

Comparative Discussion about Piagetian Searching Behavior

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ABSTRACT

Spatial searching behavior in Piagetian object searching tasks was discussed from comparative point of view. It is suggested that nonhuman primates can solve the tasks at earlier phase of their developmental course and also that the rate of such development is much faster than human infants. Also difference of responses brings great difference in performance of the tasks.

Piaget (1965) studied development of spatial concepts of human infants through a series of so-called Piagetian object permanence tasks in sensori-motor period (0 to about 2 years old), which asked infants to search an object hidden somewhere in the environment. Often Infants show the wrong and strange searching. There are typical errors for each task according to the developmental stage of the subjects. Piaget interpreted these strange searching mainly as due to immaturity or strangeness of object concept infants have, that is, in terms of cognitive development. After his study many students have tried to interpret those strange searching from many points of view ; specificity of object concept during infancy, memory, coordination difficulty between visual and manual response and so forth.

Though it is not yet interpreted completely, Acredolo et al. (1978) insisted the importance of developmental change about using visual information in the environment as a cue for searching. In their experiment with human subjects of three age group, 6 months, 11 months and 16 months, they found that the way of spatial coding changes around 11 months; 6 months aged infants searched the objects in the direction which they found it before the relative spatial relationship was changed 180° by displacement and thus they failed in searching. 16 months aged infants could search the object even though the relative relationship was changed. 11 months aged infants showed the results similar to that of 6 months infants when a landmark was not attached to one of two hidden places, that is, when a visual cue was not presented in the situation, while their results were similar to that of 16 months when the landmark was presented. From these results they insisted that the developmental process of spatial searching during infancy was the process for infants to become able to use visual information for their searching instead of using their own body as standard. Similar results were also reported from other experiments and it was confirmed that infants searching changed around 10 months concerning the way of the spatial coding as described above.(cf. Bremner 1978. Bower 1978, Baitermrrph 1975)

Does such critical period as about 10 months in human infants exist also in nonhuman primates? In other words, does nonhuman primates also change in their searching behavior, at some point in

their developmental course, in such way as using visual information for searching hidden object?

Experiment using Japanese monkeys (Shiotsubo) suggests that development of searching behavior of nonhuman primates in Piagetian tasks follows different course from that of human infants. It is suggested that there is not such a drastic change in using visual information in nonhuman primates and that their searching behavior is much more excellent than human infants.

Using locomotive response and adding necessary modification for monkey subject, similar experimental procedure was given to five infant Japanese monkeys. The object for searching was a brown towel piece of about 30×50 cm, for which enough attachment was created for the subjects to follow them. As shown in Fig. 1, the object was presented from one of two windows (24×24 cm) of a small chamber (140 cm square and 70 cm high). As a visual cue for searching, landmark (see Fig 2), a board of 50×50 cm striped by gray and orange colors was used. This landmark was put on one of two windows to decorate its fringe and thus brought visual difference between them, that is, two hiding places. After object was presented and then hidden, subjects were displaced 180° from S_1 to S_2 or S_2 to S_1 . After displacement subjects started searching by locomotion.

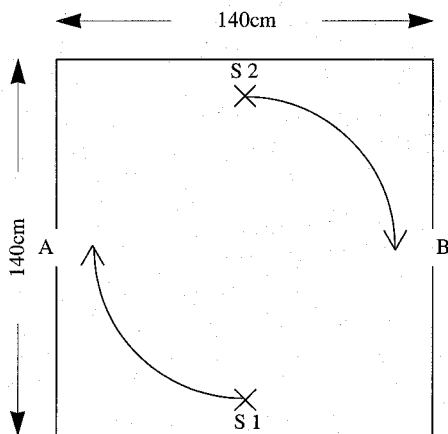


Figure 1 Small Chamber

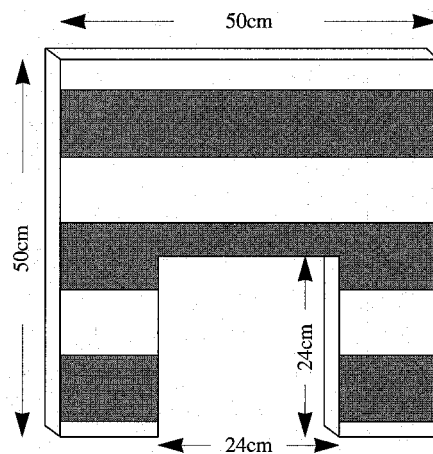


Figure 2 Landmark

The results are shown in Table 1, Fig. 3 and Fig. 4. L (Landmark) condition means trials, in which the landmark was put on either one of two windows. NL (No Landmark) condition means trials in which landmark was put on neither of the windows.

Experiment was introduced when subjects could succeed in searching the object behind one of two hiding places, that is, one of two wooden screens of 34×34 cm. This searching behavior corresponds to that of 6-8 months human children in a series of Piagetian object permanence tasks.

Correct response is such behavior of monkeys as arriving at the hiding place or at the hidden object. When three successive correct responses were observed either in the same day or in two successive days tasks were considered as performed.

As shown in Table 1, and Fig 3 and 4 the subjects could solve the tasks both of L and NL almost already at the age that the experiment was introduced. This means that the subjects could

solve the the object searching tasks of of 6-16 months human infants comparatively in much shorter period and also at earlier stage of development.

As for other studies with nonhuman subjects, there are few that tried to find the factors defining the searching behavior in the tasks. Those studies were mainly interested in applicability of developmental theory by Piaget to nonhuman infants and often insisted that the development of cognitive process in nonhuman subjects were very interpretable by his theory and that thus the phylogenetic validity of his theory was proved; the order of the tasks which the subjects become able to solve was the same as that of human infants and the final task the subjects can reach depends upon their intelligence from evolutionary point of view.

However there is a problem in these studies, especially those with primates. Like experiments for human subjects, usually searching was studied by using manual response especially with primates and for the tasks of the later stages. But when compared with human infants, manual response is not well developed nor skillful, and not even dominant response in primate infants. therefore there is a difficulty in comparing searching behavior or cognitive development or intelligence of primates and human being from the results of Piagetian object permanence tasks using manual response.

Table 1 : Result of Experiment 1

Individual Number	NL Trial		L Trial	
	Day when trial was introduced	Day through criterion	Day when trial was introduced	Day through criterion
622	51	52	53	53
631	36	36	36	36
627	44	44~45	46	46
625	46	70	47	70
636	53	53	53	53
Mean	46.0	51.1	47.0	51.6

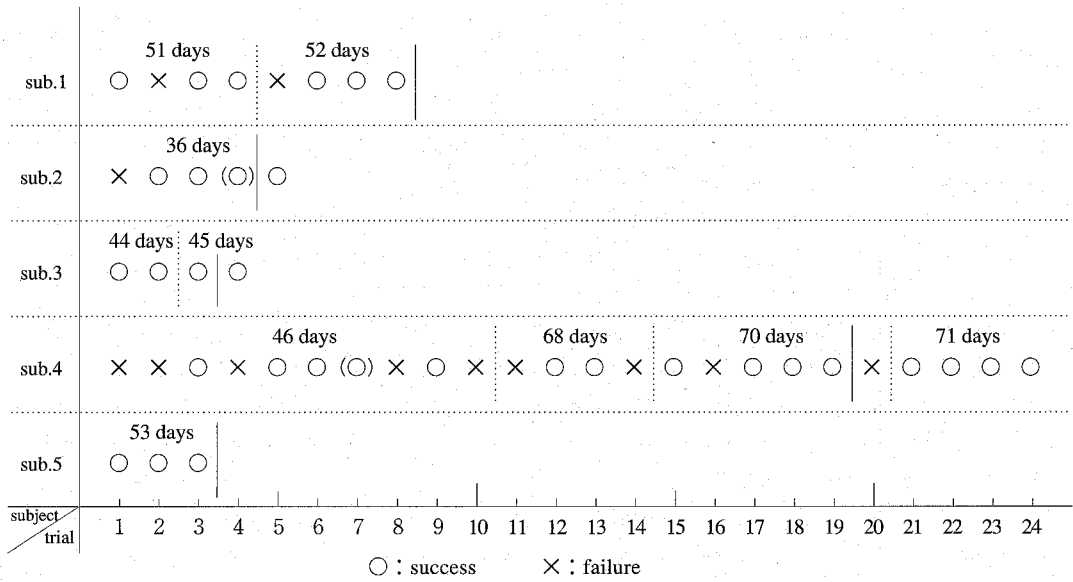


Fig 3 Individual Data in NL Condition Trials

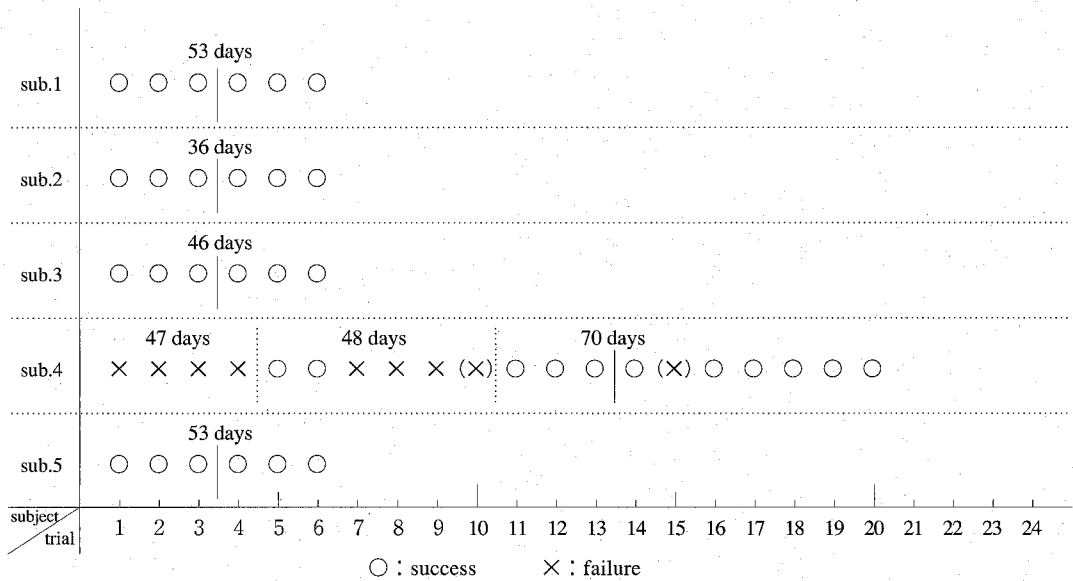


Fig 4 Individual Data in L Condition Trials

While manual response is not so better in monkeys, spatial abilities such as jumping or walking develop far much better and earlier than human infant. Therefore if these response are used for searching instead of manual response infant monkeys may show more excellent searching as the result of the above experiment.

This is suggested also by the results of the experiment by Wise et al.(1974). In their study the tasks requiring locomotive response and the tasks requiring manual response were given to rhesus monkeys. Though other experimental situations were also slightly different, they reached the criterion for each tasks at much earlier developmental ages when locomotive response was used than when manual response was used.

Antinucci(1989) also reported the same tendency with using manual response as shown in Table 2 and Fig.5. Macaques pass through the stages very early and rapidly compared to human infants and Gorilla.

Table 2
Age of Achievement (in days) of the First Four
Stages of Sensorimotor Intelligence by Each Species (Antinucci, 1989)

	Stage 1	Stage 2	Stage 3	Stage 4
Macaque	0	7	25	65
Cebus	0	32	61	102
Gorilla	0	56	168	356
Child	0	57	167	296

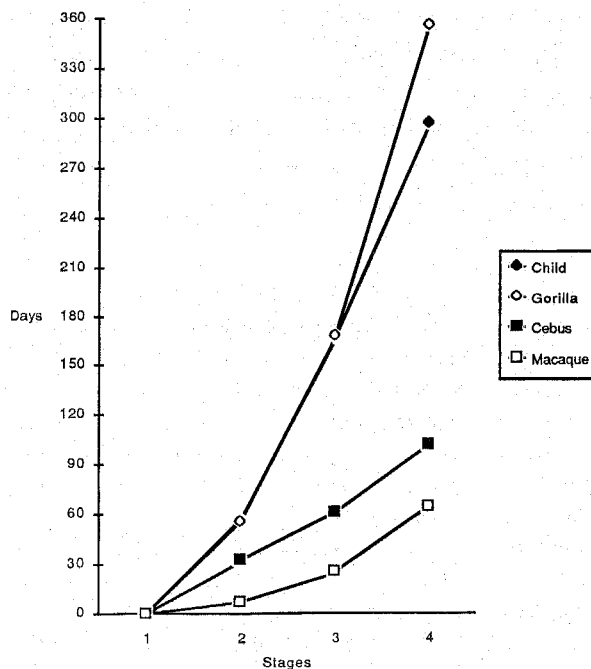


Fig.5. Ages of achievement (in days) of the first four stages of sensorimotor intelligence development in each species. (Antinucci, 1989)

Conclusion

What is shown by the above three experiments about difference between human and nonhuman primates? First macaques can pass the piagetian searching tasks in very early phase of their developmental course. Second macaques pass through the developmental stages in very fast rate. Finally differences of responses bring differences of performance : when locomotive response is used macaques can perform far much better than when manual response is used. Generally speaking macaques show excellent spatial abilities in these tasks. This cannot be explained by those theory that abilities needed for Piagetian tasks reflect phylogenetic difference as often stated.

Usually, for Piagetian object searching tasks, visual response such as looking is used at the earlier stages and then manual response such as reaching at the later stage. This is often the case with primate subject as well as with human subject. However manual response is not so often observed nor skillful in infant monkeys as in human infants of after about 5 months on while their locomotive response is much better developed from earlier period than human infants. This means that the repertoire of main responses available and used at each developmental stages should be considered different between monkey and human babies and that this difference should be taken into consideration in comparing their searching behavior or other spatial behavior.

This suggests also that it is necessary to study the development of the spatial behavior as searching the hidden object in terms of the development of the spatial behavior, such as locomotion, at each developmental stages (Antinucci, F., 1987). Indeed in Japanese monkeys motor abilities show radical improvement around 30 days after birth, including walking or jumping which relates to locomotion. And around that period baby monkeys began to succeed in searching the hidden object. On the other hand, human infants begin to crawl and then to walk after around 10 months; thus their spatial behavior begins to change radically around that time. Therefore the time that the searching behavior of human infants begins to change about using visual information in the environment as observed in the experiment by Acredolito is also the time that their spatial abilities change radically as well as. This is very suggestive together with the results here and of Wise et al. to study the development of the spatial behavior both in human infant and monkeys.

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