

## **The Acquisition of the Default Classifier in Taiwanese\***

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### 1. Introduction

For many years, especially since the publication of Rumelhart and McClelland's (1986) connectionist model of English past tense acquisition, a debate has raged over the reality of an innate rule-learning mechanism in language development (for recent summaries of arguments, see Pinker 1999 for the pro side and Bates and Goodman 1997 for the con). For a debate that is so obviously important for our understanding of the nature of the human language faculty, it is surprising that the linguistic territory that it has been fought over is so small. Following the lead of Rumelhart and McClelland (1986), the vast majority of studies have focused on the difference between irregular and regular verbs in English (e.g. Marcus et al. 1992 vs. Marchman and Bates 1994). Some work has also been done on English noun inflection (e.g. Marcus 1995a vs. Marchman, Plunkett and Goodman 1997), on inflection in languages typologically and/or genetically related to English, such as German (e.g. Marcus et al. 1995 vs. Köpcke 1998), and on inflection in other languages, such as Hebrew (discussed in Pinker 1999).

Not all languages inflect, however, most famously Chinese (or more properly, languages in the Sinitic family, including Mandarin, Cantonese, and so forth). Given the narrow way the debate is often framed, it may seem that such noninflecting languages have nothing to tell us about the existence (or lack thereof) of rules in language development. On the contrary, we believe that they have the potential to move the debate in a more fruitful direction. Precisely because Sinitic languages don't have inflection (at least no irregular verbs or nouns), one is forced to rethink the fundamental question: How might a rule-learning mechanism be manifested in a noninflecting language? More specifically, is there any system in Sinitic in which there is a dichotomy between regular (rule-governed) and irregular (idiosyncratic) patterns?

We believe that a very good candidate is provided by the nominal classifier system. Like many languages across the world (Allan 1977, Aikhenvald 2000), Sinitic languages require the use of certain morphemes ('classifiers') in certain syntactic contexts (namely after numerals and determiners within an NP). Usually the selection of a classifier depends on the semantics of the noun (shape, animacy, and so on), but there is an exception: a so-called 'general' or 'default' classifier. This acts like a 'miscellaneous' file, being selected for a variety of noun types, often ones that sometimes also go with semantically more specific classifiers. One could argue, then, that while speakers usually choose classifiers through some process involving the semantics of the noun (or perhaps sometimes they simply choose them by rote), there is also a 'default classifier rule' to fall back on in order to fulfill the syntactic obligations when memory (e.g. for which semantic features are encoded by which classifier) fails for some reason or other.

If such a default classifier rule actually exists for adults, the natural conclusion is that in order to master the language, children have to learn this rule, and there thus must be a rule-learning mechanism. If the rule-learning mechanism in Sinitic languages then turns out to

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develop in ways parallel to those found with children learning inflection, this would provide suggestive evidence that this mechanism not only exists, but follows a biologically-guided maturational path. The argument for innateness would be particularly compelling if such similarities were found, since inflection and classifier systems by their natures pose learning difficulties that differ in significant ways, as will become clear throughout this paper.

Of course, the above discussion begs two crucial questions. First, is there in fact evidence that adult speakers of Sinitic languages have such a default classifier rule? Second, if there is, is there evidence that the development of this rule follows a path familiar from the literature on the acquisition of inflection? We suggest that both questions can be answered in the affirmative. Evidence for an adult default rule in Chinese is summarized briefly below (based largely on Myers 2000). The remainder of the paper then focuses on the second question, building the argument on data from a study of the early acquisition of classifiers in Taiwanese (the variety of Southern Min spoken in Taiwan).

In Mandarin, the (apparent) default classifier is *ge* 個, and in Taiwanese it is *e* (the cognate of *ge*). In order to determine if they are true defaults, we have to be clear on what we mean. Zubin and Shimojo (1993) argue that there are three distinct functions that can be served by so-called 'general' classifiers cross-linguistically, and that within a single language these functions do not always coincide in a single classifier. In particular, Japanese has two distinct classifiers which they argue could both be called 'general' (*tsu* is used with native numerals, and *ko* with Sino-Japanese ones). The situation in Japanese may imply that classifier systems need not have a unique default classifier, but both Mandarin and Taiwanese have no problem with the definitional challenge posed by Zubin and Shimojo (1993): *ge* and *e* clearly behave like defaults in all three of their senses.

First, they may be used to fill in the gaps in semantic space between the categories for which there are specific classifiers. These gaps include people in general (each language also has a special classifier for people one should be polite to), objects that don't have a shape for which there is a special shape classifier (thus the default classifiers are typically used for largish round or ring-like shapes; Loke 1994), and abstractions, including nouns derived from verbs (though certain kinds of abstractions do have specific classifiers, such as laws, which take an 'oblong shape' classifier since historically laws were written on long strips of paper or bamboo).

This gap-filling job of the default classifier results in its cooccurring with a class of nouns that is semantically incoherent: the members have nothing in common with each other except that they all cooccur with the default classifier. The semantic incoherence of the *ge* and *e* classes thus parallels the lack of phonological coherence in regular inflectional classes. For example, the irregulars *drive*, *rise*, *ride*, and *write* undergo the same ablaut in the past tense because the stems are themselves phonologically quite similar, whereas the regulars *arrive*, *cancel*, *discombobulate*, and *itch* share no phonological similarities.

Second, the default classifiers in both Mandarin and Taiwanese can be used in contexts where the meaning of an entity is extremely vague. Thus speakers can use the morpheme for 'that' plus *ge* or *e* to refer to any kind of entity when the name for the entity itself is not used, as in Mandarin *Na-ge shi shenme?* (literally 'That-*ge* is what?'). We have also examined this property experimentally (Myers, Gong, and Shen 1999). This preference for the default classifier for nouns with extremely vague (even absent) semantics may be thought of as paralleling the use of regular inflection with verbs that aren't phonologically similar to any other words, e.g. 'He out-Gorbacheved Gorbachev' (Marcus et al. 1995).

Related observations concern the choice of default classifiers for linguistic entities that not only have no nominal semantics, but aren't even nouns. This occurs in adult's natural use of language (Myers 2000), but more striking examples are found in child speech. Hu (1993:107),



do not need to be explained by supposing that it is a default classifier. In any event, we will shortly provide evidence that young children acquiring Taiwanese recognize *e* as the sole default classifier, even using it with animals on occasion.

The second factor affecting neutralization to the default classifier for a given noun is the strength of the memory trace linking that noun to a semantically more specific classifier. Using a large corpus of written Mandarin and a measure of collocation frequency that factored out the confounding effect of word frequency, Myers (2000) found that *ge* has the lowest average classifier-noun collocation frequency of the most common classifiers in Mandarin. This suggests that the less reliably a noun appears with some non-default classifier (e.g. if it often appears with no classifier at all), the harder it is for speakers to remember what classifier is supposed to be selected for it, and so the more likely it will occasionally appear with *ge* as well. This conclusion is supported by some of our more recent experiments, in which we found the likelihood that Mandarin-speaking adults chose *ge* for a given noun was inversely related to the cooccurrence of that noun with a semantically specific classifier (see also Tyan 1997). Such observations parallel the frequency effect observed with inflection, where regular forms on average tend to be of lower frequency, a situation that is thought to arise because speakers fall back on a default rule when memory traces for irregular inflection is too weak (Ullman 1999).

If poor memory for classifier-noun collocations are what cause the classifier-noun collocation frequency effect, we predict that speakers with particularly weak memory traces and/or memory access problems should be more likely to overregularize classifiers. At least in the case of Mandarin, this appears to be true: the default classifier *ge* is overused by nonnative learners (Polio 1994), dysphasic native adult speakers (Tzeng, Chen and Hung 1991), and children (Erbaugh 1986, Hu 1993).

Children's overuse of default classifiers are, of course, especially relevant to the focus of this paper. The phenomenon is not restricted to Mandarin. Overuse of default classifiers by children has also been reported for Taiwanese (Ng 1989), Cantonese (Wong 1998), Thai (Carpenter 1991), Korean (Lee 1997), and Japanese (Yamamoto and Keil 1996, where the 'defaults' were restricted to particular semantic fields, e.g. animate or human). One possible interpretation of such a bias towards default classifiers is that children come into the world expecting linguistic systems to have default rules, even if their parents happen to speak a noninflecting language.

However, there may be explanations for why children acquiring classifier systems overuse the default other than that they are learning a grammatical rule. In particular, they may merely be picking up on a statistical pattern that need not play any special role in the adult system at all. Children acquiring German gender, for example, tend to overuse the feminine (Mills 1986), although for adults a case can be made that if any gender acts most like a default, it is more likely to be the neuter (Zubin and Köpcke 1986). The early overuse of the feminine seems to result from phonological, semantic and morphological semi-regularities in the input, patterns that connectionist models also successfully pick up on (MacWhinney et al. 1989).

This observation unfortunately makes the study of classifier acquisition in Mandarin rather unhelpful if our goal is to test for the existence of an innate rule-learning mechanism. The reason is that the Mandarin default classifier *ge* is just too common in adult speech. In a classifier elicitation study with adult speakers, Myers, Gong and Shen (1999) found a rate of *ge* use of approximately 70%. Erbaugh (1986; personal communication) found in an story-telling study (also with adult speakers) that *ge* was used 689 times, compared to only 40 times for specific classifiers, a proportion of almost 95%. Such high rates of default classifier use are expected to have their effect on children, and they do. For example, in experiments with 3- to 6-year-old children, Hu (1993) also elicited *ge* responses in proportions of 64-82% (where a

proportion of only 8% was prescriptively 'grammatical' given her materials). It is a rather trivial matter for a purely exemplar-driven model without any innate structure to pick up on such patterns and treat the most common output as the default. This is exactly how the earliest connectionist models of English inflection (e.g. Rumelhart and McClelland 1986) learned that *-ed* was the default past tense marker (though more recent models have attempted to deal with cases where the default is not the most common output, e.g. Hare, Elman and Daugherty 1995).

Taiwanese may therefore provide a more interesting case study. While the default classifier *e* is extremely common, it does not seem to be quite as common in fluent adult speech as *ge* is in Mandarin. In a corpus of adult spoken Taiwanese (transcribed from unscripted radio broadcasts) that we are currently developing, the proportion of *e* tokens relative to other classifier tokens is only about 50%. Moreover, as we show later in this paper, the proportion in child-directed speech is even lower. Hence learning the default classifier in Taiwanese may require more than simply recognizing the most common classifier.<sup>2</sup>

Nevertheless, to test the claim that overregularization in classifier acquisition and in the acquisition of inflection both arise from the application of the same innate rule-learning mechanism, we require more data than the mere existence of overregularization itself. In particular, we need answers to four crucial questions concerning possible parallels between default classifier acquisition and overregularization patterns in the acquisition of inflection. First, and most fundamentally, are we justified in studying early classifier acquisition as the acquisition of a grammatical system at all? At first it may not seem appropriate to do this, since classifiers in adult language clearly have an important extra-grammatical function of classifying entities in real-world experience, whereas the notions encoded by inflection are rather abstract, or even arbitrary (such as grammatical gender). Indeed, researchers have found ample evidence that children acquiring Mandarin (e.g. Erbaugh 1986, Hu 1993) and Taiwanese (Ng 1989) do make classifier errors along semantic lines. Nevertheless, as Carpenter (1991) argued in a study of Thai classifier acquisition, such semantic errors increase dramatically with age; the youngest Thai children treat classifiers primarily as part of a formal grammatical system, seemingly neglecting their extra-grammatical cognitive functions. There is no contradiction with the Chinese studies, since these, like virtually all studies of classifier acquisition cross-linguistically, focus on children over three years old, after semantics begins to play a role in classifier use. Ours is the first study of classifier use by Taiwanese-acquiring children as young as two years old, and at this early stage, we expect that classifiers will be treated primarily as a formal grammatical system, not an interface with the cognition of categorization.

The second question to address asks whether the early development of classifier systems follows a U-shaped learning curve. That is, do children start out by correctly parroting back adult classifier productions by rote, then reach a stage where they overregularize, and finally improve in accuracy as their use of specific classifiers gradually increases? Carpenter (1991) found no such pattern, but again she didn't study the very young children that are typically the focus of studies on the acquisition of inflection (i.e. under three years). Moreover, to count as a match with what happens with inflection, the U need not be very deep (i.e. overregularization may not be extremely common) or narrow (i.e. the rise in accuracy may occur extremely slowly). Marcus et al. (1992) found that young children acquiring English past tense inflection typically have an overregularization rate of less than 10%, and while an early drop in accuracy was seen, the rise was not so noticeable, especially since even adults can 'overregularize', as noted above.

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<sup>2</sup> Similar considerations should make Cantonese a good test case, since there the default is also much less common than Mandarin (Erbaugh 2000). Data from Wong (1998) show that young Cantonese-learning children produce noticeably more non-default classifiers than young Mandarin speakers of comparable age. Whether they show clear evidence of the acquisition of a default classifier rule, however, still requires more careful study.

The main evidence for a U-shaped learning pattern in classifier acquisition, then, would be an initial period of accurate classifier production followed by a drop in accuracy as overregularization begins in earnest.

There are data bearing on this question from Mandarin, since unlike most researchers on classifier acquisition, Erbaugh (1986) does report data on children younger than two years. Unfortunately, her data do not help answer our questions because she reports that the youngest children used the default classifier *ge* exclusively, with specific classifiers being added gradually over the course of a few years. The resulting S-shaped curve at first may seem to suggest dramatic differences between classifiers and inflection, but it must be recalled that Erbaugh (1986) also reports that even adult Mandarin speakers almost exclusively used *ge*. In such a learning environment, it's not surprising that children would tend to treat the rare specific classifier as not memorable enough to bother learning. Connectionist models trained on such patterns also tend to show an S-shaped learning curve unless the proportions of regular vs. irregular items are manipulated (see Marcus 1995b, Plunkett and Marchman 1993, 1996). Such observations further emphasize the importance of languages like Taiwanese, where the default classifier is significantly less common than in Mandarin.

If there is a U-shaped learning pattern in Taiwanese classifier acquisition, the next question to ask concerns its timing. In particular, does it typically begin to manifest itself sometime between the second and third birthdays? This is the period of time in which overregularization tends to begin for children acquiring the English past tense (Marcus et al. 1992). An innate rule-learning mechanism might be expected to mature at the same general rate regardless of the kind of language input.

Finally, if a U-shaped pattern is found, is it triggered by some change external to the phenomenon itself, such as the input to the child or the child's own growing vocabulary? With regard to inflection, the answer to this question is less clear than to the previous two. Marcus et al. (1992) and others argue that there is no evidence that any property of the input triggers the onset of overregularization in English inflection. By contrast, Marchman and Bates (1994) and others claim that factors such as the proportion of regular forms in the child's vocabulary have deterministic, though somewhat indirect, effects on when overregularization begins to occur.

## 2. Methods

This paper presents data on an as-yet unstudied group, namely two- to four-year-old children acquiring Taiwanese. These data come from a much larger project that involves building a corpus of spontaneous speech production from a set of children over the course of three years (Tsay 1997-2000). All of the fourteen children who participated in the corpus project come from Taiwanese-speaking families in Min-Hsiung township in Chiayi County (southern Taiwan). Most of Min-Hsiung is rural farm area, and the vast majority of its approximately 700,000 residents primarily use Taiwanese at home.

Although the original purpose of this larger corpus study was to study tone acquisition, the data were collected naturalistically and can thus be used to investigate many different questions (including classifier acquisition). Recordings of children at play were made through home visits on a regular basis (once a week before the age of 2, every two weeks between 2 and 3, and every three weeks thereafter). The participants, in addition to the child him- or herself, usually included a caregiver (typically the mother or grandmother) and the observing linguist. Each recording, 30-90 minutes in length, was transcribed in both Chinese characters and in IPA by the observer herself; the IPA transcriptions were then double-checked by two other linguists. This corpus will eventually be made available through the CHILDES system (MacWhinney 1995).

In this paper we focus on the five children that provided the most complete longitudinal data at the time of analysis: three girls (referred to in this paper as Jun, Ci, and Ying) and two boys (Lin and Xuan). For most of these children, we have data from the age of 2;1 (two years one month) to 4;0, but occasionally data is missing, as will be clear in figures to follow (e.g. Ci's data ranges only from 2;8 to 4;0, and Jun's from 2;1 to 3;6). After we completed analysis of these five children, we analyzed data of three additional children over the age range 2;1-2;3 (two girls, Wenx and Yi, and a boy, Sheng); these were used to confirm the existence of an initial correct-classifier stage (see section 3.2 below).

Studying classifier use in naturalistic speech poses problems irrelevant in the study of inflection. First, there is an important structural difference between inflection in English and classifiers in Taiwanese. While inflection is affixed directly to the word, classifiers are not: they may be separated by several words from the noun they collocate with, and in fact the noun itself need not appear at all. This means that in English any given child utterance of an inflected form is clearly categorizable as correct or incorrect, but such is not the case for Taiwanese classifiers. This is especially so if the noun itself is not uttered and we must rely on the report of observer as to what object the child seemed to be referring to. Of course this can lead to some vagueness of intention (and perhaps even the child herself wasn't always clear about the reference). On top of this, the children under investigation occasionally used a Mandarin noun or even the rare English word (e.g. *Snoopy*); it is possible that the processing of classifiers with non-native nouns shows special characteristics that should be studied separately.

A second problem concerns the adult judgements of classifier choices. Whereas adult speakers of English generally don't have disagreements about whether a given inflectional form is acceptable or not (for example, *went* is clearly the correct past tense of *go*, not *goed*, and free variation like *dreamed/dreamt* is rather rare), this is certainly not the case with Chinese classifiers. Loke (1996), Myers et al. (1999) and others have found much disagreement about classifier selection among adult speakers of Mandarin, and Tai (1997) found much the same variation in Taiwanese. Hence if we are to calculate accuracy rates for children acquiring Taiwanese classifiers, it won't do to impose our own prescriptive notions of 'correctness'.

Because of these concerns, data were collected for this paper as follows. All transcripts were first checked line by line for all occurrences of classifiers of all types (including classifiers selected by the semantic properties of individual entities, e.g. shape classifiers like *ki* 支 or the animal classifier *cih* 隻, but also partitive measures like *te* 塊 'piece' and container measures like *uann* 碗 'bowl'). For any given occurrence, the cooccurring noun (if any) was noted; if no noun was used in the given utterance, a comment in the transcription by the original observer/transcriber was usually sufficient to make a safe guess about what object was being referred to. The number of occurrences of a given classifier with a given noun were then totaled for each month, with separate totals for spoken Taiwanese nouns, nouns spoken in Mandarin (or very rarely, English), and unspoken nouns. Accuracy and error rates were based on tokens of individual utterances.

The determination of classifier selection accuracy then occurred in two steps. First, all classifier-noun collocations were judged by the three native Taiwanese-speaking observers involved in the project as being acceptable, unacceptable, or indeterminate (i.e. judges could not determine or agree on the acceptability of the collocation). The indeterminate cases (198 collocations, about 25% of the total) from all children were then put into a single list and presented verbally to seven of the adult caregivers whose children were involved in the project (five mothers, one father and one grandmother), along with four other adult native speakers (the three observer/transcribers plus the second author of this paper). These eleven adults were asked to judge each classifier-noun collocation as acceptable, unacceptable, or indeterminate, and

majority rule was then used to make the final categorization. We hoped that including the caregivers themselves among the final arbitrators would go some way to reducing the arbitrariness of accuracy judgments that are sometimes found in studies of classifier acquisition.

### 3. Results

Our results are divided into three categories: the role of semantics in early classifier errors, the nature of the U-shaped learning curve (including the timing of the onset of overregularization), and the possibility of environmental triggers for overregularization.

#### 3.1 Semantics and early classifier errors

Our most basic finding replicates that of Carpenter (1991): the role of semantics (i.e. grammar-external cognitive properties) appears to be more limited in the use of classifiers by the youngest children (e.g. under four years) than it is later on in life. In particular, for most of the children studied, the majority of classifier errors involve overregularization (i.e. overuse of the default classifier *e*), not semantically-motivated errors.

The following table summarizes the classifier error types across the five children that are the focus of this study (cumulative across all data from 2;1-4;0 available for each child).

Table 1. Types of classifier errors made by the five children.

	Jun	Ci	Ying	Lin	Xuan
Total classifier tokens	289	697	240	1392	788
Overregularization	9	114	40	433	20
All other classifier errors	9	13	8	23	46
Percentage of errors that are overregularization	50%	90%	83%	95%	30%

As can be seen, three children show a clear bias for overregularization errors (overuse of *e*) versus other types of errors. Only one (Xuan) seems to show a clear bias the other way, but closer examination of his data suggest that a large proportion of his non-overregularization errors are due to just two errors, repeated multiple times within single recording sessions. In one recording at age 3;0, he referred 21 times to a fishing toy with the animal classifier *ciāh* (隻) (the toy contains little plastic fish, and since he did not use the noun explicitly he may have been thinking of 'fish', for which *ciāh* is acceptable), and in another recording at age 3;3 he used the small-inanimate-object classifier *liap* (粒) 17 times to refer to a mouth (the correct Taiwanese classifier is *ki* 支).

Overall the most common classifier error that does not involve overuse of *e* is overuse of *ciāh* for inanimate objects: such instances comprise 8/9 of non-overregularization errors for Jun, 1/8 for Ying, 4/13 for Ci, 26/46 for Xuan, and 9/23 for Lin. Since as noted in the introduction, a very common semantically-based classifier error found in older children involves overgeneralization of animate classifiers (Hu 1993, Ng 1989), one might be justified in suggesting that even the young children of our study are actively learning about the semantics of classifiers. While there may well be variation across children in the age at which the semantic aspects of classifiers become important (in particular, Xuan may be 'semantically precocious'), in general we don't think that the overgeneralization of *ciāh* poses a serious challenge to Carpenter's (1991) suggestions. First, such errors are still far outweighed by overregularization errors in the majority of children. Second, the overuse of *ciāh* by Taiwanese learners may result more from

distributional patterns in the input to the child than to semantics. As noted earlier, *ciah* has a wider use in Taiwanese than its cognate animal classifier *zhi* in Mandarin. It is conceivable, therefore, that at least some young Taiwanese children temporarily hypothesize it as the default classifier, and begin to overregularize it (after all, even if a rule-learning mechanism is innate, the morphemes involved in the rule are not).

The most striking argument against viewing overuse of *ciah* as being due merely to the high cognitive salience of animacy is the fact that at least some children had a tendency to replace it with *e*. Lin, one of the strongest overregularizers of our children, is a particularly clear example of this: an amazing 230 out of his 433 overuses of *e* recorded from 2;1-4;0 involve animate nouns (this is 230 overregularizations out of 490 instances of classifiers used for animals, a rate of 47%). It is true, however, that his overregularization patterns do vary by the semantics of the noun. Thus he tended to overregularize animate objects statistically more often than vehicles (59 times out of 167 instances of classifiers used for vehicles, or 35%;  $\chi^2(1)=6.85$ ,  $p<0.01$ ), and vehicles statistically more often than books, which should take *pun* 本 (19 times out of 130 instances of classifiers used for books, or 15%;  $\chi^2(1)=16.28$ ,  $p<0.001$ ). A number of explanations for these various facts come to mind, none of which are particularly challenging the view that semantics is not important early in the development of the classifier system. For example, in the play context in which Lin was recorded, the animate objects were usually inanimate representations of animals (e.g. toys), for which the default classifier is perfectly acceptable. Moreover, Lin did not have a strong tendency to use *ciah* (correctly) for vehicles (he only used this classifier in about a fourth of his correct usages), which may somehow affect his overregularization rates for vehicles. Finally, Lin naturally tended to refer more and more to books as he got older, and if there is a tendency for overregularization to decrease over time, this will tend to lower the overall overregularization rate for books. Nevertheless, the fact remains that no semantic category was immune from Lin's overregularization of the classifier, and as we will see shortly, a more important factor affecting his overregularization rates was not semantic class of the objects referred to, but his own age.

In general it seems fair, then, to conclude that the role of semantics is far more limited in the earliest use of Taiwanese classifiers than it is later on in life, consistent with Carpenter's (1991) conclusions about Thai. That is, in spite of the clear importance that cognitive factors have for processing classifiers by older children and adults, these factors do not seem to drive initial classifier acquisition.

### 3.2 Overregularization rates

In the previous section we showed that the most common classifier error among our children was what we call overregularization, i.e. use of the default classifier *e* where it should not be (according to our adult judges). In this section we examine the most basic aspect of this phenomenon, namely the change of overregularization rates over time (in a curve shaped like a U or otherwise).

To do this, we first need an explicit formula for overregularization rates. Here we follow the formula developed by Marcus et al. (1992:29) for overregularization in inflection. They suggest that this be understood as the rate by which a child uses the regular form (in our case, the default classifier) in a situation where she should use the irregular form (i.e. specific classifier). Thus we calculate the overregularization rate by taking the total number of instances where the default classifier is used where it should not be (according to our adult judges) and dividing this by the total number of instances where any classifier is used (correct or incorrect) with a 'non-default' noun, i.e. noun that prefers a non-default classifier like the animate classifier *ciah*. In

other words, we do not include cases where the default classifier is correctly used, errors which involve the total deletion of a classifier (these sorts of errors will be examined in a later section), or errors where one non-default classifier is replaced with another (as discussed in the previous section).

Of course, overregularization in this sense depends on whether the noun is in fact pronounced and if it is, whether it is spoken in Taiwanese, Mandarin or some other language. For example, if a child incorrectly uses *e* only in noun phrases containing overt Taiwanese nouns, the overregularization rate will be lower if the denominator of the division includes all instances of headless noun phrases as well. Ideally we would like to include only tokens with spoken Taiwanese nouns, but this often reduces the amount of data available for study quite drastically. For example, of the 1392 classifier tokens of the talkative Lin, a mere 559 (40%) occurred with overt Taiwanese nouns. In this paper, then, most analyses will be based on all classifier tokens, though the possible significance of different contexts of classifier use will not be ignored.

The term 'U-shaped curve' comes from the shape of accuracy rates plotted over time. Again following Marcus et al. (1992), in the following plots the y-axis represents 1 minus the overregularization rate as defined above. We first give the plots for the five primary subjects of this study (Jun, Ci, Ying, Lin, and Xuan), showing separate lines for all classifier tokens, for classifier tokens with spoken nouns (in Taiwanese, Mandarin, or English), and for classifier tokens appearing with Taiwanese nouns. The vertical lines are 95% confidence intervals (calculated for the proportion of overregularized tokens out of all classifier tokens) which gives both an estimate of the amount of variability and also an indication of whether the overregularization rate is really changing over time (if two confidence intervals do not overlap, the associated overregularization rates are almost certainly truly different). The use of such error bars is founded on the reasonable assumption that a certain number of what we call overregularizations are actually illusory (e.g. an observer mistook what object the child was referring to, or the child selected the wrong classifier in a transitory speech error). This makes a significant increase in overregularization (i.e. drop in the curve) more meaningful (by contrast, Marcus et al. 1992 assumed that any irregular token produced with regular inflection counted as a genuine instance of overregularization).

Figure 1. Overregularization rates for Jun.

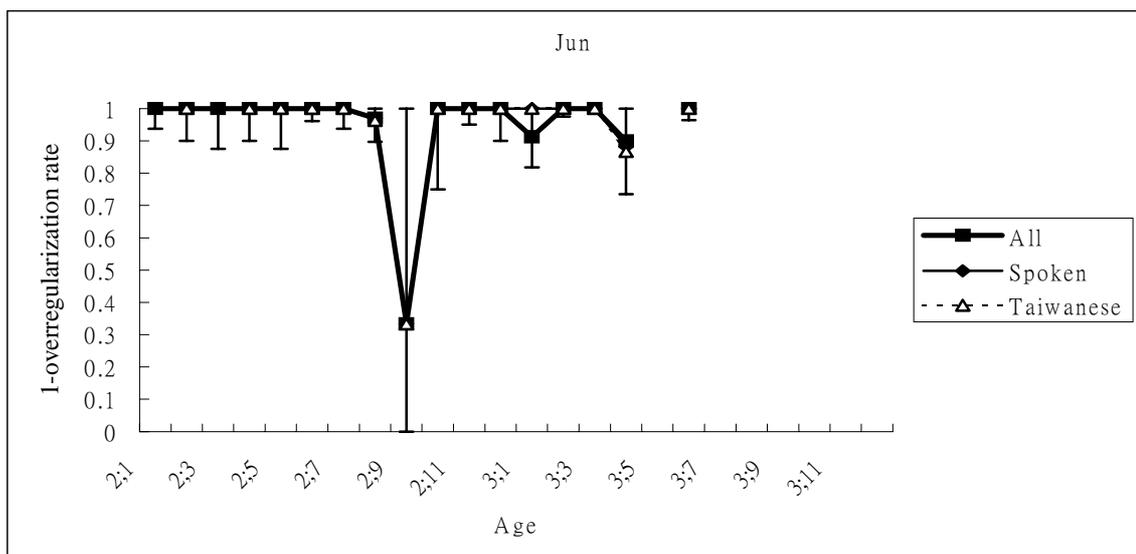


Figure 2. Overregularization rates for Ci.

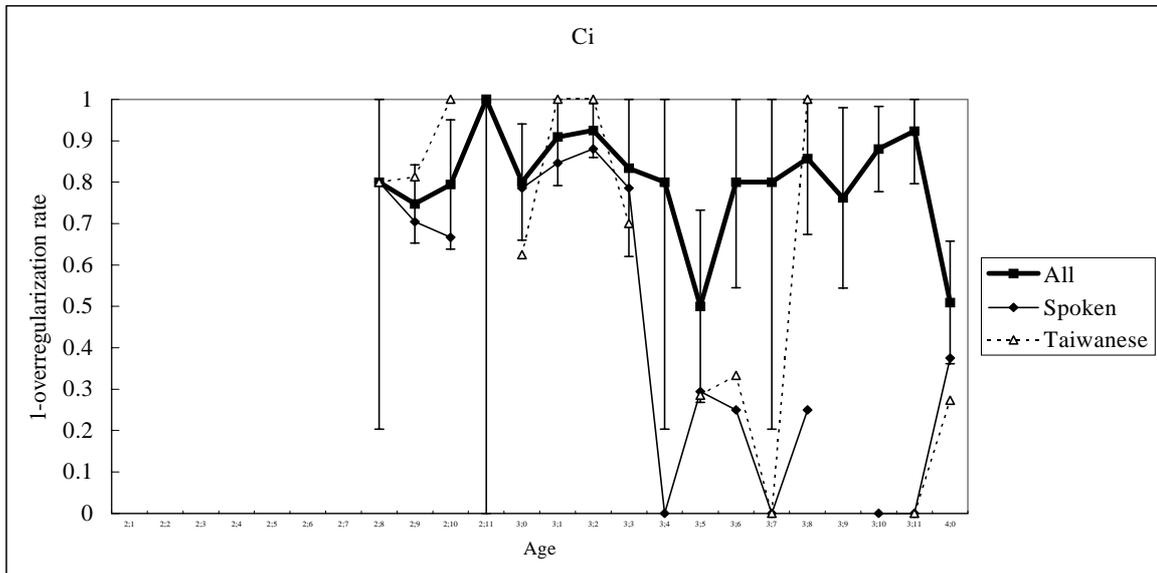


Figure 3. Overregularization rates for Ying.

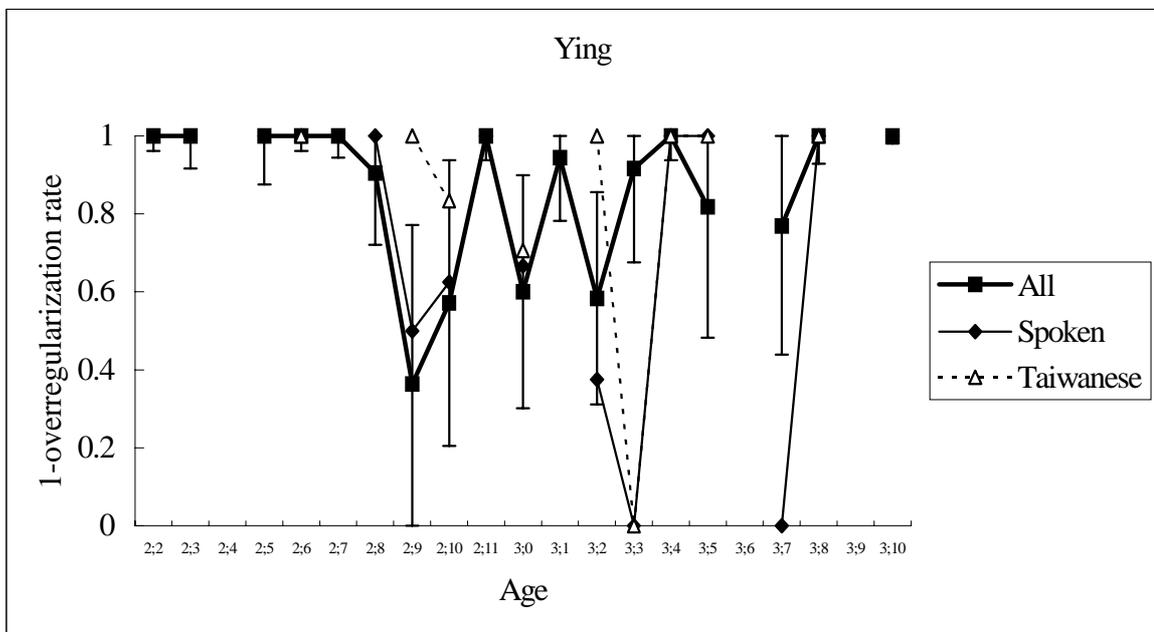


Figure 4. Overregularization rates for Lin.

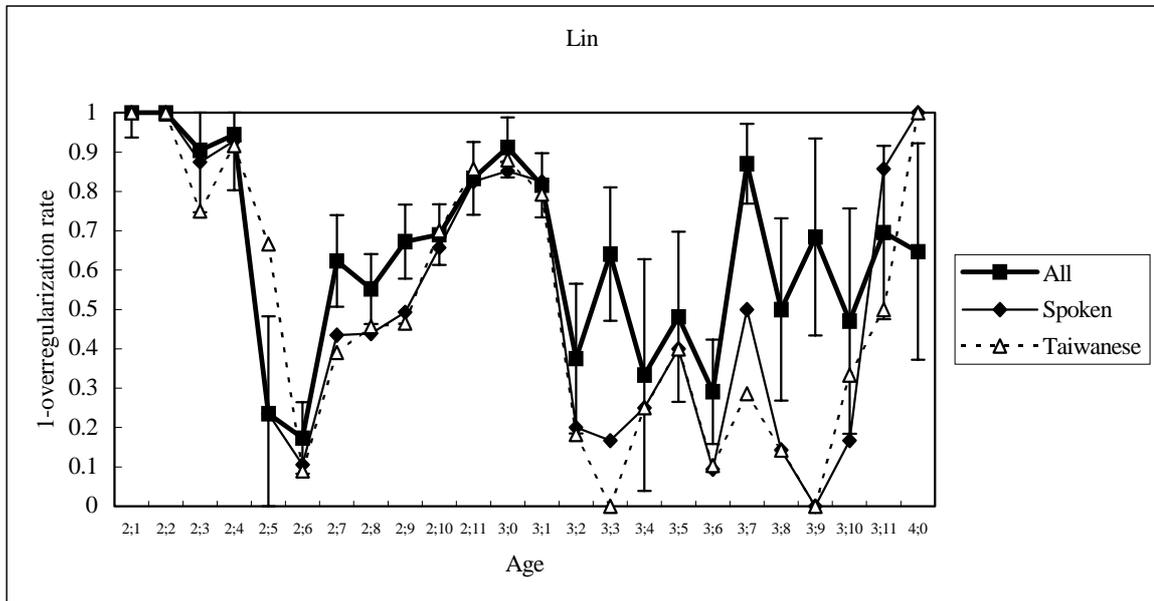
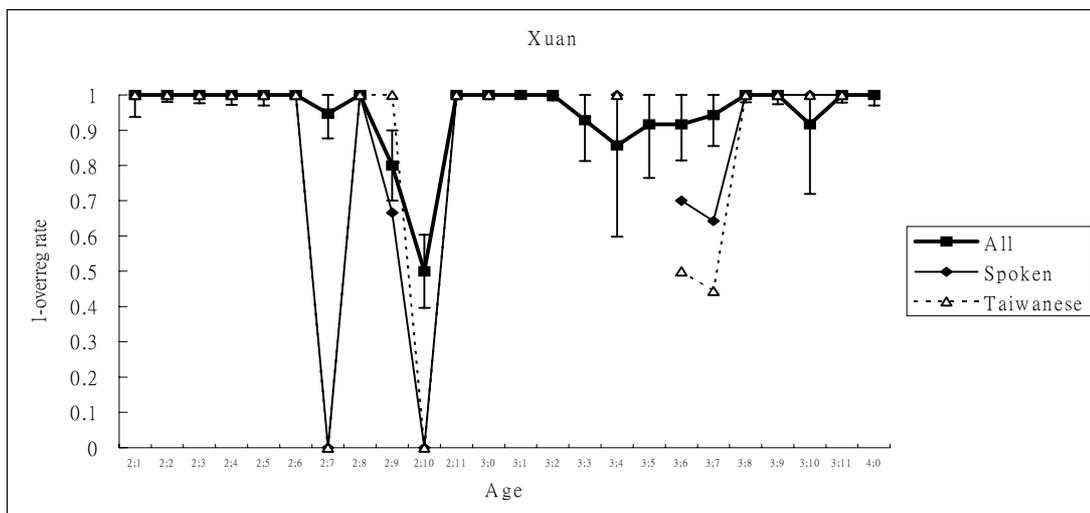


Figure 5. Overregularization rates for Xuan.



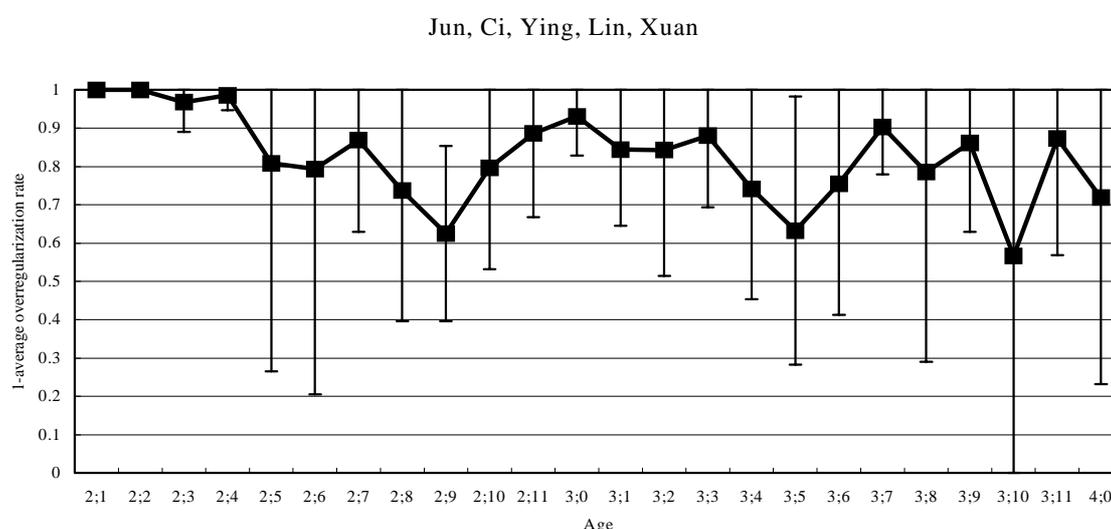
Careful study of the above graphs yields several important observations. First, for all but one child (Jun), the overregularization rates become significant enough so that the error bars do not overlap with the top of the graph (meaning that it's very unlikely that the true rates were negligible). Second, for each child, the overregularization rates as calculated for all classifiers, for classifiers with spoken nouns, and for classifiers with Taiwanese nouns, all show essentially the same pattern of rises and falls. If anything, classifier tokens with spoken nouns (and especially Taiwanese nouns) show greater overregularization rates than the rates calculated for all classifier tokens (i.e. in the above graphs the thin solid and thin dotted lines are generally lower

than the thick black line).<sup>3</sup> This suggests that including classifier tokens without spoken nouns does not artificially inflate the calculation of overregularization rates.

Third, for the overregularizing children for whom we have data from the youngest months (Ying, Lin, and Xuan), there is a period early on when the overregularization rate does not appear to be significant (i.e. the error bars overlap the top of the graph). The overregularization rate then becomes significant (sometimes quite dramatically, as with Lin) around the ages of 2;5-2;9. The remaining child (Ci), whose data don't start until 2;8, also shows a significant overregularization rate in this age period. The overregularization rate then fluctuates quite wildly, with all children showing periods without overregularization followed by further overregularizations in later months. Such fluctuations are also typical for overregularization patterns in inflection; U-shaped curves are not literally shaped like the letter U. Rather, as pointed out earlier, the key point is that there is an initial period of correct productions followed by a period where overregularization becomes noticeably more common. The right rising side of the U is much less noticeable, and it typically takes years (both for inflection and classifiers) to achieve adult-like behavior.

Another way to see the reality of the early accurate stage is to average data from all five children together, as in the following figure (here the error bars indicate 95% confidence intervals for the three to five averages for each age). Initially overregularization rates (and its variability across the children) are very low. Overregularization first becomes significant at the age of 2;9.

Figure 6. Average overregularization rates across the five children.



Data from the three additional children (Wenx, Yi, and Sheng) provide further evidence for an early stage of accurate classifier use. To save space, we put their data (ages 2;1-2;3) in a table rather than plotting them. Given variability, none of these overregularization rates is significantly distinguishable from complete accuracy (i.e. 95% confidence intervals overlap the 100% accuracy point).

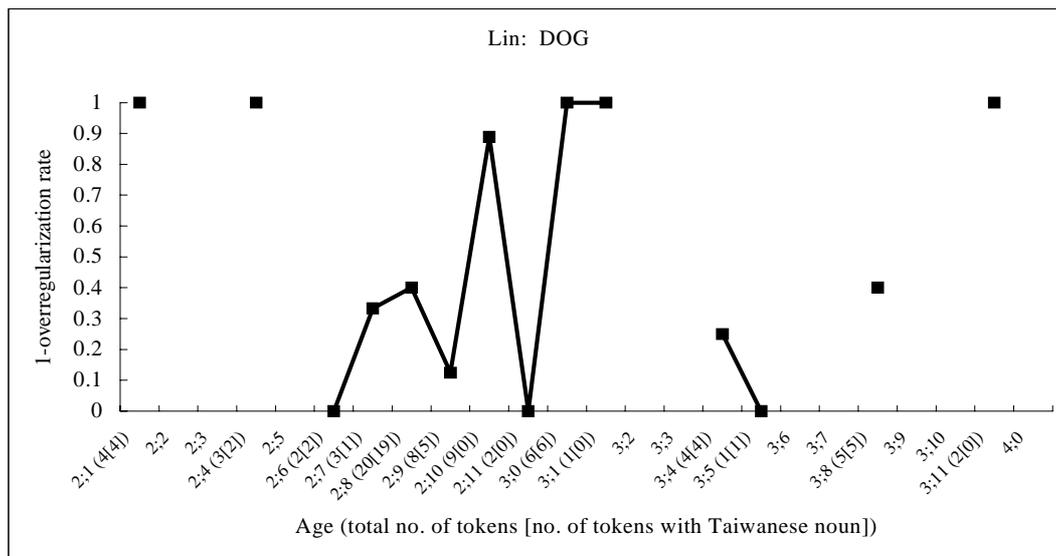
<sup>3</sup> Interestingly, a similar pattern has been found with adult Mandarin speakers (Myers 2000). A reasonable explanation is that specific classifiers provide more information than the default classifier. This explanation fits with the finding of Erbaugh (2000) that specific and default classifiers in Mandarin and Cantonese appear in complementary argument positions depending on the 'newness' of the information conveyed. As argued in Myers (2000), the lack of informativeness of the default classifier is consistent with the hypothesis that it is inserted by a default rule.

Table 2. 1-overregularization rates for three additional children

	2;1	2;2	2;3
Wenx	0.98	0.96	1.00
Yi	1.00	0.92	0.80
Sheng	0.97	1.00	1.00

It is possible that all the U-shape means is a tendency to make more errors on new words as they enter the vocabulary, not a general change in behavior. To test this, we must examine change of classifier use for particular nouns over time (similar tests are reported in Marcus et al. 1992 for English verb inflection). Our most talkative child, Lin, provides several test cases of this sort. As just one example, the following figure shows his changing overregularization rates when referring to dogs (whether by saying Taiwanese *kau* or Mandarin *gou*, or by pointing). The first number in parentheses by the age indicates the total number of tokens that this rate was calculated from; the number in square brackets indicates how many of these involved the spoken Taiwanese word *kau*. As can be seen, the pattern of accurate responses followed by a drop matches that in Figure 4, suggesting a genuine behavioral change.

Figure 7. Lin's overregularization rates for DOG.



One final possible way in which these changes in overregularization rates could be misleading is if the children were simply imitating random changes in overregularization by the adults around them, in particular the observer/transcribers. This possibility was checked most carefully with Lin, the greatest overregularizer. As it happens, the plot of the overregularization rates found in the speech of Lin's observer/transcriber (HTY) does follow that of Lin rather strikingly, rising and falling with his, though her overregularization rate is almost always less than his. The table below gives data illustrating this up to the time Lin reached 3;6.

Table 3. Overregularization rates for Lin and his observer/transcriber.

Age	2;1	2;2	2;3	2;4	2;5	2;6	2;7	2;8	2;9	2;10	2;11	3;0	3;1	3;2	3;3	3;4	3;5	3;6
Lin	0.00	0.00	0.10	0.06	0.76	0.83	0.38	0.45	0.33	0.31	0.17	0.09	0.18	0.63	0.36	0.67	0.52	0.71
HTY	0.00	0.06	0.30	0.04	0.22	0.55	0.17	0.21	0.16	0.17	0.13	0.09	0.12	0.58	0.19	0.05	0.41	0.24

The explanation for this parallel, however, is not that Lin was imitating the observer; in fact, precisely the opposite is the case. A careful search through the transcripts for the above period showed that Lin only imitated an adult's use of the default classifier 11 times. By contrast, the observer imitated Lin's use of the default classifier (including overregularizations) 100 times. For example, in one transcript (when Lin was 2;6), the observer correctly uses the vehicle classifier *tai* (台) when referring to a picture of fire trucks. Six lines later in the transcript, Lin uses default *e* for the same referent, and immediately after this the observer uses default *e* as well, and continues to use it through the remainder of the discussion. Moreover, the proportion of default classifier use in the child-directed speech found in our Lin transcripts is even lower than the proportion found in our transcribed radio broadcasts: a mere 30% of all classifier tokens.

Lin does imitate one aspect of adult classifier productions, however: the use of specific (i.e. non-default) classifiers. In the period 2;1-3;6, Lin repeats an adult's use of a specific classifier 207 times (whereas the observer repeats his only 75 times). This sharp contrast in Lin's treatment of specific and default classifiers provides further support for our suggestion that at an early stage of classifier acquisition, the child's behavior can primarily be explained by two forms of processing: rote imitation (of specific classifiers) and rule use (for the default classifier). One might even postulate that for Lin, an adult's use of the default classifier does not constitute relevant data for language acquisition, since he already knows the rule that generates it; instead, he focuses his attention on learning the exceptions to this rule.

In short, the U-shaped curve seems to be a real phenomenon. One of its most striking properties is the timing of the onset of overregularization (roughly between the ages of 2;5 and 2;9), since this is very close to the period of overregularization found with verb inflection in English (Marcus et al. 1992), namely roughly between 2;6 and 3;0 (though some children begin overregularizing inflection at an earlier age). Such similarities may arise from the genetically-programmed maturation of the language processor, or from similarities in the input and learning problem posed to the child. It is very important, therefore, to search for possible factors in the linguistic environment that may trigger overregularization, since finding them is the only sure way to rule out an innate rule-learning mechanism. This is the focus of the following section.

### 3.3 Triggers for overregularization

The question of environmental influence on language development lies at the heart of debates over nativism, so it would not be reasonable to expect a single study to settle it. All we attempt to do in this section is consider two environmental factors that have been discussed in the literature on the acquisition of inflection (e.g. Marchman and Bates 1994), and a nativist hypothesis about the triggering of overregularization (Marcus et al. 1992).

Marchman and Bates (1994) argue for what they call the 'critical mass hypothesis,' which states that the onset of overregularization in inflection is triggered by changes in the child's growing lexicon. In particular, they suggest that initial correct use of irregular inflection is attributable to the fact that early on, irregularly inflected forms dominate in the child's lexicon (since such forms tend to be of higher frequency than irregular forms). Only when a 'critical mass' of regular forms have been learned do the children begin to overregularize. That such input-triggered overregularization does not require an innate rule-learning mechanism has been demonstrated by the behavior of connectionist models (which lack innate rules) trained on such input. Moreover, Marchman and Bates claim that the total size of a child's vocabulary is a better predictor of their overregularization rates than the child's age, which further suggests that the behavioral change is environmentally triggered, not an innately-driven maturational process. Evidence in support of both claims is found in their study of 1130 English-acquiring children

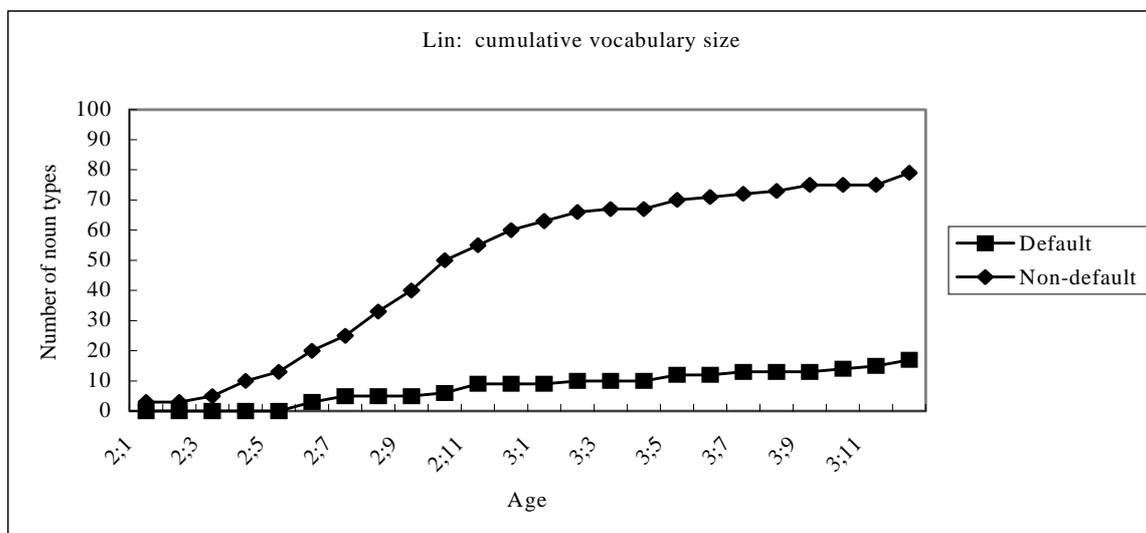
(1;4-2;6), whose parents filled out surveys on their vocabulary and inflected verb forms.

Unfortunately, these conclusions stand in sharp contrast to those of Marcus et al. (1992), who, from an analysis of longitudinal transcript data from a small number of English-acquiring children, found no evidence for changes in the proportions of regular versus irregular verbs in the children's growing vocabularies, and no evidence that vocabulary size affected overregularization rates. This is especially unfortunate since these two groups of researchers not only disagree theoretically, but also employed quite different methods of data collection. Marchman and Bates (1994) point out that the methods of Marcus et al. (1992) are limited in their ability to estimate vocabulary size accurately and to study correlations holding across large groups of children, and Marcus et al. (1992) reply (to an earlier version of Marchman and Bates's paper) that parental reports are also less than ideal, since only a limited number of verbs can be studied (i.e. those that happen to be in the survey forms) and token frequency cannot be studied at all.

Since the methods of this paper are more like those of Marcus et al. (1992), we are open to similar objections about our estimations of vocabulary size and composition. This is all the more serious since the number of classifier tokens in our corpus is much smaller than the number of inflected verbs in that of Marcus et al. (1992) (two of their subjects, Adam and Sarah, had used around 300 verbs by the age of four, whereas Lin, our most talkative child, only used about 100 distinct nouns with classifiers by the age of four). This smaller number means that we were unable to use the method preferred in Marcus et al. (1992) for estimating vocabulary size, namely the 'mark-recapture' method, which relies on the child reusing words many times over the course of development. Even Lin, our most talkative child, tended not to repeat many nouns from month to month (the maximum was two). The mark-recapture method isn't very useful with such low numbers, and so we had to rely on the less accurate measure of cumulative vocabulary size. However, as will become clear shortly, our available data are nevertheless quite sufficient for making solid conclusions.

First consider the proportion of 'regular' versus 'irregular' forms in the child's vocabulary. In our case, 'regular' refers to nouns that prefer the default classifier, and 'irregular' to nouns that prefer some non-default classifier. The following graph plots the cumulative vocabulary size in Lin's transcripts for both types of spoken Taiwanese noun ('default' and 'non-default') produced with a classifier (whether or not the classifier was correct).

Figure 8. The composition of Lin's vocabulary over time.



Even with this relatively crude measure of Lin's vocabulary, it is obvious that the critical mass hypothesis is not supported: the number of nouns preferring non-default classifiers outnumbers 'default nouns' from very early on, and the disparity just grows over time, with a final proportion of default nouns of only 17%. There simply is no 'mass' of default nouns, critical or not. Exactly the same thing is found for the other four children who are the main focus of this paper (proportion of *e*-preferring nouns in Ci's final vocabulary: 31%; Xuan: 19%; Ying: 30%; Jun: 16%). Moreover, recall that the dramatic drop in Lin's U-shaped curve occurred at the age 2;5. In our corpus, it is not until 2;6 that Lin first produced nouns that correctly preferred the default classifier (*holang* 好人 'good guy' and *phainnlang* 壞人 'bad guy'). We therefore have no evidence for the claim that correct 'regular' forms must be part of the active vocabulary before overregularization can begin.

Although such evidence is lacking, a weaker claim may still hold, namely that the size of the noun vocabulary in general correlates with overall overregularization rates. This would imply that the so-called default rule is actually just an epiphenomenon of word learning, as can be modeled with connectionism. Correlations are more meaningful with large numbers of subjects, as with the 1130 children studied by Marchman and Bates (1994). Since we have only five, it is impossible to draw any firm conclusions. As the table below shows, Lin had both the largest vocabulary (i.e. of Taiwanese nouns appearing with classifiers in our corpus) and also the highest overregularization rate (averaged over the period of the corpus). Nevertheless, the other four children show no consistent pattern.

Table 4. Vocabulary size and average overregularization rates.

	Ying	Xuan	Ci	Jun	Lin
Vocabulary size	10	42	54	58	96
Average overregularization rate	0.14	0.05	0.20	0.05	0.36

If factors such as vocabulary size and composition don't account for the onset of overregularization by our children, what does? In their study of overregularization in English past tense inflection, Marcus et al. (1992) claim that the onset of overregularization is triggered by the child's realization that inflection is obligatory in certain contexts. In other words, the child only needs to learn enough about English morphosyntax to know when marking the past tense is required. Overregularization will automatically occur then because the child's vocabulary is too small and lexical-access capabilities too unpracticed to reliably recall the correct irregular every time, so in order to obey the morphosyntax the default rule must be used. The key evidence for this claim is the observation that children begin overregularizing at approximately the same time that they stop dropping out inflection (e.g. utterances like 'Yesterday I drink' are replaced with utterances like 'Yesterday I drank').

In order to test this in our data, we needed to collect all instances of nouns found in our transcripts, whether or not they appeared with classifiers. We then had to identify which of these instances were ungrammatical due to the lack of a classifier. As with other aspects of this study, this was harder than the comparable task in English, since in many syntactic and discourse contexts it is perfectly grammatical to produce a noun without an associated classifier. Partly out of consideration of such difficulties, we relied on the nouns extracted from the Taiwanese corpus as part of a separate study on noun acquisition (part of Tai 1998-2001). These nouns were all taken from Lin, our most talkative child, who produced 408 distinct nouns (a total of 5025 tokens) over the two years of transcriptions. We then searched through the list of all utterances containing nouns and found all instances where Taiwanese native speakers (two of the original observer/transcribers) judged that a missing classifier made the utterance ungrammatical.

There turned out to be no point in examining these classifier-dropping errors systematically, since they were only found 8 tokens: half occurred during the first peak of overregularization (one at the age of 2;6, two at the age of 2;10), and the other half after the age of three (one token each at 3;0, 3;5, and 3;7). In other words, as other studies of Chinese classifier acquisition have found (e.g. Erbaugh 1986 for Mandarin, Wong 1998 for Cantonese), Lin almost never dropped out classifiers throughout the entire period of classifier acquisition. Therefore we cannot confirm the relevance of the suggestion Marcus et al. (1992) for our classifier data.

However, it is interesting to note that in these six classifier-dropping errors, it is always a non-default classifier that is dropped. For example, at 2;6 Lin said *nng kau* 兩狗 (literally 'two dog', without the required animal classifier *ciāh*). This observation may be taken as indirect support for an assumption behind Marcus et al.'s (1992) proposal, namely that overregularization and classifier-dropping are reflexes of the same thing: the young child's difficulty with the lexical access of 'non-default' forms.

#### 4. Conclusions

In this paper we have reported a number of theoretically interesting findings in the previously unstudied area of early Taiwanese classifier acquisition. Consistent with findings from other languages, we found that early on the classifier system seems to be treated mostly like a formal system, independent of its extra-grammatical categorization function. In particular, the evidence suggests to us that the early use of classifiers is under the control of two distinct processing modes: a rote-learning mode used with semantically specific classifiers, and a rule-learning mode used with the default classifier. Overregularization (overuse of the default classifier) presumably occurs when the child has trouble accessing the correct specific classifier from memory. As with the development of inflection, early classifier acquisition in Taiwanese shows a U-shaped learning curve, with rote-learning dominating at first, then followed by overregularization when the default rule is beginning to be learned. The onset of overregularization is thus not triggered mechanically by the distribution of classifier types in the input (although the pattern of input must have some effect, or else Mandarin learners would also show a U-shaped learning curve instead of the S-shaped pattern that they actually show). Moreover, the onset of overregularization in Taiwanese classifier use occurs around the same age as overregularization of inflection in English, namely between the second and third birthdays.

Parallels between the acquisition of Taiwanese classifiers and English inflection are especially intriguing given that these linguistic systems pose quite different problems for a language learner. First, whereas inflection systems live strictly within grammar, marking grammatical functions that sometimes have little to do with reality (e.g. gender), classifiers have a more ambitious job: classification. This means that learning how to choose classifiers is in principle as complex as all the myriad cognitive factors that go into human categorization of entities in the real world (e.g. Tai 1994). Second, whereas inflection is generally marked with an obligatory affix, classifiers in Chinese are separate words, and in fact nouns and classifiers often appear without the other; this makes learning of their association still more difficult. Third, as we pointed out in the previous section, classifier-noun collocations appear to be much rarer in spoken Taiwanese than inflected verbs are in spoken English. Such differences in linguistic patterns make it hard to imagine how similarities between the acquisition of classifiers and inflection could be input-driven. This leaves the possibility of a universal, innate rule-learning mechanism as an alternative worthy of further scrutiny.

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