

## AQS/ SBQS: Re-adapted Q-sort Procedure To Study Infant Differences In Rhesus Monkey Attachment Behaviour

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### Abstract

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It can be affirmed that the Q-sorting procedure has not been applied until now to depict the individual attachment differences in rhesus monkeys (*Macaca mulatta*). In this research the Q-sort test procedure in which descriptive items (93 for AQS and 101 for SBQS) put in order ranging from Most Descriptive to Least Descriptive both for mothers-infants observed in two subsequent years (First Year and Second Year), was applied the way that Stony Brook University researchers Everett Waters and Kathleen Deane did for assessing individual difference relationships in children. In this study, the application of this new method to monkeys shows significant change between the First Year and the Second Year in some subjects both in AQS or SBQS. Some of infant groups' conditions (the presence of peers for play behaviour, aunts, older sisters, etc.) influenced the individual behaviour of the focus subjects (6 different composition groups kept in 6 different and not-communicating cages). In conclusion what is the advantage of using the Q-sort method in this research? Why have we not used an ordinary ethological observation method, as was done in many other studies on Attachment behaviour in rhesus monkeys? The main reason is that the Q-sorting can reveal complex details and nuances of behaviour that are impossible to obtain through ordinary ethological observation.

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**Keywords:** AQS, SBQS, Rhesus monkeys

### 1.1 Introduction

Defining and assessing individual attachment differences in monkeys is difficult because of the complexity of the emotional bond between partners and the influences of environmental variables. Even though the monkey's environment can be easily controlled, especially under laboratory conditions, better than children's environment, the task of attachment assessing in monkeys is not just technical. Reports on attachment behaviour in children are widely known (Ainsworth, 1967-1982; Ainsworth, et al., 1978; Bowlby, 1969-1973-1980; Hinde, 1982; Parkes & Stevenson-Hinde, 1982; Bretherton, 1987-1992; Cassibba & D'Odorico, 2000). Some articles on the same topic in monkeys have also been published (Harlow, et al., 1962-1966-1969; Mason, 1963-1968; Rosenblum, 1971; Tartabini & Simpson, 1986-1987; Simpson & Tartabini, 1992; Suomi, 2005; Warfield, et al., 2011). These last publications are mostly concentrated on the effect of the attachment after mother's separation and the method of investigation is the ethological observation with the use of time-sampling, and rating of behaviours (Martin & Bateson, 1986; Suen & Ary, 1989).

John Bowlby (1991) has listed the basic features of attachment theory. Some concern the fact that attachment behaviour, as any other instinctive adapted behaviour, is conceived and it leads to the development of the affectional bonds between mothers and children. The attachment can be modified, adopted and activated according to certain conditions. Emotion, anxiety or sources of security are all reflections of the condition of the affectional bonds.

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Finally the attachment behaviour can be active for the rest of the child's life and some of his deviation can become pathological, even into adulthood (Holmes, 2001). Mary Ainsworth (1973) explains in detail the infant's use of an adult as secure base behaviour during his development and across changing situations. Also, Ainsworth conceptualized the sense of secure versus anxiety-attachment in terms of infant's ability to use the mother as a secure base. She identified the development of attachment throughout a behavioural control system and the children's learning ability. Everett Waters and Kathleen Deane (1985) pointed out some disadvantages of the control secure base perspectives used by Ainsworth and Bowlby. Their rating method did not adequately describe or explain attachment or loss. Waters and Deane provided an alternative approach to the attachment assessment (the Q-sort method) which we adopted in the following way that is trying to describe the attachment relationship in monkeys between mother and infant at an early age (before the weaning period were completed) using the Q-sorting procedure (Waters & Deane, 1985; Block, 2008). At each subject mother and infant were assigned a score on social competence (SBQS & AQS) by correlating the Q-sort description of each mother (AQS) and infant (SBQS) with a Q-sort hypothetical definition of the most competent and confident mother or infant. The Q-sort test consists of a procedure in which descriptive items have to be put in order ranging from Most Characteristic to Most Uncharacteristic for each mother and infant.

The mother-infant relationship is characterized by a variety of attachment behaviours, including seeking contact, avoidance and mother preventing infant's contact in which an observer can recognize when the infant is able to use the mother as a secure base (SBQS) to explore, to move around and to establish contact with other infants. In the SBQS the focus animal is the mother and in the AQS is the infant. This research can be a new way to show in which context the relation between mother and infant attachment develops.

## 1.2 Method

### Procedure:

The Q-sort procedure was introduced on 1953 by Stephenson and adopted exclusively in human developmental psychology, particularly studies of Patterns of continuity, changes in parental child-rearing practices (Roberts, et al., 1984), generational continuity and discontinuity of societal rejection from institutions and parents (Block, 1972), personality of children (Block, et al., 1986), and children's social competence (Waters, et al., 1983; van Ijzendoorn, et al., 2004; Verissimo & Salvaterra, 2006; Waters & Waters, 2006).

The Q-sort method consists of a certain number of items

(SBQS= 101 items, and AQS= 93 items)(see **Appendix**) with specific and descriptive statements which are typed on cards. Each item describes a different behaviour. The items describe a specific behaviour, such as Grooming, Walking or Playing, attitudes towards specific circumstances of the focal animal, and in which contexts she or he is performing the behaviour itself. Thus the items can describe the performance and the observer can judge, for instance, whether and the degree to which a mother punishes or not. We could say the same for the item "Enjoy to groom infant". If through all the observations the mother rarely grooms the infant, this means she does not like to groom him very much.

The general procedure is to distribute cards, each of which has items of 9 categories ranging from those Most Descriptive or Most Like a particular subject, to those Least Descriptive or Very Unlike the subject. At the end of the observation we provide a description of our focal animals (mothers for the SBQS and infants for the AQS) by sorting the cards (SBQS=101, AQS 93) into 9 piles. Cards that are Most Like the mother or the infant end up in HIGH numbered piles. Cards that are Unlike the mother or the infant end up in LOW numbered piles. So, for instance, cards where the item is Most Like the behaviour we observed go in pile n.9. Cards that are Most Unlike go into pile n.1.

Let takes as an example the SBQS CARDS which are 101:

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101 cards
 9 piles
  pile
 9 8 7 6 5 4 3 2 1
 cards11 1111111311111111

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Before reaching this stage, it is necessary to become familiar with cards before starting the observation and to memorize the contents and the meaning of sentence written on each card. Before starting to divide the cards into pile it is necessary to observe the monkeys interacting among themselves for at least two or three weeks. It is not correct to approach the cage, observe the behaviour and divide the cards in piles on the same day. Also, before dividing the cards in the final 9 piles, it is useful to sort the cards into 3 equal piles. (For instance if the total cards are 90, the 3 piles would consist of 3 piles of 30 cards each). In the left hand pile, we place 30 cards that are LEAST like our monkeys behaviours. In the middle pile, we place cards that are SOMEWHAT like, and in the right hand pile we place cards that are MOST like:

Least Somewhat Most  
(30)(30)(30)

Let us call LEAST Group A, SOMEWHAT Group B, and MOST Group C.

For the next step, we divide Group A cards into three piles (piles 9, 8 and 7). It does not matter how many cards are in each pile because there is a possibility to move the cards around in the following step. In Group A, pile 9 corresponds to items that represent Very Much or Much Like the observed animal's behaviour. In Pile 8, we place Like the observed animal's behaviour, and in Pile 7 Somewhat Like the observed animal's behaviour.

After this division of Group A, Group B cards have to be divided into three piles (Pile 6,5, and 4). Again, it does not matter how many cards are in each pile because there is a chance to move them from one pile to another until reaching the proper number of cards in each pile (10 cards of each pile, e.g., we have 90 cards divided into 9 piles). Pile 6 corresponds to items More Like than Unlike the observed animal's behaviour; Pile 5 corresponds to Neither Like nor Unlike the observed animal's behaviour; Pile 4, corresponds to More Unlike than Like the observed animal's behaviour. If an item written on a card does not correspond to the observed animal's behaviour, it should be placed in the middle piles. If there is Most Uncertainty the card should be placed in Pile n.5 (when we have 9 piles).

As the nest step, Group C cards have to be divided into three piles (Piles 3, 2 and 1). As in steps 3 and 4, it does not matter how many cards are in each pile. Group C cards are to be sorted as follows: Pile 3 Somewhat Unlike the animal observed behaviour; Pile 2 Unlike the animal observed behaviour, and finally Pile 1 Very Much Unlike the animal observed behaviour. When all cards are in 9 piles the cards Most Like our animal observed behaviour are in Pile 9 (far left). The cards Most Unlike are in Pile 1 (far right). As a last step, the cards have to be adjusted so that each pile has exactly 10 cards (if we have a total of 90 cards).

Since our AQS cards are 93, Pile N. 5 has 13 cards and all other Piles have 10 cards each. In the SBQS cards, Pile N. 5 has 13 cards and all other Piles have 11 cards each (see above). Looking back at the cards in Pile 9 Most Like we have to keep the items Most Like in this pile and we have to move the rest (if any) toward the middle to Pile N. 8. After this, we have to keep Most Like in Pile N.8 and move the rest to Pile N. 7, and so on until the end, i.e., Pile N. 5. Now we have to look at Pile N. 1 Most Unlike and adjust it in the same way as we have done with Piles N. 9 to N. 5. We have to keep the Very Most Unlike in Pile N. 1 and move the rest toward the middle to Pile N. 2, and so on. At the end we have to count all cards in each pile to be sure that contain the right number of cards. If we find too many cards in one pile and too few in another, we have to replace the right number of cards in each pile.

To report the results of the Q-sort we have to write the number of the items in each cards and to score it. If the number is in Pile N. 9 we score this item with a 9, if the item is in Pile N. 1 it is scored with a 1. This operation has to be done for both the AQS and the SBQS. This procedure is indispensable to analyse the obtained score, that is to create a grading. On the vertical line of the grading we locate each item of each category with the score obtained by each subject (located on the horizontal line). For example, in the AQS Category I we have 16 items on the vertical line and 12 subjects on the horizontal line. This operation has to be done for each year (First Year and Second Year). This step is indispensable for the statistical analysis of the obtained score for each year (Friedman two-way analysis of variance by Ranks)

Focal subjects: (7 males + 6 females)

Ages in days at the beginning of this study:

Sebastian: 43 (male)

Gringo: 51 (male)

Hugo: 123 (male)

Vincent: 105 (male)

Kerman: 108 (male)

Nadia: 114 (female)

Taranta (female) \*

Pepe: 97 (male)

Ingrid (female): 94

Quintana: 114 (female)

Florian: 111 (male)

Monika: 54 (female)

Sita: 103 (female)

\* Taranta was removed from the cage in the First Year. Of Taranta First Year we have the AQS (93 items) and SBQS (101 items). Of Taranta Second Year we have not date.

All subjects were divided in 6 different groups, kept in 6 different and non-communicating cages.

Sebastian and Gringo belong to Group N.1. Hugo, Vincent, Kerman, Nadia and Taranta belong to Group N.2; Pepe and Ingrid to Group N.3; Quintana and Florian to Group N.4; Monika to Group N.5 and Sita to Group N.6. The only newborn infants without similar-age infants in the group were Sita and Monika.

Composition of the groups at the beginning of this study:

#### **Group n.1**

Sebastian and Gringo's group : Bing (adult male), Amalia and Harriet (adult females and sisters). Amalia is Sebastian's mother and Harriet is Gringo's mother. Sebastian and Gringo are cousins. The group was also composed of two of Sebastian's brothers (one- and two-years old). Gringo has one 1-year-old brother. This group was also composed of another two females (two and three-years old) .

#### **Group n.2**

Hugo, Vincent, Kerman, Nadia and Taranta's group: Leopold (adult male); Josie and Celeste (adult females and sisters). Josie is mother of three adult females: Irene, Erika and Robin. Irene has three sons (one of them is Hugo) The other two sons are 3 and 1-year old. Erika has one daughter and one son (the son is Vincent). The daughter is 2 years old. Robin has two sons and two daughters (one of the sons is Kerman). The other son is 3 years old, the daughters respectively 2 and 1-year old. Celeste has two sons and two daughters (one of the daughters is Nadia's mother, the other is Taranta). The sons are respectively 1 and 3- years old. Hugo, Vincent and Kerman are cousins and they have a common grandmother, Josie. Nadia is Taranta's nephew.

#### **Group n.3**

Pepe and Ingrid's group: Nigel (adult male); Sangria and Jane (adult females). Pepe is Sangria's son and Ingrid is Jane's daughter. Sangria is also the mother of two males and two females. One of these, a 5-year old daughter, is the mother of a 1-year-old female. The other daughter is 2-years old. The brothers are respectively 4 and 3-years old. Jane is also the mother of four females and one male. The son is 2- years old. The daughters are 5, 4,3 and 1-year old. The 5-year old daughter is the mother of a 1-year-old female.

#### **Group n.4**

Florian and Quintana group's: Boris (adult male); Camilla (adult female). Camilla is the mother of 3 adult females; Isabella, Wendy, and Zoe. Camilla is also the mother of two 2 and 3-year old females. Camilla is the mother of a 1-year-old male and she is Florian's mother. Zoe is Quintana's mother. Quintana is Florian's nephew.

**Group n.5**

Monika's group: Brian (adult male); Phyllis and Lezzie (adult females). Phyllis is the mother of an adult female, a 3-year-old female and newborn Monika. She is also the mother of a 4- and a 2-year-old male. Lezzie is the mother of a 4-year-old female and of a 3-year-old female.

**Group n.6**

Sita's group: George (adult male); Annette and Gayle (adult females). Annette is the mother of an adult male (which was removed from the group at 4 years of his age), and of a 1- and a 2-year-old female. Annette is also Sita's mother. Gayle has a 1-year-old son.

**Observations**

First Year AQS- First Year SBQS/Second Year AQS-Second Year SBQS

AQS 93 items-SBQS 101 items/ AQS 93 items-SBQS 101 items

Ingrid Florian  
 PepeQuintana  
 MonikaMonika  
 Gringo Sita  
 SebastianPepe  
 SitaIngrid  
 FlorianSebastian  
 Quintana Gringo  
 HugoHugo  
 NadiaVincent  
 KermanKerman  
 VincentNadia  
 Taranta

**Criterion Sort Test**

AQS 93 Items  
 H(31)  
 87, 30, 88, 77, 74  
 81, 78, 66, 60, 76  
 53, 51, 12, 50, 35  
 11, 46, 45, 33, 32  
 43, 31, 28, 34, 25  
 24, 16, 15, 4, 9  
 7  
 M(31)  
 26, 80, 42, 38, 10  
 1, 2, 14, 13, 6  
 22, 19, 18, 58, 40  
 29, 62, 61, 59, 72  
 67, 64, 86, 85, 73  
 71, 89, 90, 36, 49  
 69

L(31)

39, 27, 3, 8, 21  
 20, 17, 41, 37, 23  
 48, 47, 44, 55, 54  
 52, 63, 57, 56, 70  
 68, 65, 82, 79, 75  
 92, 5, 93, 83, 84  
 91

Cat.(9) 32, 43, 46, 45, 53, 76, 50, 4, 28, 34 (10)  
 Cat.(8) 35, 11, 81, 33, 15, 25, 51, 66, 78, 30, 87 (11)  
 Cat.(7) 24, 7, 9, 16, 88, 77, 74, 60, 12, 31(10)  
 Cat.(6) 71, 69, 49, 36, 89, 13, 80, 18, 22, 14(10)  
 Cat.(5) 90, 85, 10, 1, 19, 40, 86, 67, 72, 59, 29 (11)  
 Cat.(4) 26, 42, 38, 2, 6, 58, 62, 61, 64, 73(10)  
 Cat.(3) 92, 83, 65, 79, 70, 41, 93, 3, 27, 39(10)  
 Cat.(2) 5, 37, 20, 52, 91, 17, 44, 48, 68, 75, 54 (11)  
 Cat.(1) 57, 56, 47, 23, 8, 21, 84, 82, 63, 55(10)

### Criterion Sort Test

SBQS 101 Items

H(33)

33, 21, 29, 55, 42  
 30, 59, 79, 66, 76  
 101, 50, 89, 84, 83  
 67, 62, 69, 92, 15  
 57, 60, 43, 75, 91  
 35, 40, 48, 46, 71  
 81, 95, 34

M(35)

3, 6, 94, 41, 86  
 24, 90, 8, 65, 80  
 97, 63, 37, 1, 88  
 13, 56, 61, 31, 82  
 16, 70, 39, 14, 17  
 19, 12, 11, 68, 28  
 20, 32, 44, 78, 100

L(33)

98, 2, 64, 58, 87  
 51, 77, 85, 72, 73  
 25, 22, 27, 26, 7  
 18, 74, 52, 49, 38  
 45, 5, 99, 93, 4  
 53, 9, 10, 47, 23  
 36, 54, 96

Cat.(9) 33, 21, 29, 55, 42, 30, 59, 79, 66, 76, 101(11)  
 Cat.(8) 50, 89, 84, 83, 67, 62, 69, 92, 15, 57, 60 (11)  
 Cat.(7) 43, 75, 91, 35, 40, 48, 46, 71, 81, 95, 34 (11)  
 Cat.(6) 3,6, 94, 41, 86, 24, 90,8, 65, 80, 97 (11)  
 Cat.(5) 63, 37, 1, 88, 13, 56, 61, 31, 82, 16, 70, 39, 14 (13)  
 Cat.(4) 17, 19, 12, 11, 68, 28, 20, 32, 44, 78, 100(11)  
 Cat.(3) 98,2, 64, 58, 87, 51, 77, 85, 72, 73, 25 (11)  
 Cat.(2) 22, 27, 26, 7, 18, 74, 52, 49, 38, 45,5 (11)  
 Cat.(1) 99, 93,4, 53, 9, 10, 47, 23, 36, 54, 96 (11)

### 1.3 Results

As a first analysis of the data, the scores obtained by each subjects (either for AQS or SBQS without distinction of categories) were correlated. Moreover, each subject was correlated with a score obtained in an ideal situation (Criterium sort). The criterium sort represents an hypothetical situation in which there is no doubt about the behaviour performed by the subjects. For instance, if a subject is very afraid of contacting peers for play there is no doubt that the items which describe this behaviour have to be located in his proper group pile and in his category pile. Of course the Criterium sort was previously selected. At the end of our observation the real score obtained by each subject was correlated with the scores on the Criterium sort. The scores of the Criterium were fixed for the First Year and the Second Year.

To represent how each subject score was correlated with all other subject scores and with the criterium sort, we applied the cluster analysis of this data both for the AQS and the SBQS in both years (First Year and Second Year). **Fig. 1a** shows the cluster analysis obtained for the AQS scores. As shown for the First Year, considering all items, the Subjects

Kerman and Nadia are highly correlated (80%). The Subjects Gringo and Sebastian are much less correlated (66%). Each subject correlated with the Criterium sort shows very variable percentages. For instance, the subject that shows a very low correlation with the Criterium sort is Gringo (21%)(AQS First Year). Instead, the subject with the highest correlation on the Criterium sort is Pepe, with 74%. Also Kerman is highly correlated on the Criterium sort (71%).

The cluster analysis for the AQS in the Second Year shows some sensible change (**Fig. 1b**). For instance, Kerman is not any more highly correlated with Nadia, but is highly correlated with Vincent (87%). Gringo and Sebastian at the Second Year are not any more correlated at 66% as in the First Year. In the Criterium sort (**Fig. 1b**) we can see some significant changes from one year to the next. For instance Gringo's correlation with the Criterium Sort, jumps from 21% in the First Year to 67% in the Second Year. Also Sebastian jumps from 36% to 55%.

The same cluster analysis was applied for the SBQS. The SBQS cluster analysis in the First Year (**Fig. 2a**) shows that Kerman and Nadia were correlated more than any other subjects (79%). Another significant result in the SBQS-First Year, for example, is that Sebastian and Sita had a very low correlation (for the same subjects, similar correlation were obtained in the AQS). In the SBQS-First Year with the exception of Kerman and Nadia, all correlations were lower than 75%.

In the SBQS-Second Year (**Fig. 2b**) Kerman and Nadia were not correlated among themselves as before, but Vincent was highly correlated (81%) with Hugo. In the Criterium sort (**Fig. 2b**), also in the SBQS we obtained some change from one year to the other. For instance Gringo who had a very low correlation (31%) with the Criterium sort in the First Year rose to 65% in the Second Year. Sebastian also increased from 34% to 53%. Only Monika decreased from 64% to 57% from the First Year to the Second Year.

Altogether the clusters represented in **Fig 1a,b** and **Fig. 2a,b** demonstrate that between the two years considered, individual differences emerge significantly. It is true that in the second year the infants are 4-months older, but this does not result in the same differences in all subjects, either in infant behaviour (AQS) or in mother behaviour

(SBQS). **Fig. 1a,b & Fig. 2a,b** also show how the subjects were correlated among themselves without considering the Categories of the behaviours described in each item. Now let us take the cases in which subjects are compared in each of the Categories (Items vs subjects). The Friedman two-way analysis of variance by rank of AQS scores (**Tab I**) shows, the following results. In the First Year we had three significant differences among subjects; that were in Category I ( $X^2= 25.36$ ;  $p < .01$ ), in Category III ( $X^2= 29.84$ ;  $p < .01$ ) and in Category VI ( $X^2= 27.53$ ;  $p < .01$ ). In the Second Year in the AQS, no significant differences were found.

Instead the Friedman two-way analysis of variance by Ranks of SBQS (**Tab. II**) shows, the following results. In the First Year, the following significant differences were found: in Category I ( $X^2= 24.80$ ;  $p < .01$ ); in Category V very significant differences ( $X^2=31.70$ ;  $p < .001$ ) and in Category VIII ( $X^2= -28.3$ ;  $p < .01$ ). In the Second Year the SBQS's results showed the following significant differences: in Category III ( $X^2= 36.60$ ;  $p < .001$ ), and in Category V ( $X^2=24.50$ ;  $p < .01$ ).

To understand the reason for such differences, note the graphs of all Categories scores obtained in AQS and SBQS (**Tab III** and **Tab IV**). In these two tables it is possible to see that, for instance, in AQS between First Year and Second Year "Social Confident - Play" differs in many cases with 1 point (45 times), 2 points (36 times), 3 points (27 times) and also with 4 points (29 times). In AQS such a result is very different in a Category like "Infant ignores peers - Play avoidance" where we have only 4 items to analyse. Since we have 9 piles of distribution the minimum difference between the two years is zero and the maximum difference is 8.

The **Tab. III** also shows, that the total maximum difference obtained between the First Year results and the Second Year in AQS is 326 (1 difference), 313 (0 differences), etcetera. The minimum differences (4) between the First Year and the Second Year were reported with 8 differences between one year and the other. The **Tab. IV** instead shows, that the total maximum differences in the SBQS obtained between First Year and Second Year was 350 (1 different), and 295 (0 differences), etcetera. The minimum difference (1) corresponds with the 8 differences between the two years.

In AQS First Year for the Category I "Social Confident - Play" there was a significant difference among subjects, but which subjects made the differences? Among 12 infants some of them were much more confident in social play than other infants. Also we have to consider the Items. Some of them were very descriptive of the observed behaviour, some other items were just descriptive or not at all. Considering the subjects and the items we found out the following facts (**Tab. V** - Summary of the AQS results). In the Cat. I "Social Confident - Play" the Item Most Descriptive was the N. 76 "Infant plays beyond mother's reach".

In the First Year the item n.76 in all subjects reached the scores 90; in the Second Year such score increased to the maximum score, that is 108 even if in the Second Year any significant differences were found. This meant that during the Second Year in all subjects the item 76 was positioned in the pile n.9, but the year in which we had significant differences was in the First Year. Also we had to consider the item Least Descriptive which in this case was n.84 "Infant play in rough and cruel ways with peers. Peers scream or withdraw from play". If all infants in this item score 1 (pile 1) the minimum score should be 12, but we got score 33. This meant that some time, especially during the First Year, infants played in rough and cruel ways with peers. These results indicated it would be advisable to try to sort out the similarities, or dissimilarities among subjects.

So, to begin, we represent the scores obtained by each subject in the 16 items of Cat. I. As we can see in **Fig. 3a** it seems that subjects such as Sebastian and Gringo are very close and lowest, in opposition to Pepe and Hugo who score much more. In fact Pepe in Cat. I is the subject who has the most descriptive items with the highest score in all items of Confidence and social play. The significant difference obtained ( $p < .01$ ) in Cat. I probably is due to the differences among Sebastian and Gringos' low scores against all the other scores subjects. In AQS, looking at the significant differences which came out in Cat. III in the First Year (**Tab.V**), we have to note that the item most descriptive is N.35 "When the infant is distressed or injured, mother is the only one he allows to comfort him". This Item also scores 101 in all subjects, which is a very high score. Only in one case the item is located in Pile 8, in all the other cases the item is located in Pile 9. The item least descriptive in this case is item n.91 "Infant grooms mother or show similar behaviours to mother's coat". The meaning of these results is that when infants seek comfort, most of them allow only the mother to do it, but it seems that some time this does not happen because we obtained significant differences.



We could say the same for the item least descriptive: some infants groom mother or show similar behaviour to mother's coat. Most of the infants do not do it. But it seems that some of them do not behave like this. **Fig. 3b** shows the total scores of each subject obtained in Cat.III (AQS) during the First Year. As we can see Sebastian and Gringo score much more than all other infants. They are different from all others. In fact Sebastian is the subject with the most descriptive behaviours in all items (Cat. III - **Tab. V**), Hugo has the least. Hugo scored very low (see **Fig. 3b**).

In the First Year (AQS) we found another significant difference in Cat. VI "Secure infant – Brief contact with mother. Infant is confident with mother" (**Tab. V**). The difference probably means that some of our infants, at this age, are not really very confident with mother. Probably the subjects who are not always confident with the mother are Sebastian and Gringo. If we have a look at **Tab.IV** and **Fig. 3c** we can understand the reasons. Sebastian and Gringo have Items (66 and 80) "When infant gets off mother's ventrum, he often stops nearby or wants to be held again right way/Equally tolerant of mother-initiative and self-initiative separation or distance" Least Descriptive with the same low score (61/12). The subject with the item Most Descriptive n.50 "Infant ignores most bumps, falls or startles" is Sita. The meaning of this is that Sita, but also Pepe, Nadia, etc. are very confident of themselves when they move around but Sebastian and Gringo are not, hence the significant difference ( $p < .01$ )(**Tab. I**).

Instead for the SBQS we have the following results (**Tab. VI**). In Cat. I "Affect" we have one significant difference among subjects in the First Year. As we did for the AQS, let us see who are the subjects who made the differences and under which items the subjects played different roles. In the "Affect" the Item Most Descriptive is N. 94 "Mother understands and responds adaptively to infant's negative reactions" (when we talk about the SBQS the focal animals are the mothers and not the infants). In all items the subject with the most descriptive behaviours is Gringo's mother. In the Affect Category the Item least descriptive is N.23 "Behaviours toward infant are cruel and cold". Item 94 in all subjects score 77 on 108. Item N. 23 in all subjects scored 20 on 12. The subject with Least Descriptive behaviours in all Items is Monica's mother. The meaning of these results is that the mother sometimes does not understand the infants' needs and she does not respond adaptively. In fact, the total score of the Item most descriptive is 77 which is far from the total 108. Even if the cruel behaviours towards infants are very rare, item 23 scores 20 on 12 (the minimum is 12 on 12). The fact that Monica's mother has the item least descriptive is supported by the fact that when we compare all subjects, Monica's mother scored the lowest (**Fig. 4a**). In this figure we can see that Gringo's mother scored the highest.

About Social Perceptiveness (Cat. III) we have one significant difference in the Second Year ( $p < .01$ ). The Item most descriptive in this category is N. 43 "Aware of social environment" (**Tab.VI**). All subjects score 98 on 108 points. The most descriptive behaviours in all items correspond to the Subject Vincent. For the Item Least Descriptive we have two items with the same score, that is N.54 "Mistakes other infants for her own" and N.47 "Rejects or punishes infant hard enough to hurt him/her". They score 17 on 12. The two subjects with behaviours Least Descriptive in all items are Monica's and Nadia's mothers.

The meaning of this is that the mothers are aware of social environment, they do not mistake other infants for their own, they reject and punish infants very rarely. These facts are supported by the results obtained graphically in **Fig.4b**. Here we can see that Vincent's, Hugo's and Sita's mothers, scores were higher than Monica's and Florian's mothers scores. Probably the significant differences are due to the difference between some subjects like Florian, Monica and all other subjects. The Mother of Florian probably is sometimes not as aware of the environment as the other mothers. Monica's and Nadia's mothers sometimes punish their own infants.

In Cat. V (**Tab. VI**) "Protection from danger" we have significant differences in both First Year or Second Year. What is interesting in this category is that the Item Most Descriptive is the same in both years, that is N.75 "When mother is asleep, she keeps infants close to her". Also the total scores in all subjects in both years are very similar (102/108 vs 103/108). In all items in the First Year the Subject with the Most Descriptive behaviour is Sebastian, in the Second Year is Pepe. In the First Year the Item least descriptive is N.36 "Hesitates to protect infant from other monkeys". In the Second Year the Item least descriptive is N. 11 "Attempts to approach infant when he/she moves away from her". Nadia's mother is the subject with Least Descriptive behaviour in all Items in the First Year, while Hugo's mother occupies this place in the Second Year.

The meaning of this is that in both years we are confident that when the mother is asleep she keeps infant close to her, even if we have sufficient individual differences to cause the significant differences obtained ( $p < .01$ ). In this last case the item least descriptive has played a role. Some mothers attempt to approach infant when he/she moves away from her. In such circumstances small differences exist among mothers. Moreover some mothers hesitate more than others to protect infants from other monkeys. These facts are supported by the results shown graphically in **Fig. 4c** and in **Fig. 4d**. **Fig. 4c** is quite eloquent: a subject like Sebastian's mother scores quite differently from Nadia's mother, and Kerman's mother from Pepe's mother. In the Second Year the scores obtained by each subject are generally lower than in the First Year, but the differences of scores between the same subject are more or less the same.

In Cat. VIII (Social interaction with monkeys other than infants) we have a significant difference in the First Year ( $p < .01$ ) (**Tab. VI**). The item most descriptive is N.91 "Prefers specific adults females companions" and the total score is quite low 84 on 108. The subject with the most descriptive behaviour in all items is Vincent's mother. The Item Least descriptive is N.68 "Seeks proximity with specific adult male". The subject with least descriptive behaviours in all items is Pepe's mother. The significant difference in this case probably comes out for both items least descriptive and most descriptive. Both items have a low score in the Most Descriptive (84) and in the Least Descriptive (35). The meaning is that sometimes mothers prefer specific adult females as companions and some other times the mothers seek proximity with specific adult males. Vincent's mother (as we can see in **Fig 4e**) scores higher than all other mothers. Vincent's mother, more than other mothers, prefers specific adult females as companions, in opposition to Pepe's mother. Pepe's and Hugo's mothers and probably also Nadia's mother seek proximity with specific adults less than all other mothers.

What is the meaning of all of this? As for the results obtained in the AQS in both years, we have all we need to formulate some conclusions. First at all it is known which Categories of behaviours yield the most significant differences among subjects and in which year they occurred, whether in the First Year or in the Second Year. Secondly we know which is the Category with more differences from one year to the other. Also we know the role of each subject (infants in AQS and mothers in SBQS) and the similarity or dissimilarity among themselves. That is why we correlated all subjects and with the Criterium sort. We wanted to go deeper into such correlations because we thought that some subjects (mothers or infants) could be more active or passive in each of the Categories. The last results shown in **Tab. V** (AQS) and in **Tab. VI** (SBQS) support these points of view.

#### 1.4 Conclusions

Before talking about the conclusions that we can infer, let us consider the method conducted throughout this research. The Q-sort method, as far as we know, was not applied before or adapted to study some aspects of the affectional system development in rhesus monkeys. So, as we mentioned in the Method and Abstract, the first step was the selection of a "perfect" AQS and SBQS Categories system. Most of this task has been undertaken by researchers at the Stony Brook University (Waters, et al., 1983; Waters & Deane, 1985). Some items have been modified, revised and polished to adjust them to our monkeys' group situations (see Method).

Problems concerning the meaning of some items have been clarified before starting the observations. For example, adverbs like "often" or "readily" which are used as comparisons quite often in our items had to be considered equally among the subjects. It did not matter very much if one mother punished her son, for instance, 56 or 78 times, but what really mattered was to select if one mother punished her son much more, more, equally, less, much less, etc. than any other mother. This was the approach of this research. Of course, no previous experience of this Q-sort method application in monkeys could assure us of finding good results. After a year of preparation for this study, and another two years of observations (made in different months), the method gave us bad results and of no significance for discussion.

So, in the end, the application of our method succeeded for the following reasons. We expected some differences from the year in which the infants were younger (First Year) to a few months later (Second Year). At the beginning of this study, of course the infants had different ages (see method). Some were about 40-50 days old, some others about 120 days old. The growth's influence could act differently on the infants' and mothers' behaviours. For instance a behaviour like "Mother contact by the infant" from 30 days to 120 days of the infant's life could change more significantly than in a infant from 120 to 210 days of life.

Keeping in mind these facts from the obtained results we can argue the following. A significant change between the First Year and the Second Year was observed in Sebastian. He was 43-days old at the beginning of this study and at the beginning of the second round of observations (Second Year) Sebastian was 3-months old. At the early stage (First Year) behavioural Category as "Infant seeks comfort (AQS)" was very expressively manifested by Sebastian. Gringo who belonged to the same group was 51 days old at the beginning of this study. Gringo's Mother (SBQS) obtained a very high score "Most Descriptive" in all items, especially in item n.94 "Mother understands or responds adaptively to infant's negative reactions".

Considering also the item Least Descriptive, Gringo's mother was shown to be not very cruel and cold with her son, but sometimes she punished him. She displayed quite tense movement but she did not change her attitude at all with her infant. She became irritated and worried and fussed often, and she responded to her infant's negative reactions. As we know, Gringo was living in a group with Sebastian. They were cousins but the difference among them was that Sebastian's mother (Amalia) was lightly sub-dominant to Gringo's mother (Harriet). The hierarchical order of all the groups was established in previous studies (Tartabini, et al., 1986-1987).

Quintana (who is living in the same group as Florian) was much older than Sebastian. In all AQS-Categories Quintana was never located either as Most Descriptive or Least Descriptive. So the age of an infant did not always play a fundamental role in the infant's performance. Some of the infants groups' conditions, the presence of peers and aunts, older sisters or brothers or other relatives could influence the infant's or mother's behaviour. Let us take the example of Sebastian. When he was distressed only his mother could comfort him (especially during the first period of the observation, that is in the First Year). At the same time during play behaviours with peers, Sebastian was not very socially confident. He had some hesitations to contact or to be contacted by peers. In fact his scores in "Social confident" were quite low.

Hugo in opposition to Sebastian (Hugo at the beginning of this study was 80-days old) in Category "Seeks comfort" - AQS, scored Least descriptive with the item "Infant grooms mother or show similar behaviour to mother's coat". This meant that Hugo did not groom his mother at all. He was not interested in it. Also Hugo did not Seek for Mother very much. He did not interrupt his activity to meet his mother. Hugo lived in a very complex group with 3 other same age infants, Nadia, Vincent and Kerman. Hugo, Kerman and Vincent were cousins. AQS results in **Fig. 1a** showed that Kerman with Nadia were highly correlated in the First Year and Kerman with Vincent one year later (Second Year). In this case it is quite clear that the group composition, peers for play behaviours and the kinship have something to do with the infants' attachment development.

Let us now consider Nadia. She was about 3-months old at the beginning of this study and her mother in the "Affect Category" (SBQS) scored the Most Descriptive with item n.94; and the Least Descriptive with the item n.23. Nadia was easily punished. Nadia's mother was not often annoyed by her infant. She displayed some tense movement even if she was not very cruel with her. Nadia's mother did not make too much fuss but sometimes she was distracted and distressed. She was not irritated, but quite often she changed her attitude toward the infant. Nadia's mother's behaviours differed from Irene's, Erica's and Robin's mothers' behaviours. They were the mothers respectively of Hugo, Vincent and Kerman. A very close relationship existed among these three subjects. Hugo, Vincent, Kerman and Nadia have in common the fact that their grandmothers (Josie and Celeste) were sisters. Josie had three daughters, Celeste one daughter. We cannot speculate about the situation in the family, but for instance the changing of attitude towards Nadia, by her mother, could have something to do with the structure of the family. Nadia's mother did not worry about her infant's activity but she responded to the infant's negative reactions.

Monika's group was less complex if compared with all other groups. Monika was the only newborn infant present in the group, as was Sita in her group (see composition of the groups in the method). Monika's mother scored very low in all Least Descriptive items, especially with the Affect's item "Behaviours toward infant are cruel and cold" (n.23). Monika's mother was less annoyed, cruel, etc. and punished less than all other mothers. Maybe the situation in her group did not provoke any particular worry. In these groups there were also present mainly adult females with the exception of one adult male and one 2-year-old juvenile. All members were blood relatives.

Finally, what is the advantage of using the Q-sort? The Q-sort has given complex details that are impossible to obtain with ethological observations. Maybe a multivariate analysis could lead to results as prolific as has been reached with the Q-sort. But with this last analysis, the ethograms with the numbers of its behaviours have to be reduced. The results could become too much synthetic and aseptic. If we consider that in the only SBQS we have 101 items which describe complex situations of the focal subject in his group, we can infer that there is much more information in one AQS or SBQS item than in a behaviour's category used in an ethological observation. We can also point out that even with a sophisticated recording system, as an event-counter with a keyboard, it is not possible to record simultaneously more than two or three behaviours. At the end, it is reasonable to think that Waters & Deane's suggestion (1985) to use the Q-sort method, was productive. Also they were probably right in thinking that the behavioural control system adopted to study the development attachment in children is "more useful as a metaphor than as an explanation for attachment behaviour".

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## Appendix

### AQS 93 items divided in 10 Categories

#### Infant Is The Focal Animal

- 1) Social confidence play 3,11,13,14,25,30,32,39,49,61,64,65,76,79,81,84
- 2) Ignores peers and play avoidance 21,42,48,73
- 3) Infant seeks for mother 2,4,6,9,12,15,18,20,23,29,33,35,36,37,41,51,52,53,68,74,77,83,91,92,93
- 4) Mother as secure base for the infant 7,24,26,28,31,34,45,58,70
- 5) Infant is interested towards objects 1,19,40,59,67,85,86,90
- 6) Secure infant. Brief contact with mother and confident 22,43,46,50,66,69,71,80,87
- 7) Infant is demanding 10,60,72,78,88,89
- 8) Infant has trouble with mother 8,16,54,55,57,62,63,75
- 9) Infant self-directed behaviours 47,56,82
- 10) Infant seeks contact with adults 5,17,27,38,44

#### Definition of Item labels.

##### 1) Social Confident - Play

- N. 3. If no other monkeys are available to play with, infant tries to wrestle with mother, or directs playful mouth-open or play-solicit posture towards her.
- N. 11. Infant is bold in approaching adult monkeys to play, explore, or interact with them.
- N. 13. Infant plays confidently even when social play becomes active or rough.
- N. 14. Infant repeats or persists in activities that have proven difficult for him.
- N. 25. Infant readily joins or plays parallel to in nearby play groups.
- N. 30. Infant is playful most of the time.
- N. 32. Infant initiates social play with peers or juveniles.
- N.39. After being punished, infant returns to the same behaviours without wariness of further punishment.
- N. 49. Infant is very active. Always moving around when he is awake. Prefers active play to quiet play.
- N. 61. When mother is nearby, infant is bolder or more confident to play or explore.
- N. 64. Infant uses a part of mother's body as a play objects or jumping platform.
- N. 65. Infant spends a great prportion of its time away from mother in solitary play and exploration.N. 76. Infant plays beyond mother's reach (>1.0 m).
- N. 79. Infant will engage in quit social play with peers, but avoids active chasing-and wrestling-type play.
- N. 81. Infant explores widely and plays throughout space available.
- N. 84. Infant plays in rough and cruel ways with peers. (Peers scream or withdraw from play).

##### 2) Infant Ignores Peers - Play Avoidance

- N. 21. Infant ignores, avoids or rejects play invitations from peers.
- N. 42. Infant ignores peers' activities; plays alone when away from mother.
- N. 48. Infant hesitates to approach or retreats easily from play objects or peers.
- N. 73. When exploration or solitary play is interrupted, infant gives up easily.

##### 3) Infant Seeks For Mother

- N. 2. When mother is occupied with other activities, infant seeks to be held carried, or otherwise cared for by other adult monkeys.
- N. 4. When infant screams, screaming stops as soon as mother holds him for comfort.
- N. 6. When mother interacts with adult monkeys, infant tries to intervene; climbs on or between them.
- N. 9. When infant returns from exploration or play, he clings on mother and/or sucks on her nipple.
- N. 12. Infant returns to mother frequently even in calm situations.
- N. 15. When infant makes contact with mother, he seeks her ventral surface.
- N. 18. Infant returns to mother and actively solicits contact when fearful or otherwise upset.

- N. 20. When infant becomes frightened and returns to mother, he clings on her for long time even after the frightening event has passed.
- N. 23. When mother cares for infant's siblings or other infants, he interferes or interrupts her.
- N. 29. When infant is distressed by mother's leaving, he follows with calls, screaming, or efforts to cling.
- N. 33. When infant is in mother's ventrum, he sucks (mouths) on nipple.
- N. 35. When infant is distressed or injured, mother is the only one he allows to comfort him.
- N. 36. When mother approaches, infant notices immediately and looks at her or approaches her in a hurry.
- N. 37. Infant is demanding; fusses and interrupts mother's behaviour if she doesn't do what he wants immediately.
- N. 41. Infant is sometimes unaware of mother's location; has to search for her when returning.
- N. 51. When frightened, infant calms down if he moves closer to mother or if she holds him.
- N. 52. Tentative when initiating ventro-ventral contact. When returning from play or exploration, infant pauses, signals, or waits for mother to complete the contact.
- N. 53. Infant solicits and/or cooperates with grooming from mother.
- N. 68. When infant gets off mother's ventrum, he often stops nearby or wants to be held again right away.
- N. 74. Infant wants to be carried when moving long distances with mother.
- N. 77. Infant prefers ventro-ventral position when in contact with mother.
- N. 83. Infant returns to mother between bouts of social play.
- N. 91. Infant grooms mother or shows similar behavioural patterns to mother's coat.
- N. 92. Infant periodically interrupts active social play to approach and make contact with mother.
- N. 93. When mother is feeding, sleeping or manipulating objects, infant tries to interrupt if he is unoccupied; calls or climbs on her.

#### **4) Mother As Secure Base For The Infant.**

- N. 7. Infant keeps track of mother's location when he play away from her; when mother moves or changes activities, infant follows visually.
- N. 24. Infant clearly shows a pattern of using mother as a base from which to explore. Moves out to play, returns or plays near her and moves out to play again, etc.
- N. 26. Infant approaches mother to observe what she is doing; shows interest in mother's behaviours, even when he is not seeking contact or safety.
- N. 28. Infant's activity cycles are coordinated with mother's; sleeps when mother sleeps, awake when she is awake, etc.
- N. 31. In risky or threatening circumstances, infant looks toward mother before deciding what to do.
- N. 34. If allowed, infant moves along with mother as she goes from place to place; doesn't have to be called; doesn't become distressed.
- N. 45. When infant cling to mother, its posture seems stable and comfortable.
- N. 58. Infant accepts restraint of risky behaviour or behaviour in risky situations.
- N. 70. Infant is interested in what mother eats; watches closely and seeks the same kinds of food.

#### **5) Infant Is Interested Towards Objects**

- N. 1. Infant is attracted to unusual or novel noises, objects or movements in environment. (Even if he returns to mother.)
- N. 19. Infant examines objects (either animate or inanimate) in detail: manipulates or carries them for a long time.
- N. 40. Infant is sometimes unaware of mother's location; has to search for her when returning.
- N. 59. Infant is strongly attracted to objects peers carry or handle during play.
- N. 67. Even if an object makes infant afraid or cautious, he will approach it if mother approaches or examines it first.
- N. 85. Infant prefers climbing and running to exploring or manipulating small things.
- N. 86. Infant is fearless with new objects or animals when he first encounters them.

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

#### **6) Secure Infant - Brief Contact With Mother. Infant Is Confident With Mother.**

N. 22. If left in the company of juvenile or adult females, infant allows mother to move away, without following or screaming.

N. 43. Returns to mother spontaneously. When infant returns to mother in non threatening situations, he does so without being called or retrieved.

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

N. 50. Infant ignores most bumps, falls or startles.

N. 66. When infant gets off mother's ventrum, he often stops nearby or wants to be held again right away.

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

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

N. 80. Equally tolerant of mother-initiated and self-initiated separation or distance.

N. 87. Departures from mother are spontaneous; leaves mother to explore or play, without her prompting him to leave or refusing to hold him any longer.

#### **7) Infant Is Demanding**

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

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

N. 72. When mother takes infant to a new area or to one not usually used, infant stays closer to mother than usual.

N. 78. Infant retreats exclusively to mother when frightened.

N. 88. Infant approaches mother and stays closer than usual when unusual happenings occur (e.g. social trouble including whole group, sudden environment changes etc.). (Doesn't necessarily approach quickly or vocalize distress.)

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

#### **8) Trouble With Mother**

N. 8. Infant adopts awkward posture when carried by mother.

N. 16. Infant screams or tantrums when mother physically rejects bids for contact. (May or may not persist in trying to get contact.)

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

N. 55. Infant becomes distressed if mother moves more than 10 meters away or moves out of sight; screams and/or follows.

N. 57. Infant jerks or tantrums in the midst of apparently competent maternal care (e.g. grooming, retrieving under threat, feeding, etc).

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

N. 63. When mother moves away from infant in calm situations, infant makes distress call, clings strongly, or tantrums.

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

#### **9) Infant Self-Directed Behaviour**

N. 47. Infant engages in self-directed behaviours other than coat care, e.g. manipulates or locks fingers, thumbs, chest, genitals, etc..

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

N. 82. When alone and/or unoccupied, infant scratches body persistently (no evident wound, mange, etc).



**10) Infant Seeks Contact With Adults**

- N. 5. There are one or two adult males which the infant approach to within one meter.
- N. 17. Infant will solicit care or interaction from one or more adult males.
- N. 27. Infant accepts being held or carried by monkeys other than mother.
- N. 38. Infant watches social interactions between adults closely.
- N. 44. Infant solicits and/or cooperates with grooming from juveniles or adults other than mother.

**SBQS 101 items divided in 12 categories****Mother Is The Focal Animal**

- 1) Affect 23, 94, 27, 72, 45, 10, 93, 4, 37, 49, 7
- 2) Self maintenance 86, 99
- 3) Social perceptiveness 58, 28, 54, 47, 39, 76, 43, 42, 101
- 4) Activity cycle 21, 98, 87, 95
- 5) Protection from danger 11, 32, 6, 36, 40, 82, 25, 69, 19, 16, 51, 71, 3, 75, 84
- 6) Responses to environment 88, 14, 62, 59, 83
- 7) Social interactions with infant 26, 52, 70, 2, 57, 50, 66, 30, 44
- 8) Social interaction with monkeys other than infants 8, 68, 60, 91, 79, 13, 92
- 9) Support/Preventing independence 18, 74, 97, 78, 85, 22, 5, 56, 1, 89, 29, 33
- 10) Care-taking 73, 90, 34, 96, 38, 41, 24, 65, 20, 81, 55, 15
- 11) Secure-base offering and comforting 31, 61, 100, 63, 77, 80, 64, 46, 35, 12
- 12) Social interaction with infants other than her own 67, 17, 48, 53, 9

**Definitions of the Item labels:****1) Affect:**

- N.23. Behaviours toward infant are cruel and cold.
- N.94. Mother understands or responds adaptively to infant's negative reactions.
- N.27. Mother easily distracted from distress.
- N.72. Is worrisome about infant's activities.
- N.45. Irritation or anger with infant continues for long time.
- N.10. Displays tension movement
- N.93. Makes much fuss over minor social or non-social trouble.
- N.4. Easily punishes.
- N.37. Changes attitude toward infant from time to time.
- N.49. Vocalizes often
- N.7. Often annoyed infant's movements.

**2) Self-Maintenance**

- N. 86. Spends much time feeding or drinking.
- N.99. Frequently grooms or scratches her own body.

**3) Social Perceptiveness**

- N.58. Indifferent to infant's following
- N.28. Acknowledges infant arrival.
- N.54. Mistakes other infants for her own,
- N.47. Rejects or punishes infant hard enough to hurt him/her.
- N.39. Ignores infant's scream.
- N.76. Recognizes distress in infant.
- N.43. Aware of social environment.
- N.42. Stops the behavior with which infant is annoyed in care-taking situation.
- N.101. Adequately interprets social contexts.

**4) Activity Cycle**

- N.21. Regularly rests.
- N.98. Often rests or sleeps.
- N.87. Motions or activities are slow.
- N.95. Adapts to infant's activity cycle.

**5) Protection From Danger**

- N.11. Attempts to approach or follow infant when infant moves away from mother.
- N.32. Keeps away infant from adult monkeys.
- N.6. Quick to retrieve infant in response to minor environmental happenings.
- N.36. Hesitates to protect infant from other monkeys.
- N.40. Retrieves infant more frequently than usual in unfamiliar settings.
- N.82. Supervises infant more closely when he/she is farther from mother.
- N. 25. Keeps infant close to mother even after unusual happenings have been over for some time.
- N. 69. Prevents infant from engaging in dangerous/difficult activities.
- N.19. Monitors infant's location or activities consistently.
- N.16. Keeps infant away from novel objects.
- N.51. Prevents infant from leaving mother in unfamiliar settings.
- N.71. Keeps infant closer when mother becomes distressed.
- N.3. Keeps infant closer when social or nonsocial happenings occur.
- N.75. When mother is asleep, she keeps infant close to her.
- N.84. Helps infant by attacking his/her adversaries.

**6) Response To Environment**

- N.88. Explores objects thoroughly.
- N.14. Is bold with new objects.
- N.62. Is attracted to novelty.
- N.59. Is alert to strange noise or movement in environment.
- N.83. Uses wide space for activities.

**7) Social Interactions With Infant**

- N.26. Accepts or is tolerant when infant climbs in or tugs at her fur or during play.
- N.52. Enjoys or accepts examination of her own body by infant.
- N.70. Approaches infant to observe his/her behaviours.
- N.2. Often makes eye to eye contact with infant.
- N.57. Signals for infant are distinct.
- N.50. Enjoys or is eager to groom infant.
- N.66. Avoids or rejects infant's playful interaction with mother.
- N. 30. Often embraces infant when he/she is in mother's ventrum.
- N.44. Allows infant to observe mother's behaviours nearby.

**8) Social Interaction With Monkeys Other Than Infants.**

- N.8. Allows other monkeys to take care of her own infant.
- N. 68. Seeks proximity with specific adult male.
- N.60. Stays close to other mothers.
- N.91. Prefers specific adult female companions.
- N.79. Allows other monkeys to interact with infant.

N.13. Aggressive in social interaction.

N.92. Active in social interactions.

### 9) Support/ Preventing Independence.

N.18. Retrieves infant if he/she does not seem busy or active.

N.74. Interferes in social play of infant.

N.97. Rejects infant from mother's ventrum in non-threatening situation.

N.78. Takes away objects from infant to examine them.

N.85. Retrieves infant before he/she has time to explore or play thoroughly.

N. 22. Tries to carry infant when mother moves from place to place.

N.5. Prevents infant from initiating social interaction with other monkeys.

N.56. Rejects nipple-contact of infant.

N. 1. Allows infant to control mother-infant distance.

N.89. Leaves infant regardless infant's response.

N.29. Accepts infant's leaving mother.

N.33. Encourages infant to leave mother.

### 10) Care-Taking.

N.73. Exerts control by direct physical acts.

N.90. Devotes more time and effort to infant's care than to care for siblings or other females' infants.

N.34. Shares food or allows infant to feed nearby.

N.96. Carries or holds infant in an odd or unskillful way.

N.38. Inspects infant's body routinely, even with no obvious need.

N.41. Is confident of baby-sitting by other monkeys.

N.24. Infant oriented

N.65. Becomes bored quickly in care-taking of infant.

N.20. Readily accepts infant's request.

N.81. Is patient in care-taking.

N.55. Mother eventually grants infant's request if he/she persists.

N.15. Behaviours of care-taking are decisive.

### 11) Secure-Base Offering And Comforting

N.31. Rejects infant during engages in social activities.

N.61. Immediately retrieves infant when he/she becomes upset.

N.100. Becomes unresponsive/unaccessible when mother is upset.

N.63. Comforting infant is exaggerated.

N.77. Rejects infant during engages in non-social activities.

N.80. Removes or leaves infant before he/she is completely recovered from distress.

N.64. Notifies infant of mother's changing location.

N.46. Readily holds infant in mother's ventrum when he/she seeks comfort with distress.

N. 35. Readily accepts physical contact with infant in non-distress context.

N.12. Affectively accepts infant's returning to mother.

### 12) Social Interaction With Infants Other Than Her Own

N.67. Avoids or rejects physical contact with infants other than her own.

N.17. Very interested in other infant.

N.48. Rejects other siblings when infant is in mother's ventrum.

N.53. Actively takes care of other infants.

N. 9. Accepts playful interaction initiated by infants other than her own.

Fig. 1a-AQS First Year Fig. 1b-AQS Second Year

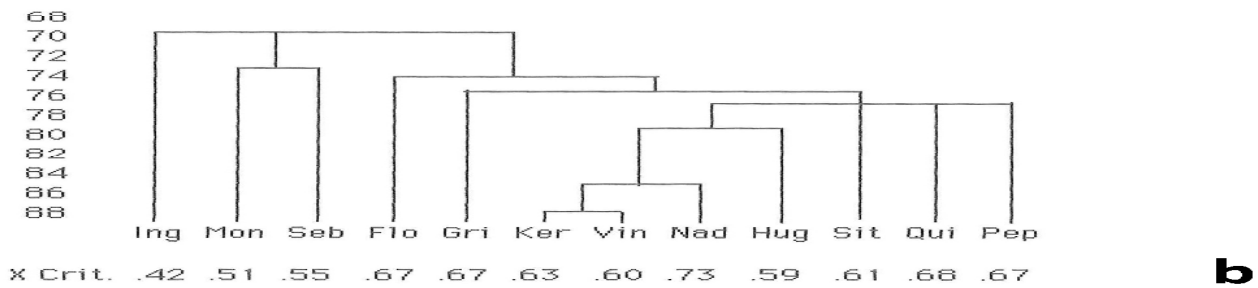
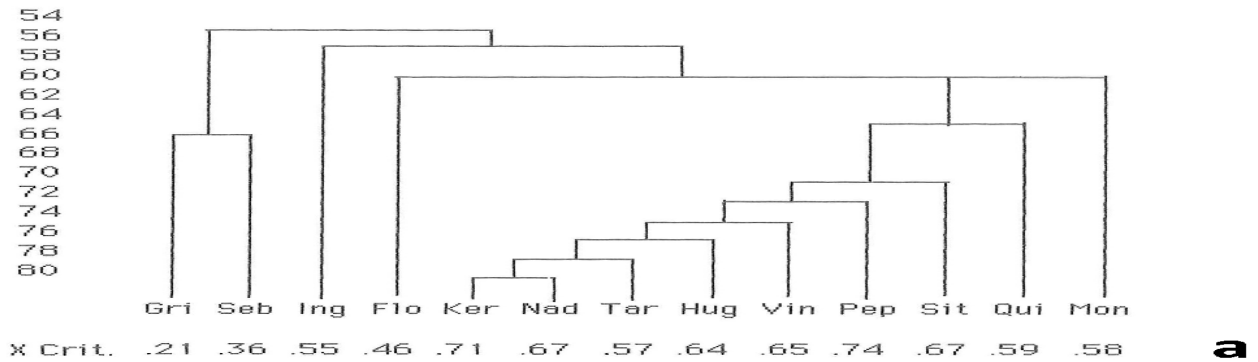


Fig. 2a – SBQS First Year Fig. 2b – SBQS Second Year

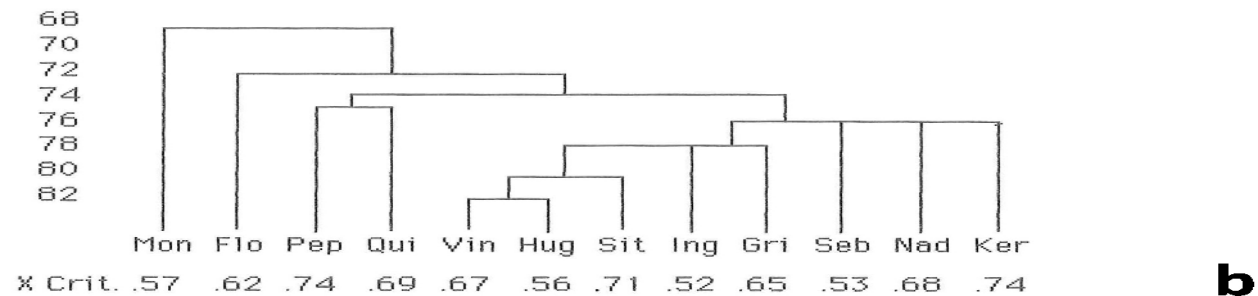
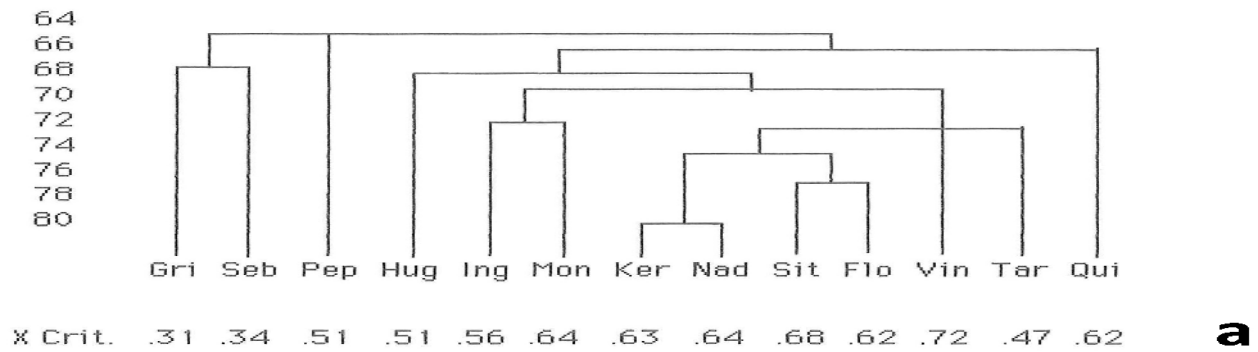
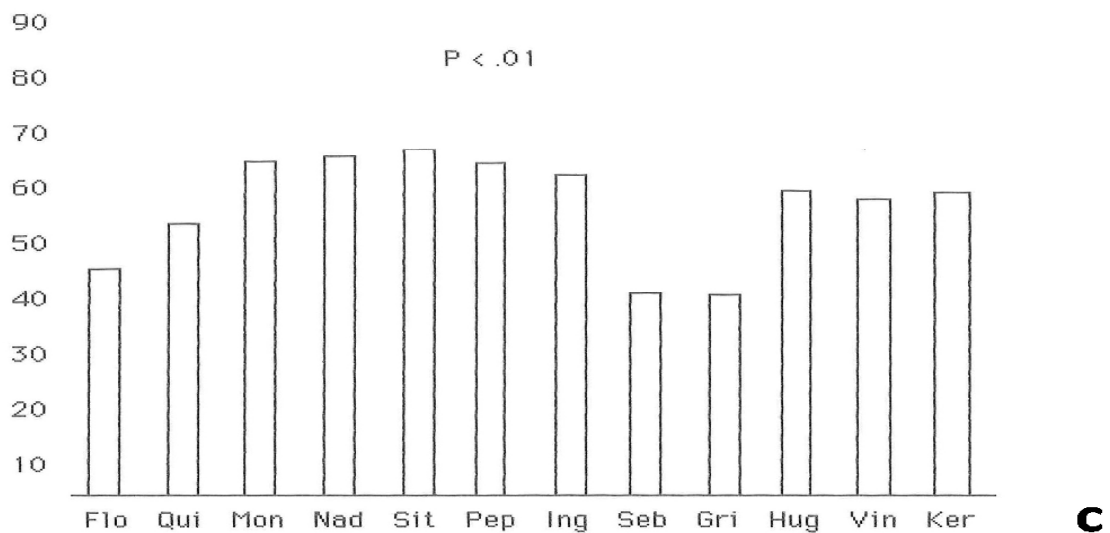
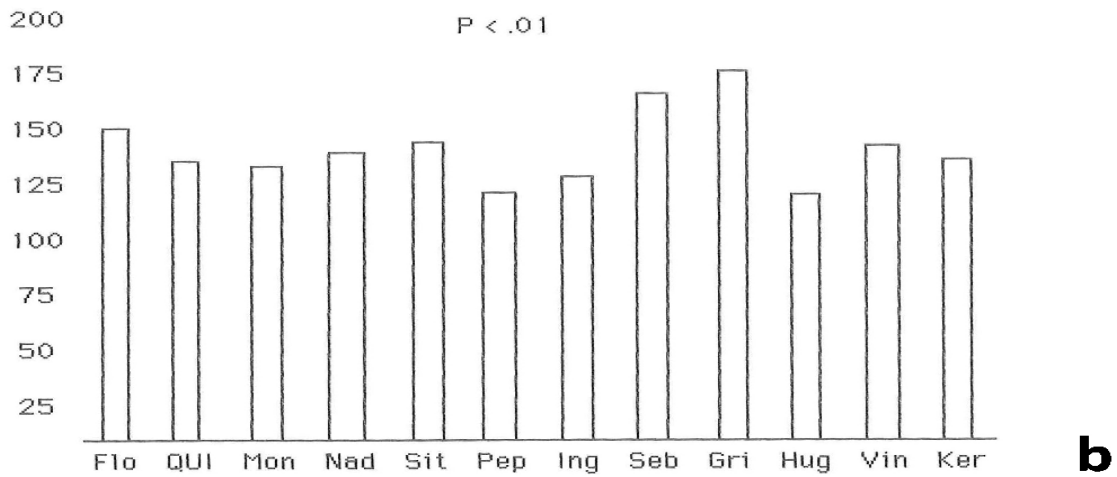
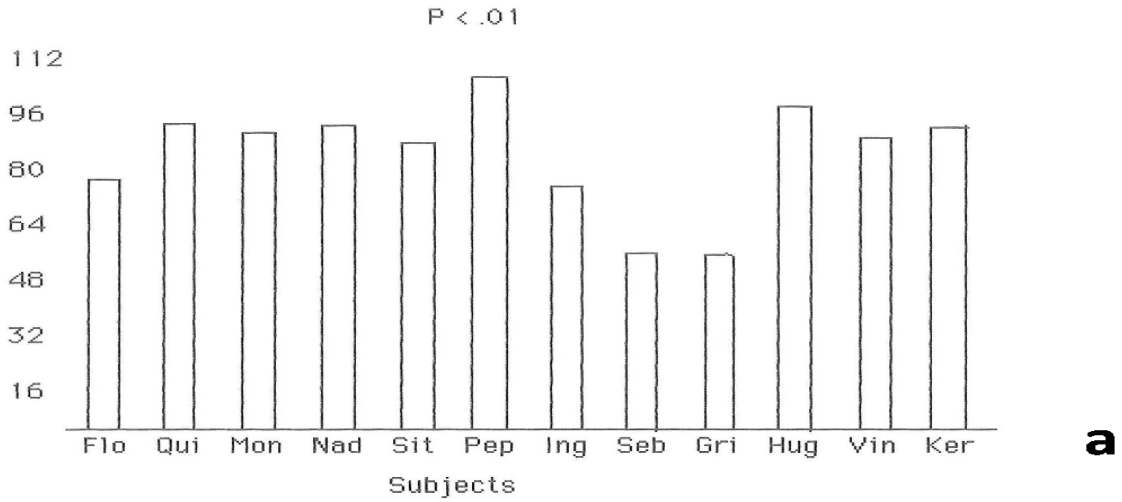
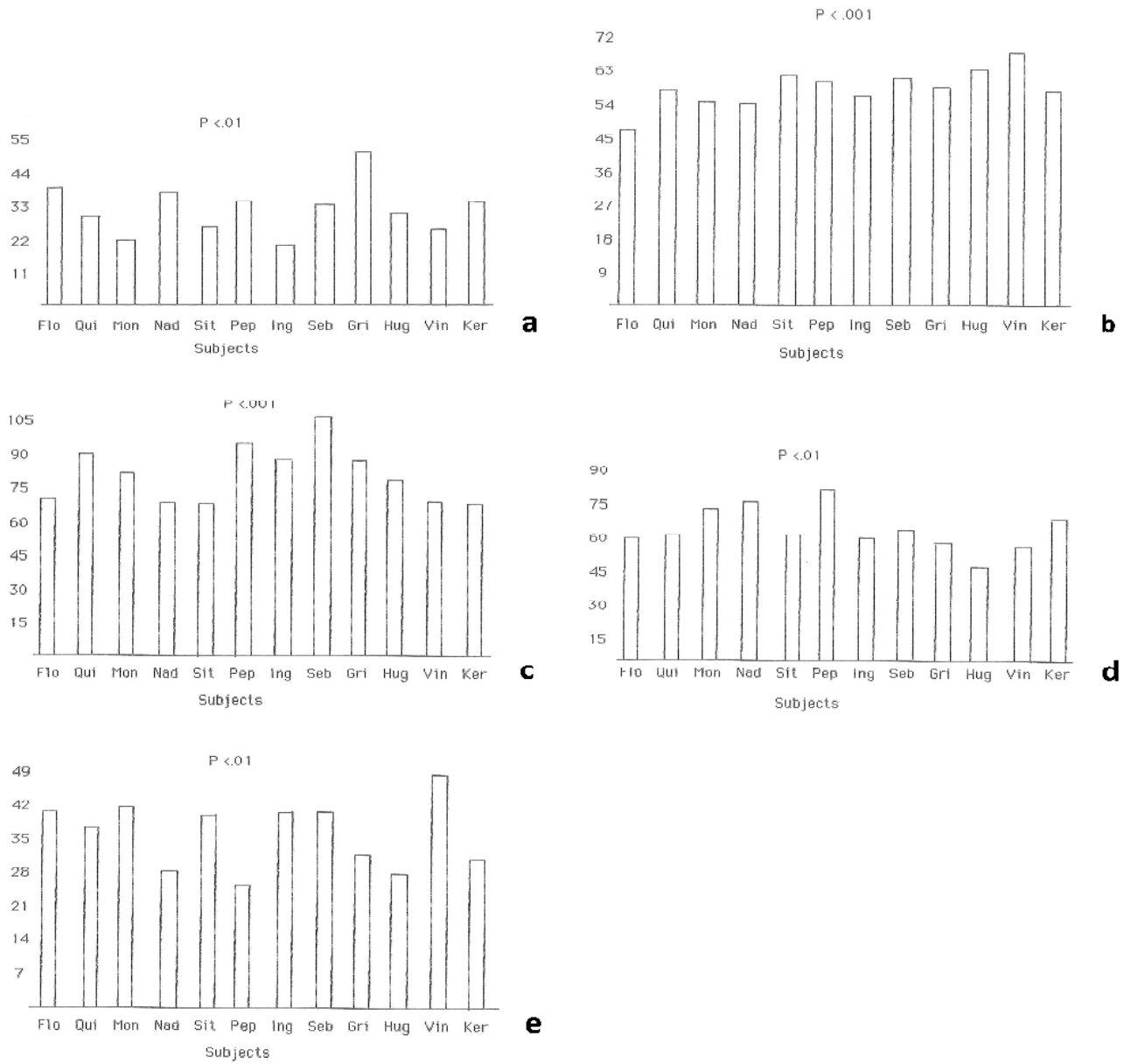


Fig. 3a - AQS First Year. Cat. I (Social confident – Play)

Fig. 3b - AQS First Year. Cat. III (Infant seeks for mother)

Fig. 3c - AQS First Year. Cat. VI (Secure infant-Brief contact with mother. Infant is confident with mother)





**Fig. 4a- SBQS First Year. Cat. I (Affect)**  
**Fig. 4b - SBQS Second Year . Cat.III (Social perceptiveness)**  
**Fig. 4c - SBQS First Year. Cat. V (Protection from danger)**  
**Fig. 4d - SBQS Second Year. Cat. V (Protection frm danger)**  
**Fig. 4e - SBQS First Year Cat. VIII (Social interaction with monkeys other than infants)**

**Tab. I - AQS - Scores**

Cat. I (Social confident-Play)		items 16 vs Ss 12	$X^2 = 12.84$ (n.s.)	II° Year
Cat. I	"	" " " " "	$X^2 = 25.36$	P<.01 I° Year*
Cat. II (Infant ignores peers-Play avoidance)		" 4 " " "	$X^2 = 11.93$ (n.s.)	II° Year
Cat. II	"	" " " " "	$X^2 = 14.00$ (n.s.)	I° Year
Cat. III (Infant seeks for mother)		" 25 " " "	$X^2 = 20.93$ (n.s.)	II° Year
Cat. III	"	" " " " "	$X^2 = 29.84$	p<.01 I° Year*
Cat. IV (Mother as secure base for the infant)		" 9 " " "	$X^2 = 14.33$ (n.s.)	II° Year
Cat. IV	"	" " " " "	$X^2 = 7.97$ (n.s.)	I° Year
Cat. V (Infant is interested towards objects)		" 8 " " "	$X^2 = 1.65$ (n.s.)	II° Year
Cat. V	"	" " " " "	$X^2 = 11.28$ (n.s.)	I° Year
Cat. VI (Secure infant-Brief contact with mother. Infant is confident with mother)		" 9 " " "	$X^2 = 22.89$ (n.s.)	II° Year
Cat. VI	"	" " " " "	$X^2 = 27.53$	p<.01 I° Year*
Cat. VII (Infant is demanding)		" 6 " " "	$X^2 = 12.21$ (n.s.)	II° Year
Cat. VII	"	" " " " "	$X^2 = 17.46$ (n.s.)	I° Year
Cat. VIII (Trobale with mother)		" 8 " " "	$X^2 = 7.75$ (n.s.)	II° Year
Cat. VIII	"	" " " " "	$X^2 = 15.83$ (n.s.)	I° Year
Cat. IX (Infant self-directed behaviour)		" 3 " " "	$X^2 = 11.92$ (n.s.)	II° Year
Cat. IX	"	" " " " "	$X^2 = 9.80$ (n.s.)	I° Year
Cat. X (Infant seeks contact with adults)		" 5 " " "	$X^2 = 12.53$ (n.s.)	II° Year
Cat. X	"	" " " " "	$X^2 = 7.99$ (n.s.)	I° Year

\* p&lt;.01

**Tab. II - SBQS - Scores**

Cat. I (Affect)	Items 11 vs Ss 12	$X^2 = 16.00$ (n.s.)	II° Year
Cat. I	" " " " "	$X^2 = 24.80$	p<.01 I° Year*
Cat. II (Self maintenance)	" 2 " " "	$X^2 = -15.75$ (n.s.)	II° Year
Cat. II	" " " " "	$X^2 = 9.30$ (n.s.)	I° Year
Cat. III (Social perceptiveness)	" 9 " " "	$X^2 = 36.60$	p<.001 II° Year**
Cat. III	" " " " "	$X^2 = 10.10$ (n.s.)	I° Year
Cat. IV (Activity cycle)	" 4 " " "	$X^2 = 16.30$ (n.s.)	II° Year
Cat. IV	" " " " "	$X^2 = 8.70$ (n.s.)	I° Year
Cat. V (Protection from danger)	" 15 " " "	$X^2 = 24.50$	p<.01 II° Year*
Cat. V	" " " " "	$X^2 = 31.70$	p<.001 I° Year**
Cat. VI (Responses to environment)	" 5 " " "	$X^2 = 9.70$ (n.s.)	II° Year
Cat. VI	" " " " "	$X^2 = 5.80$ (n.s.)	I° Year
Cat. VII (Social interactions with infant)	" 9 " " "	$X^2 = 13.50$ (n.s.)	II° Year
Cat. VII	" " " " "	$X^2 = 13.00$ (n.s.)	I° Year
Cat. VIII ( Social interaction with monkeys other than infants)	" 7 " " "	$X^2 = 8.20$ (n.s.)	II° Year
Cat. VIII	" " " " "	$X^2 = -28.30$	p<.01 I° Year*
Cat. IX ( Support/Preventing independence)	" 12 " " "	$X^2 = -3.50$ (n.s.)	II° Year
Cat. IX	" " " " "	$X^2 = 5.70$ (n.s.)	I° Year
Cat. X (Care-taking)	" 12 " " "	$X^2 = 10.80$ (n.s.)	II° Year
Cat. X	" " " " "	$X^2 = 9.70$ (n.s.)	I° Year
Cat. XI (Secure base offering and comforting)	" 10 " " "	$X^2 = 6.70$ (n.s.)	II° Year
Cat XI	" " " " "	$X^2 = 5.00$ (n.s.)	I° Year
Cat. XII (Social interaction with infants other than her own)	" 5 " " "	$X^2 = 8.13$ (n.s.)	II° Year
Cat. XII	" " " " "	$X^2 = 8.90$ (n.s.)	I° Year

\* p&lt;.01 \*\* p&lt;.001



**Tab. III - AQS I° and II° Year**

Category	n. items	Differences									
		0	1	2	3	4	5	6	7	8	
1) Social confidence - Play	16	40	45	36	27	29	7	4	2	2	
2) Inf. ignores peers-Play avoidance	4	12	9	8	8	8	2	1			
3) Infant seeks for mother	25	66	88	57	36	24	14	12	3		
4) Mother as Secure Base for the infant	9	26	43	8	16	11	1	3			
5) Infant is interested towards objects	8	63	22	6	3	1			1		
6) Secure infant-Brief contact with mother. Inf. is confident with mother	9	25	36	18	13	7	5	3	1		
7) Infant is demanding	6	15	18	15	11	5	1	5	1	1	
8) Trouble with mother	8	33	26	15	11	6	4	1			
9) Infant self-directed behaviour	3	17	19								
10) Infant seeks contact with mother	5	16	20	6	3	5	6	2	1	1	
Total		313	326	169	128	96	40	31	9	4	

**Tab. IV - SBQS I° and II° Year**

Category	n. items	Differences									
		0	1	2	3	4	5	6	7	8	
1. Affect	11	27	54	25	12	8	5			1	
2. Self maintenance	2	6	8	8		1		1			
3. Social perceptiveness	9	37	33	16	9	9	3	1			
4. Activity cycle	4	15	12	14	5	2					
5. Protection from danger	15	40	45	35	16	14	17	10	3		
6. Responses to environment	5	37	9	5	4	4	1				
7. Social interactions with infant	9	17	34	28	14	10	4	1			
8. Social interaction with monkeys other than infant	7	10	21	19	14	9	5	5		1	
9. Support/Preventing independence	12	41	35	29	13	7	10	6	3		
10. Care-taking	12	31	46	26	20	10	6	3	2		
11. Secure-Base offering and comforting	10	25	38	25	11	10	7	1	3		
12. Social interaction with infant other than her own	5	9	15	16	7	4	5	4			
Total		295	350	246	125	88	63	32	12	1	

**Tab. V - Results AQS (Summary)**

## Total Score

Cat. I (Social Confidence -Paly) I° Year (p&lt;.01)\*

Item Most Descriptive	76(90/108) - Most Descrip. Ss: Pep (in all items)
“ Least “	84 (33/12) - Least “ Ss: Ing “

76: Infant beyond mother's reach (&gt; 1 m)

84: Infant plays in rough and cruel ways with peers. Peers scream or withdraw from play

Cat. III (Infant seeks for mother) I° Year (p&lt;.01)\*

Item Most Descriptive	35(101/108) - Most Descrip. Ss: Seb (in all items)
“ Least “	91 (30/12) - Least “ Ss: Hug

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

91: Infant grooms mother or shows similar behaviour to mother's coat

Cat. VI (Secure infant - Brief contact with mother. Infant is confident with mother) I° Year (p&lt;.01)\*

Item Most Descriptive 50(99/108) - Most Descrip. Ss: Sit (in all items)

“ Least “	66 (61/12)	- Least “	Ss: Seb
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80	- Least “	Ss: Gri
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50: Infant ignores most bumps, falls or startles

66: When infant gets off mother's ventrum, he often stops nearby or wants to be held again right way

80: Equally tolerant of mother-initiative and self-initiative separation or distance

\* p&lt;.01

**Tab. VI - Results SBQS (Summary)**

## Total Score

Cat. I (Affect) I° Year ( $p < .01$ )\*

Item Most Descriptive	94(77/108) - Most Descrip.	Ss: Gri (in all items)
“ Least “	23 (20/12) - Least Descrip.	Ss: Mon “

94: Mother understands or responds adaptively to infant's negative reactions  
 23: Behaviours toward infant are cruel and cold

Cat. III ( Social perceptiveness II° Year ( $p < .001$ )\*\*

Item Most Descriptive	43(98/108) - Most Descrip.	Ss: Vin (in all items)
“ Least “	54 (17/12) - Least “	Ss: Mon
	47 - Least “	Ss: Nad

43: Aware of social environment  
 54: Mistakes other infants for her own  
 47: Rejects or punishes infant hard enough to hurt him/her

Cat. V ( Protection from danger) II° Year ( $p < .001$ )\*\*

Item Most Descriptive	75 (102/108) - Most Descrip.	Ss: Pep (in all items)
“ Least “	11 (16/12) - Least Descrip.	Ss: Hug “

75: When mother is asleep, she keeps infant close to her  
 11: Attempts to approach or follow infant when he/she moves away from her

Cat. V (Protection from danger) I° Year ( $p < .01$ )\*

Item Most Descriptive	75 (103/108) - Most Descrip.	Ss: Seb (in all items)
“ Least “	36 (21/12) - Least Descrip.	Ss: Nad “

75: /see above)  
 36: Hesitates to protect infant from other monkeys

Cat. VIII (Social interaction with monkeys other than infants) I° Year ( $p < .01$ )\*

Item Most Descriptive	91 (84/108) - Most Descrip.	Ss: Vin (in all items)
“ Least “	68 (35/12) - Least Descrip.	Ss: Pep “

91: Prefers specific adults females companions  
 68: Seeks proximity with specific adult male

\*  $p < .01$  \*\*  $p < .001$