ATTACHMENT IN SOCIAL NETWORKS
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CHAPTER 10

EXPLORING CHILDREN'S BEHAVIOR IN THE STRANGE SITUATION

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ABSTRACT

Using data from six different countries but disregarding nationality, an analysis was made of the behavior of children and of subgroups of children in the Strange Situation. Employing three-mode principal component analysis, trends in behavior were studied both for the Mother episodes, and for the Strange episodes separately, and for most episodes jointly. With continuous components, like Proximal Behavior, Distal Behavior, Resistant Behavior, and Stranger Anxiety, compact descriptions could be given of the behavior, both in terms of idealized individuals and as members of the subgroups of Ainsworth' classification system. The rather complex patterns of avoidance towards the mother were studied and commented upon. Details are presented on the development of these components over the episodes. It was also shown that the components succeed to a reasonable degree to separate the subgroups.

INTRODUCTION

There is a striking contrast between the intricacy of data collection procedures of the Strange Situation and the simplicity of its analysis and reported results. In this chapter we will show how more detailed analyses of the Strange Situation are possible, and how much more is happening than is customarily reported.

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In the Strange Situation, a child is confronted with a stressful situation which is divided into a complex series of episodes. Within twenty minutes it has to deal with a) a strange environment; b) a stranger who tries to engage it in playful interaction but leaves quite suddenly; c) the rather strange behavior of the mother who leaves and returns again several times. The Strange Situation does not seem to be similar to any of the child's known and trusted situations; even during the visit to the pediatrician the mother stays at its side. Therefore, it is not surprising that children are under stress and show very intense feelings and emotions (cf. Gaensbauer, Connell, & Schultz, 1983). The intensity of these emotions could be the reason that children express so much of themselves in the Strange Situation.

The children's behavior can be scored in all episodes on a number of scales and variables. Ainsworth, Blehar, Waters, and Wall (1978) presented more than one hundred scores per child: about 70 scores on frequency measures such as exploratory manipulation, exploratory locomotion, visual exploration, crying, smiling, vocalization, looking, etc., and about 38 scores on interactive scales such as proximity seeking, contact maintaining, distance interaction, search, resistance and avoidance. The richness of Strange Situation data is very impressive indeed. However, only a very limited part of this richness appears to be used in its analysis. Reduction is the most important characteristic of coding the data. First, the multitude of data per child is reduced to eight subcategories into one of which each child is assigned. In fact, on the basis of the more than one hundred scores the child is rated as having an A1, A2, B1, B2, B3, B4, C1, or C2 type of attachment relationship with its caregiver. Because samples of most studies are too small and children are too unequally distributed among the eight subcategories for sophisticated statistical analyses, the subcategories are often reduced to the three main categories: A, B and C types of attachment. Finally, the ultimate reduction takes place when, supposedly to increase the power of the analyses, the A- and C-categories are lumped together. The plurality of attachment relationships is then reduced to a simple dichotomy: anxious versus secure relationships. Thus, the original richness of data culminates in assigning each child to one of two categories through which "reality" is supposed to be described.

Although system theory can be used to defend the necessity of combining behaviors with the same function into higher levels of aggregation (Van IJzendoorn & Tavecchio, chapter 1, this volume), this extreme reduction obviously leads to the question whether the indirect way, using more than one hundred variables to reach a dichotomous decision about a child, could not be dispensed with. It is not unusual, therefore, to utilize only scores on the interactive scales in the two reunion episodes (4 and 7) to classify children. Furthermore, only scores on two scales appear to be critical, namely avoidance and resistance. When a child clearly avoids its mother in the two reunion episodes their relationship has to be classified as an A type. Similarly, considerable resistance determines a C type of attachment. In fact, the exclusive use of the reunion episodes seems to have more statistical rationale than a classification using all Strange Situation data. In particular, Ainsworth et al. (1978) showed that the interactive scales in the two reunion episodes have sizeable weights in the discriminant functions differentiating between A, B and C type relationships. If we make use of a mere six minutes of the Strange Situation, the question arises which information the other episodes contain. Is it possible to derive other dimensions than security of attachment from this material, or is the information completely redundant compared to the classification?

The reduction of information from the Strange Situation has led to much dissatisfaction with the A-B-C classification. Four important criticisms have been brought forward. First, the fundamental comment has been made that a simple dichotomization or trichotomization of the Strange Situation data takes only one aspect (security of attachment) into account, and neglects other relevant data and aspects (Connell & Goldsmith, 1982). Secondly, there is no clear-cut algorithm to transform the continuous variables into discrete categories; therefore, some error variance due to coding biases is unvoluntarily added to the imprecise scoring of the continuous variables. Clinical insights seem to play an indispensable role in attachment classifications, and serious proposals for classification formulas have not yet been put forward. This implies that it is not exactly known what kind of information is lost (or is added!) by "clinically" classifying the children on the basis of the scales. Although Connell (1977) tried to develop an "objective classifier" (p.126) based, among other things, on discriminant analysis of Ainsworth's data, his proposal has not been applied on a wide scale. Because Connell deleted the marginal groups B1 and B4 from his sample, the "classifier" cannot have but very restricted validity (cf. Lamb, Thompson, Gardner, & Charnov, 1985, p.135). Thirdly, ethology does not seem to suggest that natural selection would prefer a discrete instead of a continuous reality (Lamb et al., 1985). Describing reality with a limited number of categories is especially functional and effective in the theoretical discourse, in which typologies are constructed to represent as much information as is possible. We always have to bear in mind, however, that such typologies are indeed constructions that have to be changed if they appear to distort our perception of reality. Fourthly, there is a technical criticism. Discrete variables are much more difficult to handle in multivariate statistical analysis than continuous variables. One way to solve this technical problem is by using the continuous interactive scales as well as the attachment classifications in analyzing the data (see, for example, Van IJzendoorn, Van der Veer, & Van Vliet-Visser, chapter 5, this volume). Recently, an intuitive scaling of the subcategories has been used to construct a continuous variable. B3 children are given a score of 3; B1, B2 and B4 children receive a score of 2; and A and C children are given a score of 1. The resulting alleged continuous variable has been called "security of attachment" (Main, Kaplan, & Cassidy, 1985, p.82), but a theoretically sound rationale seems to be lacking, and it has not yet been shown that the variable is indeed a continuous one.

We think the above mentioned criticisms cannot be refuted by referring to studies done in the past. A thorough study of the Strange Situation is necessary to solve the problems more fundamentally. The dimensions underlying all variables have to be analyzed in relation to the classification, as well as the dynamics over different episodes. Different approaches have already been tried out. Discriminant analysis has been applied by D.B. Connell (1977), Ainsworth et al. (1978) and Lamb et al. (1985) to find out which combination of variables maximizes the difference between the categories, given the classifications. The A, B, and C classification appears to be reproduced rather well by this procedure. In addition, nonlinear mapping (Connell, 1977) and cluster analysis (Lamb et al., 1985) have been applied to try and identify groups of children given the variables but not the classifications. The pertinent question was whether the discovered clusters are similar to the A, B, C groups. The results are somewhat disappointing: The most important dimension which distinguished between the clusters is the proximity versus distance interaction dimension. This dimension is, of course, not identical to the security-of-attachment dimension (Lamb et al., 1985, p.217). Connell's nonlinear mapping showed the similarity of B1 to A children, and the marginal C-like status of the few B4 children in his sample. The groupings of A and C children did not show any overlap (Connell, 1977, p.136). Connell's dimensions could globally be typified as "distance/avoidance versus proximity/contact maintaining", and as "antithetical versus thetical attachment behavior" (resistance/avoidance versus proximity) (p.135). Finally, analysis of covariance structures has been applied (Connell & Goldsmith, 1982; Connell, 1985). Not only the influence of behavior in earlier episodes on behavior in later episodes was studied (Connell & Goldsmith, 1982), but "fundamental components" in the Strange Situation data have been derived as well (Connell, 1985). The problem with the latter analysis is the large number of dimensions, and separate analyses of the components in variables, episodes and subjects, so that changes over episodes are not combined with the components of the variables. The "structural modelling approach" of Connell and Goldsmith (1982) combines the search for underlying dimensions and their dynamics over episodes, but the small sample size (n=55) confers only a hypothetical status to the results (see Boomsma, 1983, for a discussion of the necessary sample sizes in this type of analyses). Furthermore, Connell and Goldsmith only studied the influence of the first separation episode on the first reunion episode. This is, of course, only a small part of the "mini-longitudinal" design of the Strange Situation.

In this chapter we hope to arrive at an integrated solution by applying three-mode principal component analysis. It is not suggested that this approach is the only suitable one for this purpose, but it is contended that it is an extremely flexible and powerful one. By applying three-mode principal component analysis we try to answer the question whether "a discrete number of continuous variables that represent meaningful individual differences in Strange Situation behavior" (Lamb et al., 1985, p.222) can be developed, and how these variables or dimensions relate to the classical A-B-C classification. By searching for components not only in variables but also in episodes and subjects, we hope to shed some light on the dynamics of the entire Strange Situation.

As has been said above, our main tool in the exploration will be three-mode principal component analysis (see e.g., Tucker, 1966, 1972; Kroonenberg & De Leeuw, 1980; Kroonenberg, 1983, 1984, in press; Snyder, 1986, and Appendix A). In two previous studies we have used the same method to study Strange Situation behavior (Kroonenberg, 1984; Van IJzendoorn, Goossens, Kroonenberg, & Tavecchio, 1985). The first study used preliminary data which later were corrected in many ways (Goossens, 1986). Therefore, that study should primarily be seen as a methodological exercise in three-mode principal component analysis rather than a substantive contribution to the theory of attachment. In the second study the now corrected data were analyzed, but the reporting was extremely compact and hardly suitable for showing the full power of the technique in unravelling and describing the behavior in the Strange Situation in great detail. The present study attempts to combine both methodological and substantive aspects. It will at the same time be more general, and more restricted than the previous studies. It is more general because data are available from six countries rather than one (Germany, Israel, Japan, the Netherlands, Sweden and the United States - for a detailed description see Sagi & Lewkowicz, chapter 11, this volume; and Appendix B); it is more restricted because in contrast with the Van IJzendoorn et al. (1985) study, no information is available on the variables crying and exploratory manipulation. The multinational origin of the data has important consequences for our ability to analyze the Strange Situation with respect to the attachment subgroups. The distribution over subgroups is different in all countries: for instance, relatively more C children in Israel, more B1 children in the Netherlands, etc. (see again Sagi & Lewkowicz, chapter 11, this volume; Table 1). Therefore, almost all subcategories of the classification are represented with enough subjects to allow the multivariate study of differences and similarities between the subgroups (for details on the data and their preparation for analysis, see Appendix B).

In this study we will disregard the different countries of origin of the children. Possible differences in scoring procedures between countries will be considered as differences caused by or allowed by the scoring and classification procedures. Researchers in all countries have checked their procedures against one or more colleagues in other countries so that we may assume that in principle all investigators use largely a common approach to scoring. In as far as they do not, this should be seen as a fault of insufficiently restrictive instructions, rather than "caused" by the researchers' nationality. Similarly, differences in distributions over the subgroups will be considered genuine "cultural" differences rather than instrumental ones. In the same spirit, age differences will not be considered, nor could they be as they are not part of the data base. From the original publications (Sagi, Lamb, Lewkowicz, Shoham, Dvir, & Estes, 1985; Miyake, Chen, & Campos, 1985; Van IJzendoorn, Goossens, Kroonenberg, & Tavecchio, 1984; Goossens, 1986; Beller & Pohl, 1986; Lamb, Hwang, Frodi, & Frodi, 1982; Belsky, Rovine, & Taylor, 1984; Thompson, 1981), it can be inferred that the ages vary between 12 months and 24 months. The Dutch sample in particular has a disproportionate number of older children. It should be realized, however, that generally the Strange Situation is considered applicable for all children in the stated age range (Lamb et al., 1985, p.31), be it that especially older children score higher on *proximity seeking* and *distance interac-*

tion due to their greater mobility and communicative skills (for reviews see Lamb et al., 1985; Goossens, Van IJzendoorn, Tavecchio, & Kroonenberg, 1986).

ANALYSIS PLAN

The simplest way to describe the dynamics of behavior in the Strange Situation is to show how the means (and standard deviations) change on the interactive scales or variables - proximity seeking (P), contact maintaining (C), resistance (R), avoidance (A), distance interaction (D), and search behavior for the mother (S) - per subgroup over the episodes. The episodes will be designated by a letter and a number, i.e., M1, M2, S2, S3, M4, A5, S6, M7, indicating the number of the episode (following Lamb's system of counting), and the person present, i.e., Mother (M), Stranger (S), and the child alone (A). In Episode 2 behavior of the child towards both the mother and the stranger is scored.

Starting from the assumption that interactive behavior towards the mother is functionally different from that towards the stranger, a fundamental difficulty in analyzing the behavior of a child in the Strange Situation is that in each episode, except for the second one, scores are only available on half of the variables. In particular, in S2, S3, S6 scores are available on Ps, Cs, Rs, As, Ds, and S (no search, however in S2 due to presence of mother), while in M1, M2, M4, and M7 scores are available on Pm, Cm, Rm, Am, and Dm. Finally, in A5 a score is only available for search.

There are several ways to treat this problem. A very common one is to ignore the sequential character of the data and analyze them as 38 stochastically independent (and not autocorrelated) variables. Another frequent procedure is to ignore the stranger and average the M4 and M7 scores. In one of our previous studies (Kroonenberg, 1984) the problem was solved by equating Ps and Pm, Cs and Cm, etc. But as stated in Van IJzendoorn et al. (1985) this is not really satisfactory because of the possible differences in meaning and function between behavior towards the stranger and towards the mother. In Van IJzendoorn et al. (1985) we analyzed S3, M4, S6 and M7 simultaneously by creating two "phases", one of the variables in S3+M4, and one of those in S6+M7, while in preliminary (but not reported) analyses we also added a phase S2+M2 (without search behavior). In this way we managed to analyze behavior towards the mother and the stranger together, while also allowing for the sequential or temporal aspect.

In the present study we have taken two approaches towards studying the development of behavior over time. In the first place we analyse separately the behavior towards the mother, i.e., M1, M2, M4, and M7, and that towards the stranger, i.e., S2, S3, and S6. Secondly, we used the phases approach by examining S3+M4, and S6+M7. In all analyses involving episode 2, it should be remembered that there is the difficulty that certain behaviors are mutually exclusive. A child is not likely to have a high score on contact maintaining both towards the mother and the stranger simultaneously, while this is quite possible for distance interaction. To what extent this is a problem has to our knowledge never been investigated. We, too, will not enter into such an analysis, and we hope and expect that the problem is not very serious. One of the reasons for this is that most children do not have high scores in this episode, and another is that the use of rating scales rather than frequency measures alleviates some of the dependence.

So far we have only looked at ways to treat variables and episodes, but we have not yet considered the subjects themselves. An implicit assumption in most approaches attempting to analyze dependence between variables is that subjects are random samples from certain populations, and that these samples or populations are sufficiently homogeneous to make computing averages and correlations sensible. Often by computing correlations or covariances, the subjects are "removed" from the analyses, and they only serve to assess the variability of the estimates of the variable dependence. From the literature on attachment, however, it is known that subgroups exist, even if it is not fully explored to what extent they induce a different correlational structure on the variables. If the groups share the same structure, possibly to a different degree, treating the children as replications is not a problem; if they do not, then attention should be paid to such differences. One of the virtues of three-mode principal component analysis is that many kinds of differences in structure can be accommodated and investigated along with the temporal aspects of the situation as well. And if there are children that do not fit the model determined by the majority, they can be spotted.

MEANS

The simplest way to get a first view of the development of the children's behavior in the Strange Situation is to inspect the trends in the means of each variable over the episodes.

In Figure 1, these means are portrayed, separately for the mother episodes (M1, M2, M4, M7) and the stranger episodes (S2, S3, S6). As the scale is the same for all figures, comparisons can also be made across variables assuming that the scoring of behavior is such that the intensities may be compared. Even though the means of the subgroups are plotted in Figure 1 our main concern is with the variables themselves rather than with the subgroups. The discussion of the separate variables here is to set the scene for the more complex analysis later on.

Proximity seeking

As for all variables, there is a striking and understandable contrast between the reactions towards the mother and those towards the stranger. Firstly, there is very little variance in the attitude towards the stranger. All children react the same way, the A1 and C children somewhat less than A2 and B3 children. Secondly, there is only a slight, be it systematic, increase over the episodes. Notwithstanding the increasing stress, children seem to seek comfort from the stranger. Of course, the presence of the mother leads to a stronger reaction of the children as a group, but it is also clear that not all children are affected in the same way: A1 and B1 children remain relatively indifferent, while the B4 and C children (closely followed by the B3 children) tend to seek the proximity of the mother from the start, and intensify this behavior all through the Strange Situation.

Contact maintaining

The patterns described above are virtually identical for contact maintaining, both with respect to the stranger and the mother, and with respect to the behavior of the subgroups, be it at a somewhat lower level of intensity, especially in the M1 and M2 episodes.

Distance interaction

An entirely different pattern can be observed for distance interaction. Whereas in the opening episode the children interact frequently with their mother from a distance, the entrance of the stranger seems to cool their enthusiasm in this respect considerably. Furthermore, if it is assumed that many interactions from a distance indicate that a child is relatively at ease in a given situation, it seems more difficult in the second reunion episode (M7) to put the child at ease, as is evident by the drop in distance interaction in M7. It can also be seen that the difference between subgroups only really

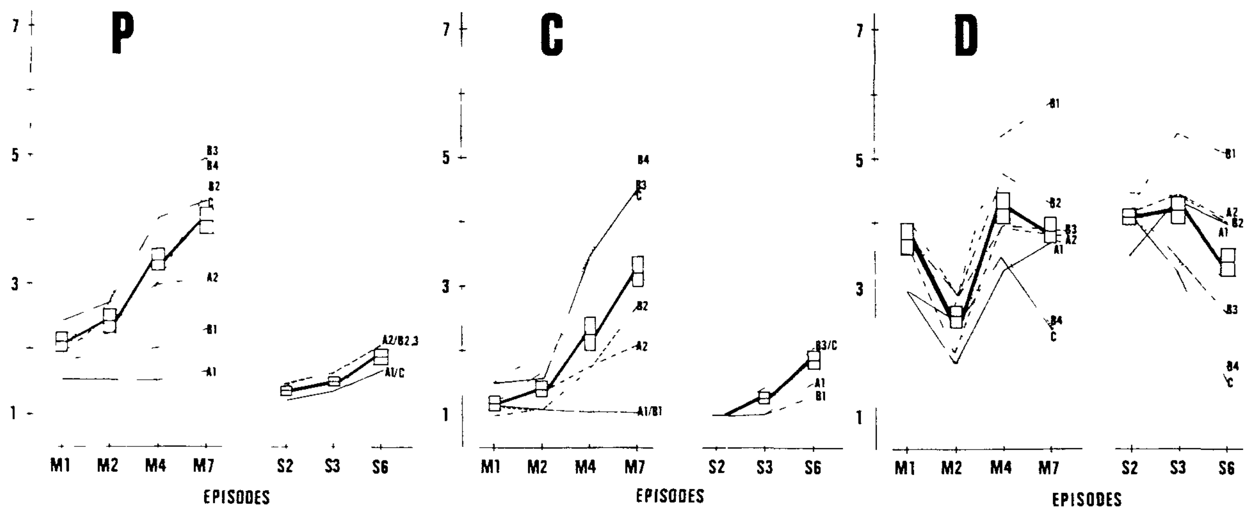

Figure 1. Trends in the means of interactive scales

Part I: Proximity seeking (P), Contact Maintaining (C), Distance Interaction (D)

(The boxes indicate the 95% confidence intervals of the means over all subgroups per episode.)

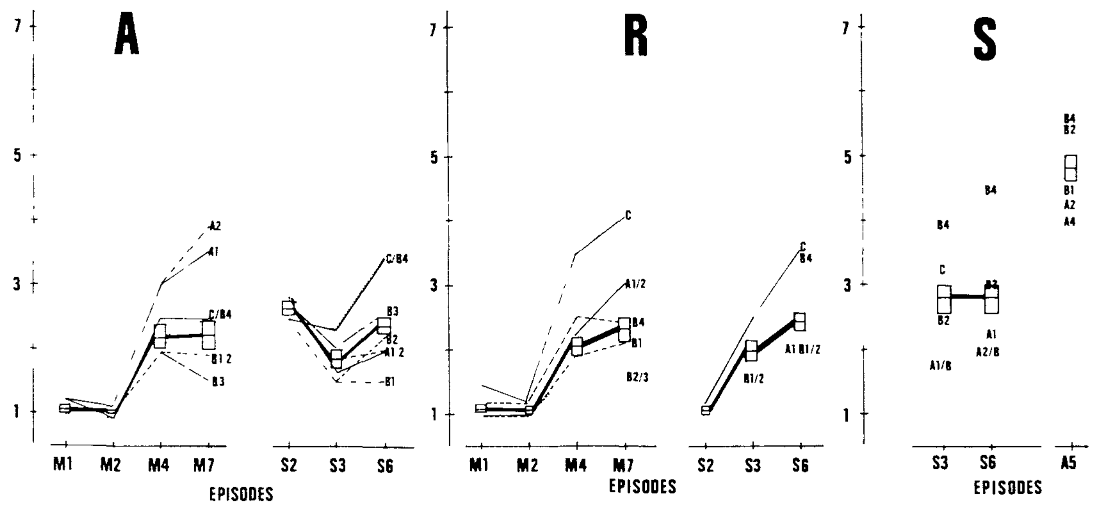

Figure 1. Trends in the means of interactive scales

Part II: Avoidance (A), Resistance (R), Search (S)

(The boxes indicate the 95% confidence intervals of the means over all subgroups per episode.)

emerges in Episode M4, and shows roughly the same pattern in M7. Note furthermore that by and large the order of the subgroups is reversed compared to Pm and Cm.

The presence of the stranger leads to a rather high level of distance interaction with the stranger in all stranger episodes, about as high as that towards the mother. Only in S6, after the child has been alone (A5), does the interaction from a distance drop somewhat. Notice that the subgroups have roughly the same position with respect to the overall averages for the stranger and the mother episodes, indicating that the amount of distance interaction seems more situation or child specific than adult specific.

Resistance

Resistance is virtually nonexistent in the first two episodes (the higher mean of the C group in M1 is due to only 8 of the 28 C's). In M4 and M7 there is a marked increase in resistance, especially in the C, A1 and A2 groups. Note that from M4 to M7, both increases and decreases occur in different subgroups. The patterns more consistently increase with respect to the stranger, except for the second episode. Note furthermore that, although the B4 and C children show higher than average resistance towards both mother and stranger, this is not true for the A1 children, who resist their mother more and the stranger less than average.

Avoidance

The intensity of avoidance towards the mother follows roughly the same pattern as resistance; it levels off a bit more, but the intensity of avoidance of the C and A subgroups is now interchanged. The trend in avoidance towards the stranger is more complex. After a high level of avoidance in the second episode, the stranger seems to be able to prevent some of this behavior when she is alone with the child for the first time, but she fails to do so to the full extent after the child has been alone. Note that the same subgroups are consistently above and below average for avoidance and resistance towards the stranger, with again the switch of the A1 children from above average with the mother to below average with the stranger.

Search

Finally, searching behavior, only scored when the mother is not present, is a fairly intensive activity of the children in the stranger episodes, and even more so when they are alone (A5). Search shows, in agreement with P and C (and D) and in contrast with A and R, a juxtaposition of the A and C children.

Summary

The scores on all variables are clearly affected by the progression of the episodes. Both averages and the variances are affected. Most averages showed a trend towards higher scores and increasing variance, but some, especially distance interaction and avoidance towards the stranger, are more complex. Furthermore, the trend is different for different subgroups. Looking at the mother episodes for the moment, it is clear that proximity seeking and contact maintaining can be seen as two indicators for one kind of "thetic" or "proximal" behavior, while avoidance and resistance for another kind of "antithetic" behavior. The patterns seem also to suggest that combining A and C subgroups does not drastically affect the antithetic patterns of scores, but it certainly does so for the thetic ones. Averaging over episode M4 and M7 seems to dampen the discriminating power of some variables, e.g., resistance and distance interaction, but not of all of them. The only real complex pattern is that of distance interaction.

Turning our attention to the stranger episodes, it seems that "thetic" behavior is largely unrelated to the subclassification, while the antithetic behavior, search and distance interaction, contains more information. Again, the trend for distance interaction and for avoidance is rather complex. On the whole, it is rather unlikely from the information in Figure 1 that the interrelationships between variables for behavior towards the stranger parallel those between the mother variables, but it is difficult to make certain statements.

An interesting aspect of Figure 1 is that one can also get an impression of the correlations between the variables, due to the patterns of the relatively homogeneous subgroup means. Roughly speaking, Pm and Cm are highly positively correlated, while Dm is somewhat less negatively correlated. The relationship between Rm and Am is far more difficult to assess. It is to a more serious study of the variable structure that we will turn next.

MOTHER EPISODES

In this section we will turn to the study of the behavior of the children with respect to their mothers and how this structure changes over time. In particular, we will investigate the deviations from the mean curves as shown in Figure 1. Thus, if we indicate a score of a child i on variable j in episode k as x_{ijk}, we will then look at $\tilde{x}_{ijk} = x_{ijk} - \bar{x}_{.jk}$ with $\bar{x}_{.jk}$ the average over all children for a variable j scored in episode k. In the regular (two-mode) principal component analysis it is usual to scale the variables as well, i.e., to equalize the variance, but as the variability is something we want to explain within the model, we will refrain from scaling here.

From Figure 1, it can already be seen that the variability increases over episodes, that is, the children react in different ways to the Strange Situation. In fact, in terms of the overall variability (i.e., sum of squares of the deviation from the respective means) the M1 episode accounts in the mother episodes for 14%, M2 for 15%, M4 for 33%, and M7 for 37%. These figures reflect the low profile in the earlier episodes compared to the intensity of the two reunion episodes which together account for 70% of the variability. The increase in variability in M7, however, is only slightly above that in M4. Note that even though on three variables (Pm, Cm and Rm) the mean levels increase, and those of the other two (Am and Dm) hardly change, this does not automatically imply an increase in the variability with respect to those means.

In the following sections we shall discuss the solution of a three-mode principal component analysis on the four mother episodes (M1, M2, M4, and M7). In particular, we shall investigate the structure in the variables and how it changes over time. To this end we will report a solution for the Tucker2 model with 4 components for the children and 3 components for the variables without a condensation in terms of components for the episodes (see Appendix A; equation A3). This will allow us to investigate how the relationships between the variable and children components change over time. The 4*3 solution for the 410*5*4 data matrix of deviations from the variable means accounts for 60% of the overall variability. The components of the variables partition the fitted variability into 35% for the first, 18% for the second and 7% for the third component, and the children components partition the same variability in 29%, 16%, 9% and 7%, respectively. As in regular principal component analysis, we will discuss the children components only through those of the variables, and without further external information on the children there is no other way to explain the distribution of the children over the axes. The overall impression of the children's scatterplot is that of a four-dimensional ellipsoid with relatively few stragglers on the outside, their number slightly increasing for the higher-order components.

Table 1
Variable components for mother episodes

	Unrotated			Varimax rotated		
Variables	1	2	3	P	D	RvA
Proximity Seeking	.58	.51	-.21	.78	.15	-.11
Contact Maintaining	.63	.19	.13	.62	-.18	.18
Resistance	.02	.01	.87	-.08	-.09	.86
Avoidance	-.04	-.21	-.43	-.09	-.12	-.45
Distance Interaction	-.52	.81	-.01	-.02	.96	.08
% Variability	34.9	18.2	6.7	30.1	22.6	7.0

Note. P = Proximal Behavior; D = Distal Behavior; RvA = Resistance vs. Avoidance

Table 1 shows the structure of the variables. After the varimax rotation of the orthonormal components, the rotated components account for 30%, 23%, and 7% respectively. Clearly proximal behavior (Pm and Cm) determines the first axis, distal behavior (Dm) the second, and the antithetical behavior (Rm versus Am) the third with resistance loading twice as heavily as avoidance.

With these straightforward interpretations of the components, we can turn to the changes of these variable components over time, and to the way the children "use" these components in different ways. To this end we will describe the profiles of "ideal-type" children on the variable components. An "ideal-type" child is defined as a child which has a nonzero loading on only one child component, and which has zero loadings on all other components. A positive ideal-type child has a positive loading, and a negative ideal-type child has a negative loading on a particular component.

Children profiles

Figure 2 gives the profiles of all four positive ideal-type children (for negative ideal-type children the profiles are a mirror image with respect to zero). The profile of the first ideal-type child representing 25% of the total variability, shows a strong increase with respect to the average in proximity and contact maintaining and a strong relative decline in distance interaction, while the resistance and avoidance contrast is just about average. For the first negative ideal-type

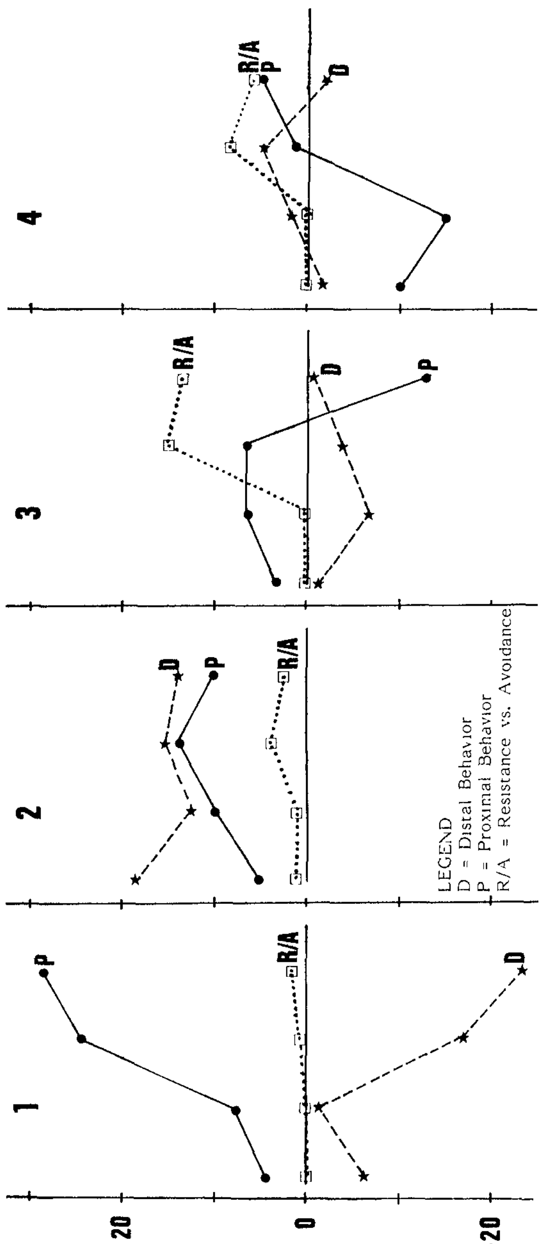

Figure 2. Profiles of ideal-type children, for mother episodes. Varimax-rotated variable components.

child the reverse is true, that is, a strong decline for proximity and contact maintaining and a strong increase in distance interaction. If one wants to relate these profiles to the Ainsworth classification, the first positive ideal-type child shows most resemblance to the B3 and - to a lesser extent - to the B4 subcategory. B3 and B4 children show relatively much proximity seeking and contact maintaining, and little distance interaction. In the B4 subcategory some resistant behavior is shown, but of course less than in the C group. The negative ideal-type does not resemble a subcategory in particular.

The profile of the second ideal-type child (16%) deviates less strongly from the average for proximity and contact maintaining, but now distance interaction deviates in the same direction in contrast with the first ideal type. The resistance versus avoidance axis still does not show important deviations, therefore we suggest that the B1 and B2 subcategories resemble this profile most. B1 and B2 show proximity seeking and especially contact maintaining behavior to a lesser degree than the other B subgroups. Their style of interaction is also more distant. The small deviation from the average for resistance and avoidance could be caused by the appearance of some avoidance in the reunion episodes, especially in episode 4 (see also Lamb et al., 1985, p.37). No subgroup directly corresponds to the negative ideal type.

The third and fourth ideal-type child have similarly shaped profiles for resistance versus avoidance, indicating that resistance is above and avoidance below the average intensity for these scales. These profiles, therefore, resemble anxiously attached subgroups. The third ideal-type profile displays a very low intensity for proximity and contact maintaining in the second reunion episode, while the intensity is above average in the earlier episodes. The A1 and especially the A2 subgroups bear some resemblance to this third profile, but one would have expected somewhat less proximity seeking and contact maintaining in the first reunion episode. Inspection of the children components suggest that no specific subgroup is associated with this ideal-type child, and that the A subgroups are more like combinations of ideal-type child two and three, than like any ideal-type child itself. The fourth ideal-type child is characterized by proximity and contact maintaining above average intensity in the last two episodes. Combined with the above average resistance and below average avoidance we suggest that C children's pattern of attachment behavior - and to a lesser extent that of B4 children - resembles this profile most. Because one of the C subcategories, C2, is rather passive and shows less active proximity seeking and contact maintaining, the P, C deviation from average is not exceptionally strong.

A fruitful line of attack for further understanding the differences between the children would be to analyze more external variables, but unfortunately they are not in the data base. It should be remembered that virtually all children are linear combinations of the ideal-type children, and that practically no "pure" children as described in the profiles are actually present. This explains partly the difficulty of relating the attachment subcategories directly to any of the axes.

It is worth noting that in contrast with the static description in the classification instructions, the ideal-type children sketched above also embody a time component. The profiles are, therefore, more informative than a mere subdivision into subgroups. For instance, the first (B3/4-like) ideal-type child shows not only a high above average Pm, Cm, and a considerably below average Dm, but also a tendency to move away from the average child on these variables. In contrast, the position of the second ideal-type with respect to the average does not change much except between the first and second episode. The third ideal-type shows considerable change between the second and fourth episodes in Rm and Am, and between the fourth and seventh episodes in the proximal behaviors. Finally, for the fourth ideal-type again variability in proximal behavior is evident. Lacking adequate significance tests and further validating variables it is difficult to make far reaching statements about these changes, but the profiles may serve as a basis for further investigations into the dynamics of the behavior of children in the Strange Situation.

Variable profiles

Not only the changes over time in the relationships between the children components and the variable components can be studied, also the profiles of the variables themselves can be investigated for each child component separately. In the present case, however, the variables align very closely with the components so that such profiles do not supply much extra information over and above that of Figure 1.

STRANGER EPISODES

The three stranger episodes can be examined in the same way as the four mother episodes. Here, too, the scores are deviations from the means of the variable-episode combinations. The three-mode analysis with again four components for the children and three for the variables accounts for 67% of the variability of the three stranger episodes. The components of the variables partition the variability into 46%, 12%, and 9% of the total variability, while the children components partition it into 36%, 13%, 10%, and 8% respectively. The four-dimensional children space seems slightly more subject to or influenced by outlying children than that for the mother episodes.

Table 2 shows the structure of the variables. After the varimax transformation of the orthonormal components the rotated components account for 36%, 12%, and 20% of the variability, respectively. The first rotated component is dominated by distance interaction, the second by proximity and contact, and the third by resistance and avoidance; all with positive loadings. Note that on the first and second components avoidance and resistance have contrasting (rather small) loadings, as do proximity and contact on the first and third rotated component. There clearly exists some similarity with the variable space of the mother episodes. But as is well known from the theory of attachment, there are no a priori grounds for assuming they are also functionally equivalent in the sense that, for instance, avoidance to the mother is indicative for the same emotion as avoidance to the stranger. The most important difference can be found in the third component with resistance and avoidance having loadings with the same sign, whereas the variable space of the mother episodes contained a component contrasting resistance and avoidance. Towards the mother children seem to show either resistance or avoidance, whereas towards the stranger children do not appear to differentiate between these anxious behaviors.

Table 2
Variable components for stranger episodes

	Unrotated			Varimax rotated		
Variable	1	2	3	P	D	A
Proximity seeking	.09	.55	.39	.06	.68	.03
Contact Maint.	-.01	.64	.26	-.10	.68	-.06
Resistance	-.37	-.27	.80	.11	.15	.90
Avoidance	-.43	-.32	.10	-.22	-.26	.43
Distance Interac.	.82	-.34	.38	.96	-.05	-.02
% Variability accounted for	46.4	12.5	8.5	35.8	11.8	19.8

Note. P = Proximal Behavior; D = Distal Behavior; A = Antithetic Behavior. All components have unit lengths.

Children profiles

Looking at the children profiles it should be realized that the ideal-type children defined in this analysis may refer to entirely different children from those in the mother episodes. We will turn to that problem in the next section.

In Figure 3 the profiles are given for the four ideal types. Each of these types defines a rather different attitude towards the stranger. The first ideal-type child shows an ever increasing amount of distance interaction towards the stranger, whereas proximity and contact maintaining remain on an average level of intensity. This child shows almost no anxious behavior towards the stranger, as is indicated by the "antithetic behavior" component being far below average level of intensity, especially in the more stressful later episodes. The first ideal-type child shows considerable sociability towards the stranger, whereas the other ideal-type children show much stranger anxiety. The main difference between the second ideal-type child and the other anxious children is the complete lack of proximity and contact maintaining, especially in the last stranger episode. There is also much less distance interaction in this last episode, indicating that this second ideal-type child does not consider the stranger a viable person for interaction. It finds the stranger rather a source of threat and anxiety. The third and fourth ideal-type children show much resistance and avoidance towards the stranger, but at the same time they mix their anxious behaviors with more positive bids for interaction. They seem to be ambivalent about the stranger. The fourth ideal-type child seems to be anxious of the stranger in all episodes, whereas the third ideal-type child is very friendly towards the stranger in the first and second stranger episode, and only begins to show stranger anxiety in the last episode. In sum, the first ideal-type child is characterized by increasing stranger sociability, the second ideal-type child can be described as showing unambiguously stranger anxiety, whereas the third and fourth ideal-type children show ambivalent stranger anxiety, with varying patterns of changes in the variable components.

SIMILARITIES BETWEEN IDEAL TYPES

In the last two sections we have examined the children profiles for both mother and stranger episodes separately. As the analyses were carried out independently of each other, there is no reason to suppose a priori that the two sets of profiles

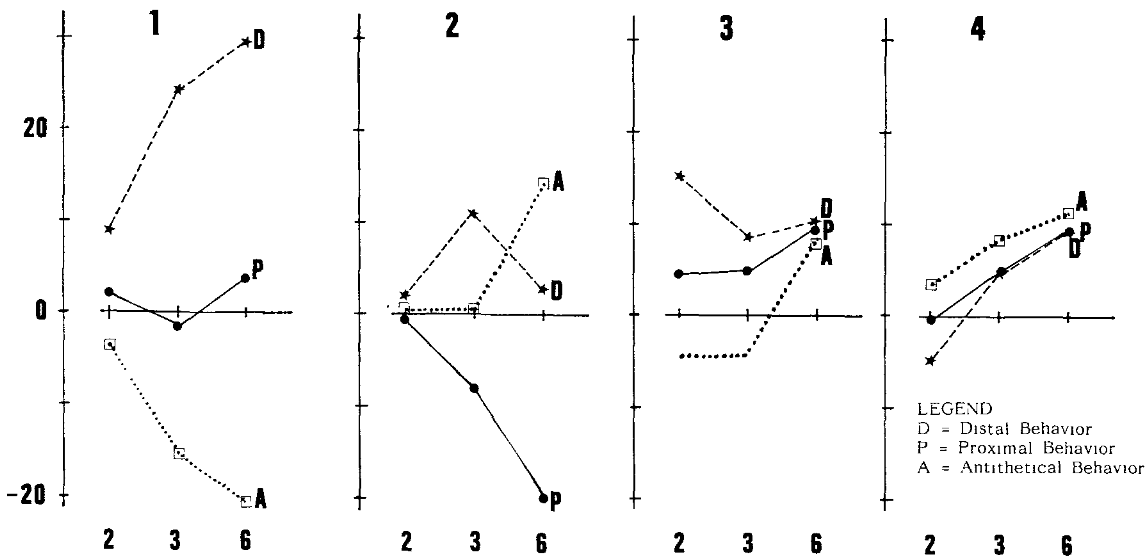

Figure 3. Profiles of ideal-type children for stranger episodes describe identical ideal-type children. In order to investigate the extent to which the two sets do or do not describe the same ideal types both collectively and separately, a canonical correlation analysis was performed using BMDP6M (Dixon, 1981), with the relevant information given in Table 3.

The sum of squared canonical correlations (or the sum of the squared multiple correlations) is .70. Thus, the two sets have 70% of variance in common. In other words, the two spaces defined by the sets overlap considerably, but each also has variance not contained in the other set. For instance, the fourth canonical variables in the sets do not correlate at all. Each canonical axis correlates highest with one of the ideal types in each set, and the order with respect to both sets is the same. This implies that, by and large, the axes for ideal-type children have the same orientation. Except for the first canonical axis (and thus roughly the first mother and stranger ideal-type child) the canonical axes of the two sets have rather low (canonical) correlations. Therefore, even though one might improve on the similarity between the ideal-type children by using their canonical variables instead of the components defined directly by the three-mode analysis, the gain is hardly enough to make the effort worthwhile.

Table 3.
Canonical correlation analysis of children profiles from mother and stranger episodes

Correlations (or congruences) between sets

Mother episode profiles	Stranger episode profiles IS1	IS2	IS3	IS4	$/R_m/$	Canonical correlation
IM1	-.60	-.30	.21	-.06	.70	.70
IM2	.03	.04	.14	-.03	.15	.01
IM3	-.13	.02	-.19	.25	.34	.37
IM4	-.02	.13	.23	.09	.07	.27
$/R_s/$	.61	.32	.39	.27		

Note. IMi = i-th ideal-type child of Mother episodes; ISi = i-th ideal-type Strange episodes. /R/ = positive square root of multiple correlation of each variable with all variables of the other set. Canonical correlations are next to the ideal-type child of the Mother episodes with which they correlate most.

It should be noted that the first canonical variables correlate -.70, while the first mother and stranger ideal types already correlate -.60. Therefore, also in this respect, the gain in using the canonical variables instead of the first ideal-type children is not large. Furthermore, it is relevant to observe that the second ideal types of the separate analyses (accounting for 16% of the variability in the mother episodes and 13% of the variability in the stranger episodes) are both associated most closely with the last canonical variables, which correlate .01, while also their mutual correlation is low, -.04. Therefore, each type of episode contains information which is not contained in the other type.

Conclusion

In conclusion it seems that the mother and stranger episodes carry both common and separate information on the behavior of the children in the Strange Situation. One way to describe this information is via component profiles of the variables over the episodes for each ideal-type child. In the present case we needed eight such profiles for describing the behavior in the mother and stranger episodes separately, all but one of which have rather low correlations (see Table 3). Given more extraneous variables it should be possible to explain the behavior of the children both with respect to the mother and stranger in more detail. Apart from this, it seems desirable to have one comprehensive analysis of at least a number of the mother and stranger episodes to acquire a more parsimonious description of the individual differences in the Strange Situation. It is to just such an investigation that we will now turn our attention.

JOINT ANALYSIS OF MOTHER AND STRANGER EPISODES

As mentioned in the Introduction, the real difficulty is to analyze the reactions of the children towards the mother and the stranger simultaneously, while still maintaining some of the temporal characteristics of the design. One solution to this problem was explored in the previous sections. Analogous to Van IJzendoorn et al. (1985) we will use in this section "phases" to tackle this simultaneous analysis. We will thus look at all mother and stranger variables combined by considering episode S3 and M4 as one phase of the Strange Situation and S6 and M7 as another. We could have included M2 and S2 as well, but this would exclude search as a variable, and it would introduce the problem of including data from one episode in which an extra dependence between the mother and stranger variables might be present due to the impossibility of simultaneous behavior towards both adults (see also the Introduction).

As in the separate analyses the variables were centered per variable-episode combination, and the variability between interactive scales was not equalized. The S6+M7 phase has a somewhat larger variability than the other phase: 55% versus 45%. The fit of the 5(children)*4(variables)*2(episodes) solution was 62% with 30.6%, 9.6%, 9.0%, 7.5% and 5.4% for the five children components, respectively; 36.5%, 9.8%, 9.3% and 6.5% for the variable components; and 54.5% and 7.5% for the two phase components. The model used here is the Tucker3 model as described in Appendix A (equation A1).

Variable components. First, we will look at the relationships between all variables, as this is in a sense the central focus of the present study. As mentioned above we will look at four variable components (see Table 4). The upper part of Table 4 refers to the variables with respect to the Stranger, and the lower part to those with respect to their mother. It is very striking that with these four components we are able to "recover" both the patterns of the stranger and the mother episodes. The varimax components 1, 2, and 4 reflect the information from Table 1, and components 1, 2, and 3 that of Table 2. The observation from the canonical analysis of the previous section that the mother and stranger episodes contain both common and separate information is thus confirmed: components 1, 2, 4, are combinations from both types of variables, component 3 is exclusively determined by the stranger variables. Component 4 is special in the sense that it parallels a mother-episode component, but also contains information from the stranger variables which was not present in the solution of the stranger episodes.

Substantively, the following patterns in the varimax solution can be observed. The first component has high positive loadings for distance interaction both towards the stranger and the mother, and a negative loading for avoidance towards the mother. This suggests that distance interaction towards the mother and towards the stranger are more quantitatively than qualitatively different. Generally, distance interaction and avoidance-M are opposite reactions. We will refer to this component as Distal Behavior. The second component shows the proximal behavior towards both mother and stranger with again a far higher intensity in the mother episodes. As could be seen from the means (Figure 1), proximity and contact are low profile behaviors in the stranger episodes with little variability. Note that, again, avoidance-M has a moderate (negative)

Table 4.
Variable components mother and stranger episodes

Variables		Unrotated				Varimax rotated			
		1	2	3	4	D	P	A	R
Proximity	- S	-.02	.25	-.17	-.03	.03	.24	-.12	-.12
Contact	- S	-.08	.20	-.24	-.01	-.07	.27	-.15	-.09
Resistance	- S	-.23	-.26	.33	.35	-.04	-.12	.26	.52
Avoidance	- S	-.25	-.18	.30	-.14	-.11	-.10	.42	.05
Distance	- S	.51	.27	-.00	-.10	.43	-.08	-.26	-.29
Search	- S	-.33	.12	.59	-.35	.14	.07	.74	-.12
Proximity	- M	-.37	.56	-.01	-.02	.10	.64	.16	-.06
Contact	- M	-.45	.31	-.20	.18	-.16	.57	.02	.15
Resistance	- M	-.03	-.21	.05	.64	-.00	-.08	-.17	.65
Avoidance	- M	-.00	-.33	-.04	-.50	-.30	-.31	.17	-.38
Distance	- M	.41	.39	.58	.18	.81	-.05	.12	.10
% variability		36.5	9.8	9.3	6.5	18.4	17.8	17.0	8.8

Note. D=Distal Behavior; P=Proximal Behavior; A=stranger Anxiety; R=Resistant Behavior

loading on this component. The component will be referred to as Proximal Behavior. The third component, characterized by high search, avoidance-S, resistance-S, and a moderate lack of distance interaction-S, is exclusively determined by the stranger variables (and thus episodes), and can be interpreted as "Stranger Anxiety", comparable to Connell's "Stranger Unsociability" factor (Connell, 1985). The fourth variable component, "Resistant Behavior (versus avoidance-M)", shows high positive resistance both towards the mother and the stranger versus moderate avoidance with respect to the mother. As we concluded before, the contrast of resistance and avoidance exists only in the case of the mother episodes. The fourth component, thus, indicates an adult specific mixture of "antithetic" behavior, in accordance with the attachment theory.

As in the separate analyses, we observe overall a reasonably simple structure for the variables which will facilitate the subsequent discussion. The only exception is avoidance towards the mother, which has a negative loading on Proximal Behavior, Distal Behavior, and Stranger Anxiety. This implies that avoidance-M tends to have below average values for children showing high intensities for Proximal Behavior and/or Distal Behavior, and/or Anxiety with respect to the stranger.

Core matrix. As explained in Appendix A, the core matrix of a three-mode principal component model indicates how the variable components, child component and phase components are related (or weighted). The values indicate how much each component combination contributes to the estimated (or reconstructed) scores based on the fitted model, and these values can be transformed to percentages variability accounted for (Table 4). Our discussion of the core matrix will deal with two aspects. First, what the two phases S3+M4 and S6+M7 have in common (based on the first phase component and the first core plane), and secondly in which aspects they differ

Table 5
Core matrix of combined analysis of mother and stranger episodes

Phase component 1: Common aspects of phases

	Raw weights				Percentage variability				
Child compo-nent	Variable components D 1	P 2	A 3	R 4	Variable components D 1	P 2	A 3	R 4	Sum
1	31	-29	-28	-13	11	9	9	2	31
2	-10	14	-18	-14	1	2	4	2	9
3	-20	-17	- 7	5	5	3	1	0	9
4	- 3	- 6	12	-16	0	1	2	3	5
5	0	- 2	6	- 9	0	0	0	1	1
Phase component 2: Differences between phases									
1	2	1	1	- 0	0	0	0	0	0
2	2	7	- 4	1	0	1	0	0	1
3	4	- 0	1	- 1	0	0	0	0	0
4	- 3	11	8	4	0	1	1	0	2
5	13	- 8	-11	- 5	2	1	1	0	4

Note. D = Distal Behavior; P = Proximal Behavior; A = Stranger Anxiety; R = Resistant Behavior.

(based on the second phase component and the second core plane). As can be judged from the percentage variability accounted for per component (54.5% versus 7.5%), the two phases have far more common aspects than differences. From the entries in the core matrix it follows that the first four child components reflect almost only the common aspects of the two phases (common: 31%, 9%, 9%, 5% variability accounted for; difference: 0%, 1%, 0%, 2%), while the fifth child component reflects primarily the differences between phases (common: 1%; difference: 4%). Furthermore, it is evident that the core matrix has a rather complex pattern which defies simple description. The original, nonrotated, core matrix has a simpler pattern, but the bipolarity of the unrotated variable axes makes the description somewhat uncomfortable.

Just as for the separate analyses in the previous section, each of the child components (or ideal-type children) may be interpreted in terms of components of the variables. The first (positive) *ideal-type child shows in the two phases* considerable Distal Behavior (variable component 1: core element of 31), below average Proximal Behavior (2:-29), low Stranger Anxiety (3:-28), and relatively low Resistant Behavior (4: -13). As avoidance-M is weighted negatively by the first, and positively by the second and fourth variable component, the net avoidance-M is slightly or moderately above average. These ideal-type children come closest to B1 and possibly A2 children. As before the negative ideal-type shows the reverse pattern: very much below average Distal Behavior (1:-31); above average Proximal Behavior (2:29), considerable Stranger Anxiety (3:28), relatively high Resistant Behavior (4:13) and little avoidance-M. This negative ideal-type resembles B4 or C children most.

For the second (positive) ideal-type child, lower Distal Behavior (1:-10) is coupled with higher Proximal Behavior (2:14) at an overall lower intensity compared to the first ideal type. The lack of anxiety towards the stranger (3:-18), a lower than average Resistant Behavior (4:-14), and a somewhat above average avoidance-M complete the picture (avoidance-M is positive on 1 and 4, and negative on 2). This ideal-type child can be compared most adequately with the B2 subcategory, perhaps in combination with the next ideal-type child. The third (positive) ideal-type child has a lower than average Distal Behavior (1:-20), and less than average Proximal Behavior (2:-17), but Stranger Anxiety, Resistant Behavior, and avoidance-M are all about average. The fourth ideal-type child is more or less average on Distal Behavior; it has moderate Stranger Anxiety (3:12) and its score is lower on Resistant Behavior (4:-16) and rather high on avoidance-M. In addition, as is evident from the second core plane, it tends to show more Proximal Behavior in the second than the first phase. In fact, it reacts more intensely on all interactive scales in the S6 and M7 episodes than in the preceding ones, be it not very much. Here the resemblance with some subgroup of avoidant children appears to be significant. Finally, the fifth (negative) ideal-type child is characterized more by change than anything else, in particular it shows less Distal Behavior (-13) in the later than the earlier phase, especially more Anxiety (+11), about the same avoidance-M, more Resistant and Proximal Behavior, and on the whole it shows above average avoidance-M.

Characteristics of individual children

From the above descriptions it is rather difficult to get a good picture of the individual children; in particular, because they are generally combinations of more than one ideal-type child. One may therefore argue that the core matrix is too compact a description for a detailed understanding of the individual differences between children. Furthermore, the orientation of the axes in the child space does not necessarily coincide with familiar descriptions in terms of the classification into subgroups. The necessary information will be supplied by constructing "joint plots" for each of the phase components, that is by displaying how the children and variables are related to each other for the aspects they have in common, and for the ways in which they differ. As explained in Kroonenberg (1983, p.164ff), given 5 components for the children and 4 components for the variables, at most a four-dimensional representation is possible in the joint plots. Instead of showing the 6 possible combinations of components we will show only the first, third, and fourth components against the second component for the common part, and only the first two components for the differences (for an explanation see below).

Common aspects of phases. Figures 4A to C are based on the joint plots for the common characteristics of the phases. The original plots contain all variables and all 410 children. The present stylized versions only give the centroids of each of the classification subgroups plus approximate confidence intervals based on 2.1 times the standard error for each of the axes. The value 2.1 is chosen to reflect the situation in which all 21 pairwise contrasts between means may be visually tested by an extension of a procedure described by Gabriel (1978). The value of 2.1 is also in agreement with a Bonferroni adjustment for the simultaneous testing of all pairwise contrasts between means. The orientation of the axes is such that they correspond to the varimax solution given earlier.

The centroids in the plots are connected by a line running from A1 through A2, B1, B2, B3, B4, to C. The second component (Proximal Behavior) was chosen as the common axis in the plots because it was considered theoretically more important and interesting than the first or "Distal Behavior" one. It should be noted that the subgroup information was not explicitly used in the analysis.

Figure 4A shows the plane of the Proximal and Distal Behavior axes. With respect to the variables, it is dominated by three groups of variables at angles of roughly 120°, i.e., the (Pm, Cm, Ps, Cs) group, the (Dm, Ds) group, and the (Rm, Am, Rs, As) group. The subgroup centroids show a fairly regular progression through the plane. A characterization of the subgroups in terms of their centroids on the axes is given in Table 6. In Figure 4A we see that with the two dimensions given, and using the contours of the centroids for rough significance testing as explained above, A1, A2, B1, B2 are all clearly and recognizably different, and all are different from the B3, B4, and C groups. B3 and B4 are on the borderline of significance, while B4 and C are not separated. To distinguish between B4 and C we need either the third or the fourth axis, as the B4 children show more Stranger Anxiety than the C children, and the latter show more Resistant Behavior than the former.

The Figures 4A, B and C and Table 6 together provide the descriptive information to type each of the subgroups. Up to a point, these descriptions will coincide with the classification instructions. On the other hand, they give a more independent account than, for instance, discriminant analysis can give. As our prime focus is the variables rather than the subjects we will not discuss each subgroup in detail, but merely cite a few highlights.

Compared to the "normative" B3 subgroup all other subgroups score above or below average on Resistant Behavior (versus avoidance-M): A1 to B2 subgroups show more avoidant behavior, B4 and C more resistant behavior. The B3 subgroup also has an almost zero mean on the Distal Behavior axis. B1 and B2 children have higher scores on Distal Behavior, whereas the avoidant-attached children show less Distal Interaction to mother and stranger, and B4 and C even less than A1 and A2. Although the "normative" B3 subgroup has almost zero means on the Distal and Resistant Behavior axes, the same subgroup has the highest mean on the Proximal Behavior. A1 to B1 children show very low intensity Proximal Behavior, whereas B4 and C children stay close to the mean of the normative subgroup. It is satisfying that this pattern, based on components for mother and stranger episodes, parallels the instructions of the classification system, which is primarily based on the mother

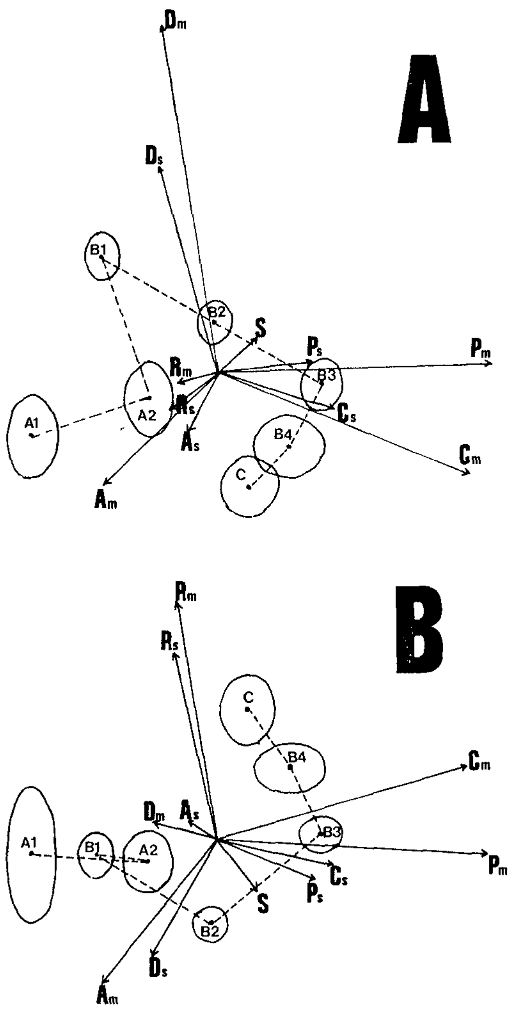

Figure 4. Joint plot of subgroup centroids with approximate confidence ellipsoides and interactive scales (associated with the first phase component)

A: Thetic Behavior versus Distal Behavior
B: Thetic Behavior versus Resistant Behavior
(For description of variables - see text.)

episodes. The inclusion of stranger episodes in the analysis does not distort, but rather adds information to the classification procedures, e.g., generating a component for Stranger Anxiety. In this respect we see that the normative B3 subgroup does not deviate from the anxiously-resistant children in showing moderate anxiety, but B4 children strongly differ from the other children in showing considerable Stranger Anxiety. A1 to B2 subgroups seem to be far less disturbed by the stranger's presence than the B3 to C subgroups. The B4 subgroup - which we characterized as dependently attached to their caregiver (Van IJzendoorn et al., 1985; Sagi et al., 1985) - resembles B3 most on the Proximal Behavior axis, and is closest to the C group on Distal Behavior. B4 holds an intermediate position on the Resistant Behavior axis, and is unique in its extreme score on Stranger Anxiety.

From the perspective of axes, it is not clear how a one-dimensional continuous scale could be derived from Strange Situation data without distorting or ignoring much information. The ordering of subgroups A1 to C appears to be different for all components:

Proximal Behavior	: A1<B1<A2<B2<C <B4<B3
Distal Behavior	: C <B4<A1<A2<B3<B2<B1
Resistant Behavior (versus avoidance-M)	: B2<A2<B1<A1<B3<B4<C
Stranger Anxiety	: B1<A1<A2<B2<C <B3<B4

The only component on which a scale "security of attachment" could be based, seems to be Distal Behavior. On this component, C/B4/A1/A2 score on one side of the continuum, whereas the secure groups score on the opposite side. The dichotomization into anxiously and securely attached children cannot be derived from our data; on the contrary, it seems to be more in accordance with the data to cluster the A1 to B2, and the B3 to C subgroups. Theoretically, however, such a dichotomization does not imply concrete hypotheses about differential antecedents and consequences of the two clusters. Because subgroups do not show the same ordering on all components, and because adjacent subgroups within the same main classification group do not always score in clusters, the question could be asked whether the information contained in the Strange Situation could not be better represented by continuous variables, resembling our components, rather than by discrete categories, which cannot easily be traced back to (a combination of) the constituting variables.

As noted before, the role of avoidance-M is rather difficult to assess from Table 6, as it loads on three axes (negatively on Proximal, Resistant and Distal Behavior). When all

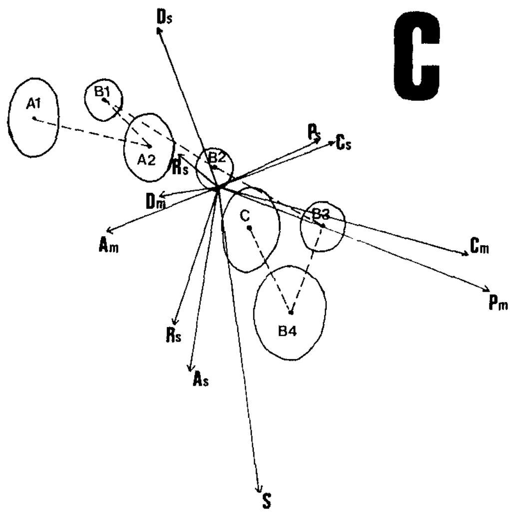

Figure 4. Joint plot of subgroup centroids with approximate confidence ellipsoides and interactive scales (associated with the first phase component)

C: Proximal Behavior versus Stranger Anxiety
(For description of variables - see text.)

Table 6
Mean coordinates of subgroups for axes of joint plot (associated with first phase component)

	Means on axis			
Subgroup	Proximal Behavior	Distal Behavior	Resistant Behavior (versus Avoidance-M)	Stranger Anxiety
A1	-1.02	-.35	-.08	-.38
A2	- .38	-.15	-.13	-.22
B1	- .63	.64	-.09	-.48
B2	.03	.28	-.27	-.11
B3	.57	-.06	.03	.23
B4	.40	-.42	.20	.70
C	.17	-.63	.72	.22

signs on these axes are negative, as is the case for the A1, and A2 subgroups, there is much avoidance-M for these groups. This can clearly be seen in Figure 4A and B. The above trends conform to the common characteristics attributed to the various subgroups (see e.g., Lamb et al., 1985), but in this analysis the role of the stranger variables and their relationships with the mother variables has become much clearer. Furthermore, it is also very clear that there exists a tremendous variability between children in one subgroup, and on the basis of the original joint plots it is very tempting to question several assignments to subgroups. It should be emphasized that subgroup membership was not used in the analysis except for post-hoc calculations of the means.

Turning now to the differences between the two phases no clear structure emerges with respect to the subgroups, as can be seen from Figure 5, which represents 7% of the total variability. There is no differentiation on the first, most important, axis, and some A and C contrast for the second one. This implies that the changes from Phase 1 to Phase 2 are not much related to subgroups. There is some evidence that many C children have relatively more avoidance-M (and less Dm, and Pm, Cm) in M7 than in M4, while just a few A children show more Dm and Pm, Cm and less Am in M7 than in M4. There is also a group of children, mainly some C, B4, and B2, which show more Stranger Anxiety in S7 and less distance interaction in S6 and M7 than in S3 and M4.

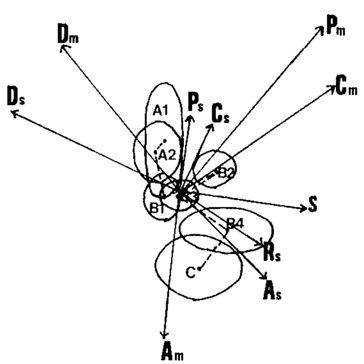

Figure 5. Joint plot of subgroups centroids with approximate confidence ellipses and interactive scales (associated with the second phase component)

DISCUSSION AND CONCLUSIONS

The results of the three-mode principal component analyses on the multinational data set could have acquired much more significance if informative measures for, among other things, frequency of crying and exploratory behavior, had been available. Unfortunately, not all researchers score exact frequency measures because of their irrelevance for globally classifying children in one of eight attachment subcategories. Furthermore, all kinds of external data about the 410 children were lacking. Even sex and age of the children could not be used in our analysis as these background variables have not (yet) been added to the multinational data set. On the other hand, the nationality of the children has been ignored on purpose. We started from the assumption that the coding instructions were rather strictly adhered to and were interpreted in the same way in all countries, notwithstanding some possible sample-specific interpretations (see Lamb et al., 1985, p. 212). The question whether the same psychological value has to be attributed to the same scores in different countries is explicitly left aside (see, however, Sagi & Lewkowicz, chapter 11, this volume).

With these restrictions in mind, it appears possible to suggest some answers to the central question posed in the Introduction: 'Are there a number of continuous variables besides "security of attachment" which can give us more information about individual differences than is contained in the rather global, discrete A-B-C typology?' The interactive scales in the two reunion episodes are known to determine the classification to a large extent, but in our analyses we have also used data from other episodes. For example, data from the stranger episodes have been included allowing us to characterize the relationships between the child's behavior in both the mother and the stranger episodes.

The discussion is organized around three main topics. Firstly, we will tackle the question of how the description of Strange Situation behavior through the nominal classification can be complemented with some continuous dimensions. In this way we hope to represent the richness of the Strange Situation data more adequately than through a "simple" trichotomization. Secondly, the usual categorization of mother-child relationships in several different subgroups will be discussed, as well as a typology of stranger-child interactions. Special attention will be paid to the status of the B4 subgroup. Thirdly, we will focus on the dynamics of the Strange Situation procedure. In our analyses time was included by means of the episodes, and this allowed us to look at, possibly systematic, changes in behavior in the course of the episodes.

Discrete versus continuous descriptions

With respect to the description of Strange Situation behavior by a set of continuous variables, this study showed that there are three important components describing the behavior in the mother episodes: Proximal Behavior, Distal Behavior and Resistance versus Avoidance. The stranger episodes, too, can be described by means of three components, namely Proximal Behavior, Distal Behavior and Antithetic Behavior, this last component indicating a combination of resistance and avoidance instead of a contrast between the two. The combined analysis of the mother and stranger episodes showed a similarly clear structure: Proximal Behavior and Distal Behavior return as components on which behavior towards the mother as well as that towards the stranger loads. A third component "Resistant Behavior (versus avoidance-M)" indicates the contrast between resistance and avoidance-M. The fourth component is specifically bound to behavior in the stranger episodes, and has been called Stranger Anxiety.

The results from the combined analysis of the stranger and mother episodes may be compared with results from Lamb et al.'s (1985, p.217) cluster analysis and Connell's (1977, p.136) nonlinear mapping (which, incidentally, is not a clustering technique as claimed by Connell). Both studies indicated the importance of the distance interaction versus proximity contrast which is paralleled by our first *unrotated* component (Table 4: Ds=.51; Dm=.41; Pm=-.37; Cm=-.45). Connell's "Distance/Avoidance versus Proximity/Contact Maintaining" axis, however, shows avoidance loading positively on the Distal Behavior component. In our case we may conclude that distance interaction-M and proximal behavior-M are in fact orthogonal, and as mentioned before avoidance-M has a rather complex relationship with the other variables. In accordance with Lamb et al. (1985), we must conclude that it is too simple to restrict the Strange Situation behavior to a Security of Attachment dimension. Nor can we equate Security of Attachment with our Distal Behavior axis, notwithstanding the contrast between anxiously and securely attached children on this axis (see Table 6), because the ordering is not as it should be for such a dimension.

The emphasis placed on proximal and antithetical behavior in the coding instructions is paralleled in our analyses by the importance of the components for proximal and antithetic behavior. On the other hand, the component Stranger Anxiety appears to supplement the information from the classification. Although Sagi & Lewkowicz (chapter 11, this volume) suppose Stranger Anxiety to be a culture-specific factor influencing the classification, we doubt whether this component is contained in the classification. The distribution of anxiously versus securely attached children certainly does not appear to be influenced by Stranger Anxiety (Table 6). We suggest it would further our knowledge of antecedents and consequences of Strange Situation behavior if future research takes Stranger Anxiety into account. In addition, from the component Resistant Behavior and the complex loading pattern of avoidance-M, it can be inferred that the construction of a continuous variable "Antithetic Behavior towards the Mother" by adding the scores of Rm and Am does not do justice to the intricate nature of the relationships between the antithetic and other behaviors.

Subgroups

Without explicitly using the classification into subgroups in the main analyses of the mother and stranger episodes, it is clear that the subgroups can easily be traced in our solutions. Even though the particular directions of the ideal-type children in the various child spaces are in some sense arbitrary, the ones described often showed characteristics of the usual subgroups from the Ainsworth classification system. With linear combinations of those ideal-types the other groups can be reasonably described, be it that we have not worked this out in detail, except for the combined analysis of the mother and stranger episodes. The reasonable recovery of the subgroups indicates that children which were "clinically" classified into a subgroup tend to end up roughly in the same sector of the child space, suggesting that the linear combinations of variables and children (and episodes) used in the three-mode analyses at least approximate the clinical assignment rules. On the other hand, the clusters of children from a specific subgroup are not particularly tight: the borders between the clusters are rather vague, and the clusters overlap a great deal. Unless combination rules exist which do a spectacularly better job at separating the subgroups, one may wonder if the discrete classification procedure should not be seen as a procedure to transform continuous dimensions into discrete ones. If one accepts this possibility, one may try to devise "statistical" assignment rules rather than "clinical" ones for assigning children into subgroups. Previous research on statistical versus clinical prediction has often shown the former to be superior (e.g., Sawyer, 1966; Einhorn, 1972). Statistical prediction has the additional advantage that the uncertainty of classification can be determined. Furthermore, it may prevent the kind of gross errors that seem to exist in the present data set. That classifications were incorrect was judged from a child's location in the child space far away from any other member of its subgroup.

Summarizing the relationships between ideal-type children and subgroups, we note that the difference between anxiously and securely attached children was clearly reproduced in the four ideal-type profiles of the mother episodes. The first two profiles indicated securely attached children, and the last two anxiously attached children. Furthermore, within the B group the difference between B1/B2 and B3 could be found in the first and second ideal-type profile. The C-category was represented in the fourth ideal-type profile. Only the A-category could not be reproduced easily from the data. We also suggested a typology of stranger-child relationships. In describing the ideal-type children for the stranger episodes, the first ideal-type child could be characterized by a high degree of stranger sociability, the second ideal-type child could be described as unambiguously anxious toward the stranger, and the last two ideal-type children had to be considered as ambivalently anxious toward the stranger, mixing resistance and avoidance with proximity seeking and contact maintaining.

Because the contours of established subgroups are already rather vague and overlap each other, the status of so-called "marginal" subgroups as B1 and B4 will almost certainly be more controversial. In an earlier study it was concluded (Van IJzendoorn et al., 1985) that B4 children as well as C children were characterized by a high degree of dependent behavior such as crying and clinging mixed with relatively positive interactions toward the mother, and extremely negative reactions toward the stranger. Dependent children, as they were called, showed almost no avoidant behavior and still less exploratory behavior and distance interaction. The difference between C and B4 children was found to exist in the degree of resistance to the mother in the second reunion episode. If we take the results of this study into account, and especially data presented in Table 6, B4 children again show little distance interaction and show (some) resistant behavior. B4 children, however, resemble B3 children more on the Proximal Behavior component, showing more proximity seeking and contact maintaining than the C group. The difference between B4 and all other subgroups may be characterized best by their unique position on the Stranger Anxiety component. B4 children show the most Stranger Anxiety of all subgroups. Because of these characteristics, the present results confirm and strengthen our previous typing of B4 children (but it should be remembered that the present data contain the earlier data of the Dutch sample). Dependency implies fixation on the familiar adult in a somewhat ambivalent way, and unwillingness to socialize with strangers, and this is precisely the picture arising from our analyses.

Dynamics of the Strange Situation

With respect to the dynamics of the Strange Situation, patterns could be described but their interpretations are still rather tentative. The means showed clearly the increasing intensity in the course of the procedure, and showed furthermore an increasing variability and differentiation between the children. It was our intention to shed some light on the structure of this increased variability by using three-mode analyses.

One way was to show profiles of children for both the mother and stranger episodes separately (Figures 2 and 3). These profiles provide clear indications that varying patterns of reactions towards the increasing stress of the Strange Situation exist. Some children show increasingly deviating scores away from the average, while other children show more irregular patterns. The changes occur on different variables for different children. It is still too early to explain in detail why certain changes occur for a certain type of children on particular variables. In particular, more external information is necessary.

The second way to investigate the dynamics was to separate the aspects the S3+M4 (Phase 1) and S6+M7 (Phase 2) episodes have in common from those they do not. In that analysis, too, we were looking at deviations from the means per variables for each episode. The basic conclusion was that the overall structure between the variables and the position of the children on those variables do not change much between Phase 1 and Phase 2, notwithstanding the overall increasing means (Figure 1). Whereas the major part of the accounted variability (55%) reflected the classification in many ways, the changes between Phases 1 and 2 (accounting for only 7%) show little relationship to the classification. The changes seem to be far more related to individuals than to groups. Primarily, there is a tendency to have higher scores in the second phase for Proximal Behavior and Stranger Anxiety coupled with lower scores on Distal Behavior for some children, while the reverse pattern is true for another group of children.

Final remarks

The relationship between behavior in the stranger and in the mother episodes is rather complex. Three-mode principal component analysis suggests that there is substantial common variance (70%), but each set of episodes also contains variance, not shared by the other set. This is, for instance, expressed in low correlations between the different canonical axes. Only the first axes, corresponding with the first ideal-type children of both the mother and stranger episodes, correlate moderately high (-.60). This implies a relation between Stranger Sociability and B1/B2 type of attachment (see Thompson & Lamb, 1983; Lamb, Hwang, Frodi & Frodi, 1982). The direction of influence is unclear: Is a child with a high degree of Stranger Sociability more likely to be classified as a B child, or are B children more sociable to the stranger. It seems that in this respect three-mode principal component analysis has less to offer than modelling with structural equations (Connell & Goldsmith, 1982), in which specific causal connections between behavioral components in different episodes are tested. The size of the aggregated multinational data set is large enough to study the dynamics of the Strange Situation reliably with such a method provided it is theoretically justifiable to analyze all children together irrespective of their classification.

In summary, three-mode principal component analysis of 410 subjects observed in the Strange Situation procedure showed that the subgroups of the classification system can be discriminated from each other using behavioral components. However, the contours of the subgroups are rather vague and show much overlapping. Therefore, it would be better not only to use the "simple" nominal classification in analyzing outcomes of the Strange Situation, but to use continuous component scores as well. We showed that these components contain information not available in the classification, as for instance a component measuring Stranger Anxiety which deserves further study and application.

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APPENDIX A: THREE-MODE PRINCIPAL COMPONENT ANALYSIS; A SHORT DESCRIPTION

In the Strange Situation we have information available on several interactive scales from a number of children in several episodes We are, among other things, interested in knowing whether the measurements can be described by a smaller number of linear combinations of the interactive scales. Such linear combinations will be referred to as components, and the values on the components will be called loadings. We will assume that a few of these components will adequately approximate the systematic part of the data. If we look only at one episode the components can be determined by standard principal component analysis.

If we include all episodes, the data can be classified by three different kinds of quantities or "modes" of the data: children, scales, and episodes. We are still interested in the variables, but now for all episodes simultaneously. Moreover, we are interested in knowing whether the children are mere replications of each other or can be seen as linear combinations of what we may call "idealized children" or "ideal-type children", i.e., children loading exclusively on one component. Similar questions may arise with respect to the development of the measurements over time, that is, whether the longitudinal changes in the structures of the variables can be described for several episodes together.

One way to approach such questions is to analyze these questions for each mode separately. For instance, the structure in the scales or variables can be investigated after averaging over the episodes or by analyzing the (children x episodes)-by-variables matrix disregarding the dependence between the observational units and the autocorrelation between the variables in different episodes. A more satisfactory way to analyze the data, which can be arranged in a three-dimensional block of children by scales by episodes, is to search for linear combinations of all three modes simultaneously. This would entail finding principal components for each of the three modes and determining how these components are related or weighted. These relationships or weights are explicit parameters in the three-mode models to be used, and they are collected in a small three-mode matrix or block, which is commonly called the "core matrix".

From a technical point of view, three-mode principal component analysis is a generalization of the singular value decomposition of two-mode data (for a technical discussion of the singular value decomposition, see e.g., Good, 1969). In essence, the decomposition is a simultaneous principal component analysis of, for example, both children and variables, in which the weights for each of the M components of the children and P components of the variables are represented by the two-mode matrix G (or X=AGB' with A of order (IxM), B of order (JxP), and G of order (MxP)). For two-mode data, the core matrix G is necessarily square (P=M) and diagonal under the assumption that the component matrices are orthonormal for both variables (B) and children (A). Each element g_{mm} of G is equal to the singular value or square root of the eigenvalue associated with the m-th component of the variables and the m-th component of the children.

In three-mode principal component analysis, there are three component matrices - A, B, and C - instead of two. And as with the data matrix, the core matrix G with singular values has three modes, and it again contains the weights (or relationships) between the components. But these relationships are far more complex than in the two-mode case, as any component of a mode can have a nonzero weight with any component of another mode.

A more formal description of the three-mode principal component model may be made as follows. If we write the elements of the data matrix X of children by variables by episodes as x_{ijk} (i=1,..,I;j=1,..,J;k=1,..K), then the model (the so-called Tucker3 model) has the following form

$$x_{ijk} = \sum_{m=1}^{M} \sum_{p=1}^{P} \sum_{q=1}^{Q} a_{im} b_{jp} c_{kq} g_{mpq} + e_{ijk} , \qquad \text{(A1)}$$

which may be written in matrix notation using the Kronecker product

$$X = AG(C' \otimes B') + E . \qquad \text{(A2)}$$

As discussed above $A=(a_{im})$, $B=(b_{jp})$, and $C=(c_{kq})$ are component matrices of children, variables and episodes, respectively, and they can be taken columnwise orthonormal without loss of generality. $G=(g_{mpq})$ is the core matrix with the relationships between the components (or weights for the combination of components). Finally, $E=(e_{ijk})$ is the matrix with residuals or errors of approximation.

A slightly different but instructive way to interpret the core matrix is to view it as a (miniature) data box with "idealized" quantities rather than observational ones, that is "latent" variables instead of manifest ones, ideal-type children instead of real children, and trends instead of episodes.

A value g_{mpq} in the core matrix is then the score of an idealized child m on a latent scale p for a particular trend q. In this way the core matrix can be seen to embody the basic relationships that exist in the data.

One may expand the three-mode model given in (A1) to provide more detail by not computing components for, say, the third mode at the cost of parsimony of description. In particular, equation (A1) may be written as

$$x_{ijk} = \sum_{m=1}^{M} \sum_{p=1}^{P} a_{im} b_{jp} n_{mpk} + e_{ijk}, \tag{A3}$$

with

$$n_{mpk} = \sum_{q=1}^{Q} c_{kq} g_{mpq} \tag{A4}$$

and thus

$$X_k = AN_kB' + E_k \tag{A5}$$

in which X_k is the (IxJ) matrix of observations for the k-th episode. The N_k are the so-called "core matrices for episodes". The model described by (A3) is often called the Tucker2 model.

In the main body of the chapter we have analyzed the four mother episodes and the three stranger episodes each with model (A3), and the joint analysis of mother and stranger variables with model (A1). Figures 2 and 3 are based on the "core matrices for episodes". The panels of these figures show for each of the four child components the n_{mpk} as curves of the variable components p over the episodes $k=1,..,k$. The core matrix given in Table 5 is the matrix G from equation (A2).

The analyses presented here were performed using the programs TUCKALS2 (model A3) and TUCKALS3 (model A1) developed by Kroonenberg using the alternating least squares (ALS) algorithms described by Kroonenberg & De Leeuw (1980; Kroonenberg, 1983), in which the technical aspects of the algorithms are dealt with. More extensive descriptions of the technique and related issues can be found in Tucker (1966, 1972), Kroonenberg (1983; 1984), Harshman & Lundy (1984a,b), and Snyder (1986).

APPENDIX B: DATA PREPARATION

In this Appendix, we provide a summary of the data base used in this chapter. Several researchers from six different countries pooled their data from the Strange Situation. A. Sagi supplied two data sets, one with 258 Kibbutz children (Sagi et al., 1985), and one with 36 day-care children (Sagi et al., 1985), both from Israel. J. Belsky contributed the data of 58 American children (Belsky et al., 1984), E.K. Beller the data of 40 German children (Beller, 1984). F.A. Goossens and M.H. van IJzendoorn the data of 137 Dutch children (Goossens, 1986; see also Van IJzendoorn, Goossens, Kroonenberg, & Tavecchio, 1984); M.E. Lamb the data of 51 Swedish children, and K. Miyake those of 28 Japanese children (Miyake et al., 1985). The complete data set was brought together by A. Sagi in Israel, in cooperation with J.P. Connell. The date of the version used here is 20 March 1986.

The records contain several missing data; especially entire episodes in the Israeli data are frequently not available (see Sagi et al., 1985; Sagi & Lewkowicz, chapter 11, this volume). The complete data set consists primarily of mother-child dyads, but the Belsky data also contain father-child dyads, while in the Israeli Kibbutz data father, mother and metapelet occur as adults. For the analysis reported here, only mother-child data are included, which have at most one complete episode missing. For the 410 dyads remaining, all other missing data on the interactive scales were substituted by mean values. In particular, the scale mean of the appropriate attachment subgroup of the country in question was substituted. When for a country all values on a scale were missing, the mean over all countries was used for the relevant subgroup. This was done for the Belsky data, which contained no valid data for Search for any episode. The missing value for an American child (Thompson data), and the one unclassified child (Israeli Kibbutz data), were excluded from the computation, wherever necessary. The 27 C1 and 9 C2 children were taken together as one C group, to avoid a too great imbalance in the number of children per subgroup. Differences exist between distributions of children over subgroups between the various countries. With respect to the main groups A, B, C, the differences are not particularly large, compared to the "global" distribution (see Sagi & Lewkowicz, chapter 11, this volume, Table 1.).

A detailed report on the data preparation is available from the authors.