Babies infants knowledge

Claims about infant number competence contrast with claims of toddler ignorance. Consider explanations of the discrepancy.

1- Introduction:

This essay will explore the researches which claim that babies are born with a predisposition to learn about objects and numerosities. It also aims to understand the issues that why some psychologists are still unconvinced about inborn knowledge. And if babies are so smart, why are preschoolers so ignorant? The question is to what extent is the sense of numbers innate and to what extent is it learned?

Piaget used observational and informal experiments to study infants. He denied the existence of innate knowledge. Early Piaget experiments (1942) described that infants are born with no understanding of numerosity. He argued that the number concept is built from previously existing sensorimotor intelligence.

In contrast, recent researchers argue that sensitivity to number is innate and even young infants possess strikingly mature reasoning abilities in the numerical domain.

Vygotsky (1978) pointed out “... children's learning begins long before they enter school... they have had to deal with operations of division, addition, subtraction, and the determination of size. Consequently, children have their own preschool arithmetic, which only myopic psychologists could ignore” (p. 84).

Similarly, recent experiments have shown that infants between 4 to 7 months are able to discriminate two items from three items, but not 4 items

from 6 items (Starkey et al 1983). In 1992, Karen Wynn argued that “ human infants can discriminate between different small numbers of items” (p. 749). Wynn used differences in looking times as evidence of knowledge. Similar logic in Baillargeon’s (2004) studies of infants is reported.

In contrast to claims about infant capabilities and predispositions, recent studies of toddlers (preschoolers) suggest slow development and gradual understanding of numerical skill.

Now we will discuss the researches which claim about infants’ knowledge of number competence contrast with claims of toddler ignorance.

2- Studies which claim about human infants’ knowledge of number competence:

2. 1- Wynn’s approach:

In 1992, Karen Wynn, came up with the idea of using a technique called Preferential Looking Time (PLT) to study the mathematical abilities in babies. Wynn took advantage of the fact that infants will gape, eyes wide with surprise, at things they don't expect to see, to show that babies as young as five to ten months old can add and subtract small numbers.

In her experiment Wynn (1992) shows the baby a Mickey Mouse doll and then places it behind a screen. As the baby continues to watch, the researcher places a second Mickey behind the same screen. In half the trials, she then uses a hidden trapdoor to remove one of the dolls. Then screen drops and Wynn found that babies stared much longer when only one Mickey doll is there. They had apparently expected to see two. But were the babies

really calculating " one plus one equals two"? Or did they simply realise that one plus one had to equal something more than one? To answer that question, Wynn tried the babies on " one plus one equals three". The babies were appropriately surprised when three dolls appeared from behind the screen rather than two. According to Wynn (1992), “ infants possess true numerical concepts- they have access to the ordering of and numerical relationships between small numbers and can manipulate these concepts in numerically meaningful way” (p750).

Wynn argued that looking for longer time at the wrong results of 1+1 and 2-1 is evidence that infants have innate number knowledge. There are many questions which need explanations e. g. were infants surprised or familiar? Were they responding to differences in quantity or numerosity? Can infants really add and subtract? etc.

Leslie B. Cohen and Kathryn S. Marks in ‘ How infants process addition and subtraction events’ mentioned….

“ Wynn has argued that infants are not only sensitive to number; they are able to manipulate small numerosities. She pointed out three major claims about infants’ abilities:

- Infants understand the numerical value of small collections of objects.
- Infants’ knowledge is general and can be applied to varying items and different modalities (for example, Starkey, Spelke, & Gelman, 1990).
- Infants are able to reason at the ordinal level and compute the result of simple arithmetic problems (i. e., add and subtract)”... (P. 5-6).

Wynn (1990) argued that children learn the meanings of smaller number words before larger ones within their counting range, up to the number three or four and by the age of 3 ½ years they can learn cardinal principle.

But in everyday life we are failed to provide the evidence regarding the competence in early years of life. There is no doubt that many studies reported that children have an innate understanding of the basic counting but many other studies which do not support these findings.

2. 2- Starkey, Spelke, & Gelman approach:

In 1990, Starkey, Spelke, & Gelman found that infants between ages 4 and 7½ months can differentiate two items from three, but not 4 items from 6. In this study, 7 month old infants were presented with two photographs of two or three items accompanied with two or three drumbeats. Starkey et al.'s criterion was same as Wynn's (difference in looking time). The infants looked significantly longer at the photos with the number of items matching the number of drumbeats. This study did not tell us that infants perceived that 2 is more than 1 or 3 is more than 2. The ability to understand even small numerosity from the early months of life seems to suggest that there is an innate mechanism for number which forms the basis for further development of numerical skills and abilities. Starky et al. (1990) interpreted these results as evidence that infants can recognize the number distinctions both in audio and visual display.

This research is also controversial. There are contrasting claims which abandon ideas of competence. According to Mix, Huttenlocher, and Levine (1996), " it has been claimed that acquisition of the conventional number system is guided by preverbal numerical competencies available in infancy

(Gallistel& Gelman, 1992; Gelman, 1991). Thus, if infants have an abstract number concept, this should be evident in early childhood" (p. 1593).

Mix, Huttenlocher, and Levine (1996), using a procedure adapted for preschoolers, found that three-year-olds were unable to correctly match auditory to visual numerosity.

3- Studies which deny the claim of human infants' knowledge of number competence:

3. 1- Mix, Huttenlocher, and Levine approach:

Mix, Huttenlocher and Levine (1996) tested infants, toddlers and preschool children from a variety of backgrounds to see at what age they began to recognize the connection between repeated sounds and similar numbers of objects before them and when infants and children begin grasping the basic concepts of mathematics. They conducted three experiments to find out whether preschool children could do significantly well on similar tasks as used by Starkey et al.'s (1990) infants studies.

They found that infants were unable to make the audio-visual matches but could make visual-visual matches. Similarly, three year olds were able to make visual matches between groups of objects and sets that corresponded in number, but only made the same number of audio-visual matches they would have made had they been guessing. According to Mix, Huttenlocher and Levine (1996) " In contrast, 4-year-olds performed significantly above chance in both conditions, indicating that the ability to detect audio-visual numerical correspondences develops during this age period"(p. 1600).

They argued that if Starkey et al.’s (1990) claims about infants are true then preschoolers should show a similar competence. By their studies, Mix, Huttenlocher and Levine (1996) found no evidence that 3 year olds can detect audio-visual numerical correspondences. The developmental period between 3 to 4 years was found to be a crucial for mathematics, as preschoolers quickly expand their ability to understand the abstract relationship between numbers and sets as dissimilar as objects and events. They also tested toddlers' ability to perform nonverbal calculation and found that the ability develops between ages 2 ½ and 3.

Some studies have suggested that abstract numerical knowledge develops in infancy, but Levine and Huttenlocher found that babies only have an approximate understanding of numbers and at age of 3 years children can represent number exactly.

Mix, Huttenlocher and Levine (1996) claim that:

- The discrepancy is due to the contrast criteria between infant study and preschool study. For infant study criteria was looking for longer time and in preschool study an active choice response was needed, which was much more demanding criteria.
- The ability to match and calculate correctly, nonverbally, is neither innate nor independent of general ability.

Mix (1999) studied preschool children to see whether they ‘ recognise numerical equivalence between sets that vary in similarity’. She pointed out that if claims about number competence in infancy are true then children should be able to judge numerical equivalence for other types of similarity.

She emphasized that none of the tasks in infants' studies " requires the explicit numerical comparison of one set to another" (p. 272).

According to Mix (1999) " a prevalent claim is that numerical abstraction emerges very early, perhaps as part of an innate knowledge structure that is specific to the number domain (Gallistel & Gelman, 1992). This implies that development of numerical competence should have some advantages or at least follow a distinct path compared to other domains" (p. 290). But she did not find any evidence. She proposed that discrepancy between infants and toddlers knowledge of number competence is because of different levels of understanding. She clarified that preschool matching task was different as compared to infant looking time task and these both task measures different type of numerical knowledge. (p. 291)

In 2002 Mix, Huttenlocher and Levine critically reviewed " the idea that quantitative development is guided by an inborn ability to represent discrete number" (p. 278). They tested the quantitative competencies of infants and young children mentioned in their article. They arise many questions which are very important and need clarification:

- ' What non-numerical cues do infants use?
- How does a number-based representation develop from such origins?
- How do children differentiate and ultimately integrate discrete and continuous quantification?'

3. 2- Clearfield and Westfahl approach:

Clearfield and Westfahl (2006) conducted three experiments on 3 to 5 months infants to see how familiarization affects their looking time during

addition problems. They replicated Wynn's (1992) procedure in first experiment and found that infants looked longer at incorrect outcome same as in Wynn's findings. They strongly argued on the basis of their results that " infants responded to the stimuli based on familiarity rather than the mathematical possibility" (p. 40) (number competence) of the event in Wynn's original finding and in Experiment 1. They also pointed out that there was no statistical difference in infants' looking towards 1+1= 2 and 1+1= 3 (in Wynn's finding). They asked for future research to confirm this. (p. 40)

In their article, Clearfield and Westfahl (2006) mentioned that Cohen and Marks (2002) challenged Wynn's (1992) finding about infants' number competence. Clearfield and Westfahl (2006) also told about Wynn's (2002) response to it i. e. she rejected their challenge by saying that they did not replicate her study exactly.

4- Discussion:

Evidence show that infants have inborn number competence and even they can manipulate simple arithmetic (Wynn, 1992). There is a considerable debate is going on young children's ability about numerosity especially with regard to addition and subtraction. The problem is word number learning which they learn at later years. By the age of 2 years, children can count up to three or more (Gelman &Gallistel, 1978).

Wynn's (1992) finding is challenged by Cohen and Marks (2002) as cited by Clearfield and Westfahl (2006). But Wynn's (2002) rejected this challenge and still strict with her claims about infants' inborn number competence.

Clearfield and Westfahl (2006) interpreted that infants do not have counting ability but their performance on infants' studies was based on familiarization. They insisted that researcher must work on the issues of familiarization and other basic perceptual processes rather than more controversial concept of number competence in infants.

Learning the number system is one of the most difficult tasks for a young child. It is a slow process which takes many years to complete. Researchers have explored questions about the roots of numerical knowledge using looking time techniques with infants. It is still unclear to what extent is the sense of numbers innate and to what extent is it learned and how early the child acquires a meaningful counting procedure? Results of early counting studies appear unstable with each other. Some studies focus on conceptual competence (early counting) and some suggest that understanding the purpose of counting take place in later years.

Young children often confuse to answer how many are there? It requires children to tell the last word when counting a set. They usually start counting the objects (Wynn, 1990). Counting out a number of objects from a large set is much complex than counting the number sequence. This all need a practice and clear understanding which develops later on. There is evidence " that five year old children take large number words to apply to specific, unique cardinal values" (Lipton & Spelke, 2005, p. 9). They argued that infants are born with innate knowledge of number from which they learn an understanding of number words and verbal counting. It is still unclear that if infants look so smart then why toddlers look so ignorant.

Some researchers criticized the infants' studies that they were not manipulating numbers when confronted with small quantities but may be they looking for total surface area of objects, not for number. We really do not know what was in infants' mind. But criteria in Mix et al.'s study (1996) required children to point out the picture matching in numerosity, was much more demanding. And other studies involving counting ' how many objects there are?' require more understanding and more skill. To conclude all the interpretations about infants and preschoolers, it seems that criteria for judging preschoolers knowledge of number was too demanding. It is clear that at least some of number knowledge is innate. But the question still remains as to how much of it is innate, and how much is learned.

In 2004, Zur & Gelman argued that 4- and 5-year olds can easily be taught the basics of addition and subtraction. They concluded that even 3- year old children can do addition and subtraction by predicting and checking under supportive environment. Zur & Gelman (2004) study is instructive because their emphasis is on practice and how teachers use different strategies.

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