DOCUMENT RESUME

ED 111 514 PS 008 039

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TITLE Mother-Infant Interaction and Intellectual Functioning at Age Six.
INSTITUTION State Univ. of New York, Buffalo.
SPONS AGENCY Grant Foundation, New York, N.Y.; National Inst. of Mental Health (DHEW), Bethesda, Md.
REPORT NO NIMH-MH-08792
PUB DATE Apr 75
NOTE 12p.; Paper presented at the Biennial Meeting of the Society for Research in Child Development (Denver, Colorado, April 10-13, 1975)

EDRS PRICE MF-$0.76 HC-$1.58 Plus Postage
DESCRIPTORS Attachment Behavior; *Infants; *Intelligence Level; Intelligence Quotient; Kindergarten Children; Language Development; *Longitudinal Studies; Mothers; *Parent Child Relationship; *Social Differences
IDENTIFIERS Reflectivity Impulsivity

ABSTRACT

This study looked at the relationship between mother-infant interaction and children's performance on cognitive measures at age 6. The data on mother-infant interaction were collected for 30 middle class and 30 working class, first born Caucasian girls, 10 months of age. The data collection consisted of observations made in the home and measures taken in a laboratory setting. In the followup study 5 years later, 25 of the original middle class children and 21 of the working class children were tested with the Illinois Test of Psycholinguistic Ability, the Peabody Picture Vocabulary Test, and the Matching Familiar Figures Test. The results indicated that, for the middle class group, many of the variables measured at home were significantly correlated with later scores on cognitive tests. Although fewer correlations were significant for the working class group, most were in the same direction as for the middle class group. Analysis of the laboratory data and the scores on the cognitive tests revealed a highly consistent set of correlations between early attachment measures and later test scores, especially for the middle class group. It was concluded that mothers' interactions with infants at the age of 10 months were clearly related to the children's cognitive test performance at age 6. (JMB)

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In 1967, we began a study of the effects of experience on infant development, through which we hoped to specify some of the differences in home experiences between children of different social classes, who -- we could predict from other studies (e.g., Tulkin, 1968) -- would later differ significantly in IQ and school achievement, as well as more specific measures of cognitive style such as reflectivity-impulsivity. Most of the objectives from this early study were achieved. Specific behavioral differences in the home experiences of infants from different social classes were reported (Tulkin & Kagan, 1972). Social class differences were also found on various measures of early cognitive development, e.g., differential responding to mother's voice and stranger's voice (Tulkin, 1971, 1973a), and differential responding to meaningful and nonmeaningful speech (Tulkin, in press). We were quite puzzled, however, by the failure to find significant correlations between home experiences and laboratory findings, which -- in some ways -- left us no closer than we were before to defining the specific experiences through which social class had its effect on development; again, social class had eluded definition.

This left the nagging question of whether the differences observed in these infants were really important for later development; and to answer this question we needed to do a follow-up.

Method

The infants who were followed up came from the sample which we have reported on in previous publications: 30 middle-class and 30 working-class

10-month old first born Caucasian girls. For the infancy study, each subject was observed at home twice, each time for two hours. Behaviors were recorded every five seconds, and interaction variables were constructed (e.g., "percentage of reciprocal vocalization" is defined by the percentage of times an infant vocalization was followed by a maternal vocalization in the same or immediately following five-second interval; "interaction sequences" are defined as periods of time during which mother and infant are responding to each other in any modality within five seconds of each person's behaviors). More details of the home observation methodology can be found in Tulkin and Kagan (1972).

In the laboratory infants were seated in a high chair and presented various stimuli. Vocalization, looking behaviors, heartrate deceleration, and physical movements were coded. Infants were also observed in a play session consisting of an initial adaptation period, followed by presentation of three single toys for four minutes each, followed by two "conflict" trials in which they were presented with an old toy that they had just played with, and a new toy which they had not yet seen. (These pairs of toys had been equated for intrinsic attractiveness in a pre-test done with another group of infants). For more details on the laboratory methodology see Tulkin (1971, 1973a,b, in press).

Finally a separation session took place in which infants were given all the toys to play with, and after they had played for 30 seconds, mother was signalled to leave the room.

The major problem with follow-up studies is locating subjects. Fortunately through a great deal of good detective work, we were able to locate 25 of the 30 middle-class subjects and 23 of the 30 working-class subjects (although two working class families refused to participate in the follow-up). There are no differences in terms of the 10-month data between subjects

who could and could not be located. For the follow-up, the subjects, who were between 5½ and 6½ years old, were visited at home on two separate occasions, and after a warm-up period, the tests were administered. We were interested in examining relations between early assessments and language development so we administered the Illinois Test of Psycholinguistic Ability. We also gave subjects three dolls and asked them to make-up a story. These stories are currently being analyzed by Deborah Keller-Cohen in the Department of Linguistics at the University of Michigan. We were also interested in a general IQ measure, and administered the Peabody Picture Vocabulary Test. Finally, since we had some measures from the earlier study which could be seen as related to the reflectivity-impulsivity dimension, we administered the Matching Familiar Figures Test.

Results

Table 1 reports correlations between home observation variables and summary scores from the follow-up tests. Many of the home variables are significantly related to scores on all 3 tests in the middle-class group, although none of the observation variables is related to the latency measure on the Matching Familiar Figures Test. The home observation variables which yield the highest correlations involve reciprocal interaction between mother and infant. The mean length of the three longest interactions at 10 months correlates .69 ($p < .001$) with the mean for the I.T.P.A., and -.41 ($p < .05$) with the number of errors on the M.F.F.

It is important to note that these findings do not argue that the mothers have "done something" to the infants which later make them smarter. The importance of the role of the infants is evident from the correlations between infant vocalizations at 10 months and test scores at age six.[2]

Peggy Rubach has just begun a study in which we will be assessing infants immediately after birth, and again at 10 months, in order to attempt to separate out the infant's own contributions to both mother-infant interaction and later cognitive development.

In the working-class group fewer correlations were significant, although most were in the same direction as the middle-class data.

Table 2 presents correlations between 10-month laboratory assessments and test scores. Differential looking at mother and stranger after hearing their voices was significantly related to test scores in both classes, and differential vocalization after meaningful and nonmeaningful speech correlated with scores in the working-class group. Latency to touch toys in the play session was not positively related to latencies on the M.F.F., suggesting that different processes may be involved in these behaviors. Time playing with new toys during the "conflict" trials correlated with test scores in the middle-class group only.

The most consistent findings related to laboratory assessments involve the relationships between variables reflective attachment and later test scores, especially within the middle-class group. Fretting during separation, reduced playing when mother was gone, and shorter latencies to approach mother when she returned were all significantly correlated with test scores. Group means further portray the differences: middle-class infants who did not approach their mothers had a mean I.T.P.A. score of 41.7 in contrast to 44.9 for the approachers. Non-approachers were 10 points lower on the Peabody, had 50% more errors on the M.F.F., and had a mean M.F.F. latency which was less than half of the latency of the approachers.

Discussion

It is clear from the data presented that what is going on in infants'

lives at age 10 months is related to test performance at age six. Again we want to emphasize that we are not pushing a "causative" interpretation. Further we are not arguing that the infant's experiences at 10 months represent the critical input for the development of the intellectual skills assessed in the follow-up. There is no doubt that the mothers who interacted a lot with their infants at age 10 months continued to interact positively with their children as they grew up. Since we didn't do longitudinal observations, we don't know the specific types of later maternal behaviors which could be related to the earlier observations. Even on a gross level, however, we found relationships: For middle-class subjects, the number of siblings in the family at the time of the follow-up was positively correlated with the amount of time mother spent over two feet away from the child at 10 months ($r=.38$, $p < .05$), and negatively correlated with percentage of response to spontaneous frets ($r=-.50$, $p < .01$). In the working-class group, 10-month home variables were significantly correlated with the number of months between the subject and her next oldest sib (e.g., interaction sequences, $r=.56$, $p < .01$; percent response to spontaneous frets, $r=.58$, $p < .01$; time over two feet away, $r=-.52$, $p < .01$). So, while we cannot talk about direct causality, we <u>can</u> talk about a process which begins in infancy and continues as the child develops.

It is essential to emphasize the importance of cultural values for any assessment of continuity. Kagan and Klein (1973) have argued, based on data from Guatemala, that there is more resiliancy from infancy to childhood than we had previously recognized. What we need to understand is that in Guatemala there is also a discontinuity in parental attitudes concerning the nature of children, in which infants are seen as passive beings not needing stimulation, and in fact, needing some protection from

from stimulation. As the children develop, they are seen differently. In contrast, data from maternal attitude scales given to mothers in the present study showed that the middle-class mothers of 10-month old infants believed that reciprocity between a mother and her infant is important, and Tulkin and Cohler (1973) reported correlations between adoption of this view and behaviors reflecting positive interaction. The lower magnitude of the correlations for follow-up data in the working-class group may be attributable to changes in attitudes of mothers toward their children, similar to the case in Guatemala.

The correlations between 10-month laboratory variables and six year test scores came as an exciting surprise, because for the most part, 10-month lab variables were not correlated with home observation variables. Yet they apparently tapped into processes which are related to later performance. The biggest surprise was the highly consistent set of correlations between attachment measures and later test scores. Mary Ainsworth, Silvia Bell, and others have emphasized the relationship between attachment and cognitive development, and the present data add considerable validity to this argument. The importance of the relation between affective and cognitive variables in infancy needs to be more carefully explored if we hope to understand continuities and discontinuities in early development.

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Footnotes

[1]The infancy study was supported by grant MH-08792 from the National Institute of Mental Health to Jerome Kagan. The follow-up study was supported by The Grant Foundation and The Research Foundation of State University of New York. Author's address: Psychological Clinic, 4230 Ridge Lea Rd., Buffalo, N.Y. 14226.

[2]These correlations are lower, however, if we just look at vocalizations of the infant when not involved in interaction with mother. A solitary vocalization ratio was constructed, defined as the amount of infant vocalization while mother was over two feet away divided by the total amount of time the mother was over two feet away. Solitary vocalization was not significantly correlated with I.T.P.A. mean, but was correlated with errors on the M.F.F. ($r=-.55$, $p<.01$).

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Table 1

Mother-Infant Interaction and Test Performance at Age Six

	Middle Class				Working Class			
	ITPA Mean	Peabody IQ	M.F.F. Errors	MFF Lat	ITPA Mean	Peabody IQ	M.F.F. Errors	MFF Lat
Time Over 2'Away	-.22	-.46*	.47*	.10	-.42	-.25	.51*	-.09
Interaction Sequences	.55**	.21	-.46*	.03	.33	.04	-.35	-.08
Infant Vocalization	.51*	.21	-.64**	.31	.07	.20	.14	-.01
Maternal Vocalization	.39*	.16	-.38	-.12	.32	.09	-.49*	.08
Reciprocal Vocalization	.49*	.16	-.27	-.11	.24	.01	-.38	-.02
Environmental Objects	.40*	.19	-.34	.35	.55*	.44	-.31	.14
Time in Playpen	-.33	-.43*	.50*	-.11	-.19	-.20	.21	.18
Time with No Barriers	.22	.31	-.39	.11	.41	.43	-.28	.00
Time Holding Infant	.22	.48*	-.36	-.06	-.18	-.32	.06	-.27
Mean Length Held	.07	.33	-.21	.01	-.39	-.48*	.24	.04
Entertain Infant	.13	.45*	-.35	.13	.26	.09	-.06	-.31
Give Objects to Infant	.27	.40*	-.25	.26	.38	.29	.04	-.27
% Response to Spontaneous Fret	.50**	.37	-.36	.09	.32	.22	-.46*	.06
% Response with Vocalization	.29	.37	-.51*	.26	.44	.29	-.68**	.51*
Prohibition Ratio	-.31	-.46*	.31	.04	-.15	-.02	.12	.32
Play Episodes	.28	.16	-.48*	.12	.56*	.43	-.29	.13
Mean of 3 Long Interacts	.69**	.15	-.41*	.08	.19	-.09	-.24	-.20

* $p < .05$

** $p < .01$

Table 2

Infant Lab Variables and Test Performance at Age Six

	Middle Class				Working Class			
	ITPA Mean	Peabody IQ	MFF Lat	MFF error	ITPA Mean	Peabody IQ	MFF Lat	MFF error
Differential voc after meaningful & nonmeaningful	.06	.12	.04	-.06	.37	.39	.28	-.37
Differential looking after mother & stranger voices	.37	.21	.33	-.44*	.45	.49*	.46	-.46
Latencies to touch toys in play sessions	-.38	-.44*	-.22	.46*	-.10	-.26	-.52*	.16
Time playing with new toys	.46*	.55*	.06	-.25	-.51*	-.22	.01	.26
Amount of fretting during separation	.51*	-.09	.59**	-.42*	.24	.09	-.14	.27
Latency to approach Mom after separation	-.45*	-.37	-.63**	.67**	-.14	-.11	.29	.39
Time playing with toys during separation	-.37	-.30	-.06	.25	-.62**	-.31	.11	-.07

* .05

** .01