The Acquisition of Japanese Numeral Classifiers -Linkage Between Grammatical Forms and Conceptual Categories-

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Abstract

This study examined the acquisition of Japanese numeral classifiers in Japanese preschool children, ages 3 to 6, with a primary emphasis on developing comprehension ability. Numeral classifiers, which exist in a large number of Asian languages, are a group of morphemes that usually occur adjacent to quantity expressions. The selection of numeral classifiers is determined by the inherent semantic properties of the noun whose quantity is being specified, suggesting that developing patterns of comprehension should be linked to underlying patterns of semantic and conceptual development. Previous research claims that children acquire certain distributional patterns very early but that the acquisition of the semantic system is a very slow process. We argue instead that, different techniques and stimulus contrast sets reveal a much greater sensitivity to semantic relations in young children than was previously considered possible. Reasons for the apparent slowness in classifier acquisition are also discussed as are the broader implications for relations between grammatical and conceptual development.

Introduction

Many languages throughout the world have grammatical systems that require a linkage between abstract, generative conceptual categories and grammatical forms. These abstract categories can have an indefinitely large number of subcategories, thus the category of flat two-dimensional objects includes not only familiar sub categories like sheets of paper and leaves, but also indefinitely novel categories that conform to the abstract structural description. Relations between such categories and grammatical forms can often be elaborate and multi layered in the numerical classifier systems of some languages. In these studies, we ask how developing patterns of language comprehension and production for numerical classifiers in Japanese might help us understand links to patterns of semantic and conceptual development for categories whose levels of abstraction might seem to be far beyond the cognitive capacities of preschool children. Grammatical structure may top into implicit conceptual structures of high degrees of abstractness and complexity; and they may do so in ways that, early in development, go for beyond those seen in explicit reports. A central question in this research is therefore whether an emerging competency in grammar accesses and perhaps acts as a scaffold for conceptual distinctions that are otherwise unavailable to the young children.

The numeral classifiers are a grammatical system that reflects how language speakers categorize objects during enumeration. Syntactically they occur as a group of morphemes that are usually adjacent to quantity expressions. The selection of numeral classifiers is determined by the inherent semantic features of the noun whose quantity is being characterized. In Japanese, the following three structures are typical numeral classifier constructions, with the classifier in the examples, *-mai*, referring to flat and two-dimensional objects such as paper, cloth, leaves etc.

kami o ***ni-mai*** *kat-ta*
paper OBJ. **two-CL** buy-PAST
'(I) bought two sheets of paper.'

kami ***ni-mai*** *o kat-ta*
paper **two-CL** OBJ. buy-PAST

ni-mai *no kami o kat-ta*
two-CL GEN. paper OBJ. buy-PAST

(All three examples have basically the same meaning.)

There are approximately 150 Japanese numeral classifiers of which roughly 30 are in frequent daily use (Downing 1984); but in other Asian languages, numeral classifiers have an even more extensive distribution. Adams and Conklin (1973) found 37 Asian languages with numeral classifiers and argued that animacy and shape and function were critical semantic features in most of them. Other language groups with classifier systems show similar patterns (Croft, 1994). There has, however, been far less work systematically comparing those aspects of shape, animacy, and function that are categorized with classifiers. Thus, we do not yet know if there are universal constraints on the sorts of categories so employed. Studies on the early origins of classifiers are therefore of special interest as the earliest forms across languages might converge to yield a common framework; and the developmental patterns might bring any possible constraints into relief much as they appear to do for aspects of grammatical knowledge.

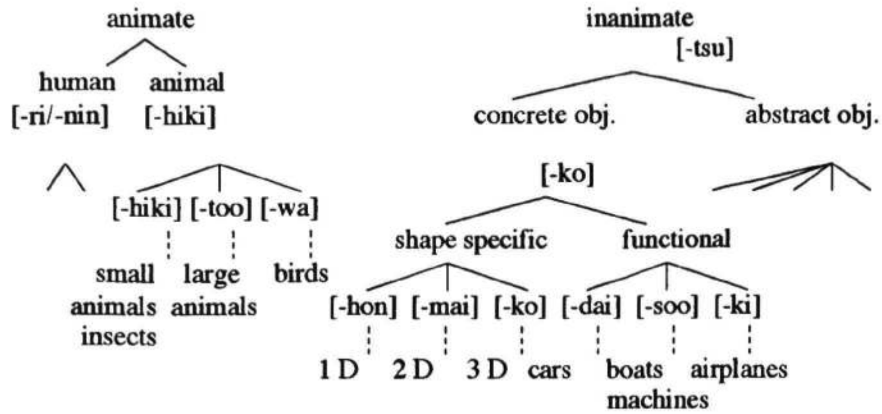

Figure 1. Japanese Numeral Classifier System

In Japanese, classifiers are divided into two major categories of animate and inanimate (see Figure 1). Animate classifiers are further divided into two sub-categories: classifiers for human beings and classifiers for animals. Inanimate classifiers are also divided into two categories, with classifiers for concrete objects and classifiers for abstract objects. Finally, concrete object classifiers are divided into two categories: shape specific classifiers and functional (non-shape specific) classifiers. Shape-specific classifiers have a broad semantic field, referring not only to inanimate concrete objects, but also plants and natural substances when they have a solid shape like an icicle.

Since a classifier's use depends on its referents' attributes, patterns of acquisition of classifiers have often been discussed as providing a potentially important source of information about underlying patterns of semantic and conceptual development (Adams and Conklin 1973, Clark 1977, Kokuritsu Kokugo Kenkyusho 1983, Craig 1986, Carpenter 1987, Matsumoto 1987). Yet, despite the strong interest in numeral classifier system and its relation to cognitive development, only four languages have been investigated in terms of the acquisition of numeral classifiers: Japanese (Sanches,1977; Kokuritsu Kokugo Kenkyusho,1983; Matsumoto,1985 a b and 1987; and Uchida, 1992), Mandarin (Erbaugh, 1986; Fang, 1985 and Hu, 1993); Thai (Gandour et al., 1984 and Carpenter, 1991), and Korean (Lee, 1994).

Cross linguistically children can acquire the syntactic constructions of numeral classifier phrases very early on (as young as 2 years); but the acquisition of a corresponding semantic system seemed to be a much slower process. Children first acquire a general classifier as a place holder and overuse it for any referents, a tendency that persists in much older children. Pin-pointing the precise acquisition order of specific classifiers is difficult, but in general, animate classifiers emerge first. In addition to a somewhat unclear development pattern of classifier acquisition, certain discrepancies seem to occur between recent research in cognitive development and work on classifier acquisition. In other areas of cognitive development young children are seen as using complex concepts in a flexible and productive manner. Two and a half-year-olds can overlook perceptual appearance in favor of category membership when appropriate (Gelman and Coley, 1990); and inductions about word meaning are guided by knowledge of two major ontological categories - object and substance (Soja, Carey and Spelke 1991). More recently, children who are just at the dawn of language acquisition, 18 months, seem to understand such global conceptual categories as animals and vehicles (Mandler, Mauer and McDonough 1991). There are also impressive early conceptual competencies in the acquisition of noun classes that can fill similar semantic roles as numeral classifiers. In Sesotho, a Bantu language in South Africa, children can mark agreement productively with demonstratives and possessives at age 2 and can mark most of the nouns appropriately at age 3 (Demuth, 1987). In French, children first use nouns without articles and when they start using articles children make enormous gender agreement errors, but by age 3 children can assign proper articles to nouns most of the time (Clark, 1985). In Spanish, children can master gender-marking and gender-agreement before they are 4 years old (Perez-Pereira, 1991). In German, 3 year olds show virtually no errors in pronoun use in connection with the natural-gender rule (Mills, 1986).

The literature on the acquisition of numeral classifiers therefore does not seem to fit well with other work on semantic and conceptual development. We see no reason for assuming that either the conceptual complexity of the classifier categories or the grammatical complexities of their usage should cause children to be unable to link up grammar and conceptual structure until well into middle childhood. Instead, the apparent developmental delay may be occurring for a very different reason that in the end will reveal, almost paradoxically surprisingly sophisticated and abstract linkages between grammatical and conceptual structures in very young children. The delay may be caused by the faulty assumption that failures with lower level categories entails failures with higher level ones. We predict that young children can easily conceptualize categories in numeral classifier systems and link them to grammatical forms. Previous research may have underestimated children's ability to acquire numeral classifier system accurately because the conclusions are all drawn from children's production data In this study we focus primarily on children's comprehension of numeral classifiers. Thus, both an excessive focus on production tasks and misleading assumptions about ease of categorization at different levels of abstractions may have created an illusion of lengthy development for classifiers.

In the studies that follow we tested 11 numeral classifiers that are in frequent daily use and that have been tested in production research. This enabled a direct comparison between production and comprehension ability. The 11 classifiers are from four different categories; a classifier *-ri/nin* for a human being (*-ri* is used to count up to 2 and if the number is more than two, *-nin* is used. There are other human classifiers but *-ri/nin* is used most commonly and can be considered as a default human classifier); three animal classifiers *-hiki*, *-too* and *-wa* (*-wa* is used for birds, *-too* is used for animals which are larger than human beings, and *-hiki* is used for animals which are not referred to with *-wa* and *-too* and is also used to count animals in general); three shape-specific classifiers, *-hon*, *-mai*, and *-ko* (*-hon* is used for one dimensional concrete objects, *-mai* is used for two dimensional objects and *-ko* is used for three dimensional objects, however *-ko* is increasingly used as a default concrete inanimate classifier); three functional classifiers *-dai*, *-soo*, *-ki* (*-dai* is used for machines including cars, TVs and such, *-soo* is used for boats, and *-ki* is used for airplanes); and a default inanimate classifier *-tsu* (*-tsu* is used for almost all kind of inanimate entities, both concrete and abstract, however specific classifiers tend to be used as long as objects being counted meet the criteria of those specific classifiers). We tested the comprehension of numeral classifiers under two different conditions using the point-to-a-picture task. In Experiment 1, classifiers from different domains were compared, and in Experiment 2, classifiers from the same domains were compared.

Experiment 1

Method

One hundred fifty-seven children (ages 3, 4 and 5) from three Japanese daycare centers participated in the experiment. Experiment 1 consisted of four conditions. For each condition, 12 cards, each containing three pictures were prepared. In Experiment 1, numeral classifiers from different domains were tested against each other. Therefore the contrasts among classifiers were maximized, such as animal classifiers vs. shape classifiers vs. functional classifiers.

The experimenter explained to the child that they were going to play a point-to-a-picture game. The rule was that the experimenter would count the items in one of three pictures in a card, then the child had to find out which picture the experimenter counted and point to it. After the explanation, the experimenter placed one of the cards containing three different pictures in front of the child and counted the items in one of the three pictures. The verbal experiment. Experiment 1 consisted of four conditions. For each condition, 12 cards, each containing three pictures were prepared. In each picture there were two instances of the same item. In Experiment 1, numeral classifiers from different domains were tested against each other. Therefore the contrasts among classifiers were maximized, such as animal classifiers vs. shape classifiers vs. functional classifiers.

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Four to seven days after the sense classifier conditions, the same children participated in the nonsense classifier conditions to measure any picture biases. The procedure was identical to the sense classifier trials, but three classifiers in each test were replaced with three nonsense words.

Results

The number of correct responses for each classifier from the four trials were aggregated in each sense classifier condition. The base rate was determined based on the nonsense classifier results.

At age 6, all the tested classifiers are interpreted correctly ($p<.0005$, one tailed t test), except for a classifier *-ki* for airplanes ($p<.05$). At age 5, the classifier-*ki* is not interpreted correctly while the rest of the classifiers are ($ps<.0005$ for 9 classifiers and $ps<.005$ for a bird classifier *-wa*.). At age 4, except for-*ki*, all the classifiers are understood correctly ($ps<.0005$ for 8 classifiers and $ps<.005$ for 2 classifiers). At age 3, only four classifiers are understood correctly: *-too* for large animals ($p<.0005$); *-hiki* for small animals in Condition 1 ($p<.05$), *-hon* for one dimensional objects ($p<.005$), and *-ri* for human beings ($p<.0005$).

An analysis of frequency to chose correct picture with sense classifier over nonsense classifier revealed that at age 4 children start comprehending almost all the tested numeral classifiers, which include three general classifiers and eight specific classifiers . A classifier-*ki* for airplanes seems to be the most difficult classifier for children to comprehend and correct comprehension of this specific classifier may not occur until age 6.

Even at age 3, children start differentiating a general classifier *-ri* for human beings from other general classifiers, *-hiki* for animals and *-tsu* for inanimate objects. They also differentiated a classifier *-too* for large animals and *-hon* for one dimensional long objects from other specific classifiers tested together. We tested the classifier *-hiki* twice, first as a specific classifier for small animals and insects and the second as a general classifier for animals. *-Hiki* was differentiated in Condition 2 by 3 year olds when it was tested against-*ko* and *-dai*, from a concrete object category and a functional category respectively, but it was not

Table 1 Mean Percentage of Correct Responses

	3 years old	4 years old	5 years old	6 years old
Condition 1.	(N=68)	(N=88)	(N=80)	(N=72)
Too (large Animal)	.50 ***	.44 ***	.58 ***	.72 ***
Ki (air plane)	.40	.36	.51	.56 *
Mai (2D object)	.27	.58 ***	.88 ***	.79 ***
Condition 2.	(N=68)	(N=88)	(N=80)	(N=72)
Hiki 1 (animal)	.44 *	.77 ***	.93 ***	.90 ***
Ko (3D object)	.34	.47 ***	.64 ***	.86 ***
Dai (machine)	.43	.63 ***	.81 ***	.88 ***
Condition 3.	(N=76)	(N=88)	(N=96)	(N=60)
Hon (1D object)	.45 **	.56 ***	.77 ***	.93 ***
Wa (bird)	.32	.59 ***	.63 **	.78 ***
Soo (boat)	.34	.48 *	.65 ***	.68 ***
Condition 4.	(N=76)	(N=88)	(N=96)	(N=60)
Hiki 2 (animal)	.55	.77 ***	.85 ***	.83 ***
Tsu (inanimate object)	.26	.34*	.57 ***	.75 ***
Ri (human being)	.58 ***	.67 ***	.89 ***	.80 ***

*p < .05, **p < .005, ***p < .0005

differentiated when tested against two general classifiers *-tsu* and *-ri* in Condition 4. The mean percentage of correct response for *-hiki* at age 5 and 6 are higher in Condition 2 than in Condition 4. The objective in experiment 1 was to maximize the contrast among three classifiers but it is likely that having two animate categories, animal and human being, in Condition 4 made the contrast less strong, and thus affected the children's performance with the classifier *-hiki*.

There is clearly a large gap between children's comprehension and production ability and an interesting pattern of difference (see Figure 2-5). Production data has shown that children, ages 4 to 7, are capable of using general classifiers such as *-tsu* (inanimate general classifier) and *-ri* (human general classifier), but are incapable of using specific classifiers such as *-wa* (birds), *-too* (large animals), *-hon* (1D objects), *-mai* (2D objects), *-dai* (vehicles and machines), *-soo* (boats) and *-ki* (airplanes). In comprehension, specific classifiers such as *-too, -wa, -hon and -mai* were interpreted correctly, and about as well as general classifiers. Although at age 7, the three functional classifiers, especially *-ki* and *-soo* were hardly produced correctly, 6 years olds could comprehend *-ki* and as early as age 4, they could comprehend *-soo*. Comprehension often precedes production by several years in the acquisition of Japanese numeral classifiers. In the strong contrast comprehension task, children showed a much more fine-grain categorical ability which could not be demonstrated in their production. One exception involves comprehension of the 3D classifier *-ko* and the general default inanimate classifier *-tsu* which lagged behind the production data, indicating that children especially at younger ages, classify those two classifiers as across the board default classifiers. They apply them both to animate and inanimate entities, which resulted in correct production and relatively poor comprehension. The comprehension data therefore shows how correct production did not necessarily mean that children had an adult like understanding of *-ko* and *-tsu*. In Experiment 1, 11 classifiers were tested under conditions in which the contrast among the three classifiers were maximized, which meant that classifiers from three different categories were tested against each other. The critical follow up question asks if children demonstrate the same level of comprehension if three classifiers within the same category are tested against each other. To address this question, we conducted Experiment 2.

Experiment 2

Method

Thirty-two children (ages 3, 4 and 5) participated in the experiment. Experiment 2 consisted of three weak contrast conditions. In each test three classifiers from the same category were tested against each other. The procedures were identical to Experiment 1.

Results

At both age 4 and 5, the children did not comprehend all three functional classifiers in weak contrast conditions. At age 4 the shape-specific classifier *-ko* for 3D objects and the classifier *-too* for large animals were not interpreted correctly, but the rest of the tested classifiers were

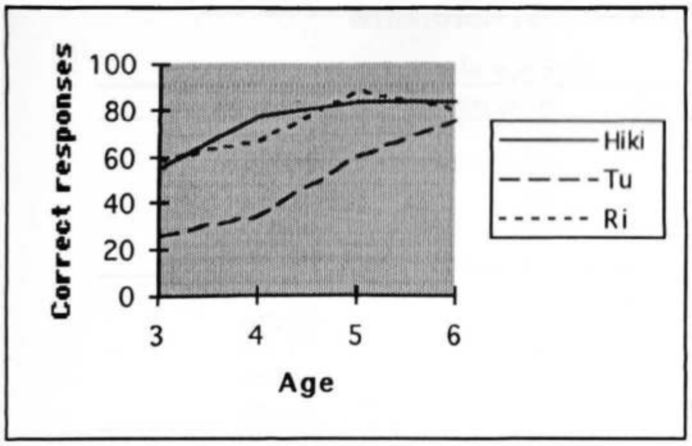

Figure 2: General classifiers - comprehension data

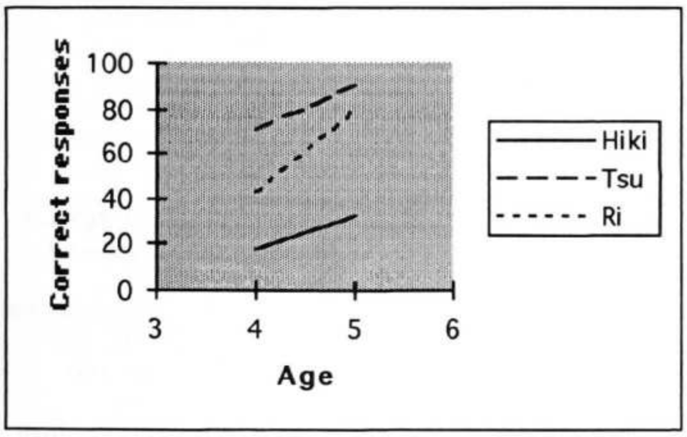

Figure 3: General classifiers - production data (Matsumoto, 1985)

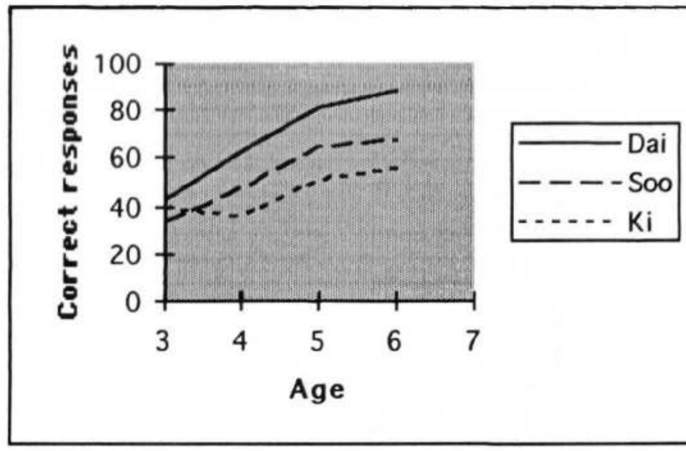

Figure 4: Functional classifiers - comprehension data

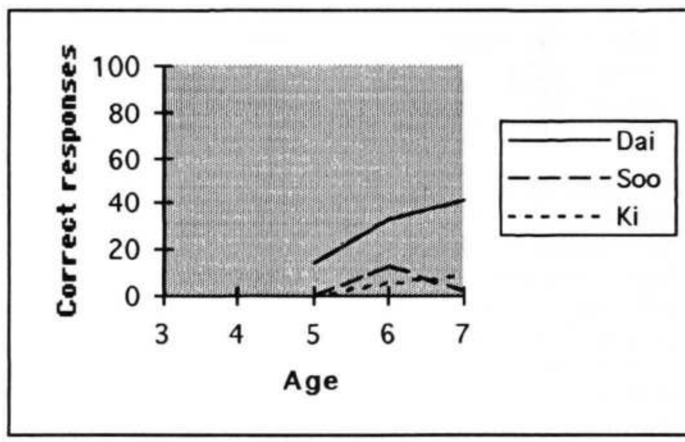

Figure 5: Functional classifiers - production data (Matsumoto, 1985)

($ps<.005$). At age 5, both shape specific classifiers and animal classifiers were understood in the weak contrast condition ($ps<.0005$). Again the classifier *-ki* for air planes was the most difficult classifier for children to acquire. Only at age 6 in the strong contrast condition, did children comprehend this classifier. Since *-ki* is the least frequently used by adults among 11 numeral classifiers, it makes sense that it is the last classifier to be acquired. Interestingly, when these three functional classifiers were tested in the weak contrast conditions, 4 and 5 year olds could not differentiate them, however in the strong contrast conditions, they could differentiate two classifiers *-soo* and *-dai* from classifiers in other categories.

The results from the strong contrast and weak contrast conditions indicate that comprehension of the tested classifiers from three different categories proceeds through a differentiation of broader categories (animal classifiers vs. shape specific classifiers vs. functional classifiers) to much finer distinctions (small animal classifier vs. large animal classifier vs. bird classifier). Although children could not differentiate specific classifiers from the same categories (weak contrast), children could differentiate them when they were tested against specific classifiers from different categories (strong contrast). It is likely that children start conceptualizing the classifier system at around age 3, but it is at a broader and higher level in a hierarchical categorical structure, then gradually master more specific subclasses until, by age 6, they form an adult like semantic system for commonly used classifiers.

This view is consistent with Mandler, Bauer and McDonough (1991), who claim that basic-level categories do not form an entry level in the development of hierarchical categorical systems, with children appearing to begin categorizing at a more global level, then gradually the global categories become differentiated to finer distinctions.

General Discussion

The strong contrast comprehension tests revealed a much greater sensitivity to the semantic relations underlying numeral classifiers in young children than was previously considered possible. Production research had suggested a slow acquisition process in which first inanimate general classifier *-tsu* and 3D object classifier *-ko* appeared as a generic classifier before other specific classifiers were used. Then in each category domain, acquisition proceeded from more general to specific classifiers. However even at age

Table 2: Mean percentage of correct responses from weak Contrast Test and Strong Contrast Test

	Four year olds		Five year olds	
	Weak contrast	Strong contrast	Weak contrast	Strong contrast
Condition	(N=64)	(N=88)	(N=76)	(N=80)
Ki (air planes)	.38	.36	.38	.51
Soo (boats)	.42	.48 *	.39	.65 ***
Dai (machines)	.36	.63 ***	.33	.81 ***
Condition 2	(N=64)	(N=88)	(N=76)	(N=80)
Hon (1D objects)	.53 **	.56 ***	.59 ***	.77 ***
Mai (2D objects)	.52 ***	.58 ***	.77 ***	.88 ***
Ko (3D objects)	.42	.47 ***	.58 **	.64 ***
Condition 3	(N=64)	(N=88)	(N=76)	(N=80)
Too (large animals)	.34	.44 ***	.53 ***	.58 ***
Wa (birds)	.50 **	.59 ***	.63 ***	.63 ***
Hiki (animals)	.63 ***	.77 ***	.63 ***	.93 ***

*p < .05, **p < .005, ***p < .0005

seven, the generic inanimate classifier-*tsu* and 3D classifier -*ko* were still over used with a large number of nouns. Yet in these comprehension studies children as young as 4 years had a good grasp of 10 out of 11 tested numeral classifiers and even at age 3, children comprehended not only the generic classifiers -*hiki* and -*ri* but also the specific classifier -*too*. By age 6, children displayed adult like understanding with almost all the 11 classifiers. The acquisition of classifiers proceeds, not from general to specific classifiers, but through a differentiation of broader categories to much finer distinctions which is similar to the process of the conceptual categories in the taxonomy examined by Mandler, Bauer and McDonough (1991).

Our data showed that the young children are capable of conceptualizing highly abstract, complex conceptual categories that are represented in the numeral classifier system. We further claim that it is grammatical structure and emerging competency in grammar that make this implicit conceptual structure accessible to children and facilitate conceptualization, otherwise, these conceptual distinctions would be unavailable to children.

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