MATERNAL BEHAVIOR AND INFANT SECURITY IN OLD WORLD MONKEYS:

CONCEPTUAL ISSUES AND A METHODOLOGICAL BRIDGE BETWEEN HUMAN AND NONHUMAN PRIMATE RESEARCH

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Background Comment

This work has an interesting history. It did not start from any particular interest in macaques. Instead, it began with concern about two fallacies that seemed to be creeping into attachment research.

The first is the idea that early maternal sensitivity somehow triggers the onset of infant attachment and that once triggered it is more or less in place. This is not what usually happens in the development of behavioral or other control systems. Instead, they are put together over time. This involves both activation of components by appropriate inputs, environmental support to get the components inter-coordinated, and lots of practice to consolidate and calibrate the system. From this point of view, you would expect attachment to continue developing well beyond infancy. And you would expect maternal support to be important on an ongoing basis and to change substantially as the attachment system develops.

The second fallacy was what we call a "developmental bias", a preference for explaining things in terms of early experience rather than concurrent influences. This is most evident in the fact that so many longitudinal attachment research designs only measure maternal behavior early and effects (e.g., security or some sort of competence) later. They don't include a second assessment of maternal behavior concurrent with the outcome. As a result, they cannot determine whether it is early care or later care or some combination of the two that is influencing the outcome. Is attachment stability due to the fact that once the control system sets up (at around one year of age) it is inherently stable, or is it that maternal sensitivity is very stable and is a continuous influence on security?

To address these questions, you have to be able to measure attachment/secure base relevant maternal behavior both in infancy and at older ages. The Ainsworth scales do a good job in infancy. But it is not clear that (or how) being responsive to signals when a infant is in arms can cause it to explore away, maintain contact, and make all the other adjustments involved in the secure base behavior of a one-year-old. Much less the wider ranging secure base explorations of a three or four year old. Most things require a bit more explicit instruction and feedback.

Over a period of several years, we tried to figure out a satisfactory way to conceptualize and measure maternal behavior in support of secure base behavior and attachment development beyond infancy. Time and again, the range of behaviors seemed to expansive and to complex to capture in a workable measure. The opportunity to work for two years with an experienced primatologist, Kiyomi Kondo-Ikemura, was a chance to approach the problem once again—this time in a somewhat more manageable text. For the first few weeks, infant macaques are either on or very close to their mothers almost all the time. Then, in the transition to weaning and beyond, they explore quite far afield. At this point, the mothers' behavior is less like the sensitivity to signals and close contact emphasized in Ainsworth's infancy work and more like the kind of supervision, availability, we see in

mothers of toddlers and preschoolers. We had previously developed the Attachment Q-set to describe secure base behavior of 1-4 year old human infants and found it rather easy to develop a comparable q-set to describe the secure base behavior of infant macaques exploring on and off their moms and running to them when they needed a haven of safety. With this item set, it was easy to develop a method for scoring the infants in terms of their ability to use mother as a secure base.

We were quite pleased to find that it also proved quite easy to develop a corresponding q-set to describe maternal behavior. A problem we hadn't been able to solve in humans. All it took was Kiyomi's extensive field experience with a wide range of macaque species and a number of visits to laboratories and the Bronx Zoo where we could make additional observations and check an even wider range of species. It took only about 4 months to developed a satisfactory set of items that seemed applicable to a wide range of Old World monkeys.

With these two measures in hand, it was easy to collect data on mother macaques and their offspring in what we might call the "toddler and preschool ages" and show that attachment security at this age is very strongly related to the quality of care received *at the same time*. In addition to revealing very strong links between maternal care and infant behavior, this allowed us to show that the link continues well after the "babe in arms" period. It also allowed us to make our points about the continuing role of maternal behavior in attachment development.

I am not sure that many attachment researchers took the point to heart. In part, they might not have expected or recognized that a study of monkey behavior was supposed to have much impact on their own work. There might also be a little resistance there as well. Most importantly, there is the fact that even if one got the point - we hadn't yet solved the problem of measuring maternal attachment support beyond the ages covered by the Ainsworth scales. So it wasn't as if readers could run right out and add measures of maternal behavior to the second and third waves of their longitudinal studies. We had a point without a measure.

But the point seemed important enough to persist with and over the next 2-3 years Yuan Goa and I and then Melanie Elliott and I made quite a few home visits and visits to various out-of-home settings trying to come up with the item set we needed for maternal attachment/secure base support after infancy. The solution came when we recognized that if we couldn't solve the problem for all contexts (as Ainsworth had) we could solve it for a single important context - free-ranging play in a playground-like setting. In retrospect our problem had been focusing on the home setting - where thing is too familiar. The child knows where mother is when she steps out of site, all the play objects are already very familiar (so you don't see the pull of novelty vs. the interest in proximity), and there aren't too many opportunities to get in trouble. In addition, maternal behavior at home is not as much "on guard" as it is when attachment behavior is being played out on a more open field. And the mother's supervision and availability isn't apparent in specific behaviors such as close watching, following, and questioning. Add to this the fact that mothers feel they have a pretty good idea of what their children might do at home and feel free to engage in substantial bouts of their own activity - which can last quite a few minutes unless a sound (or lack of one) or a signal brings secure base support back onto the front burner.

Once we settled on a solution for a specific context and realized what it should be, the Secure Base Support Q-set fell into place in a couple of months. Using this we have been able to show that mothers' support for secure base behavior is clearly an ongoing enterprise. Moreover, it is strongly related to the mother's attachment representations (as measured by the Adult Attachment Interview). Papers reporting this work are in preparation.

So we had an idea that seemed important for the coherence of attachment theory and research and hammered away at it for over a decade, first from one direction and then another, until we finally solved the measurement problems needed to get the idea in play in specific research designs. For us, the monkey study was fun to do and proved a useful stepping stone. That, not what we learned about monkeys, is why we consider this an important study.

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Research on nonhuman primates played an important role in Bowlby's (1969/1982) interpretation of human infant attachment as an adaptive behavioral control system. The psychological interpretation of this model in terms of the secure-base phenomenon (Ainsworth, 1967, 1973) was similarly influenced by field and laboratory observations of nonhuman primates. Throughout the late 1960s and early 1970s, interactions between experts in human infant attachment and nonhuman primate behavior were frequent and mutually beneficial. Unfortunately, and to the disadvantage of both areas, such interactions are now rare.

The discovery of qualitatively different patterns of attachment among human infants was an important source of this divergence; for much of the 1970s and 1980s, attachment research focused almost exclusively on individual differences, psychometric issues, and construct validation (e.g., Ainsworth, Blehar, Waters, & Wall, 1978; Sroufe & Waters, 1977; Waters, 1978; Waters & Deane, 1985). Recently, language and cognition have taken significant roles in attachment theory and research (e.g., Oppenheim & Waters, in this volume; Owens et al., in this volume). These trends, constructive in themselves, have diminished the relevance and accessibility of attachment study to field and experimental primatologists.[1]

Another factor attenuating links between attachment and nonhuman primate research is the differing emphasis placed on separation responses. Attachment theory today places little emphasis on how distressed an infant or child is during separation. Instead, infant assessments either employ extended observations of secure-base behavior (without separation) at home (Waters & Deane, 1985) or focus on avoidance and contact resisting during laboratory reunions (Ainsworth et al., 1978); beyond infancy, separation procedures are less useful (Posada, Waters, Cassidy, & Marvin, n.d.) and give way to secure-base observations and narrative (interview) methods. These are not mere preferences or conveniences; any proposed measure is subjected to empirical validation. In contrast, experimental primatologists have focused on distress elicited by social separation and isolation procedures. This is an operationist approach; separation responses are judged to be attachment related by definition and, in any event, of interest in and of themselves. In order to reestablish links between attachment and nonhuman primate research, we must bridge these differences.

One of the goals of this report is to clarify the behavioral referents of the secure-base concept. To do this, we have adapted a widely used measure of human infant secure-base behavior for use with Old World monkeys. The Attachment Q-Set (AQS; Wa-

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[1] An exception to this generalization, Stevenson-Hinde (1983) has presented the case for supplementing traditional behavioral assessments with more molar variables, which she describes as measures of "personality" traits. For an example of "personality"-trait measures applied to nonhuman primates, see Bolig, Price, O'Neill, and Suomi (1992).

ters & Deane, 1985) is based on Bowlby and Ainsworth's secure-base concept; the items were developed on the basis of extensive naturalistic observations of human infant attachment behavior; and, most important, Q-sort data can be analyzed at the level of specific behavior or in terms of constructs such as security and dependency. We have also developed a Q-set describing the behavior of female Old World monkeys as they support, ignore, or hinder their infants' secure-base behavior. Such a measure is important because attachment theorists have, at times, emphasized the attachment-activating role of maternal care to the exclusion of its maintenance function. This has led to misapprehensions about attachment theorists' views of early experience; it has also led attachment theorists into traitlike characterizations of phenomena that are clearly dyadic and interactive. This has complicated relations between attachment theory and other disciplines, including primatology.

We focused on attachment behavior in Old World monkeys for two reasons. First, they have been used as a model in human attachment research since Harlow's first studies of surrogate mothering (Harlow, 1958). Second, their development has now been studied in detail in both field and laboratory situations. Interestingly, the case for using macaques as a model of human social attachments has rarely been examined in detail. Given that the central hypothesis in human attachment theory is that early attachments serve as prototypes for adult attachment relationships (see Waters & Deane, 1982), one might question the relevance of focusing on a species that does not form adult pair bonds. Species such as marmosets and gibbons, or other species that provide sustained parental care and also maintain relatively monogamous pair bonds in adulthood, would be theoretically preferable; however, their unavailability has restricted opportunities for research.

The present study was conducted on free-ranging Japanese macaques. Our goal was to evaluate the hypothesis that patterns of secure-base behaviors, postulated to index attachment security in human research, are associated with concurrent patterns of supportive maternal behavior. Although the emphasis in human attachment theory and research has been on the effects of early maternal care on subsequent infant attachment behavior, Waters, Kondo-Ikemura, Posada, and Richters (1990) have suggested that the association may owe more to consistency in maternal behavior than to direct effects of early care on later infant behavior. Moreover, the contemporaneous coordination of infant and maternal behavior in the course of secure-base and exploratory behavior is central to our understanding of the function and evolution of attachment relationships and thus deserves attention in developmental and cross-cultural work with both humans and as wide a range of nonhuman species as possible.

Relations between maternal and infant behavior have been reported in a wide range of research on macaques and related species (e.g., Stevenson-Hinde & Simpson, 1981), but the focus has been on discrete (usually time sampled or sequential) behaviors (for reviews, see Hinde, 1983; and Mineka & Suomi, 1978) that are difficult to relate to the concept of attachment security. As a consequence, this work has been cited only rarely in the human attachment literature. The present study addresses both the suitability of the Q-sort method for research with Old World monkeys and the relevance of macaques and closely related species as models of human attachment. It also provides information about the sensitivity of Q-sort data in detecting individual differences under naturalistic rather than experimentally induced conditions, an issue that is important because effects in longitudinal and naturalistic research, with which we are most often concerned, are typically much smaller and more difficult to detect than, for example, the effects of major separations or controlled laboratory manipulations.

Q-SORT METHODOLOGY

The Q-sort methodology employed in this research has three components: (1) procedures for developing sets of behaviorally specific items used to describe individuals; (2) procedures for assigning a score to each item in a Q-set by sorting the items into rank order (from most descriptive to least descriptive of an individual); and (3) procedures for data reduction and data analysis.

Constructing an Item Pool

A Q-set is a set of items that serves as a vocabulary for describing individuals. Traditionally, Q,-set items have been phrased in terms of psychodynamic or personality-trait language, often with strong motivational connotations (e.g., "Feels a lack of personal meaning," "Has a brittle ego defense system," "Has repressive or dissociative tendencies"). In the present research, the Q-sort method is adapted for use with items that are behaviorally specific and refer specifically to the contexts in which the behaviors occur. In developing this Q-set, we were careful to avoid unnecessary jargon, to state each item in the

affirmative (so that low placement does not introduce double negatives), and to define explicitly what low placement means for each item. Waters and Deane (1985) describe in detail the rationale underlying the human AQS. These item characteristics have been incorporated into a revised 90-item version of the infant AQS (Waters, 1987). Steps in adapting the AQS for use with Old World monkeys and for developing a parallel Q-set to describe maternal behavior in support of infant secure-base behavior are described below.

Q-Sort Procedure

The goal of the Q-sort procedure is to assign a score to each item in a Q-set. This typically involves sorting the Q-set items into nine piles, with a specified number of items in each pile. Thus, the subject is described in terms of an array of scores on behaviorally specific items, rather than in terms of a single global rating. Sorts from different observers or different occasions can be compared by correlating item placements across subjects or by computing the correlation between pairs of Q-sort descriptions across items. Alpha reliabilities (Cronbach, 1951) can be computed from these data. The reliability of a Q-sort description can be increased by averaging sorts from multiple occasions or multiple observers (Block, 1961/1978).

This sorting procedure has several advantages over simply rating each item individually or assigning a single global score to a particular construct. First, the Q-sort method does not assume that observers have detailed normative information about each item. That is, the question is always whether item A or item B best describes the subject, not whether the subject should be scored high or low relative to other subjects on a particular item. The method also reduces halo and desirability effects by limiting the number of items that can be placed in each Q-sort pile. (For discussion of these and other advantages of this scaling method, see Bern & Funder, 1978; Block, 1961/1978; and Waters & Deane, 1985.)

Data Analysis

Q-sort data lend themselves to a wide range of analytic strategies. The most common are item-level analysis, scale and cluster scoring, and criterion-construct scoring. In item-level analyses, the Q-sort procedure is employed to assign scores to each item, and then the items are treated as individual variables. Waters, Garber, Gornal, and Vaughn (1983) illustrate a strategy in which individual Q-set items are identified as correlates or noncorrelates of a target behavior (e.g., amount of visual regard received from peers), and then these two categories of items are summarized by cluster analysis. When subjects can be divided into several groups, individual t tests or one-way ANOVAs can be used to compare the groups in terms of individual items, or, where appropriate, one-way MANOVAs or T2's can be used to compare groups in terms of sets of related items (e.g., Park & Waters, 1989). Item-level analysis is primarily useful in the early stages of research, when it is useful to survey a broad range of behavioral domains to determine where important effects are to be found. Then follow-up observational studies with traditional observational measures can be conducted to replicate and examine these results in detail.

Cluster and scale-level analyses involve cluster analysis or psychometric item analysis to identify subsets of Q-set items and then summing each subject's scores on these items to obtain a cluster or scale score. This procedure has two primary advantages over item-level analysis. First, it reduces the number of statistical tests performed. Moreover, the psychometric advantages of aggregation (Block, 1977; Epstein, 1979; Rushton, Brainerd, & Pressley, 1983) accrue to scores based on multiple items. That is, aggregating items reduces error variance and thus reduces its attenuating effect on correlations and on statistical power (Nicewander & Price, 1978). This is achieved at the expense of some of the exploratory/descriptive advantages of item-level analysis.

Criterion construct scoring involves having experts sort Q-set items to describe the hypothetical subject scoring highest on a particular construct. Waters and Deane (1985) describe the development of criterion Q-sort definitions for attachment security, dependency, and sociability. Waters, Noyes, Vaughn, and Ricks (1985) illustrate the development of criterion sorts for social competence and self-esteem in children and methods for empirical analysis of these conceptual definitions. The criterion sort defines a construct in terms of an array of scores. An individual subject can be scored on the construct by computing the correlation between this array of scores and the array of scores that describe that particular subject (i.e., a correlation between N items and N items, within an individual subject). Individual subjects are scored on the construct in terms of the similarity between their own Q-set item profiles and those of the hypothetically highest-scoring subject. This is typically obtained by computing the correlation (across items) between the Q-sort descrip-

tion of the subject and the Q-sort description of the hypothetical highest-scoring subject. One advantage of this approach is that it makes implicit constructs public. This should be of considerable comfort to researchers who are uneasy with the openness of construct-oriented research.

The criterion-sort method has been very successful in capturing constructs that are difficult to operationalize in terms of one or a few behavioral criteria (e.g., the ability to use the mother as a secure base from which to explore). Note also that the observers who describe an individual subject need not know what constructs their descriptions will be scored for. The ability to keep observers blind to the constructs under study can minimize halo effects that often contaminate conventional trait-rating methods (Cooper, 1981). The criterion-sort method also allows researchers to evaluate unanticipated or alternative hypotheses by constructing criterion sorts and scoring subjects on new variables long after data collection is completed. Finally, like scale and cluster scores, criterion scores tend to be more reliable than item-level scores, and they reduce the number of statistical tests performed on a given set of data.

METHOD

Subjects

Subjects were 24 mother-infant pairs of Japanese macaques (Macaca fuscata) observed at the South Texas Primate Observatory in Dilly, Texas. They were members of troops totaling 311 adults and 69 infants that range freely in a 50-acre compound.[2] The infants ranged in age from 1 to 3 months, a time when infants actively leave their mothers to explore but are not yet totally independent of them. There were equal numbers of high and low-ranking females, equal numbers of male and female infants within maternal ranks, and equal numbers of infants above and below 8 weeks of age.[3]

Infant Secure-Base and Exploratory Behavior Q-Set

The AQS (Waters & Deane, 1985) assesses the full range of behaviors addressed in Bowlby's control-systems analysis of infant attachment behavior. The items cover eight domains of behavior: (1) Attachment/exploration balance; (2) Response to comforting and differential responsiveness; (3) Affect; (4) Social interaction; (5) Object manipulation; (6) Independence and dependency; (7) Social perception; and (8) Endurance and resiliency. The Q-set was subsequently revised (Waters, 1987), minimizing unnecessary jargon, stating items in the affirmative (so that low placement does not introduce double negatives), and explicitly stating for each item the behaviors associated with low placement. The revised item set is presented in Appendix A (in this volume).

The first step in developing the Attachment Q-Set for Infant Macaques (AQS-M) was to identify items that could be adopted from the human Q-set with minor revisions (e.g., changing "leaves infant with baby-sitter" to "leaves infant with juvenile or adult female monkeys"). The second step involved writing 32 additional items to capture behaviors that do not have clear analogues in human infant behavior or that refer to situations rarely encountered by human infants. These primarily involved aspects of social interaction, object manipulation, and independence and dependency. The final version of the AQS-M consists of 94 items; these are listed in Appendix C (in this volume).

Maternal Attachment Behavior

In order to describe maternal behaviors that might help organize infant attachment behavior by supporting the infant's secure-base and exploratory behaviors, we developed a Q-set by writing items related to each of the 94 items in the AQS-M and then editing and revising to eliminate redundancy. The Maternal Q-Set for Macaques (MQS-M) consists of 93 items covering eight facets of maternal behavior: (1) Offering contact or comfort; (2) Comforting behavior; (3) Protection from danger; (4) Affect; (5) Caretaking strategies; (6) Promoting independence or teaching; (7) Social interaction with infant; and (8) Self-maintenance behaviors. For completeness, the MQS-M also describes behaviors that might compete with maternal behavior or might be antithetical to it (e.g., object exploration and foraging). We also included marker items related to maternal status and social adjustment. The MQS-M items are listed in Appendix C.

Q-Sort Descriptions of Maternal and Infant Behavior

Observation Procedure

Observations were conducted by Kiyomi Kondo-Ikemura and a biopsychology graduate student whom she trained in the meaning of the Q-set items

[2] For a detailed description of this facility, its current status, and its prospects, see Lampe (1983).

[3] Information on infants' age and maternal rank were provided by the South Texas Primate Observatory staff.

and Q-sort procedures. Agreement of at least 80% on each Q-set item was established through training observations of macaques and langurs in indoor naturalistic habitats at the New York Zoological Park. Additional agreement trials were conducted at the Texas facility prior to formal data collection.

The target animals (adults and infants) were observed in a randomly constructed order. The two observers worked independently and never focused on the same mother or infant, or on a mother and her own infant, at the same time. After observing a target animal for 90 min, the observer generated a Q-sort description before observing another animal. The total set of 48 observations was distributed over a period of 3 weeks. The two sorts of each animal were averaged to obtain a single composite Q,-sort description. Like many other types of behavioral data, Q-sort descriptions are considerably improved by averaging across observers and occasions.

Q-Sort Procedure

As outlined above, scores were assigned to Q,-set items by sorting them into nine piles according to a predefined distribution. Items in pile 9 are those most characteristic of the subject during the observation interval. Piles closer to the center (pile 5) contain items that are successively less characteristic of the subject; items in piles 4, 3, and 2, for example, are successively less characteristic (i.e., the opposite) of the subject. Items in pile 1 are least characteristic or most unlike the subject. This sorting is accomplished in three steps. First, the items are sorted into three piles, characteristic (pile A), undecided or neutral (pile B), and uncharacteristic (pile C). Then the items in pile A are subdivided into three piles, most characteristic (pile 9), characteristic (pile 8), and somewhat characteristic (pile 7), with pile 9 on the left. At this point, any number of items is allowed in any pile. Next, pile B is sorted to yield pile 6 (more like than unlike the subject), pile 5 (neutral or not applicable), and pile 4 (more unlike than like the subject). Pile C is then sorted to yield pile 3 (somewhat unlike the subject), pile 2 (unlike the subject), and, on the far right, pile 1 (most unlike the subject).

The sorting is completed by adjusting the number of items per pile to fit a predefined distribution (usually rectangular or quasi normal). Beginning with pile 9, the most characteristic items are selected and the remainder moved to pile 8. The required number of "characteristic" items is selected for pile 8 and the remainder moved to pile 7. This continues until piles 9, 8, 7, and 6 are completed. Then, working toward the center from pile 1, the necessary pile sizes are obtained for the items that are most uncharacteristic, uncharacteristic, etc. The advantage of working from the outside piles toward the middle is that decisions are usually easier to make in the more characteristic and uncharacteristic items and that, when working with quasi-normal distributions, it is easiest to let the large center pile be fixed by default. When this sorting is completed, each item is assigned a score equal to the number of the pile in which it was placed. Items in pile 9 receive a score of 9, etc.

Q-Sort Definition of "Attachment Security"

Working from Bowlby's attachment theory, extensive experience with the human AQS, and familiarity with criterion sorts for human attachment security, Everett Waters sorted the AQS-M to describe the hypothetical infant monkey that is most able to use its mother as a secure base from which to explore. The item placements for the AQS-M security criterion sort are presented in Appendix D (in this volume). The five items specified as most characteristic of the hypothetical most secure infant monkey were the following: (1) "Monitors mother's location and activities"; (2) "Proximity/exploration/proximity cycles are evident"; (3) "Departures from mother are spontaneous"; (4) "Initiates playful interaction with mother"; and (5) "Approaches mother to observe." The first and second items are prototypical secure-base behaviors; the third reflects the expectation that a secure infant is willing to explore (presumably predicated in part on confidence in the mother's availability and responsiveness), and the fourth and fifth items reflect the expectation that a secure infant will be comfortable and confident in the mother's presence.

The five items specified as least characteristic of the hypothetical secure infant monkey were the following: (1) "Adopts awkward and uncomfortable posture when held"; (2) "Easily annoyed with mother"; (3) "Expects mother will be unresponsive"; (4) "Becomes distressed when mother moves away"; and (5) "Transition from contact to exploration is executed awkwardly." These are behaviors deemed to be most uncharacteristic of an infant that is confident of the mother's availability and responsiveness and that is able to use her effectively as a secure base. The similarity of an infant macaque's behavior to this criterion was determined by correlating the array of AQS-M item scores with the array of scores

that make up the criterion sort. In principle, therefore, scores range from + 1 to - 1; in practice, they range between and + .7 and - .1. The alternative to secure-base behavior is lack of secure-base behavior, not the opposite of secure-base behavior.

The fact that Bowlby's attachment theory can be mapped onto the behavior of infant Old World monkeys does not guarantee that the security concept affords a particularly powerful perspective on their behavior. This is an empirical question. Whether our initial criterion sort is the best possible formulation of the security concept for research with infant macaques is also an empirical question. The present approach at least has the advantage of making the security concept more explicit than if we had simply rated infant macaques on attachment security. This facilitates communication across disciplines and holds out the prospect of using empirical data to improve on the present security definition.

RESULTS

There were no significant differences between the security scores of male and female infants (.33 and .40, respectively) or between young and old infants (.35 and .38, respectively). However, infants of high-ranking mothers scored significantly higher than those of low-ranking mothers (.43 and .29, respectively; $p < .05$). Twenty-three of the 93 MQS-M items were significantly correlated with infant security scores; they are organized into the three categories shown in Table 1.

The first of these consists of eight items related to active maternal supervision. The more secure the infant, the more characteristic it is of its mother to

TABLE 1

CORRELATIONS BETWEEN AQS-M SECURITY SCORES AND THE MQS-M

Content Areas	Pearson r
Active supervision	
1. Allows other monkeys to hold infant	-.64**
2. Keeps infant closer for some time after unusual event has ceased	.55**
3. Carries infant when moving from place to place (i.e., doesn't just walk off)	.54**
4. Alert to subtle changes in the environment	.50**
5. Does not hesitate to punish infant in appropriate circumstances	.47*
6. Ceases caretaking behavior if infant wiggles or gets	-.45*
7. Monitors infant's location and activities	.44*
8. Retrieves infant or drives adults away if infant approaches them (esp. adult males or dominant females)	.44*
Sensitive to infant signals / available / supportive	
9. Occupied in caretaking, to the exclusion of other	.64**
10. Devotes more time to infant than to older siblings	.53**
11. Quickly becomes bored with	-.52**
12. Accepts or tolerates infant using mother's tail or body during play	.50*
13. Changes attitude toward infant frequently	-.46*
14. Prevents infant from leaving in unfamiliar	-.42*
15. Recognizes infant signals of fear, etc.	.41*
16. Retrieves infant from play with novel objects	-.40*
Maternal adjustment or rank	
17. Seeks proximity with a specific adult	-.66**
18. Keeps infant close when asleep	-.58**
19. Movement and activities are relaxed	.57**
20. Displays tension movements	-.51*
21. Rests regularly	.50*
22. Comforting is exaggerated	-.43*
23. Frequently initiates (vs. receives) interaction from other	-.42*

* $p < .05$. ** $p < .01$.

keep the infant close even after threatening situations have abated (item 2), when moving from place to place (item 3), and when the infant approaches adults carelessly (item 8). The mother's alertness to environmental changes (item 4) and to changes in the infant's behavior (item 7) are also correlated with infant security. In addition, active involvement in caretaking, as reflected in persistence (items 5, 6), and caution in sharing the infant (item 1) were more characteristic of mothers with more secure infants.

The second category consists of eight items related to the mother's sensitivity to infant signals, responsiveness, and availability. These are closer to the behaviors that have been postulated most often as being critical determinants of attachment security in human infants. In human research, however, the emphasis has been on early maternal behavior as a determinant of subsequent infant secure-base behavior; as noted earlier, our own interest is in the organizing and maintaining role that concurrent maternal behavior plays in relation to secure-base behavior throughout infancy and beyond (see Waters et al., 1990).

The third category of secure-base correlates consists of seven items related to maternal rank and adjustment. The results showed that mothers of secure infants are more likely to behave in a relaxed manner when alone (items 19, 20, 21), with her infant (items 18, 22), and in social situations (items 17, 23). It was more characteristic of these mothers to receive than to offer social bids or grooming. In contrast, mothers of less secure infants scored higher on items indicating that they sought safety in the troop through social proximity to, or social interaction with, a specific adult.

DISCUSSION

Closely coordinated face-to-face and feeding behaviors, analogous to those typically defining maternal sensitivity in research on human infants (e.g., Ainsworth et al., 1978; Belsky, Taylor, & Rovine, 1984), are not a distinctive feature of infant-mother interaction in macaques. Rather, the mother's willingness and ability to organize her behavior around the infant and to serve as a secure base is probably the critical factor organizing and maintaining the infant's secure-base behavior after the onset of locomotion; this appears to be a more critical factor than either early or concurrent microinteractions. In contrast to most middle-class human infants, infant macaques risk serious accidental and intentional injury from adult and juvenile conspecifics as soon as they venture far from the mother. This risk is probably much greater than the risk of predation. In such unsafe circumstances, the concepts secure base from which to explore and haven of safety are much more than mere metaphors. Our results indicate that an infant macaque cannot use its mother as a secure base from which to explore unless she is powerful enough to protect it. But high social rank alone is not enough; to serve effectively as a secure base, the mother must be an active caregiver and supervisor throughout the day; she must be accessible and maintain access to the infant as social situations within the troop change. This is a very challenging task. Indeed, explaining such apparently purposeful behavior requires models at least as complex as the control systems that Bowlby invoked to explain infant secure-base behavior.

Unfortunately, the caregiver's role in organizing and maintaining secure-base behavior has received little attention. Attachment theorists have focused instead on the role of species-specific maternal care as an activator of the attachment control system; the continuity of care and the role of concurrent care in longitudinal outcomes have received little attention. Although attachment theorists may too readily look to early experience for explanations of longitudinal outcomes, such a developmental bias is not a central tenet of attachment theory. The importance of early experience is an empirical question. As Richters and Waters (1990), Waters, Hay, and Richters (1985), and Waters et al. (1990) have emphasized, a viable alternative hypothesis is that individual differences in caregiver behavior are significantly stable and that concurrent care plays a significant role in longitudinal effects. This hypothesis can be examined by assessing concurrent caregiver behavior along with longitudinal outcomes. The outcome of such research is not a test of key attachment concepts; rather, it influences how we formulate for future research Bowlby's control-system model, Ainsworth's secure-base concept, and the notion that mental representations (even those constructed years later) of early experience are important in adult relationships. Supervision, monitoring, and support are ongoing processes in parent-child as well as adult-adult attachments; that they are continuous processes is central to attachment theory.

The middle-class human infants most often studied in academic research are relatively safe when they venture off to play and explore; they are certainly very safe in comparison to the infant macaques observed in this study. This may account for the lack of emphasis in human attachment research on variables such as maternal status and vigilance.

Unfortunately, as statistics on child abuse and homelessness attest, not all human infants and children are as safe as they should be (Daly & Wilson, 1981; Hausman & Hammen, 1993). Only through closer attention to the organization, functioning, and continuity of maternal behavior over time can attachment theory contribute to prevention and intervention in complex situations such as child abuse and homelessness. An important first step toward this goal would be programmatic research to develop measures of secure-base support by human caregivers. The Q-sort method illustrated in the present study may be suitable for this work.

Maternal care variables, especially sensitivity to infant signals and cooperation versus interference with ongoing behavior, are the most consistent correlates of infant attachment security; the correlations, however, are usually in the range of .1-.3 (Ainsworth et al., 1978; Goldsmith & Alansky, 1987; Lamb, Thompson, Gardner, & Charnov, 1985; van IJzendoorn, Goldberg, Kroonenberg, & Frenkel, 1992). Much stronger relations between maternal and infant behavior were found in the present study (see also Pederson & Moran, in this volume).

Several distinctive features of the present study may have contributed to this difference. First, focusing on the initiating rather than the maintaining role of maternal behavior, attachment researchers have often assessed maternal behavior early in infancy and attachment behavior months later. We focused, instead, on the secure-base-maintaining function of concurrent maternal behavior., In addition, previous research on maternal behavior has adopted a microanalytic perspective, focusing on the details of sensitivity to infant signals; in the present study, we give comparable weight to the organization of maternal behavior over longer periods of time. In a sense, where previous research focused largely on tactics in infant-mother interaction, the Q-sort method enabled us to give equal weight to both tactics and strategy.

Ainsworth's Baltimore longitudinal study was unique in that each infant-mother dyad was observed in naturalistic settings for 12-15 hours in each quarter of the first year of life; subsequent studies have involved less than 1 hour of observation, often just a few minutes, in laboratory or constrained (e.g., feeding in a high chair) home situations. In the present study, subjects were observed for a total of 3 hours in a naturalistic setting. Because brief observations and constrained situations cannot reliably estimate subjects' typical rates of behavior, correlations based on such observations underestimate the correlations that would be obtained with more representative (reliable) data (see Block, 1977; Epstein, 1979; and Waters, 1978).

Previous research has relied on global rating scales and time-sampling methods, neither of which is particularly well suited to the task of measuring infant secure-base behavior or concurrent maternal behavior. The Q-sorts employed in the present study are behaviorally specific, they enable the observer to take into account the behavioral context in which behaviors occur, and they readily take into account the fact that a wide range of behaviors and behavior sequences are functionally equivalent in terms of secure-base functioning. In brief, small correlations do not always imply weak associations; often, for psychometric reasons, they underestimate important relations. Attachment researchers may have accepted too readily weak or false negative results regarding the effects of maternal behavior on infant secure-base behavior. Both improved measurement and a broader view of what should be measured can help clarify this important issue.

The Q-sort method permits surveying a much wider range of behavior than we can typically accommodate in time-sampling procedures; it can capture behavioral detail and also summarize the functioning of complex behavior patterns. Most important of all, it makes explicit the behavioral referents of attachment constructs such as security and sensitivity. The Qsort method will not replace conventional observational methods; as with any other broad-band measure, it is most powerful when used to guide and focus more detailed observational work that builds or. the outlines it draws. This can expand the reach of human attachment research and help rebuild bridges that once linked work on human and nonhuman primates.

ATTACHMENT Q-SORT FOR INFANT MACAQUES [1]

K. Kondo-Ikemura, & E. Waters
February 20, 1987

1. Infant is attracted to unusual or novel noises, objects or movements in environment.
(Even if he returns to mother)

   Low: Ignores or avoids unusual or novel noises, objects or movements in environment. (6)

2. Infant seeks being held or carried or otherwise protection from adult monkeys other than mother, when she is occupied with other activities.

   Low: Doesn't ask care-taking for other adults by his own. (4)

3. Infant tries to wrestle with mother, or directs playful mouth-open or play-solicit posture to mother, if no other monkeys are available.

   Low: Even if there are no playmates, infant doesn't direct playful behaviors toward mother. (6)

4. When infant screams, screaming stops as soon as mother holds him for comfort.

   Low: Screaming continues even after mother holds him for comfort. (8)

5. Infant approaches one or two adult males within one meter.

   Low: Doesn't approach any adult males on his own. (3)

6. When mother interacts with adult monkeys, infant tries to intervene; climbs on or between them.

   Low: Tolerates or joins in mother's social interactions. (4)

7. Infant keeps track of mother's location when he plays away from her; when mother moves or changes activities, infant follows visually.

   ** Middle if doesn't move away very much from mother. (8)

8. Infant adopts awkward posture when carried by mother.

   Low: Adjusts his posture to mother's movement. (2)

9. When infant returns from exploration or play, he clings on mother and/or sucks on her nipple.

   Low: Makes casual contact or proximity with mother. (5)

10. When adult monkeys other than mother approach or sit nearby, infant stops play, freezes or returns to mother.

[1]The numbers after each item (in parentheses) is the item's placement in the criterion sort used to score infant attachment security. For information about scoring subjects on a criterion sort, see www.johnbowlby.com; Measurement Library link to *The Q-sort method in attachment research* .

Low: Play or exploration isn't disrupted when adults approach. (4)

11. Infant approaches adult monkeys other than mother to play, explore or otherwise interact, without hesitation.
Low: Avoids other adult monkeys and doesn't approach them. (6)

12. In addition or instead of keeping track of mother visually, infant returns to her repeatedly even in clam situation.

    Low: During play or exploration, infant monitors mother's location and activity without having to approach. (3)

13. When social play gets rough and active, infant continues toplay confidently.

    Low: Not confident in rough play; victimized, freezes, flees or screams. (5)

14. Infant repeats or persists in activities that has proven to be difficult for him.

    Low: When it has proven to be difficult for him, infant doesn't try again. (5)

15. When infant makes contact with mother, he seeks mother's ventral surface.

    Low: Content even if he can't contact with her ventrum. (7)

16. He screams or tantrums when mother physically rejects infant's bid for contact.

    (May or may not persist in trying to get contact)

    ** Middle if mother never physically rejects infant. (2)

17. Infant will solicit care or interaction from one or two adult males.

    Low: Ignores or avoids any adult males. (4)

18. Infant returns to mother and actively solicits comfort for mother when wary, fearful or otherwise upset.

    Low: Sits, freezes or screams until mother retrieves. (9)

19. Infant examines objects (either animate or inanimate) in detail; manipulates or carries them for a long time.

    Low: Examines objects briefly and leaves them. (5)

20. When infant becomes frightened and returns to mother, he clings on her for long time even after the event has been over.

    Low: Ready for going play once frightening events have been over. (3)

21. Infant ignores, avoids or rejects play invitations.

    ** Middle if infants is too young for social play. (4)

22. Infant accepts mother's leaving without following or screaming if left in the company of juveniles or adult females other than mother.

    Low: Follows with distress or screams by mother's leaving, even if with juveniles or adult females. (6)

23. Infant tries to interrupt mother, when she cares for siblings or other infants.

    ** Middle if there are no siblings or mother isn't concerned about other infants. (5)

24. Infant clearly shows a pattern of using mother as a base from which to explore.

    Moves out to play, returns or play near her and moves out to play again, etc.

    Low: Always away from mother or near mother when plays around. (9)

25. If infant notices play group, he actively joins in.
    (May or may not play with peers actively, but tries to play in the same manner as peers are doing)

    Low: Avoids or ignores play group. (6)

26. Infant approaches mother to observe what she is doing; shows much interest in mother's behaviors.

    Low: May or may not be attentive to mother's behaviors, but rarely approaches her to observe what she is doing. (7)

27. Infant accepts being held or carried by monkeys other than mother.

    Low: Refuses or protests.

    **Middle if no effort to hold or carry from others. (5)

28. In coordination with mother's activity cycles; when mother sleeps, infant also sleeps; when mother is awake, infant is also awake, etc..

    Low: Infant's activity cycles are not synchronized. (6)

29. When mother leaves infant, he becomes distressed and follows with calling or screaming and tries to cling on her.

    Low: Sits right where he is and screams.

    ** Middle if stays or follows without distress. (5)

30. Infant is playful most of the time.

    Low: Infant tends to be quiet and withdrawn. (8)

31. When something looks dangerous or threatening, infant looks at mother as a good source of information.

    Low: Decides what to do without using mother's behaviors as a cue. (7)

32. Infant initiates social play with peers or juveniles.

Low: May respond to play invitations, but doesn't initiate social play on his own.

** Middle if too young for social play. (6)

33. When infant is in mother's ventrum, he sucks (mouths) on nipple.

    Low: Indifferent to nipple-contact even when he is in mother's ventrum. (6)

34. If allowed, infant moves along with mother as she goes from place to place; doesn't have to be called or carried; doesn't become distressed.

    Low: Would be left behind unless mother actively calls or carries him; doesn't move play when mother moves.

    ** Middle if decision to move along with mother is not left in infant, e.g. mother retrieves infant before moving. (7)

35. When infant is distressed or injured, mother is the only one he allows to comfort him.

    Low: Would accept comforting from monkeys other than mother, if offered. (8)

36. When mother approaches infant, he notices immediately and looks at or approaches her in a hurry.

    Low: Doesn't respond to mother's approaching him until she is close to him or picks him up. (5)

37. Infant is demanding; fusses and interrupts mother's behaviors if she doesn't do what he wants immediately.

    Low: Patient; sits and watches if mother doesn't respond immediately. (1)

38. Infant is interested in social environment; watches social interactions between adults closely.

    Low: Doesn't watch social interactions between adults very closely. (5)

39. When mother punishes infant's behaviors, he returns to the same behaviors without wariness of farther punishment.

    Low: Doesn't repeat punished behaviors ordoes so with care or cautiously. (3)

40. When infant plays with objects, he allows mother to examine them.

    Low: Carries away objects or protests when mother tries to examine them.

    ** Middle if mother ignores what he has or steals rather than sniffing, touching or looking at. (7)

41. Infant is sometimes unaware of mother's location and has tosearch for her when returning.

    Low: Even if social situation becomes chaotic, infant knows where mother is and returns to her without mistakes. (2)

42. Infant ignores peers' activities; finds his own activities more interesting.

    Low: Stays with peers rather than to play on his own. (3)

43. Returns from exploration and play are spontaneous in non-threatening situation; mother doesn't have to retrieve infant.

    Low: Doesn't return to mother unless he is called or retrieved by mother or unless something upsets him. (9)

44. Infant solicits and cooperates with grooming from juveniles or adults other than mother.

    Low: Avoids or doesn't cooperate with grooming from juveniles or adults other than mother.

    ** Middle if monkeys other than mother never groom infant. (4)

45. Infant clings on mother in a comfortable posture and position when in contact with mother.

    Low: Doesn't cling on mother or clings in an awkward posture or position when in contact with mother. (8)

46. Infant walks, runs and climbs without bumping, stumbling or falling.

    Low: Bumps, stumbles or falls occur during play. (5)

47. Infant engages in self-directed behaviors other than coat care, e.g. manipulates or licks fingers, thumbs, chest, genital, etc..

    Low: Infant's self-directed behaviors consist of coat-care. (2)

48. Infant hesitates to approach or retreats easily from play objects or peers.

    Low: Is confident during exploration and play; takes initiative with peers and playthings. (3)

49. Infant is very active. Always moving around when he is awake. Prefers active play to quiet play.

    Low: Prefers low intensity play. (5)

50. Infant ignores most bumps, falls or startles.

    Low: Runs to mother, screams or stops play/sits alone etc. (5)

51. When something in environment frightens infant, his fear is reduced if he moves closer to mother or held by her.

    Low: Remains fearful, even if he approaches and is held by mother. (7)

52. When infant returns to mother after play or exploration, he seeks signs of tolerance or acceptance from mother before clings on; pauses, signals or waits for mother to complete contact.

    Low: Tries to cling on mother directly, without pausing to seek signs of tolerance or acceptance from mother.

(Mother may show her acceptance and sit still or reach infant)

** Middle if infant approaches mother, but never makes physical contact on his own. (2)

53. Infant solicits or cooperates with grooming from mother.

Low: Avoids or doesn't cooperates with mother.

** Middle if mother never grooms infant. (3)

54. When mother doesn't respond to infant's bids for care or attention, he immediately tantrums or gives up and walks off other activities.

Low: Waits for a response or repeats bids rather than tantrums or gives up immediately; acting as if mother will shortly do what he asked. (1)

55. Infant vocalizes or moves closer with distress when mother moves more than 10 meter away or out of sight.

Low: Notices mother's moving away without screaming or approaching.

** Middle if mother never moves more than 10 meter away or out of sight. (2)

56. Infant displays distress-related motor patterns (e.g. auto-orality, stereotypies, etc.) in low stress situation or long after stressful experiences pass.

Low: Doesn't display such patterns or displays them after stressful experiences pass. (2)

57. Infant jerks or tantrums in response to competent effort of maternal care (e.g. grooming, retrieving under threat, feeding, etc.).

Low: Accepts mother's care-taking without jerks or annoyance unless it is necessarily uncomfortable. (1)

58. Infant accepts necessary restraint and limits set by mother.

Low: Resists necessary restraint and control. (5)

59. Infant is strongly attracted to the objects which other monkeys are handling or brought into play.

Low: Peer's play thing doesn't attract him. (6)

60. When infant is attacked by other monkeys, he calls mother for help and waits for her rescue.

Low: Escapes or counterattacks on his own without mother's help. (6)

61. When mother is nearby, infant is bolder or more confident to play or explore.

Low: Infant's boldness and tentativeness is the same regardless of mother's location. (4)

62. Infant screams or tantrums as a way of getting objects from mother, resisting her control or intruding on her behaviors.

    Low: Makes demand to mother without scream or tantrum unless injured or frightened. (3)

63. When mother moves away from infant in calm situation, infant elicits distressed vocal, strong cling or tantrum.

    Low: Notices or/and follows without distressed vocal, strong cling or tantrum. (1)

64. Infant uses a part of mother's body as a play object or jumping platform.

    ** Middle if mother doesn't allow. (7)

65. Infant shows great interest in non-social exploration or play.

    Low: Only interested in social play. (4)

66. When infant spontaneously returns to mother in non-threatening situation, proximity or contact with mother is brief.

    Low: Proximity or contact with mother lasts more than one minute. (without infant's sleeping). (4)

67. Even if the object makes infant afraid or cautious, he will approach it if mother approaches or examines it first.

    Low: Doesn't approach; remains wary or afraid of them.

    (If infant is held by mother, remains clinging or avoiding)

    ** Middle if never cautious or afraid. (8)

68. Infant gets off of mother's ventrum, but stops near mother or wants to be held again.

    Low: Once he gets off of mother's ventrum, infant goes directly to play. (1)

69. Infant spends more time away from mother than he does in proximity, contact or interaction with her.

    Low: Spends more time in proximity, contactor interaction with mother than in exploration or play away from mother. (Excluding sleeping time). (7)

70. Infant is interested in what mother eats; watches closely and wants the same kinds of food.

    Low: Little interest in mother's food or her choice. (7)

71. When infant finishes with an activity or discards an object, he finds something to do first without returning to mother between activities.

    Low: Returns to mother for rest, affection or interaction before finding a new play or an activity. (3)

72. When mother takes infant to an unfamiliar area which is newt o them or not usually used, infant is closer to mother than usual.

Low: Unfamiliar area doesn't change infant's closeness to mother. (6)

73. When exploration or solitary play is interrupted, infant gives up easily.

    Low: Resumes the activity after the interruption. (4)

74. Infant wants to be carried when moving long distance.
    Low: Walks by himself.

    ** Middle if too young to walk long distance. (3)

75. When infant screams, he screams hard and for long time.

    ** Middle if never screams. (3)

76. Infant plays at distance beyond mother's reach (> 0.3 m).

    Low: Plays within mother's reach. (8)

77. Infant prefers ventro-ventral position when in contact with mother.

    Low: Content even when he can't make ventro-ventral position or avoids ventro-ventral position when in contact with mother.

    ** Middle if no clear preference in position. (7)

78. Infant retreats exclusively to mother when frightened.

    Low: Retreats to any of several monkeys when frightened. (7)

79. Infant will engage in quiet social play with peers, but avoids active chasing- and wrestling-type play.

    Low: Prefers vigorous social play.

    ** Middle if doesn't play at all. (4)

80. Infant will go greater distance or longer time from mother than he will allow mother go from him.

    Low: Tolerates both mother-initiated and self-initiated separation and distance equally. (6)

81. Infant explores widely and plays throughout space available.

    Low: Only explores or plays in a small portion available. (8)

82. Infant scratches body persistently, when alone and unoccupied (no evident wound, mange, etc.).

    Low: Rests, plays or grooms without persistent scratch. (2)

83. Infant returns to mother between bouts of social play.

    Low: Sits alone between bouts of social play. (9)

84. Infant plays roughly and in cruel way with peers.

    Low: Plays active games without hurting peers.

    ** Middle if play is never very active. (3)

85. Infant prefers climbing and running to exploring or manipulating small things.

    Low: Prefers manipulatory play to gross motor play. (4)

86. Infant quickly gets used to observer or observation situation that initially made him wary.

    Low: Remains wary of observer and observation situation. (5)

    ** Middle if not initially wary of observer or observation situation.

87. Departures from mother are spontaneous; infant departs from mother on his own.

    Low: Doesn't depart from mother unless mother prompts him or other monkeys invite him to play. (9)

88. Infant approaches mother and stays closer than usual when unusual happenings occur (e.g. social trouble including whole members, sudden environment changes etc.).

    (He doesn't necessarily approach quickly or vocalize by the event)

    Low: Doesn't approach mother when unusual happenings occur. (7)

89. Infant seeks for mother's help when exploration or play becomes difficult or is blocked.

    Low: Deals with a difficulty on his own or moves to different activity; doesn't seek mother's help. (5)

90. Infant is curious; when monkeys other than mother manipulate small objects, infant approaches or/and observes carefully.

    Low: Little interest in monkeys other than mother manipulating objects. (7)

91. Infant grooms mother or shows similar behavioral pattern to mother's coat.

    Low: Not interested in mother's coat care or only interested in her coat as a play thing.

    ** Middle if never touches mother's coat. (6)

92. Infant periodically interrupts active social play to approach and contact with mother.

    (May or may not return and continue social play)

    Low: Doesn't interrupt active social play to seek mother; may return to her after the bout of play. (5)

93. When mother is feeding, sleeping or manipulating objects, infant tries to interrupt if he is unoccupied; calls or climbs on her. (4)

    Low: Tolerates or joins in mother's non-social activities; doesn't demand to be center of her attention.

94. Infant is fearless with new objects or animals when he first encounters them.

    Low: Afraid of new objects or animals when he first encounter them.

    ** Middle if there are no new objects or animals other than monkeys.

    ** Middle if infant never bothers mother so much. (4)

SECURE BASE Q-SORT OF MOTHER MACAQUES

Kondo-Ikemura, & E. Waters
March 19, 1987

1. Mother moves around when infant is playing at a distance.

   (Infant's track of mother may be difficult)

   Low: Sits in conspicuous place or doesn't move repeatedly from place to place.

2. Mother makes eye-to-eye contact with infant when holding him in her arms.

   Low: Avoids or is indifferent to eye-to-eye contact with infant even if infant tries todo so.

   ** Middle if lack of eye-to-eye contact is due to infant.

3. When mother observes social conflicts between monkeys or unusual happenings, she retrieves, restrains or stays in proximity with infant.

   Low: Doesn't keep infant closer even when she observes social conflicts or unusual happenings.

4. Mother punishes infant for slight provocation or misbehaviors.

   Punishment should consist of biting, grasping, open-mouth, etc.; doesn't imply simple rejection.)

   Low: Doesn't punish infant at all or only after serious or persistent misbehaviors.

5. Mother prevents infant from approaching or interacting with most adults females.

   Low: Allows infant to approach or initiate social interactions with any adult females.

6. Mother is quick to retrieve infant in response to slight strange noises or happenings.

   Low: Doesn't retrieve infant unless happenings may cause infant danger.

7. Mother is often made uncomfortable by infant's behaviors in ventrum; moves infant's position, jerks or shows other annoyed behaviors regularly.

   Low: Comfortable with infant in ventrum.

   (Regardless of frequency of holding infant)

8. Mother allows other monkeys to hold, carry, groom or otherwise take care of infant.

(Care-taking should consist of physical contact.)

Low: Actively refuses or retrieves infant ifother monkeys shows care-taking attempt.

** Middle if no effort of care-taking from others.

9. When infant emits distressed vocalization in exploration or play, mother is quick to respond; calls, approaches orretrieves infant.

Low: No response to infant's distressed vocalization.

10. Mother displays bizarre movements or stereotypies which are obviously out of context in the situation.

Low: Doesn't have any abnormal behavioral repertories.

11. When infant moves away from mother, she goes after him without preventing him from his activities.

Low: Retrieves or restrains infant to keep him close to mother when he moves away.

** Middle if mother accept infant's leaving over a long distance without any acts on her own.

12. When infant returns to mother in nonthreatening situations, she looks at him and embraces affectively.

Low: Whenever infant returns to mother, she simply accepts him without looking at.

13. Mother attacks, chases or bites other monkeys hard in slight social trouble; she is aggressive and bad-tempered.

Low: Escapes quickly, screams or shows fear grimace in slight social trouble; she is timid and weak.

14. Mother is bold with novel objects and approaches them to explores when first exposed to them.

Low: Mother is wary of novel objects even after other monkeys examines them.

15. Mother grooms other monkeys or solicits being groomed when they are nearby.

Low: Doesn't grooms other monkeys when they solicit or avoids being groomed herself.

16. When infant approaches or manipulates novel objects or animals, mother retrieves him or takes them away.

Low: Allows infant to approach or manipulate novel objects or animals.

17. Mother has much interest in infants other than her own; inspects a part of their bodies; tries to hold them, etc..

Low: Even when other infants are nearby, mother doesn't show any interest in them.

18. If infant is away from mother, she calls, approaches or retrieves unless he is occupied with play or exploration.

    Low: Doesn't notice or ignores when infant sits at a distance without playing or exploring.

    ** Middle if infant is always active during exploration or play.

19. In general situations, mother looks at infant to check his location and activities when she is at a distance from him; when infant moves, mother follows him visually, etc..

    Low: Rarely checks infant's location and activities.

    ** Middle if infant is never away.

20. Mother's responses to infant's signals are often delayed.

    (signal = infant distressed call, approach to be picked up or carried, etc.)

    Low: Mother's responses to infant signals are prompt.

    (Mother's responses may or may not positive.)

21. Mother plays any roles to regulating infant-mother distance; follows, calls, retrieves or restrains infant.

    Low: Doesn't play any roles to regulating infant-mother distance.

22. Mother refuses carrying infant in most situations; makes infant walk on his own.

    Low: Carries infant according to situations or infant's request (e.g. moves long way, escapes from attack, infant's illness or fatigue).

23. Treatment of infant is rough and careless; drags infant, stamps on, pushes hard, etc.

    Low: Treatment of infant is careful and tender.

24. In non-threatening situation, mother will interact, care or supervise of infant in favor of interaction with other adults.

    Low: When other adults seeks for interaction, mother responds to them in favor of interaction, care or supervision of infant.

25. Mother keeps infant close to her, even after unusual events have been over.

    Low: Leaves or releases infant right after unusual events are over.

26. Mother accepts or is tolerant of infant using her body or tail for or during play.

Low: Withdraws or punishes infant playing on her body.

** Middle if infant never uses mother's body as a play object.

27. Once infant goes off of mother's ventrum, she rejects infant's bid for contact and/or turns her back for a while.

Low: Holds infant right away even after he goes off and wants to be held again.

28. When infant approaches or pauses near mother, she looks athim or retrieves him if necessary.

Low: Ignores infant's approaching.

29. Mother accepts infant's moving beyond 1 m..

Low: Prevents infant from moving beyond 1m.

30. When mother sits and infant is in mother's ventrum, she embraces him with one or both arms.

Low: Doesn't embrace infant in her ventrum when sitting.

31. When infant isn't distressed, she ignores or rejects infant's approach, bid for contact or signals if mother is engaged in social activities.

Low: Accepts or tolerates infant's approach, bid for contact or signals in favor of social interactions with others.

32. Mother prevents infant from approaching or interacting with most adults males.

Low: Allows infant to approach or initiate social interaction with any adult males.

33. Mother encourages infant to leave by pushing away gently, gradual departure from infant, etc.

Low: Does nothing to make infant leave mother; waits for his departure.

34. Mother shares food with infant; allows him to eat the same food or to take food from her.

Low: Doesn't allow infant to eat along with her; pushes infant from food or moves away; will not share food.

35. When infant initiates physical contact with mother in non-distress context, mother rejects or avoids infant's bid.

Low: Accepts physical contact in any occasions.

36. When infant gets involved in social conflicts, mother is bold to retrieve infant or counterattack his adversary even at the risk of conflict with other adults.

Low: Mother is timid to retrieve infant and/or doesn't help infant.

37. Mother is inconsistent in responding to infant's bid for contact or interaction; sometimes responsive and unresponsive in other times.

Low: The level of mother's responsiveness is consistent.

38. Mother inspects infant's body routinely even without obvious need.

(Inspection =/= groom; inspection means manipulating infant's body to find or look at dirt or injury; groom means parting fur and picking up a small object in stereotyped way.)

Low: Only inspects infant's body in response to seeing some obvious problem or rarely inspects him.

39. If mother is moving and infant approaches to make contact, she walks slower or pauses to let him complete approach.

Low: Walks at her own pace.

40. When infant initiates social play with peers or juveniles, mother retrieves or restrains infant most times.

Low: Allows infant to initiate social play with any peers or juveniles.

41. When other adult monkeys (or older juveniles) are nearby or take care of infant, mother is easy to leave him farther and for longer time.

Low: Other monkeys' supervision of infant doesn't change mother's supervision of infant.

42. Mother notices infant's response to care-taking in non-threatening situations; mother adjusts her behaviors when infant shows annoyance during grooming or carrying.

Low: Persists despite infant's annoyed behaviors; infant shows further annoyance.

43. When mother goes out of infant's sight, she keeps in touch with him by occasional vocalization in non-threatening situations.

Low: Doesn't vocalize to keep in touch with infant when mother goes out of infant's sight unless something happens.

44. Mother allows infant to sit close to her or follows closely when she forages food (i.e. she doesn't concern about stealing food she found).

Low: Keeps infant at a distance when she is looking for food.

** Middle if infant is always carried (i.e. can't approach and steal).

45. Even when infant was punished and stopped misbehaviors, mother repeats or continues punishment.

Low: When infant stopped misbehaviors, she stops punishment.

** Middle if never punishes.

46. When infant is distressed and returns to mother for contact, she holds him in ventrum right away.

Low: Ignores, delays or rejects infant's request for contact; doesn't hold him.

47. Mother bites, pushes to a degree which causes infant to scream long or hard, or flee or avoid mother for a short time.

Low: Mother's punishment stops without injury or making him avoid her.

48. Mother refuses to divide attention between infant and other young monkeys when infant is in ventrum; pushes them away or moves away from them.

Low: Responds to other young monkeys even when mother is caring for infant in ventrum.

49. Mother imposes or persists in grooming or coat care despite infant's protest or effort to explore.

Low: Only grooms or cares for infant's coat when infant accepts.

50. Mother grooms infant whenever he solicits grooming or rests in ventrum.

Low: Rarely grooms infant even when he solicits.

51. Mother stays alone rather than with other adult monkeys.

Low: Stays with other adult monkeys in most time.

52. Mother allows infant to examine or groom her coat, without moving, pushing infant away or shaking body.

Low: Prevents infant from manipulating her coat.

** Middle if infant never manipulates her coat.

53. Mother tries to hold or carry infants other than her own if they obviously needs immediate care.

Low: Doesn't take care of other infants in any situations.

54. In changing or alarming situation, mother has to look for infant before she retrieves him; she doesn't know where he is.

Low: Even when the situation is chaotic, mother retrieves infant without mistakes.

55. When mother initially ignores infant's call or contact seeking, she gives in if infant persists.

Low: Refuses even if infant persists.

** Middle if mother never refuses.

56. Mother pushes away infant or withdraws nipples when infant tries to suck on them.

Low: Accepts nipple-contact whenever he is in ventrum.

57. When social play gets rough and/or infant screams or is victimized, mother retrieves infant from play.

Low: Lets infant continue rough play regardless of his behaviors.

58. If mother and infant walks together, she pauses or adjusts to infant pace.

Low: Walks at her own pace.

59. Mother is occupied in feeding when food is available.

Low: Mother's feeding duration is short.

60. Mother stays close to other monkeys who have the same aged infants as her own.

Low: Stays close to monkeys who doesn't necessarily have the same aged infants as her own.

** Middle if stays away from any monkeys.

61. When infant is attacked, threatened or otherwise emits distressed call, mother retrieves him right away.

Low: Retrieving infant is delayed or doesn't occur; infant often returns to mother on his own.

62. Mother prefers specific adult female companies.

Low: No preference among adult female companies.

63. Comforting infant is active or exaggerated; mother not only retrieves infant, but also embraces, rocks or some times lip-smacks to infant when she comfort him.

Low: Comforting infant is casual; just looks at and holds him.

** Middle if mother never comforts infant.

64. Mother signals intention to change her location by looking, gesture or vocalization to infant.

Low: Changes her location without signaling infant.

65. Bouts of care-taking are brief; mother seizes infant's care without clear interrupting events or strong infant's signals.

Low: Bouts of care-taking are long once it stars.

66. When infant tries to play with mother (e.g. playfully pulls her body, approaches with open mouth, etc.), she rejects and/or punishes him.

Low: Tolerates or responds to infant's playful interactions.

67. Mother scratches body persistently when alone and unoccupied.

(No evident wound, mange, etc.)

Low: Rests, grooms or socially interacts without persistent scratch.

68. Mother makes proximity with a specific adult male in most of the time.

Low: Avoids any adult males.

69. Mother retrieves, restrains or moves closer to infant if his activity might lead to fall or other injury.

Low: Doesn't retrieve, restrain or moves closer to infant in the situation that might lead fall or injury.

70. Mother is interested in infant's exploration or play; approaches him to observe his activities.

Low: May or may not be attentive to infant's activities, but rarely approaches him to observe his activities.

71. Mother retrieves, restrains or keeps proximity with infant when she becomes distressed (wary, fearful, sick, troubled in social interaction, etc.).

Low: Becomes less attentive to infant or even avoids him.

72. Mother prevents infant from being involved in social conflict; when infant approaches certain monkeys who are dominant or may cause infant trouble, mother retrieves or restrains infant.

Low: Only responses to infant after he is involved in social conflict.

73. Mother relays solely on physical acts to control infant; e.g. restrains or retrieves by grasping a foot, punishes by-bite, instead of lip-smacking, grooming, facial expression or gesture.

Low: Doesn't relay solely on physical control; uses gesture or vocalization as well to control infant's behaviors.

74. Mother interferes with infant play in non-threatening situations, when she observes infant playing with peers.

Low: Doesn't interferes with infant's social play; calls or retrieves infant after social play bout except in threatening situations.

75. Mother will sleep even when infant is playing at a distance.

Low: Only sleeps if infant is retrieved first or plays nearby.

** Middle if infant never goes away.

76. Mother holds or carries infant even if he wants to explore or walk by himself.

Low: Allows infant to leave ventrum or walk by himself.

77. When infant isn't distressed, mother ignores or rejects infant's approach, bid for contact or signals if mother is engaged in non-social activities (e.g. resting, feeding, self-grooming, etc.).

Low: Accepts or tolerates infant's approach, bid for contact or signals.

78. When infant is exploring objects, mother takes away theobjects from him to examine by herself.

Low: Does not intrudes infant's exploration unless the objects are novel or dangerous.

79. When mother is holding infant, she allows other monkeys to touch, manipulate or otherwise approach infant.

Low: Turns away or threatens other monkeys showing interest in infant while holding him.

80. Mother continues to hold infant when he seeks comfort from her, but then she removes or leaves infant before he departs for exploration on his own.

Low: Allows infant to stays in her ventrum until he begins to explore.

81. When mother takes infant to an unfamiliar are which is new to them or not usually used, mother retrieves or restrains infant more often than usual.

Low: An unfamiliar are doesn't change mother's supervision of infant.

82. When infant goes farther form mother, she looks at infant more closely.

Low: Supervision doesn't increase according to mother-infant distance.

83. Mother uses wide space available for activities.

Low: Stays in the same place.

84. When infant gets involved in social trouble, mother is quick to come to aid by attacking his adversaries.

Low: Tries to remove infant from social conflicts and escapes together.

85. Mother retrieves infant even before he finishes exploration or play; mother doesn't give infant enough time to explore or play by his own.

Low: Allows infant to explore as long as he wants.

86. Once infant contacts with mother, mother allows infant to sit in ventrum or to ride on her as much as he likes.

Low: Limits duration of being in ventrum or riding; periodically removes infant.

87. Mother is active ; always moving around.

Low: Stays still; spends long period sitting or resting.

88. Mother adjusts infant's position or posture when he clings on her in awkward position or posture.

Low: Doesn't show concern about infant's position or posture.

89. Mother leaves infant even if infant screams, follows in a hurry or otherwise becomes upset.

Low: Returns to infant, carries infant along or leaves infant only when he tolerates.

90. Mother devotes more time to grooming, coat-care or otherwise care-taking of infant than to those of siblings or peers.

Low: Devotes equal or less time and effort to care to infant than siblings or/ and peers.

91. Mother screams hard and for long time over social trouble.

Low: Doesn't show any excitement unless social trouble is serious enough to cause hurt to mother and/or infant.

92. Mother adapts to infant's activity cycles; sleeps when infant sleeps; waken when infant is waken.

Low: Mother's activity cycles aren't synchronized with infant's.

93. Mother carries or holds infant in an odd or unskillful way.

Low: Carries or holds infant skillfully and in standard posture for his age.