DOCUMENT RESUME

ED 129 415 PS 008 806

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TITLE Mastery Motivation: A Concept in Need of Measures.
PUB DATE Apr 76
NOTE 39p.; Paper presented at the Biennial Southeastern Conference on Human Development (4th, Nashville, Tennessee, April 15-17, 1976)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Behavioral Science Research; *Cognitive Development; Cognitive Tests; Early Childhood Education; Family Environment; *Infant Behavior; *Infants; Interviews; *Measurement Techniques; Middle Class; *Motivation; Observation; Persistence; Play; Research; Task Performance
IDENTIFIERS *Bayley Scales of Infant Development; *Mastery Motivation

ABSTRACT

The major objective of this series of studies was to clarify the concept of mastery motivation and to develop measures of this concept applicable to 1-year-old children. Three studies were made with 44 infants, aged 12 to 13 months. The first study, "Aspects of Mastery Motivation and Cognitive Functioning," utilized structured situations in which infants could indicate their mastery motivation through persistent task-directed behaviors. Scoring of the tasks resulted in a three-part classification of mastery motivation behavior into effectance production, mastery of an emerging skill, and attempts to solve difficult problems. Infants' cognitive ability was measured and an interdependence of cognition and motivation was indicated. The second study, "Mastery Motivation and Free Play Behavior," was based on data from 41 of the 44 subjects. Findings suggested that measures of the quality of exploratory play, but not the quantity, were related to measures of persistence and cognitive ability in two structured tasks. The third study, "Cognitive Play Experience and 13-Month-Old Infant Performance with Objects," utilized interviews with mothers to determine the kinds of experiences infants had while practicing skills in object play in interaction with others. The key variable, variety of cognitive activity in social play, was significantly related to infant mastery motivation and cognitive functioning. Following reports of the three studies, two papers are presented which discuss the studies and the concept of mastery motivation. (MS)

Mastery Motivation: A Concept in Need of Measures*

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Mastery Motivation: A Concept in Need of Measures

Introduction

Leon J. Yarrow

For some time now we seem to have been locked in on perceptual, motor and cognitive development in infancy. This focus has given us a limited view of the infant. It has been difficult to measure other aspects of infant functioning and there has been a basic unease about conceptualizing more complex functions in the infant. (This may be a carryover of our anachronistic view of the infant as a bundle of isolated reflexes, a view which the research of the past 10 to 15 years should have dispelled.) Although studies during the past decade have catalogued a great variety of apparently simple behaviors of infants, (such as orienting to stimuli, maintaining brief attention to them, habituating to them, locomoting towards them) we have thought of these behaviors very literally as indications of the infant's perceptual and motor abilities. Our interest in this study was to broaden our perspective on early development by developing measures to assess other aspects of infant development. I believe that these behaviors have implications in regard to the infant's motivation.

Behaviors which index mastery motivation are more easily identified in older children than in infants. Probably mastery motivation is quite diffuse early in infancy, but it gradually becomes sharpened and differentiated. It is reasonable to assume that after the infant has acquired a rudimentary sense of self, after he has distinguished the boundaries of himself from other people and from the inanimate environment, he begins to develop a feeling that what he does has some effects, that is, he comes to associate his actions with changes in the outside world. These associations mark the beginnings of a

sense of competence, the development of an expectation that he can exert some control over his environment.

Our thinking has been stimulated especially by the theoretical writings of Robert White who, in rejecting traditional drive reduction theories of motivation, has proposed that human beings are motivated to master and deal competently with their environments. A number of other investigators and theorists have suggested that young children are impelled by motives to mastery (Bronson, 1971; Erikson, 1950; Hunt, 1965; Piaget, 1952; L. Murphy, 1962, 1975; B. White, 1975) and the sense of efficacy that comes from affecting and controlling the environment is intrinsically motivating. This concept is an appealing one, but we cannot hold to its reasonableness on purely theoretical or intuitive grounds. It is necessary to operationalize the concept and to develop behavioral measures of the infant's motivation to have effects on and to master the inanimate environment. This is essentially what we have tried to do in this study. Its major objective is to clarify the concept of mastery motivation and to develop measures of this concept applicable to one year old children. For the moment we have limited our concern to mastery of the inanimate environment and have ignored the infant's motivation to affect and control other people.

The sample for this study consisted of 44 infants, 23 boys and 21 girls, 12 to 13 months of age. All were from middle socioeconomic backgrounds. Our first step in this research was to develop indices of mastery motivation. We studied behavior in three situations: First, we observed infants in a free play setting. Second, in a structured situation, we chose a number of tasks which were developmentally appropriate for one year olds, ones which required the use of a variety of perceptual, cognitive and motor skills, as well as tasks which provided the infant with opportunities to secure direct feedback from

objects. The third session with the child was in the home where the Bayley Scales were administered and an interview was conducted with the mother concerning the kinds of play activities she and other familiar persons engaged in with the child.

Ultimately, we are interested in the origins of mastery motivation. We want to try to gain some understanding of the ways in which the early environment interacts with the infant's temperament to influence the emergence of individual differences in mastery motivation. But first we must consider the adequacy of the tasks as measures of the concept--their validity. The usual measure of validity in a test is to compare scores on the test with some external criteria. However, since there are no generally accepted other measures of this concept, we have looked at the internal consistency of these measures, and at their relationship to the infant's behavior in another situation. We analyzed the interrelationships among the measures on each of the tasks and we analyzed the relations between the measures derived from these tasks and similar measures from the child's free play behavior and ratings of behavior during the Bayley Examination. Finally, we looked at the relations between the measures of mastery motivation and the infant's cognitive development on the Bayley scales, the MDI and the PDI as well as several more specific clusters of items derived from the Bayley.

In essence, we are first asking the question of whether the varied tasks we have chosen to study this phenomenon hang together, whether there is a unitary concept of mastery motivation. Secondly, we are asking whether they have any degree of cross-situational consistency, whether they are related to spontaneous behaviors in a more natural setting. The third issue we are examining is whether these motivational measures are related to contemporaneous cognitive development. Finally, we are interested in how the

the child's earlier experiences are related to this kind of motivation. Thus far, we have taken only a small segment of the child's recent experience and looked at its relationships to our measures of mastery motivation.

The first paper to be presented by George Morgan will describe the mastery motivation tasks and will present the interrelations among the measures. The second paper by Kay Jennings will consider the relations of the mastery motivation measures to infant's free play behavior. The third paper by Juarlyn Gaiter will consider the links between the social experiences of the infant as reported by the mother and the infant's cognitive and motivational characteristics.

Aspects of Mastery Motivation and Cognitive Functioning

George A. Morgan

As Dr. Yarrow stated in his introduction to the symposium, a major objective of this research was to develop measures which reflect infants' motivation to master the environment. In this paper I will describe these measures, some of the relationships among them and the relationships between them and cognitive functioning, as indexed by the Bayley Scales of Infant Development. The data presented in this paper come from the two structured testing sessions conducted when the infants were approximately 13 months old.

For the session designed to measure aspects of mastery motivation, we pilot tested a wide variety of tasks, selected to fit one of two broad definitions of mastery motivation. First, there were tasks at which an infant could indicate his motivation to gain control over the environment by producing visual and/or auditory feedback. Second, there were tasks at which the infant could show persistent attempts to solve or master a problem. In both cases we were primarily interested in persistent task-directed behaviors.

For the first type of task we selected five "toys" with which one-year-old infants could relatively easily produce interesting feedback or effects. I would like to describe some of these effectance toys and the types of behaviors which we took as indicators of motivation to produce effects. The first slide shows an infant pulling on a string to ring a bell. The next slide shows an infant pressing buttons which open doors and produce sounds. In another effectance production task, pushing a plunger made colorful balls whirl around inside a cylinder. The infant could also produce effects by

simply shaking the toy. Behaviors of this type, even though not producing the effect in the intended way, were included in our measure of persistent task-directed behavior. This measure was the amount of time the child spent trying, not necessarily successfully, to produce or repeat the effect.

The non-effectance tasks, were more difficult to perform, posing a problem for the infant to solve or complete. We originally viewed all of these remaining tasks as a single "mastery of problems" group; however, for conceptual and empirical reasons, which will be described below, these items now seem to belong in two groups.

Some of these tasks involved offering infants the opportunity to practice combining objects, a perceptual/cognitive and fine motor skill which is just emerging at this age. The next slide shows an infant trying to put a block into a bottle but having some difficulty. In the next slide the infant is trying to put a peg in a hole. Just playing with or mouthing the pegs or blocks as contrasted to trying to put them in the holes, was not recorded as time spent persisting at the task. Many infants put several blocks in the bottle or repeatedly tried different combinations of pegs and holes, apparently practicing this emerging spatial relations skill.

The rest of the tasks involved attempts to overcome a barrier or obstacle in order to attain a goal object, i.e., problem solving. The next slide shows an infant trying to reach an object through a glass barrier rather than reaching around it. This was considered persistent task behavior because we felt that the infants were attempting to attain the object. The next slide shows another barrier-type task, which involved getting the top off a bottle to obtain blocks. In this case, the infant rather cleverly figured out how to

use his teeth to remove the lid. In another problem the infant had to push a handle away from himself in order to get a toy clown to rotate within reach. Pushing the handle, direct reaching and trying to pull the whole apparatus toward oneself were common task-directed behaviors.

All problems were solvable and were presented in relatively short trials (one minute in duration). The persistence score was based on the proportion of time, prior to a solution, spent trying to solve the task. In order to reduce confounding due to ability differences, trials on which the infant made a rapid solution were excluded from his persistence score. Thus, the problem solving persistence score was based on those trials in which the infant either did not solve the problem or did so only after we had an opportunity to assess his task directedness.

To summarize, for each of the 11 tasks given during this mastery session, we had a score based on the amount of sustained task-directed behavior. Even though it is admittedly hard to tell when someone is "trying" to do something, the operations used in this study seem to have been sufficiently clear. Scoring reliabilities for this persistence measure on the 11 tasks ranged from .79 to .98 with a median of .95.

As stated earlier we initially felt that the persistence scores might fall into two broad categories; however, further examination led us to the three part classification presented above: effectance production, trying to perform and practice an emerging spatial skill (as represented at this age by repeatedly putting pegs and blocks in holes), and trying to solve difficult problems (as represented at this age by efforts to circumvent barriers).

The empirical support for this three part classification was based, in part, on a factor analysis of the 11 task scores, which revealed three main factors, corresponding generally to the three categories described above. This suggests that these three types of tasks elicited different aspects of mastery motivation. Thus, on both conceptual and empirical grounds we decided to classify the tasks into three groups: effectance production, practicing spatial relations skills, and solving these problems.

In addition to the scores for persistent task directedness, we obtained measures of the infants' affect, interest in exploration based on the amount of time spent in usual inspection & manipulation of objects, and a measure of ability based on how many tasks were solved.

In the Bayley testing session, the infant was examined by a different experimenter who had no knowledge of the performance on the mastery session. In addition to the standard mental development index (MDI), four clusters of more differentiated aspects of infant functioning were derived: Problem Solving, Perceptual Discrimination, Language, and Practicing Spatial Relations Skills. The later cluster, based on items requiring repetition of a skill such as putting cubes in a cup, was felt to reflect the infant's motivation, being analogous to the measure of practicing an emerging spatial skill in the mastery session.

Indeed, these two conceptually similar persistence measures, one from each of the sessions, were quite highly related ($r=.66$). That is, infants who try hard to master the emerging skill of appropriately combining objects were generally the same ones who persist at somewhat similar tasks, even in a different setting. Given the complete methodological independence and the

different styles of experimenter-infant interaction in the two situations, the high consistency across sessions, in this aspect of mastery motivation, is noteworthy. The Bayley test does not provide a measure of effectance production or a pure measure of persistence at trying to solve difficult problems. However, there was a significant across session correlation ($r=.35$) between persistent problem solving in the mastery motivation session and an overall rating of persistence at the Bayley items, which included some similar problems. These findings suggest that there may be relatively consistent individual differences for specific aspects of mastery motivation which hold up even in different settings.

In contrast to these significant correlations for similar tasks, the Bayley Cluster, Practicing Spatial Relations Skills, was not related to persistence at effectance production or trying to solve problems in the mastery session. This finding is consonant with the low within session correlations among the three aspects of mastery motivation. It appears to reinforce the notion that the infant's striving to produce effects is relatively distinct from his attempts to perfect skills and that both are relatively independent of his motivation to try to master difficult problems. In spite of their empirical independence, we feel that there is an underlying conceptual unity in these three types of persistent, task-directed behaviors. Each may reflect a somewhat different mode through which an infant expresses his motivation to master the environment.

Now I would like to turn to the relationships between mastery motivation and cognitive ability, as indexed by the number of mastery tasks solved and by the Bayley mental development index. These findings indicate that persistence

and cognitive functioning are, perhaps inextricably, intertwined, at least for the same type of task. Beginning first with the relationships within the mastery session, there were moderately high correlations between the persistence score of each aspect of mastery motivation and the number of tasks in that category which were solved. These correlations were .53, .81, and .58, respectively, for effectance production, spatial relations skills, and problem solving. This finding seems important because we endeavored to keep our persistence scores conceptually and statistically independent from whether the infant solved the task. Remember that it was not necessary to solve a task for an infant to show persistent, task-directed behavior such as trying to repeat an effect or pushing on a barrier. Remember also that when an infant solved a problem rapidly (in less than 25 seconds) he was not given a persistence score for that particular trial. This means that, within each of the three types of tasks, the most generally skillful infants worked long and hard, even at the tasks which they did not solve easily. However, persistence at one type of task was much less related to performance on the other two types (median r=.28), this again supports our finding that the three types of mastery tasks are relatively independent of each other.

Now I want to turn to the more important across session relationships between persistence and ability. Both task directedness and number of solutions in the mastery session were related to the Bayley MDI, and corresponding Bayley clusters. For example, the overall persistence score in the mastery session was correlated with MDI (r=.60), and, more specifically, persistent practicing of spatial relations skills was correlated with the Bayley cluster, Perceptual Discrimination (r=.74). Similarly, the total number of mastery

problems solved was related to the MDI (r=.72); and, specifically, the number of spatial relations problems solved was highly correlated with the somewhat analogous Bayley cluster, Perceptual Discrimination (r=.83). Thus, infants who do well on the Bayley try hard at the mastery tasks and solve more of them.

When we tried to sort out the relative contributions of persistence and ability for predicting Bayley scores, several interesting findings emerged. Multiple regressions seem to indicate that ability in the mastery session is much more important than persistence, for predicting scores on two Bayley clusters: Problem Solving and Perceptual Discrimination. This finding is consistent with the traditional notion that the Bayley MDI is primarily a measure of cognitive ability. As expected persistence seems more important than mastery session performance for predicting the more motivational Bayley cluster, Practicing Spatial Relations Skills. A provocative finding, which is more difficult to understand, is that the Bayley language cluster is much better predicted from all three aspects of persistence than from any of the performance scores on the mastery items. This suggests a link between the motivation to master the inanimate environment and early indications of language development, but do not have a satisfactory theoretical interpretation of why that might occur. Of course, it is also possible that infants who have better language skills are more able to understand instructions and persist more for that reason. If this is the case it is unclear why infants with better language don't solve more mastery problems.

In conclusion, the concept of mastery motivation in infancy appears to be complex and multifaceted, having at least three aspects: effectance production, the mastery of emerging skills, and attempts to solve difficult

problems. These aspects of motivation appear to be difficult to separate from the infants' ability in these areas, indicating the interdependence of motivation and cognition.

Mastery Motivation and Free Play Behavior

Kay D. Jennings

Thus far in our discussion of mastery motivation, we have talked about how infants behaved when presented with special tasks designed to elicit mastery behavior and about how persistence at these tasks related to their performance on the Bayley. Also relevant to the concept of mastery motivation is infants' spontaneous exploration or play with objects they find about them; such play is often seen as motivated by their striving to master their environment. Through exploratory play, infants discover properties of objects and learn about relationships between objects. Piaget has described how manipulative and exploratory behaviors lead to the development of cognitive schemas for the broad range of the infants' environment.

A free play session was, therefore, included in this study in order to examine the relationships between infants' self-initiated play behavior and both their persistence and performance on the structured tasks from the mastery session and the Bayley session. In free play, we were especially interested in the amount of time spent in play, the quality of that play, and the kind of play activities chosen. Originally, we had been interested also in looking at infants' spontaneous attempts to set up problems and at their persistence on difficult tasks, but extensive piloting indicated that such behaviors were rare in individual free play at this age.

Method

The infants were seen in a playroom containing many attractive toys and common household objects, such as a purse, pot and teaspoons; these play objects were selected to stimulate exploratory behavior and to provide

a wide range of play possibilities. The mother was present but occupied with an interview; thus, nearly all the infants' play was self-initiated. The free-play session preceded the two structured-task sessions by several weeks; the mean age of the infants was 12.2 months. In order to control for a halo-type experimenter bias across sessions, neither the observer nor the interviewer participated in the other sessions for a given baby. A fifteen-minute segment of play behavior from the middle of the session was videotaped and later coded. The basic data consisted of counts of the number of twenty-second intervals in which specific behaviors occurred. Data were available for 41 of our 44 subjects.

The variables to be focused upon in this paper are (a) the total amount of active play or exploration, (b) the amount of effectance production, or behavior that produces auditory and/or visual feedback (such as banging the pot with the spoon), (c) the continuity of play, which was the number of time intervals in which a play activity from the previous time unit was continued, and (d) the amount of cognitively mature play. Three types of cognitively mature play were differentiated: combining objects (such as putting the lid on the pot), producing effects by more sophisticated methods than shaking or banging (such as turning the hourglass), and using a toy for the purpose it was designed (such as pushing the car or talking on the telephone). The amount of cognitively mature play was the number of intervals in which one or more of these types of mature play occurred.

Results

In order to provide a background for examining how infants' free-play behavior related to their behavior in the two other structured sessions, a

brief summary of the infants' free play behavior should prove helpful. The amount of exploration or play was quite high, occurring in 85% of the time units. The amount of cognitively mature play was considerably less, occurring in 23% of the time units. The total amount of play was not significantly related to the amount of cognitively mature play; thus, infants who played more did not necessarily spend more time in cognitively advanced play. Similarly, the three kinds of cognitively mature play were found to be independent of each other.

Turning to the central questions of this part of the study, some relationships were found between infants' free play behavior and their behavior when presented with structured tasks in the other two sessions. In order to provide a framework for presenting these results, the free play measures can be grouped into whether they assessed more quantitative or qualitative aspects of play. The quantitative measures assessed the amount of time spent in activities that were well within the capabilities of all infants; these measures were the total amount of exploration or play and the amount of effectance production. The amount of exploration in free play was found to relate to the amount of exploration of objects in the mastery motivation session ($r=.36$, $p<.05$); thus, some consistency in exploratory behavior was found between two quite different settings. Relationships between free play exploration, however, and the persistence and ability measures from the other two sessions were inconsistent and largely nonsignificant. That is, infants who explored more in free play did not persist more nor solve more problems when presented with structured tasks. The independence of exploration and ability across sessions is consistent with the relationships found within the single free play session (as discussed

previously), in which the amount of exploration was independent of the amount of cognitively mature play.

Turning to the other quantitative variable, effectance production in free play was found to relate to positive affect in both other sessions and to rapid adaptation or warming up in the mastery session; similar relationships were found within the free play session itself. Producing effects in free play, however, was not related to measures of persistence or ability in the other sessions. Even when only more sophisticated means of producing effects (which excluded shaking or banging) were considered, such relationships with persistence and ability were not found. To put these findings in descriptive terms, infants who spontaneously did a lot of banging, shaking, rolling the musical toy, or turning the hourglass during free play, appeared to be relatively happy and quick to adapt to new situations; but they did not persist more on structured tasks nor did they show greater ability when compared to infants who engaged in less effectance production during free play. (There was a trend, however, for the amount of more sophisticated effectance production to relate to persistence on the effectance production items in the mastery session, $r=.27$, $p<.10$.) Thus both quantitative measures, the amount of exploration and the amount of effectance production, failed to relate to persistence and performance in the other sessions.

In contrast to the amount of play, measures of qualitative aspects of play, continuity and cognitively mature play, were found to relate to persistence and ability. Continuity in play related to the number of problems solved in the mastery session ($r=.45$, $p<.01$), particularly to the number of barrier problems ($r=.59$, $p<.01$). Continuity also related to persistence on the barrier problems. It was not, however, related to the

Bayley MDI. Thus, infants who showed some ability to sustain and focus their attention during play, an emerging ability at this age, were better able to solve problems, particularly those requiring enough understanding of spatial relationships to obtain a toy from behind a barrier.

The amount of cognitively mature play was also found to relate to persistence and ability in the two structured sessions. Infants who spent more time in cognitively mature play showed more persistence in the mastery session (r=.33, p<.05). They also more frequently attempted to repeat a problem spontaneously (r=.33, p<.05); for example, after successfully obtaining a toy from behind a barrier, they would attempt to put the toy back behind the barrier in order to repeat the problem rather than playing with it. In addition to relating to these measures of task orientation and persistence, the amount of cognitively mature play related to the number of problems solved in the mastery session (r=.35, p<.05) and to the Bayley MDI (r=.44, p<.01). (Of the Bayley clusters, only Perceptual-discrimination was related to cognitively mature free play, r=.41, p<.01.) Thus infants who spent more time during free play practicing emerging skills and engaging in other kinds of cognitively mature play were more cognitively advanced on independent structured tests.

The differentiation of cognitively mature play into the three types was useful for determining which kinds of mature play were most related to persistence and ability at particular tasks. Of the three types of mature play, combining objects showed the most relationships. Infants who more frequently put things into the pot or stacked blocks in free play persisted more at the spatial-combination problems in the mastery session (r=.34, p<.05)

and solved more of these problems (r=.35, p<.05). These infants also had higher Bayley MDI scores (r=.33, p<.05), doing particularly well on the Perceptual-discrimination cluster (r=.40, p<.01) and the Problem-solving cluster from the Bayley (r=.39, p<.05). Thus, there was consistency across all three sessions in the area of practicing and perfecting emerging spatial skills. Such consistency was not found for the second type of cognitively mature play, sophisticated effectance production. As indicated earlier, infants who more frequently pushed the musical roller or turned over the hourglass in free play, did not persist longer or perform better on the effectance tasks in the mastery session, although there was a trend in this direction for persistence. The third type of cognitively mature play, the appropriate use of toys such as talking on the telephone, related to the total number of problems solved in mastery session (r=.35, p<.05), and more specifically to persistence and performance on the barrier problems. On the whole, the measure of all cognitively mature play was more related to persistence and ability in the structured-task sessions than any of the component types of mature play, perhaps because the relatively low frequencies of the component types led to less stability in these measures.

To summarize the results presented in this paper, measures of the quality of play, but not the quantity, were found to relate to measures of persistence and ability in the two structured task sessions. Of the quantitative measures, amount of exploration in free play was related to exploration of the testing apparatus; and amount of effectance production in free play was related to positive affect and to rapid warming-up in new situations.

Conclusions

These findings suggest that the wide spread assumption of a link between the amount of general exploration and cognitive ability needs to be re-examined. In our data, the quality of the exploration seems more important than the gross amount of exploration. Touching, mouthing, and banging objects extracts only a minimal amount of information regarding their properties; whereas, behaviors more specifically adapted to the particular object elicit a greater amount of information and produce more specific feedback. Similarly, play activities that are sustained over time are more likely to result in consolidation of information about the play object, thus perhaps facilitating concept development.

In conclusion, free play behavior and cognitive ability seem related; but the connecting link appears to be the quality of the infants' exploratory play. Although the causal nature of this relation cannot be determined, an interactive relationship seems likely. On the one hand, infants who spontaneously practice emerging skills seem likely to perfect these skills sooner than other infants. On the other hand, cognitively advanced infants are more able to engage in the kinds of play that more fully exploit the learning potential of their environment.

Cognitive Play Experience and 13-Month-Old Infant Performance with Objects

Juarlyn L. Gaiter

Methodological issues concerning our measurement of mastery motivation in a problem solving session and the use of these indices in assessing the spontaneous free play behaviors of infants have been presented. This paper will consider experiential measures of infant play with others in relationship to measures of mastery motivation and cognitive development.

The beginnings of play activity and its increase in variety and complexity with age is thought to be an important gauge of the child's cognitive maturity. Carew, Chan and Halfar (1975) found that a child's early intellectual experiences with another person correlated significantly with later measures of cognitive performance at age three. Typically, this person is the mother who supports the child's own motivation to produce effects with objects and to seek a variety of stimulating activity. The mother may also facilitate the child's acquisition of cognitive skills as well. A longitudinal study by Yarrow, Rubenstein and Pedersen (1975) noted that the behavior of the mother in presenting and highlighting objects relates to the infant's tendency to orient himself to the object environment and to actively strive to secure objects.

In a home interview when the infant was 13 months old, the mother was asked to relate the routine play of the infant with other people including older siblings, familiar neighbors, friends, the father, and herself. The purpose of the interview was to determine the kinds of experiences infants had in practicing skills in object play in interaction with others. The

interview focused on the infant's social experience in contrast to spontaneous, individual play behavior which we sampled in the 12 month free play session. Each play activity related by the mother was later classified as either cognitive or non-cognitive according to a determination of the basic function of the activity.

Four classes of cognitively enriching play were differentiated. The first class of cognitive play was termed spatial relations skills. This class included activities in which an adult assisted the infant in perceiving the appropriate association of two or more objects such as, stacking objects, placing a peg in a pegboard or placing the correct shape in a puzzle board. A second category included social imitation or pretend play. Mothers reported instances of active mimicking by the child of an action initiated by an adult such as encouraging the baby to imitate tooth brushing and combing hair. Infants at this age imitate familiar behaviors and this activity coincides with learning to refer to objects in their absence as well as with progress towards communication using language. The practice of language skills, a third cognitive class included activities which could be described as teaching interactions in which the adult read to the infant, labelled objects and coaxed the appropriate word from the child. A fourth class of activity was termed effectance behavior and was largely composed of social situations in which someone encouraged the infant to make a toy work so that it produced obvious feedback; for example, manipulating a busy box or playing a piano along with a sibling. Presumably, activities of this sort reflect the infant's desire to validate his ability to produce effects and to sustain the effect by persisting at an activity already mastered. Piaget's theory suggests that such repetitive activities represent infant attempts to consolidate an achievement.

Non-cognitive activities which mothers reported were recorded and included roughhousing with father, teaching the baby to walk, wagon rides and so forth. These activities were excluded from the major cognitive measure which was derived by summing the number of different types of cognitive activities recorded for each infant. This summary measure was called variety of cognitive activity in social play. Correlations were computed between this measure and other indices of infant intellectual and motivational behavior, specifically: 1) competence, as measured by the Bayley Mental Scale, and number of mastery motivation tasks solved and, 2) mastery motivation as measured by persistent task related behaviors.

Recently, in the interest of obtaining specific dimensions of infant cognitive functioning, there has been a trend toward conceptually differentiating infant test scores. For the developmental testing phase of this study items from the Bayley Mental Development Scale ranging from 11.3 to 19.1 months were conceptually sorted into four clusters. This range included the lowest item failed by at least one infant up to the highest item passed by at least one infant. The items were selected for the four clusters on the basis of either a common underlying psychological process, the cognitive function tapped or, the class of response which was elicited. The four Bayley clusters which resulted from this conceptual sorting process were: 1) practicing spatial relations skills, 2) perceptual discriminations, 3) language and 4) problem solving.

Our key variable, variety of cognitive activity in social play was significantly correlated with measures assessed in both the mastery motivation session and the developmental testing session. This key measure was significantly correlated with the Bayley Mental Development Index, the major

measure of infant cognitive functioning used in this study (r=.45) and to two of the four differentiated measures derived from the Bayley, language (r=.52) and perceptual discriminations (r=.39). Thus, infants who had experienced a variety of cognitively stimulating social play with objects performed especially well on the language and puzzle items of the Bayley. The relationship found between variety of cognitive activity in social play and language is especially striking. It is consistent with the literature in demonstrating the significant influence of early tutorial stimulation of young children with adults and later assessments of language and verbal facility in children (Moss and Kagan, 1958, Bing, 1963, Clarke-Stewart, 1973, and Bruner, 1973). This finding also supports Piaget's theory that language symbolization is gradually derived from the developing ability of children to externalize their actions on objects. Play activity with objects is thought to be a necessary function for later language ability, (Piaget, 1962).

Turning now to the mastery motivation session, variety of cognitive activity in social play was significantly correlated with persistence in practicing a developing skill (r=.35) and with an overall score of persistence in task oriented behaviors (r=.37). These findings suggest that infants whose social environment fostered a variety of stimulating activity with objects were more persistent in performing the mastery motivation tasks. This was especially apparent on those tasks requiring the practice of developing skills such as combining small objects. We conclude from these findings that cognitively stimulating social experiences importantly influence the course of motivation and cognitive development in infants.

No significant relationships were found between variety of cognitive activity in social play and the quantity and quality of spontaneous behavior with objects that infants displayed in the individual free play session at

12 months. It is possible that in a setting where object play is task oriented, a social context facilitates the motivation to attempt and to persist at a task for infants who have experienced a variety of stimulating activity in a social context. In contrast, an individual free play situation possibly facilitates familiar behavioral patterns with objects which require less persistent effort in their execution. At any rate, behavior in a free play situation does not seem to be differentially influenced by the infant's history of cognitively stimulating play experience.

These findings emphasize the fact that variety of cognitively stimulating play experiences importantly re concurrent measures of infant mastery motivation and cognitive func ing. Further sampling of the infant's cognitive experiences in social play, as well as his motivation and cognitive performance in a follow-up study may hopefully lead to a patterning of predictive relationships for later competent performance.

Mastery Motivation: A Concept in Need of Measures

Discussion

Leon J. Yarrow

The findings of this study emphasize the many-faceted nature of mastery motivation. Previous discussions of competence or effectance motivation have dealt with a global concept; different aspects of functioning have not been sharply distinguished. In this research, we have distinguished three major components of mastery motivation in the infancy period. These components seem conceptually meaningful and there is some empirical basis for these distinctions. These three aspects are: 1) Behaviors which are aimed at producing clear and direct effects, attempts to elicit feedback from objects; 2) actions which involve repetition of activities in the service of perfecting skills which are just emerging at this developmental period; 3) the third aspect is evidenced by behaviors which involve focused attention and persistence in trying to solve age-appropriate problems. The question remains whether these are three separate concepts. We believe and there is empirical support for this belief that there is a larger concept of mastery motivation of which these are parts. There may be variations within an infant in the relative strength of these components, but there remains a core of conceptually similar behaviors which we think become associated in time with the child's feelings of competence.

The close interdependence of these motivational measures and measures of cognitive development in infants would lead one to question whether looking at cognition and motivation as sharply delineated areas makes conceptual sense, or whether the distinction is an arbitrary one which has grown out of now outmoded theories. Our data are consistent with newer conceptualizations of dynamic systems in which there is constant interaction between parts that

are arbitrarily distinguished only for immediate heuristic purposes. Especially during infancy, cognition and motivation are so closely related that it may be impossible to specify for many behaviors the boundaries. To the extent that we can separate the concepts, we would hypothesize a reciprocal interaction between cognition and motivation. This means that the child's motivation to explore his environment in more than superficial ways leads to his learning about the properties and functions of objects; he learns what objects are like and what they can do. Similarly, the child through practicing new perceptual and motor skills, perfects these abilities. These skills in turn enable him to make contact with and explore a wider segment of the environment and to make finer discriminations of the properties of objects. It is important to see this as not simply a circular process, but as a sequential and hierarchial one. One activity leads to the consolidation of old skills and the emergence of new. For example, these activities have implications for the development of higher cognitive functions. In the process of exploring and acting on objects, the infant becomes aware of the similarities and differences in their characteristics and functions which is an essential step in the development of symbolization.

Just a note about these indices of mastery motivation. The specific tasks which we chose are developmentally appropriate for this age; the specific skills required for these tasks are ones which are especially relevant to the developmental capacities of the one year old. In studying this concept at another age, different tasks requiring different skills would be used. However, we believe that the same motivational categories, (effectance, practice of emerging skills, and problem solving), would be relevant.

One important issue which we have only touched on in this report is the question of the conditions which encourage and sustain expression of goal-oriented behaviors. In this study, we have looked at two kinds of conditions: the environmental experiences which facilitate and sustain expression of mastery motivation and the intrinsic rewards that are associated with these activities. We would expect that the satisfactions the child gets from mastering difficult problems and from the acquisition of new skills, would strengthen his motivation to continue these activities. In this study we really do not have good measures of the child's satisfaction in these activities. We plan further analyses of the relationship between our simple measure of the child's expressed affect during the tasks and the measures of persistence.

We have data on the early environments of a number of these infants which will enable us to look at the relations between the six month environment and the development of these characteristics at one year. In this study we have found relations between the contemporaneous environment and mastery motivation at one year. These findings can be interpreted in terms of an interactive framework in which the child and the environment mutually influence each other. The infant who exerts greater control over and extracts more information from his environment is creating a reinforcing system of stimulation which operates contemporaneously and over time. In a sense, he is helping to create his environment. Through his behavior he elicits more stimulation which in turn is associated with more differentiated capacities to cope with and assimilate stimuli. The stimulation he gets provides more information because he has developed more differentiated capacities to cope with and assimilate it.

It is likely that the poor predictability of measures of intellectual development during infancy may partly be related to the failure to consider motivational factors. We hope in future studies to investigate the implications of early mastery motivation for later functioning, and to develop more complex designs to study dynamic systems in interaction.

Comments on Mastery Motivation:

A Concept in Need of Measures

Peter M. Vietze

In his seminal paper proposing that mastery might be worthy of consideration as a replacement for the growing number of drives being postulated as energizers of behavior, White (1959) took the full burden of motivation off the infant. Instead, part of the force motivating behavior was to be placed in the environment. Since White's proposal there have been few attempts to develop measures of his constructs. Instead, the function of his paper has been to help others find justification for related conceptualizations. In the preceding papers, Yarrow, Morgan, Jennings, and Gaiter have presented the results of an initial effort to study the complex of effectance, mastery, control, and competence. They have broken these concepts down into a number of components which they call mastery motivation.

Most other investigators who have chosen to refer to White's paper have focused on the effectance or effect-making aspect of his notion of competence. Among these are John S. Watson and Michael Lewis. The present investigators also have invested in effectance as a central part of mastery. However, they have not been concerned exclusively with this aspect of competence and they are to be praised for this. Rather, they have attempted to explore a variety of possible measures of mastery and tried to relate these to indices of the infant's competence as well as measures of the environment. My comments will focus on each of the papers in turn and then I will make some more general observations.

George Morgan has presented some of the issues and problems which went into the formulation of new measures of mastery. It should be said that perhaps one reason there has been little infant research in the area of motivation lies in the difficulty of trying to operationalize

such an illusory construct. It is difficult to determine what anyone is "trying" to do--let alone an infant. Critics might say, "How does one know when an infant is trying?" Morgan and his associates have settled on time spent with a task as a measure of attempts at mastery. Is time on task a good measure? Let me illustrate this dilemna using instrumental learning as an effectance task for an example. The goal in such a task is to learn how to make an effect. Once the infant has learned how the effect operates, what more is there to do? Perhaps if the task or effect has some intrinsic value the instrumental response will persist; however, once the instrumentality is removed, continuation of the response could be either mindless perseveration or rewarding persistence. By itself, such a task and measurement of time spent engaged in it would not provide much useful information about motivation. However, by measuring time spent on a variety of tasks and problems, one might have a more useful index of motivation. The present investigators have chosen this route examining persistence across several conceptually related though structurally different situations. If consistency in persistence can be demonstrated then we might have more confidence that time on task is a valid measure for infants.

The finding that the infants who had high persistence scores in the mastery assessment also had high Bayley MDI scores is most interesting. It suggests that infants whose general tendency is to persist on a task that presents some challenge also score higher on one of the standard tests of infant intelligence. Perhaps this is an indication that the work ethic of our cultures is formed early. I should point our, however, that it seems to me that an infant with persistent tendencies must have

environmental support for such a style of interacting with its world or else great frustration would result. Take the example of a persistent infant who is learning something about objects by continual dropping; if someone doesn't retrieve the dropped objects the exploration could not continue. Examination of individual differences in the relationship between persistent behavior and Bayley MDI performance with relation to parental encouragement or support for mastery would provide some indication of the importance of the environmental context for mastery. It is my contention that as infants get older there is an increasing amount of interference from others in being able to be persistent.

The unexpected relationship between persistence measures and the language cluster from the Bayley may have some explanation in the interactional relationship the infant has with its parents. It is conceivable that infants who are more persistent get more attention from the adult agents in their world. This increased attention would be beneficial to the infant's language development. However, one must be careful in examining whether such a hypothesis is reasonable since there may be other equally plausible explanations.

The paper by Kay Jennings, presenting findings on the relationship of mastery and free play, provides some most important information. If children are to learn mastery of their physical environment at all it will be, I expect, in situations where they have the time and the freedom to explore objects without any restrictions or constraints. Jennings first informs us that the original goal of this study was to examine how the children made their own problems and solved them, but that this was abandoned when pilot testing revealed little evidence of this sort.

It may be that self-initiated problems do not appear until after the child has learned to solve problems already extant in his or her world.

In her paper, Dr. Jennings has separated the quantitative aspects of exploratory play from certain qualitative characteristics of play. In doing so, she has allowed the testing of the hypothesis that play opportunities do contribute to the child's growing mastery of the environment. In addition, the hypothesis that the amount of exploration is related to cognitive measures could also be examined. The finding that quality of play showed stronger relationships to persistence and cognitive ability suggests that greater attention must be paid to the actual form of exploration and that a simple index of amount of time spent with an object is not adequate for predicting intelligence or explaining its development. The fact that the quantitative measures of exploratory behavior were related to affect in the various testing situations as well as to the exploration of objects in the earlier mastery motivation session is an indication that amount of exploration, especially effect-producing play, may be expressive in nature rather than cognitive.

The particular measures of exploratory behavior in a free play setting might be conducive to examination of individual differences. One possibility for this would be to classify the infants into groups according to their style of play and exploration. It is conceivable that some of the children would show higher levels of what has here been called cognitively mature play while others might be characterized by the less sophisticated forms of play such as banging objects together to produce auditory or visual effects. The free play data provide

rich possibilities for analysis of individual styles of play and exploration which could then be related to the performances observed in the mastery motivation sessions and scores derived from the Bayley Scales assessment.

Juarlyn Gaiter presented findings from a home interview with the mothers of the subjects. The goal of the interview was to determine patterns of play which emerged from interactions with the people in the infant's world. The interview focused on the mother's perceptions of the infant's experience in a variety of play situations which could not have been observed within the scope of the study. While the use of interviews as the sole source of information to determine behaviors of children has been criticized extensively, its present use does not seem unwarranted. The measure derived from the interview, variety of cognitively stimulating play, was shown to be related to persistence as well as competence. This suggests that the social agents in the infant's world provide input which facilitates the infant's development of mastery. These results suggest that direct observation of the infant in a variety of social situations might provide insights into the ways in which the infant is influenced by social agents while interacting with the physical environment. Such direct observation would also provide us with those elements common to a variety of situations in which the infant learns mastery skills.

To sum up, the three papers presented evidence that mastery can be conceptualized in a vareity of ways, and that several methodologies are required at this stage of the operationalization of the mastery construct. Observations in structured as well as unstructured settings seem to be

necessary in order to discover the limits of the infant's demonstration of mastery behavior. In addition, information provided by the parents must be included in order to keep from overlooking important perceptions of the infant's growing competence not usually available to us as scientists.

The present investigators are to be applauded for going beyond the initial theorizing of White and beginning to examine the operational implications of effectance, mastery, and competence. While the data presented form a picture of inter-relationships among presistence, exploratory behavior, cognitive functioning, and play, this picture consists of bivariate relationships which can be improved upon. I believe that a more vivid picture can be constructed from the data collected by treating these data with multivariate data analytic techniques. My own view is that constructs such as mastery and effectance can only be understood in terms of multiple measures which are considered to operate together. Part of the advantage of measuring different components of a construct is the possibility of considering the variables as they operate symphonically to produce a higher order behavioral index.

Another aspect of the present data which is important to consider is the fact that the subjects were also observed earlier--when they were 6 months old. At that time, measures of the social and physical environment were taken and the present data become more intriguing from the perspective of longitudinal precursers of mastery motivation. These earlier observations also allow the investigators to test the strength of their conceptualization of mastery since there exist in the earlier data set measures of the amount of environmental feedback to which the infants

were exposed. In the same context, the intention to follow these infants to see how their performance at 3 years of age is predicted by mastery motivation at a year will provide further validation checks on the way in which mastery has been conceptualized here.

As mentioned above, the approach taken by the investigators lends itself rather well to the analysis of individual differences. The attempt to discover generalizations of the construct being examined here across individuals may account for the fact that the correlations presented are not higher. Perhaps we should look for individual differences in motivation in our efforts to discover the roots of competence in infancy. Knowing that an individual infant will utilize a particular set of behavioral tendencies in approaching a problem or task might facilitate our being able to structure the environment to match his or her style.

In closing, let me underscore the point that the utilization of a multi-method approach in exploration of a construct whose measurement has been neglected is imperative. The investigators have shown how their initial ideas of the meaning of mastery have evolved and emerged to include a number of important factors previously overlooked in the study of infant competence. Furthermore, they have demonstrated consistency in mastery across situations, thereby strengthening the validity of their measures. The results presented here indicate that considering only the infant or only the environment would result in a failure to account for some of the most important factors in understanding how mastery motivation and cognitive functioning interact. Dr. Yarrow's comments on the relationship of cognitive and motivational factors emphasize the importance of the present set of papers in contributing to the understanding of infant-environment interaction.

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