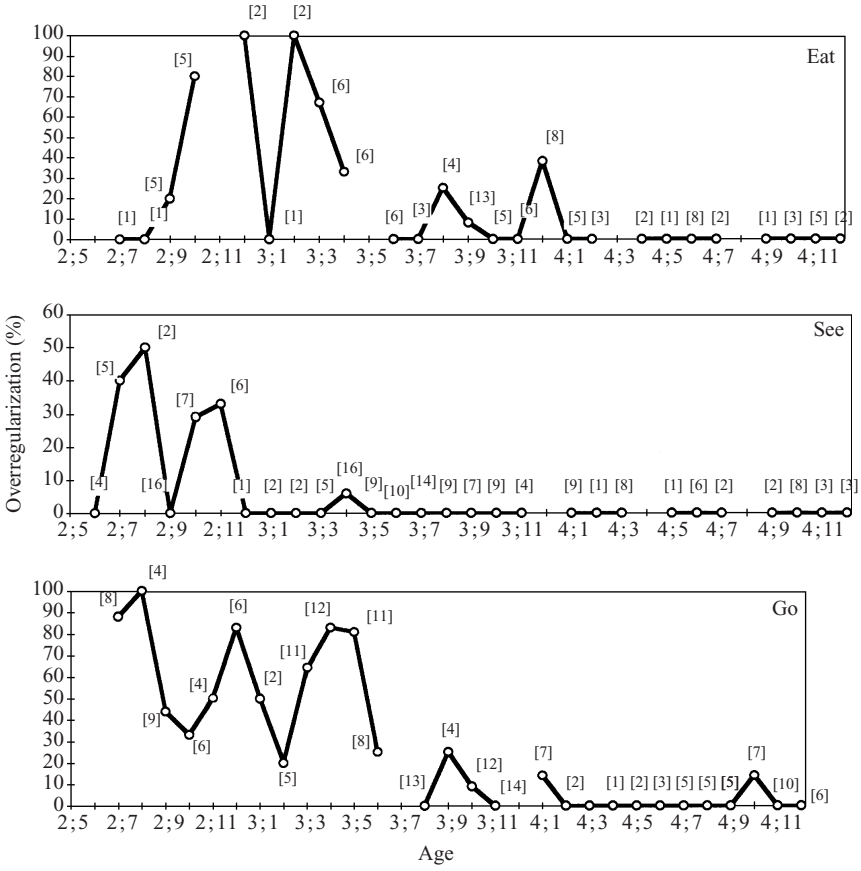

Fig. 1. [ ] = number of irregular past forms in sample, overregulars and irregulars.

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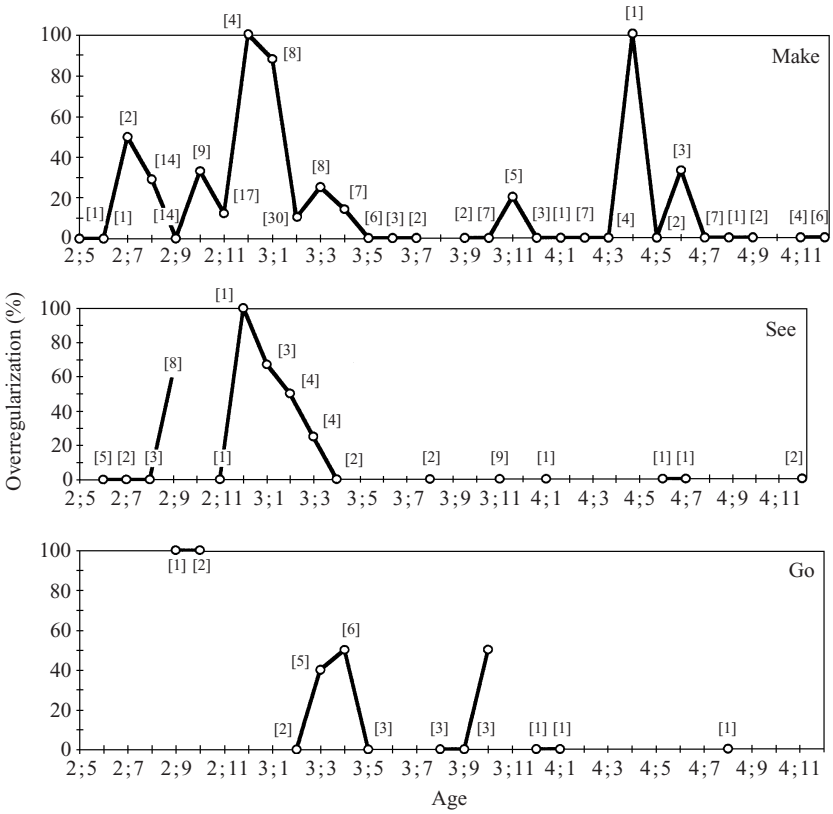

Fig. 2. [ ] = number of irregular past forms in sample, overregulars and irregulars.

over-time for seven of these eight verbs (*eat*, *see*, *go*, *make*, *break*, *take*, *think*; *catch* not shown).

The verb *eat* provides a good illustration of developments in such verbs (Figure 1). A correct past irregular form *ate* was recorded in Abe's first monthly sample (age 2;5). The decline of overregularization took a period of some months, during which 35 sampled responses were caught. Applying the usual sampling correction logic, this implies that the decline to zero rates took some 700 or so speech outputs and inputs AFTER the learning of the correct irregular past. Marcus *et al.*'s version of blocking + retrieval error predicts a sudden and sharp decline to near-zero rates after the learning of the irregular past form. Obviously this did not occur for *eat–ate*.

The other seven verbs of this slow-decline group show a similar pattern: substantial and frequent overregularization during a post-irregulated period which lasts for weeks to months. In all these cases, the high-rate post-

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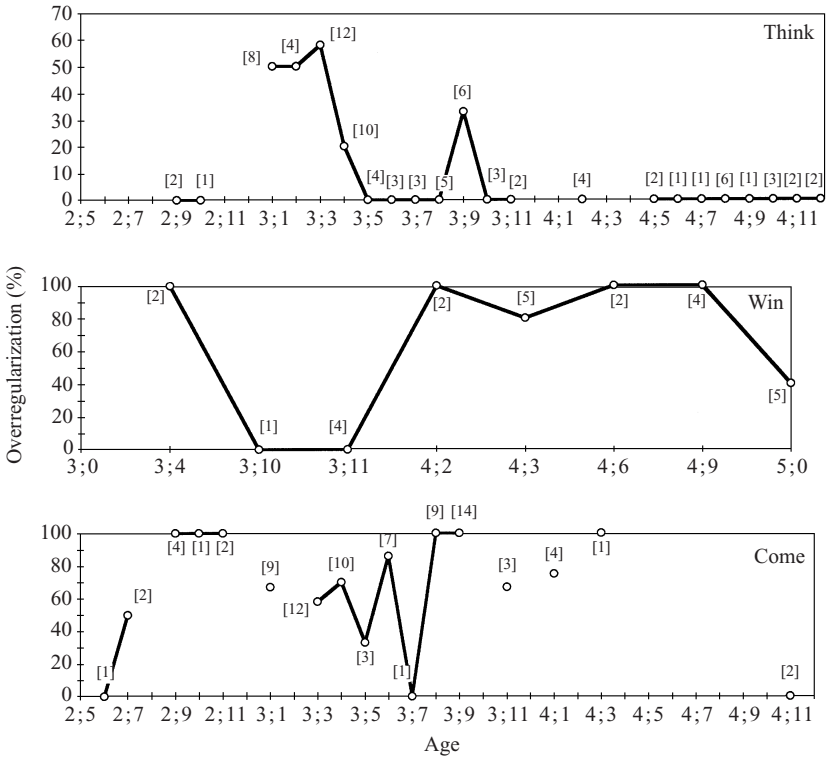

Fig. 3. [ ] = number of irregular past forms in sample, overregulars and irregulars.

irregular learning period can be projected to have lasted for hundreds of child outputs and parental inputs. ('Learning period' will be used here to refer to the post-irregular past period during which either competition or retrieval practice processes might be taking place. It is meant to be theoretically neutral, unlike 'competition period' (competition account) or 'practice period' (blocking + retrieval error account).

In these graphs, one high-frequency verb, *see* (Figure 1) nicely illustrates how a high-rate initial learning period can be statistically swamped in an extended sample by a long post-learning period. As can be seen from the graph, *see* was substantially overregularized in its first five months of post-irregular use, a learning period corresponding to about 40 sampled responses (and thus perhaps 800 actual responses). But *see* was so frequent in output and input that this initial learning period took very little time to complete. So most of the sample was spent in the low-rate post-learning period. As a result, the overall sample rate for *see* was just 4%, even though the learning period for *see* lasted, probably, for some hundreds of responses.

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A second, smaller class of irregular verbs (*win* ($n = 29$), *hear* ($n = 34$) and *come* ($n = 76$) *never* showed any clear rate decline during the sampling period (*win* and *come* are pictured in Figure 3). The most striking of these verbs was *come*: it was sampled 76 times, which corresponds to perhaps 1500 actual outputs. It can be assumed these three verbs eventually emerged from their post-irregular past learning periods, but there is no way of telling how long this took. A third major category consists of three very frequent verbs, two of them very high-frequency. These three verbs – *forget* ($n-67$, rate – 0·00), *find* ($n = 146$, rate = 0·02), and *say* ($n = 285$, rate = 0·01) never showed anything but occasional random sporadic overregularization. None of their developmental curves are pictured here, because there is nothing to see, except a virtually zero-rate flat line over the months.

Finally, just one frequent verb, *fall*, ($n = 129$, overall rate = 44%; not pictured here) actually had the developmental look of a blocking-appropriate history. Its record begins with 20 overregularizations in a row in the early months of Abe's samples, during which there are NO correct irregular forms. Either the overregular form *falled* was simply highly preferable on other grounds (see later discussion of Stemberger's work), or the irregular past form really was not known yet. Then after the first correct irregular past form appeared in the samples, only a few more overregularizations randomly appeared among tens of correct irregular uses in the succeeding months. That is, overregularization was 100% before the first correct use of an irregular verb form, and then very quickly dropped to near-zero rates. *Fall* alone, out of 65 verbs, clearly showed the kind of post-irregular learning sharp decline pattern predicted by Marcus *et al.*

Obviously, overall, Abe's overregularization rates commonly stayed high for periods of many hundreds of responses after the irregular past form had been learned. His records, more complete than any other subject's (Marcus *et al.*, 1992), are also more contrary to blocking than any other subject's. Marcus *et al.* briefer summary of the empirical patterns in Abe's verb-over-time results largely agrees with the summary above. But Marcus *et al.* do not accordingly conclude that Abe's data are obviously contrary to any reasonable form of blocking. Instead, they claim that Abe's verb-over-time are so 'chaotic' that nothing can be judged from them.

Why would these records be said to be so discountably 'chaotic'? Marcus *et al.* point out that sometimes individual verbs of the same total sample frequency have different overregularization rates. For example, as pointed out above, the overregularization rate for *come*, recorded 76 times, never approached zero; the rate for *forget*, recorded a comparable 67 times, was always 0%. That is, frequency, the major systematic variable emphasized in both blocking and competition models, does not always PERFECTLY predict Abe's overall overregularization rate for individual verbs.

Further consideration of the data, however, argue strongly against this

conclusion. First, in general (see Table 1) Abe's verb rates show the overall systematic effects of frequency quite well: lower-frequency verbs have higher rates, and higher-frequency verbs have lower rates, just as any extant model of overregularization processes would currently predict. This is not 'chaotic.'

It is true that frequency *per se* does not account for ALL the variation in Abe's rates, though it accounts for a good deal. This only means that verb frequency is one variable that substantially affects the course of over-regularization, but is not the only such variable. Having more than one variable affect a development does not make it 'chaotic'.

What other variables might affect overregularizability? Bybee & Slobin (1982) long ago showed that in their subject sample, phonological variables such as whether the verb stem ends in a dental consonant or a vowel, also affect rates. More particular to Abe, Stemberger (1993) isolated another such phonological variable, the relative frequency of the vowel of the irregular stem and the overregular stem.

In any language or dialect, some vowels are generally more frequently used than others. Looking at Abe's frequently used irregular verbs during his months of highest overall overregularization, Stemberger found the following pattern: if the irregular verb form had the more frequent vowel, Abe tended to favour the irregular form. If, conversely, the regular form had the more frequent vowel, Abe tended more to the overregular verb form. For example, in the pair *came-comed*, the vowel for *comed* was generally more frequent in Abe's speech; *comed* was very persistently chosen. In the pair *found-finded*, the vowel of *found* was generally more frequent, and accordingly, *finded* was relatively rare in occurrence. This phonological variable accounts for a good deal of the variability in verb rates that verb frequency does not account for. This gives two variables which systematically give shape to these purported 'chaotic' data.

These two variables do leave unexplained the complete non-over-regularization of *forget*. *Forget*, however is generally remarkable in its resistance to overregularization across all children. If one looks at all the children in records in Marcus *et al.*, Slobin (1971), or Kuczaj (1977), it seems that NO child has yet been recorded as having overregularized *forget*. This is especially noteable because the irregular verb *get*, which is phonologically like the end of *forget*, does get overregularized (see Marcus *et al.*; *get* was not scored in this discussion because *got* is often a no-change verb). For what it is worth, the writer's guess is that the overregularizations of *forget* would have three syllables (*forgetted*, *forgotted*), unlike any other main verb in these samples. Very possibly this makes *forgetted* (or *forgotted*) an especially clumsy verb-form to pronounce, so that even if acceptable grammatically, it is always passed up for phonological reasons. In any case, Abe's disinclination to overregularize forget is not peculiar to him. Thus, all in all Abe's overall data are not 'chaotic.' They are quite systematic.

Marcus *et al*. also claim that unusual pragmatic circumstances during Abe's speech recordings may have produced higher rates. But these claims are rebutted by further analyses in Maratsos (1993), a rebuttal analysis accepted implicitly by Pinker (1993).

So at this point, Abe's data, which comprise the richest individual irregular past data-set on record (Marcus *et al*., 1992), strongly *disconfirm* any empirically reasonable form of quick-decline blocking. The only pro-blocking explanation of his very high rates might be to posit some particular difficulty or anomaly in Abe's retrieval of words in general, or of inflected forms. Marcus *et al*. themselves do not attempt this, and later discussion (a section on individual differences) will show how utterly unlikely this hypothesis is.

Adam : considerable overregularization masked by overall rates

We now turn to Adam, an initially very promising subject for blocking accounts. Adam's data comprise about 120 h collected from 2;3 through 5;2, or again an average of about 45 min a week. Under the scoring procedures adopted here, Adam's samples include 1471 irregular and overregular past tokens from 45 irregular main verbs. This gives an overall overregularization rate of 3·6%, very modest compared with Abe's rate of 24%. But of course, as discussed above, such overall rates are very likely even in competition accounts, for large samples. Only less frequently used verbs might be expected to have higher rates.

Table 1 shows that in fact, Adam's 22 verbs in the 1–9 sample frequency range were overregularized at surprisingly substantial rates, an average verb-rate of 54% (!). Our usual sampling arguments indicate this high rate be taken, potentially, quite seriously. For again, we are looking only at the sampling tip of an output iceberg. Adam, like Abe, was recorded about 45 min a week. He was recorded at preset times, so there is no known bias towards more-talkative samples, though possibly the visitor atmosphere might have encouraged him to talk. By all indications, however, he was a generally a very talkative child.

If his recorded output does constitute 45/min a week out of a true 'talk week' of 40 h a week, it comprises about 1·5% of the total output. That would imply that this 54% rate applies to verbs which were actually produced around 1–400 times during the total sample period. In fact, Adam's effective sample for the one to nine frequency category is just one to six, because no irregular past verbs were sampled seven, eight or nine times. So this implies a lower range of outputs, 1–400 outputs. Still, if 54% really does represent the overregularization rate for verbs used (and, by further inference, heard) this often, it indicates that Adam's overregularizations persisted at high rates for a considerable time, even if he overregularized much less robustly than a subject like Abe.

Marcus *et al.*, however, raise three objections to trusting data from such verb samples in the 1–9 range, each of which will be answered here:

(1) Higher-frequency verbs are the ones for which blocking says children have had substantial enough retrieval practice to make memory errors negligible. Thus, these are the ones for which blocking most clearly predicts low errors, and by which it should be tested.

But our sampling considerations show that for higher-frequency verbs, competition models also plausibly predict very low rates, except for markedly robust overregularizers such as Abe. Verbs sampled 10 times or more plausibly correspond to past irregular forms that Adam used an average of 650 or more times. So either account plausibly predicts low rates for verbs used 10 times or more.

(2) Marcus *et al.*'s argue that for verbs of sample frequency less than 10, the individual verb-score is based on very few data-points, and so each verb-score is not very reliable. But a basic principle of statistics is that a GROUP of individual scores has more reliability than the individual scores. Adam's average of 54% for verbs sampled one to six times is based on 22 such individual verb scores. This gives an average rate more believable than each individual verb-rate that went into it.

(3) Marcus *et al.*'s third objection recapitulates the legitimate concern already met in dealing with Abe's verb-rates: especially with low-frequency verbs, a good part of the sample may come from the period in which the irregular past tense was not even known yet. During this period, over-regularization rates could be 1·00, and raise the overall verb rate, even if after the irregular past was known, rates immediately dropped to near-zero. As with Abe's data, further empirical analysis is required to judge the matter.

First, an obvious corollary of the argument is that within the frequency-range of interest, the lowest frequency verbs should be most susceptible to the effect. They have the lowest inputs of all. So one might expect their overregularization rate would be much higher than the more frequent verbs of the sample.

But in fact, the 54% rate was quite constant throughout the frequency range. There were 11 verbs sampled just once. Of these, five were over-regularized, giving a rate of 44%, obviously no higher than the 54% overall rate. Verbs sampled twice had an average rate of 50%; verbs sampled three times, 50%; verbs sampled four times, 80%; verbs sampled five times, 50%; six times, 67%. (There were no verbs sampled seven, eight or nine times). The 54% average seems to be remarkably stable throughout all these frequency-ranges.

For verbs that were sampled more than once, one can check the over-regularization rate of the verb in the months AFTER the first irregular past form first appeared. In Adam's data, eight of these 11 multi-response verbs had an irregular past form for their INITIAL response. For these eight verbs,

the rate for the succeeding uses was 65%. For the three verbs which had an overregular past as their first response, the rate after first use of the irregular form was 67%. It seems that rates remained high even after the irregular past was known. In fact, in all likelihood, the irregular past was already known for all of them. (Later discussions will bear out that for Adam, irregular past learning generally preceded regular past learning). It was probably a matter of chance whether the initial recorded verb response happened to be an irregular or overregular past form for all these verbs.

These arguments support the conclusion that Adam, though a less robust overregularizer than Abe, did overregularize at high rates for a considerable learning period. When sampling considerations are taken into account, given the numbers above, one can plausibly conclude that he overregularized at rates of around 50% for 1–400 responses even after the irregular past form was known. Only low-frequency verbs could show this effect. But the internal analyses of the data strongly support the conclusion that the high rate is real, not an artifact of other sampling problems. Such data again oppose Marcus *et al.*'s low-rate version of blocking + retrieval error.

Sarah's data

Sarah (Brown, 1973) was recorded in the age range 2;3 through 5;1. During this time there were 134 samples of a half-hour each. So her sample time per week was a little less than a half-hour (about twenty-seven minutes a week). Thus her samples captured perhaps about 1·1% of her total output during this period. This sample produced a total of 801 irregular and overregular past forms of 56 verb types. Her overall overregularization rate was 7·9%, neither as high as Abe's nor as low as Adam's.

Again, lower-frequency verbs were captured at higher overregularization rates overall. For verbs captured one to nine times – corresponding perhaps to verbs used 1–800 times – the average verb was 29%. This is very substantial even if not as high as Abe and Adam's rates for low sample frequency verbs. Sarah's rates furthermore dropped off less precipitously than Adam's for verbs in the 10–49 sample frequency range (11% compared to Adam's 1%).

Because of her smaller samples, the frequency range of one to nine, corrected for sampling problems, plausibly corresponds to verbs actually used about 1–900 times during the sampling period. So a preliminary estimate is that she overregularized verbs produced (and heard) 1–900 times at a rate of 29%. This is substantial.

Again, it is necessary to worry about the possibility that low-rate verbs had long initial periods during which the irregular past was not known. The first check, as before, is to see whether rates were markedly higher in the less frequent verbs in the frequency range. Fifteen verbs were sampled just once.

Four of these were overregularized, giving a rate of 28%, compared to with the overall sample rate of 29%. The eight verbs sampled five to nine times show an overall rate of 24%, a rate quite comparable to the overall 29%.

Again, we look at the verb responses which occurred after an initial irregular past use. Eighteen verbs allow this scoring. The average verb rate for these post-irregular responses is 26%, again very close to the general one to nine sample frequency rate of 29%.

All these figures indicate that the general 29% rate is a very reasonable estimate of the true post-irregular overregularization rate for this sample, especially given that the 15 verbs sampled just once show a 28% rate. So given sampling considerations, this implies a general rate of around 30% for verbs used in the range 1–900 times, even with the irregular past form known. Again, Marcus *et al.*'s version of blocking predicts a quick plunge to near-zero rates as soon as the irregular past form is used. Sarah's data do not conform to this prediction, unless a rate of 30% is held to be a 'low rate' for verbs used tens to hundreds of times.

Why are there strong individual differences?

Abe's data in particular have always comprised a particularly difficult problem for low-rate blocking hypotheses. Indeed, if any currently available single normal subject's data look utterly incompatible with low-rate blocking, it is Abe's. Such marked differences, however, might make one wonder if there was not some special or general deficit in Abe's functioning which would disqualify his data. Or even if one accepts his data, they raise the question of why such basic tensing processes should show such strong individual differences among normal subjects.

First, it is important to see if any evidence indicates Abe might have some anomalous lexical retrieval problem that would produce exceptionally high overregularization rates in a way consistent with blocking + retrieval error mechanisms. In fact, available evidence makes this idea very dubious. First, his overall grammatical acquisition generally followed normal lines of development for English-speaking children, as laid down in sources like Brown (1973) (see Kuczaj, 1976, 1977; Kuczaj & Maratsos, 1975). The main overall difference was that his grammatical development was faster than the average. He reached Brown's MLU Stage V mark by the age of around 2;8–2;9. This is early according to general norms (Chapman & Miller, 1981), but not so precocious as to be suspicious in some other way. Eve (Brown, 1973), for example, achieved MLU Stage V status even earlier (age 2;1).

This above-average general development by itself implies Abe if anything was a good word learner and retriever; correlations between vocabulary learning and grammatical development are well-established (Marchman & Bates, 1994). Furthermore, at age 4, his tested Peabody Vocabulary Test I.Q.

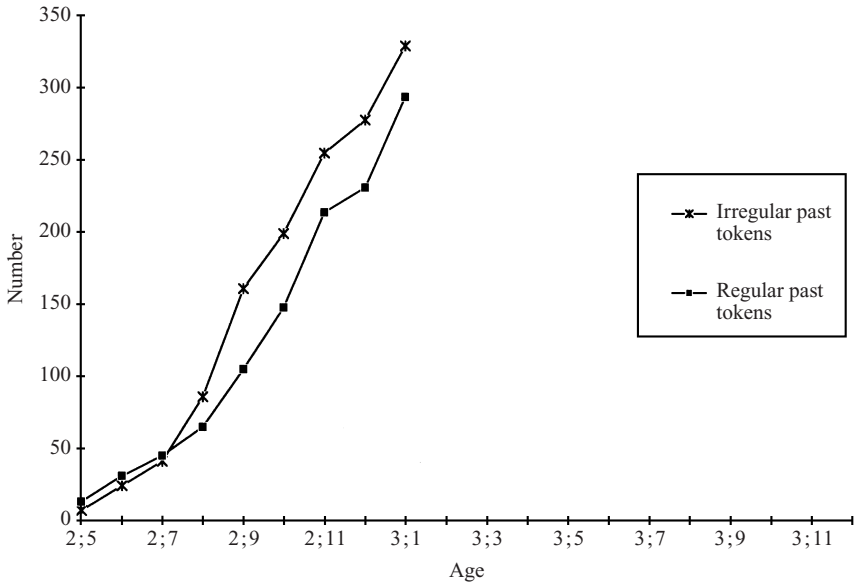

Fig. 4. Abe: cumulative irregular and regular past tokens.

was in the 140's (Kuczaj, personal communication). This more specifically indicates gifted word learning and retrieval.

Secondly, any look at his transcripts shows a child who was extremely fluent, even witty – not an easy accomplishment for a preschool child. There is NO indication of him 'tumbling over his words,' or having trouble finding the words he needed.

Thirdly, developmental data show that he was specifically efficient in retrieving morphologically inflected forms, regular or irregular. Marcus *et al.* themselves remark on Abe's superiority in achieving stable retrieval of past tense forms. They note that as Adam and Sarah approached Brown's 90% use mark for obligatory correct regular past tensing (regular verb forms like *melted* or *pushed*), their rates still wobbled below and above the 90% mark for many months. Abe's past tensing rates, in contrast crossed 90% at 2;9, and never dipped below it again. Instead they quickly went to, and stayed at, a plateau of 100% correct use.

Abe (Kuczaj, 1976) furthermore showed this highly efficient, stable arrival at the 100% plateau for a wide range of the verb-related morphemes scored by Brown (1973), and some others (e.g. uses with auxiliary verbs) also scored in Kuczaj (1976). These scored forms included both regular verb forms and irregular verb forms such as the different forms of *be*. Adam and Sarah in contrast frequently showed the 'wobble' pattern for the morphemes Brown

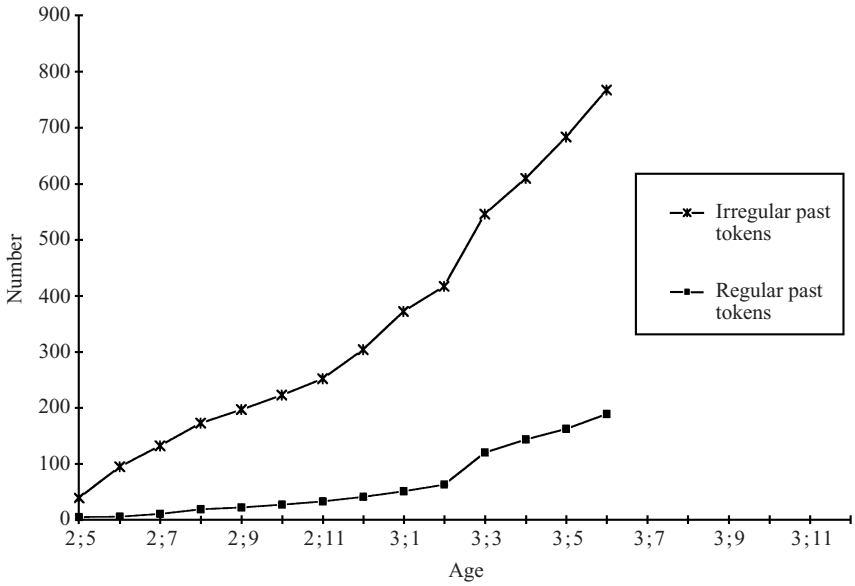

Fig. 5. Adam: cumulative irregular and regular past tokens.

(1973) scored. These observations imply that Abe was generally a MORE efficient retriever of inflected forms than Adam and Sarah. Nothing supports a notion that he had, relative to them, severe difficulties, as blocking + retrieval error might naturally imply to explain his high overregularization rates.

Clearly, deficit-based explanations do not work very well. More promising suggestions, however, can be found in the overall developmental balance between regular and irregular past tensing in Abe's development, compared to Adam's and Sarah's. For Adam and Sarah, substantial use of irregular past tensing preceded mature regular past tensing, which was not true for Abe. One useful general measure here is the ages at which irregular past tensing and regular past tensing respectively reached Brown's 90% criterion for use in obligatory contexts. Irregular past tensing was much earlier for Adam and Sarah, but not for Abe. Adam reached the 90% criterion for irregular past tensing at 2;11, but had not quite reached the 90% mark for regular past tensing at 3;6 (the point at which Brown, 1973, and Cazden, 1968) stopped tabulating. Sarah achieved 90% irregular past tensing at 3;1, but had not quite stabilized on 90% regular past marking by 4;0 (when, again, tabulation stopped). Abe, in contrast, reached the 90% for both regular and irregular past tensing together, at the age of 2;9, after some months in which percentages for both rose from rates around 50% at 2;5.

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More detailed measures such as monthly type and token counts, show the same comparative patterns. Appendix I gives month-by month figures for the three subjects; graphic representations (Figures 4–9) allow simple visual inspection. For example, consider the use of irregular and regular past tense tokens.

As Figure 4 shows, from 2;5 through 3;1, Abe's cumulative totals for irregular and regular past tokens rise together in parallel. During the same months (2;5 through 3;1), Adam (Figure 5) cumulatively produced many irregular past tenses, accumulating 329 recorded uses by 3;1. But regular past tense tokens did not keep pace, and by 3;1, only 51 had been recorded. Sarah (Figure 6) likewise produced irregular past tense tokens at a far higher rate than regular past tokens in the 2;5 through 3;1 period. (Because Adam and Sarah's overall development was slower, the figures show data for them after the age of 3;1).

The same cross-subject differences are obvious when the cumulative total of different verb types is tabulated. Abe (Figure 7) began in the earliest months of recording with roughly equal numbers of irregular and regular verb types; by 2;8, the cumulative variety of regular verb types far outstripped the cumulative variety of irregular verb types, and continued to rise far more quickly. Adam (Figure 8) in contrast begins with far more irregular verb types in use. Only at 3;2 does the cumulative number of irregular verb types come to equal the number of irregular types. For Sarah (Figure 9), irregular verb types similarly cumulate more quickly, until the number of regular verb types catches up around 3;7.

One can look at these data a variety of ways. One can use sample periods outlined by MLU (e.g. stage III through stage V) instead of chronological periods, for example (see Appendix I). In fact, Kuczaj (1977) shows that for irregular past tense learning, sheer experience is more important than general grammatical advancement. So MLU is probably less relevant than simple chronological age. In any case, however, in all cases the basic picture is the same: for months Adam and Sarah show robust irregular past use accompanied by relatively sparse regular past tensing; Abe's irregular past tensing was always accompanied by comparably robust regular past tensing. Surely this relative developmental superiority in the knowledge and use of the regular past tense is linked to Abe's far more robust overregularization, rather than some (so far unevidenced) anomaly in Abe's general grammatical development, or lexical retrieval apparatus.

What are some of the possible explanatory links? To start with, these differences in developmental synchrony in themselves probably had effects on the children's developments. In Adam and Sarah's development, irregular past verbs had many months of productive use in the absence of much likely competition from sparsely productive, regular, past tensing. Furthermore, during this early period, we can imagine Adam and Sarah's early-occurring

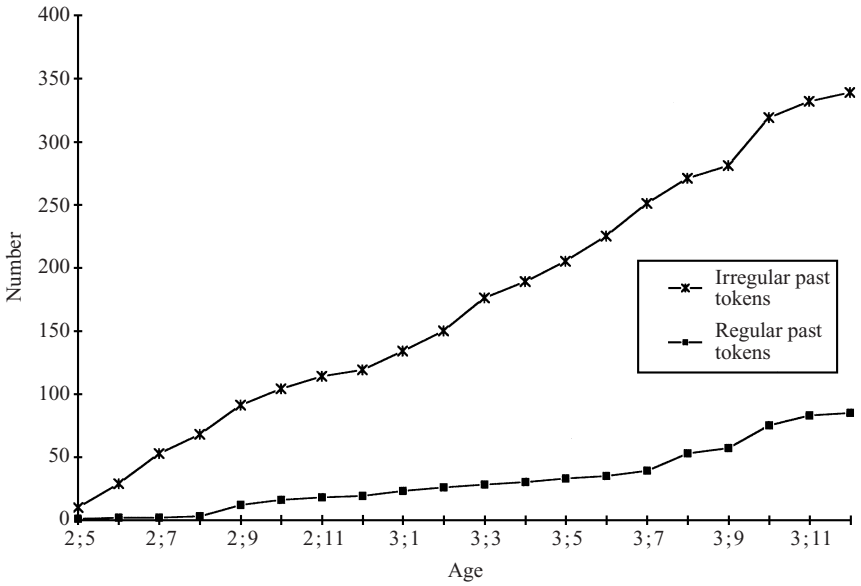

Fig. 6. Sarah: cumulative irregular and regular past tokens.

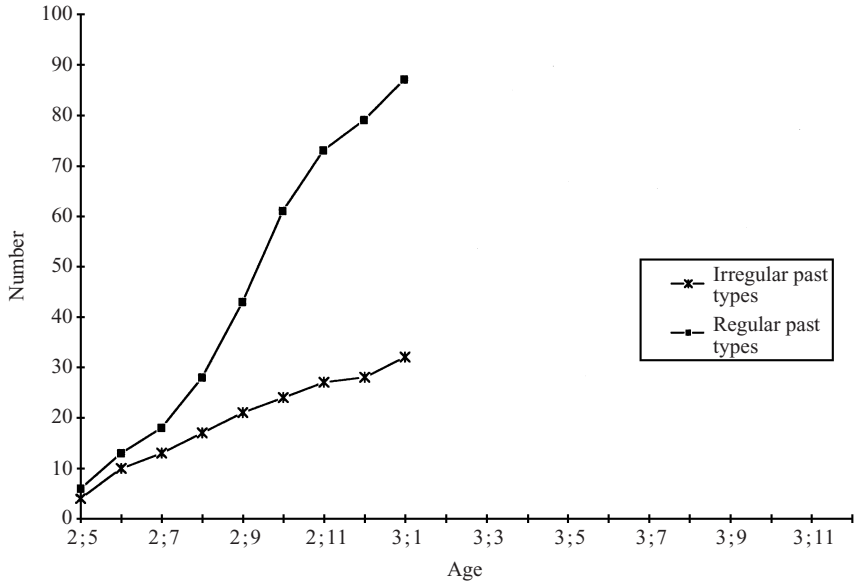

Fig. 7. Abe: cumulative irregular and regular past types.

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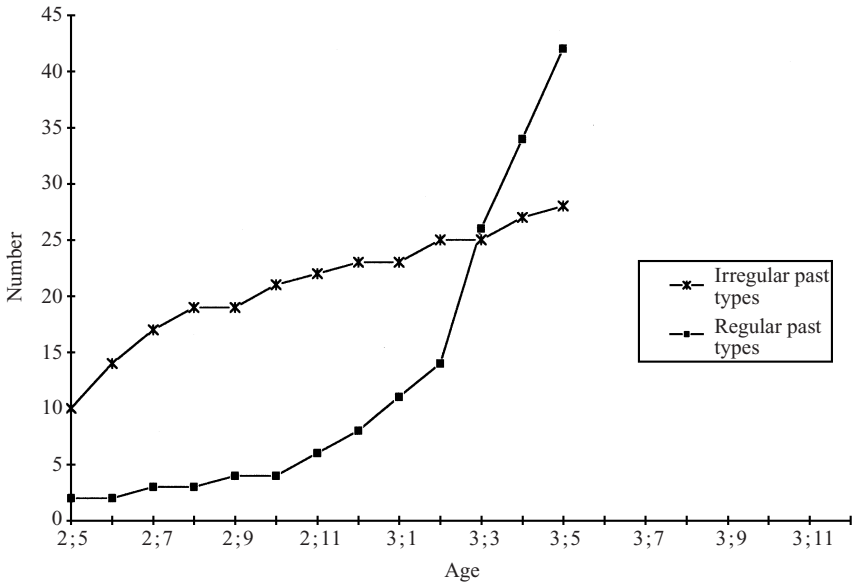

Fig. 8. Adam: cumulative irregular and regular past types.

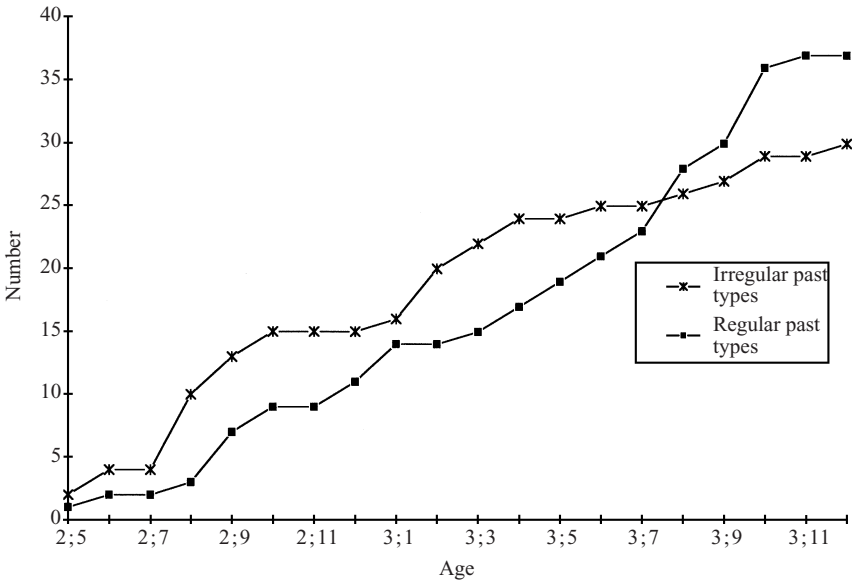

Fig. 9. Sarah: cumulative irregular and regular past types.

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frequent irregular verbs having a 'head start' on learning, so that by the time regular past tensing could emerge as a possible productive competitor, irregular verbs were already buffered by previous learning. The irregular–regular competition may have been over for many such verbs before it could even begin.

But there must also have been underlying reasons for Abe's relatively earlier onset of productive regular past tensing, and these causes may have favoured higher overregularization rates as well. For example, Abe was probably generally a superior vocabulary learner, as indicated by his Peabody I.Q. score. Regular verbs tend to be less frequent in the input than irregular verbs. Superior vocabulary learners might be relatively more likely to learn less frequent items. This would give them in turn a relatively larger group of regular verbs for which regular past tensing could then be early analysed, leading to quicker cumulation of a variety of regular past uses. This last development in turn, under a wide range of acquisitional models, would lead to a quicker productive status for the regular past operation. At the same time, the accompanying potential of 'mass action' from a larger variety of elements would also increase the strength of the regular past operation as a competitor for grammatical expression (see, for example, MacWhinney, 1978; Maratsos & Chalkley, 1980; Marchman & Bates, 1994), even once both irregular past tensing and regular past tensing were productive.

Lexical mechanisms provide just one possible quantitative (not qualitative) source of Abe's superior learning of regular past tense operations, and his more robust tendency to employ them in production. No doubt other possibilities exist, such as acquisitional or productive mechanisms more sensitive to those grammatical patterns which are more widespread (e.g. regular past tensing, as compared to individual irregular past tenses).

In all these speculations, however, it must be remembered that nothing known about Abe's overall development (Kuczaj, 1976; Kuczaj & Maratsos, 1975) indicates any QUALITATIVE difference in how he analysed grammar; the overall paths he took through development were very much in the normal acquisitional framework. These differences appear to be quantitative in nature; he was not a qualitatively different kind of subject, if there is any such thing among the range of normal language learners.

Abe's more robust overregularization rates thus are correlated with a general, systematic aspect of his grammar: he also acquired productive regular past tensing itself relatively much earlier than Adam and Sarah. This fact, plus the other aspects of his development that indicate high, not low, lexical and morphological learning and retrieval, largely dispel any possibility that his higher overregularizations were somehow due to deficits or anomalies in his functioning. Indeed, Pinker (1993) has publicly stated that Abe's data cannot be accounted for in blocking + retrieval error frameworks. But as has been seen, his data seem simply to comprise the relatively rich records of a

quantitatively somewhat gifted normal subject. These records, plus the signs of substantial overregularization periods in Adam and Sarah's data, indicate serious problems for the low-rate blocking + memory retrieval hypothesis.

It is worth noting an irony here. Grammatical development as a field has treasured children's ability to analyze general grammatical patterns. In reality, however, Adam and Sarah's pattern of less robust overregularization (compared to Abe) almost certainly is the more typical pattern. For example, they reached the various MLU points at ages much more typical of the average range than did Abe (see norms in Chapman & Miller, 1981). So the low-overall-rate overregularizer is probably the norm in English acquisition; for most children, only very close analysis probably shows the evidence for substantial overregularization periods that are so easily lost in our samples.

GENERAL DISCUSSION

To summarize, four major points have served to focus this discussion: 1) Limitations in our recordings will likely hide obvious indications of substantial post-irregular learning overregularization periods for all but very robust overregularizers (such as Abe). 2) When such limitations are allowed for, Adam and Sarah's records show evidence for high-rate post-irregular learning periods. 3) Abe's post-irregular learning periods are obvious, and when sampling limitations are allowed for, remarkably long. 4) Individual differences between Abe vs. Adam and Sarah do not appear to stem from any deficits or anomalies in Abe's lexical retrieval processes, morphological retrieval processes, or specific oddities of his overregularization processes. Rather, they are systematically related to aspects of his generally superior learning and use of regular past tensing, and very likely to aspects of his quantitatively superior competence. Overall, his acquisitional patterns are, furthermore, qualitatively normal.

It will be assumed for further discussion that these points are correct. Is there any way of saving blocking + retrieval error overregularization accounts? One could stipulate that perhaps toning up irregular past retrieval is in fact a relatively long, difficult, high-error process, lasting many tens to hundreds of responses. While this would save blocking + retrieval error accounts empirically, they would also become empirically indistinguishable from competition accounts.

Furthermore, among the three subjects, Abe was likely the best overall learner and retriever of words, morphologically inflected or not. It would be necessary for this revised form of a blocking explanation to say Abe nevertheless had far more severe problems with irregular past form retrieval. This is not very plausible. Competition accounts, to the contrary, can readily coexist with hypotheses that his superior competence may have led to both relatively earlier learning of regular past tense, and thus to a more competitive regular past operation.

The dispute between slow, inductive competition processes and quick-acting, heuristic-guided blocking processes has its own interest. More broadly, as discussed earlier, Marcus *et al*. originally argued that evidence for blocking would comprise strong support for symbol-rule processes, because only these could represent blocking mechanisms. The conclusions here thus remove this potential support for symbol-rule representations. As noted before, competition models are representationally compatible with either competition-network mechanisms or rule-symbol accounts, so the analyses simply return overregularization phenomena to a theoretically neutral state, providing no clear support to either side.

Finally, some methodological implications of these analyses are clear, and not necessarily fortunate. Rubino & Pine (1998) have shown low error rates can be deceptive because too general a classification category is used. This paper brings up an additional problem: our samples comprise small portions of the actual output. In some situations, they may, as a result, especially when one needs to make fine-grained analyses such as the history of individual word developments, miss periods of substantial error because these periods pass relatively quickly in time, or may be very sparsely sampled. Supplementing initial analyses with finer-grained categories of analysis (as in Rubino & Pine, 1998) or highly inferential internal analyses (as here) may help overcome these difficulties.

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APPENDIX

IRREGULAR AND REGULAR TYPES AND TOKENS FOR ABE, ADAM AND SARAH AT DIFFERENT AGES

	Number tokens		Number types		Number new types	
Age	Ir	Reg	Ir	Reg	Ir	Reg
Abe						
2;5	7	13	4	6	(4)	(6)
2;6	17	18	8	7	6	7
2;7	17	14	8	6	3	5
2;8	45	20	8	11	4	10
2;9	75	40	15	21	4	15
2;10	38	43	9	25	3	18
2;11	56	66	14	22	3	12
3;0	23	17	6	12	1	6
3;1	51	63	15	23	4	8
Adam						
2;3	28	1	8	1	(8)	(1)
2;4	2	4	2	2	1	1
2;5	39	5	7	2	1	0
2;6	56	1	11	1	4	0
2;7	37	5	11	1	3	1
2;8	41	8	9	2	2	0

2;9	24	3	10	2	0	1
2;10	26	5	13	1	2	0
2;11	29	6	12	3	1	2
3;0	52	8	12	5	1	2
3;1	68	10	10	4	0	3
3;2	45	12	14	8	2	3
3;3	129	58	16	17	0	12
3;4	64	23	17	15	2	8
3;5	74	19	17	11	1	4
3;6	74	27	20	17	1	4
Sarah						
2;3	3	—	1	—	—	—
2;4	10	—	2	—	1	—
2;5	10	1	2	1	1	1
2;6	19	1	3	1	2	1
2;7	24	—	3	—	—	—
2;8	15	1	8	1	6	1
2;9	23	9	8	5	3	4
2;10	13	4	7	2	2	2
2;11	10	2	5	2	0	2
3;0	5	1	4	1	0	0
3;1	15	4	8	4	1	3
3;2	16	3	9	3	4	3
3;3	26	2	13	2	2	1
3;4	13	2	10	2	2	2
3;5	16	3	6	3	0	2
3;6	20	2	10	2	1	2
3;7	26	4	11	4	0	2
3;8	20	14	13	6	1	5
3;9	10	4	8	2	1	2
3;10	38	18	13	10	2	6
3;11	13	8	5	6	0	1
4;0	7	2	6	2	1	0

Age–MLU stage correspondence for the subjects:
Abe: III at 2;5; V at 2;8.
Adam: III at 2;11, V at 3;6.
Sarah: III at 3;0, V at 4;0.

It seems to this writer, at least, that Marcus *et al*. have no clear basis for stipulating that retrieval errors would be low in rate. In discussing why English-speaking children omit obligatory initial sentence subjects, for example, Pinker (1984) has supported the view that memory-processing errors account for children's omissions. These omissions are very frequent in some children and last for many months.

So memory-retrieval problems have no automatic bias towards low vs. high error rates. On the other hand, competition processes do seem to imply high rates more clearly than blocking + retrieval error processes. So Marcus *et al*.'s argument that universal low rates favor blocking accounts will be accepted here.

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