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10. Modeling the sensitivity-attachment hypothesis

Abstract

A model is proposed to test to the sensitivity attachment hypothesis. The advanced model takes constancy and change of sensitive responsiveness and attachment behavior during the first year of life into account. Results of the model favour Ainsworth's original hypothesis in a new way.

Introduction

The central tenet of attachment theory that maternal sensitive responsiveness is related to the child's quality of attachment has stimulated more than twenty years of research. Ainsworth's pioneering Baltimore study provided strong evidence in favour of what will be called subsequently the sensitivity-attachment hypothesis. A correlation of .45 was obtained between early sensitivity and later quality of attachment (Ainsworth, Blehar, Waters & Wall, 1978). Studies by Grossmann, Grossmann, Spangler, Suess and Unzner (1985), Smith and Pederson (1988), and Van den Boom (1994) among others provided additional support.

Other studies found low magnitude or nonsignificant relations (e.g., Frodi, Bridges & Grolnick, 1985; Isabella, Belsky & von Eye, 1989; Maslin & Bates, 1983). About ten years ago Lamb, Thompson, Gardner, and Charnov (1985) concluded that the role of maternal sensitivity is not as strong as was originally proposed. Two years later Goldsmith and Alansky (1987) reported an average correlation of .17 between early sensitivity and later quality of attachment.

In light of these mixed findings, the status of the sensitivity-attachment hypothesis remains unclear. Should it be accepted or rejected? From a classical statistical point of view, a hypothesis is accepted when the null hypothesis can be rejected. It seems, however, that advocates and opponents of the sensitivity-attachment hypothesis have a different (statistical) null hypothesis in mind. Advocates claim that the observed relationship is significantly different from zero. Belsky and Cassidy (1994), for instance, contend that there is an abundance of correlational evidence showing that attachment security is related to early sensitivity ratings. What remains unclear according to them is whether the modest magnitude of the statistically significant findings is due to limitations of the measurements (of mothering and of security), or to a limited actual influence of maternal behavior. Opponents, on the other hand, assert that the relationship is significantly smaller than one, or at least smaller than .45 as originally reported by Ainsworth et al. (1978). Goldsmith and Alansky (1987) also concluded that, "..., an effect that has enjoyed the confidence

of most attachment researchers is not as strong as was once believed" (p. 811).

How can this dilemma be solved? Adding similar research with similar designs, similar instruments and similar statistical analyses will not be helpful in this regard. One possible solution would be to encourage new inquiries that pay close attention to conceptual or theoretical issues, more specifically to the mechanisms governing the development of attachment. This approach was adopted by Waters, Kondo-Ikemura, Posada, and Richters (1990). Another possibility is to improve the general strategy used in testing the sensitivity-attachment hypothesis. In this chapter, we will try to resolve the dilemma by offering an alternative null hypothesis consisting of a testable statistical model. Lamb et al. (1985) followed a similar route by suggesting causal modeling as a tool to gain insight into the relation between early sensitivity and later attachment.

The model advanced in this chapter, which is somewhat more sophisticated than the Lamb et al. model, is based on a combination of Covariance Structure Models and Hierarchical Linear Models (Muthén, 1991; Willett & Sayer, 1994). It differs from previous models in that it takes *age-related changes* into account, more specifically the *development* of the child's attachment behavior and the mother's sensitive responsiveness. We will focus on attachment behavior instead of attachment classifications, in which the history of the relationship is incorporated in one measure, because this allows for the interesting possibility to examine developmental change. The model stems from the methodological tradition that originated from the work of Wohlwill (1973), and fits into the recent trend of dynamic modeling.

The model will be introduced by reflecting on the traditional strategy to test the sensitivity-attachment hypothesis. Following others (e.g., Lamb et al., 1985; Waters et al., 1990), it will be argued that a significant correlation between early sensitivity and later attachment behavior is insufficient to accept the hypothesis. Next, we will consider the issue of the number and timing of measurements of sensitivity and attachment behavior. Both of these considerations provide the necessary requirements for the model. Then, the model is formulated. And finally, but most importantly, the model will be applied to empirical data. The discussion focusses on an evaluation of the model and its applications and further improvements will be suggested.

At times, our remarks may seem unduly critical. Suffice it to say, however, that it is not our intention to discredit the researchers who shaped the field. On the contrary, our approach is motivated by the belief that the sensitivity- attachment hypothesis deserves an adequate and insightful test.

The traditional test

The sensitivity-attachment hypothesis can be briefly summarized as follows. The quality of maternal care, in particular the mother's sensitive responsiveness, is the major determinant of variations in attachment behavior. In the majority of studies the sensitivity-attachment hypothesis is tested by computing a measure of association between maternal sensitive responsiveness measured at an early age and the quality of attachment measured at the

same age or later in development. The time span between the measurements of maternal and child behavior ranges from a few hours to more than a year.

A significant positive correlation is generally accepted as evidence in favor of, if not as proof of, the sensitivity-attachment hypothesis. This evidence is inconclusive, however, as suggested by several authors (Lamb et al., 1985; Van den Boom 1994; Waters et al., 1990). Especially Lamb et al. (1985) presented several alternative explanations. They argued that different (causal) processes can account for the observed correlation between sensitivity and security of attachment.

To exemplify these alternative explanations we use path-analytic diagrams, in which variables are symbolized by names and causal relations by arrows.

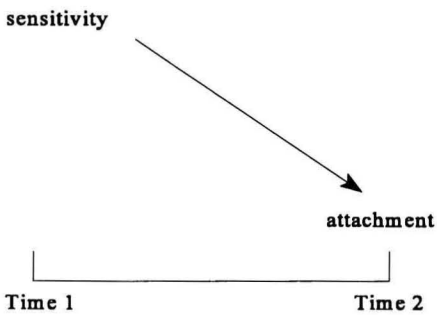

Fig. 1: Observed relationship between sensitive responsiveness and attachment.

Figure 1 illustrates the empirical (observed) relationship between early sensitive responsiveness and the child's security at some point later in time. Several rival explanations can be offered for this relationship.

These explanations qualify the observed relationship as spurious. For our purposes it suffices to describe two alternative pathways that can account for the association between sensitive responsiveness and the quality of attachment. In the first alternative, illustrated in Figure 2, it is assumed that sensitivity is a relatively stable characteristic of the mother.

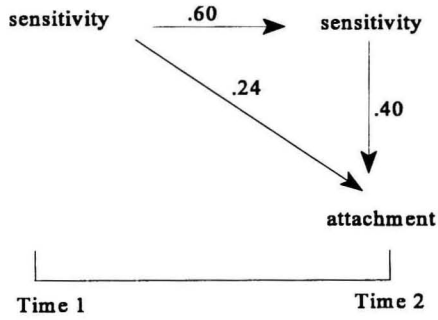

Fig. 2: First alternative explanation of the relationship between sensitive responsiveness and attachment

In addition, it is assumed that a concurrent relationship exists between the mother's sensitivity and the child's security of attachment. Both assumptions seem plausible. It seems likely that certain personality characteristics affect sensitivity and it is, therefore, likely that this characteristic is pretty stable (Ainsworth et al., 1978; Koomen & Hoeksma 1993; Martin, 1989). With regard to the second assumption, several studies have documented concurrent correlations between sensitivity and attachment. If we assume that the

first correlation equals .60 and the second one .40 the so-called implied (i.e., spurious) correlation is .24.

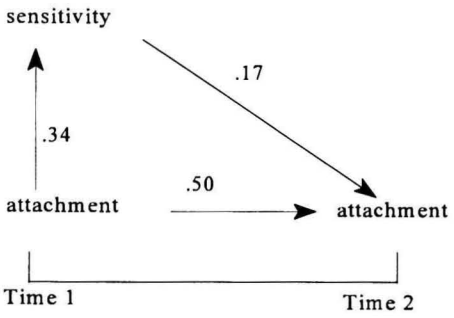

Fig. 3: Second alternative explanation of the relationship between sensitive responsiveness and attachment.

The second alternative explanation is represented in Figure 3.
This explanation reflects that the empirical (observed) correlation between sensitivity and attachment is caused by a stable characteristic of the child, and this characteristic affects the mother's sensitive responsiveness. Researchers (e.g., Chess & Thomas, 1982; Kagan, 1984) interested in temperamental characteristics in children implicitly adhere to this alternative explanation.
It should be stressed however that the child's attachment behavior could also account for this path. If we assume that the effect of the child's characteristic on maternal behavior is .34, and the stability coefficient is .50, then the spurious correlation would approximate the average correlation reported by Goldsmith and Alansky (1987).

In sum, the traditional test is inconclusive because it does not take into account alternative causal processes. To solve this problem, Lamb et al. (1985) suggested a comparison of different structural equation models corresponding to the alternative explanations, such as those displayed in Figure 1. The advantage of their proposal is that it stresses the processes occurring during the interval between the measurement of early sensitive responsiveness and later quality of attachment. To our knowledge, this suggestion has never been followed. However, even untested the models are valuable, because they point to a *first* prerequisite of an appropriate test of the sensitivity-attachment hypothesis. *An appropriate model must account for the behavior of mother and child during the time span of the measurements.*

Age-related changes

As indicated before, the interval between measuring responsiveness and the child's security of attachment ranges from less than a day to more than a year. Based on the length of the interval, studies can be classified as either predictive or concurrent. Predictive studies are generally considered to be a more critical test of the sensitivity-attachment hypothesis than concurrent ones. A substantial association between early sensitivity and later attachment security is valued higher than the same correlation obtained concurrently.

The timing of the measurements of maternal sensitive responsiveness is determined by the investigator. An obvious reason to select early ages is to document the history of the mother-child interaction (Ainsworth et al., 1978). Selection of early points in time may also be dictated by another reason. Waters et al. (1990) pointed to what they designated "the developmental bias", that is, the tendency to

look for causes in the remote past at the expense of contemporary causes. As far as sensitive responsiveness is concerned, there are no theoretical guidelines to select specific points in time. One could even argue that attachment theory is non-discriminating in this regard. If sensitive responsiveness is a stable characteristic of the mother, a single measurement occasion would be sufficient. A stable characteristic can be expected to remain the same over different occasions.

Timing of the measurement(s) to observe the child's attachment behaviors is far more critical. According to Bowlby (1969) the child is able to discriminate attachment figures after three months of age. After six months of age the infant starts to display secure base behavior. The next phase begins at approximately four years of age. Not only the development of the child's attachment behaviors, but also the child's motor and cognitive development exert their influence. In other words the child's attachment behavior is assumed to change with age. To capture these changes more than one measurement occasion is necessary.

These observations lead to a somewhat ironic paradox. A few occasions to measure maternal sensitive responsiveness would be sufficient, whereas a relative large number of occasions is needed to measure the child's attachment behavior. Surprisingly, the majority of attachment research that is available offers the opposite picture. Almost without exception sensitivity is observed more frequently than the child's attachment behavior.

The panel models discussed in the previous section presuppose that mother and child behaviors are measured at least twice (see Fig. 1). What happens between measurement occasions is accounted for by means of stability coefficients, that are attached to the causal paths. Given our consideration concerning the trait-like character of maternal sensitivity and the theoretically assumed changes in the child's behavior this situation is far from optimal.

As far as the child's attachment behavior is concerned this is easy to detect. According to theoretical notions the child's attachment behavior changes with age. As a result, the stability of the child's behavior is (also) age dependent, that is, the stability coefficient not only depends upon the interval length between the two measurements, but also on the chronological age of the child. For instance, the stability of a child's attachment behavior during a three-month-interval is likely to be different if measured between six to nine months of age compared to nine to twelve months of age. An appropriate model must take these age dependent stabilities (and changes) in the child's behavior into account. It is somewhat less clear why an appropriate model should also account for age relatedness in maternal behavior. Suffice it to say that constancy is a special case of change (Baltes & Nesselroade, 1979).

This leads to the *second* requirement for an appropriate model to test the sensitivity-attachment hypothesis. *The model should account for age-related changes (and constancy) in the behavior of both mother and child.* How this can be accomplished is discussed in the next section.

An alternative model

Ainsworth conceived of sensitivity as a general maternal characteristic. Her well known operational definition states that the optimally sensitive mother is able to perceive things from her baby's point of view. She is alert to perceive her baby's signals, interprets them accurately, appropriately and promptly, unless no response is the most appropriate under particular circumstances. Let us assume that maternal sensitivity (designated by X) is measured on several occasions (designated by t, running from 1 to T). Given the first requirement, an appropriate test should account for the behavior of the mother during the period spanned by the measurements. If the mother is indexed by i, her sensitivity over time can be represented as:

$$X_{ti} = ß_{x0i} + e_{xti}$$

The model reads as follows. The degree of sensitivity, X, on occasion t, of mother i, consists of an individual constant $ß_{x0i}$ and an occasion specific residual e_{xti}. The assumption that sensitivity is a trait-like characteristic is represented by the parameter $ß_{x0i}$ without a subscript t. The parameter does not change over time. Temporal fluctuations in the degree of sensitivity are reflected by the residual e_{xti}. The model is in accord with the classical measurement model. It partitions the variance in two portions, the systematic portion $Var[ß_{x0i}]$, and the residual portion $Var[e_{xti}]$. The first is designated by σ_{x0}^2, and the second by σ_{xe}^2.

Given the second requirement, the test should also account for age-related changes. Although sensitivity is presumably a stable characteristic, systematic changes across time cannot be ruled out (see Koomen & Hoeksma, 1993; Van den Boom & Hoeksma, 1994). To account for this possibility, an extra coefficient is added to take possible age-related changes in sensitivity into account. The resulting model is:

$$X_{ti} = ß_{x0i} + ß_{x1i}.Age_{ti} + e_{xti}$$

The additional coefficient $ß_{x1i}$ refers to linear changes with age (Age_{ti}) in maternal sensitivity. The model can be conceived of as a regression model. Note, however, that every parameter is indexed by i. In other words, the equation symbolizes not just a single regression line, but a number of regression lines, that is, one for every mother in the sample. The intercept and linear coefficient are thought to vary between mothers. For some mothers the degree of sensitivity may increase, for others it may decrease. In the first case $ß_{x1i}$ will be positive, in the latter case it will be negative. The variance of $ß_{x1i}$ is designated by σ_{x1}^2. Because the parameters vary randomly, the model is a special case of the random regression model. Other labels for the same model are Hierarchical Linear Model (Bryk & Raudenbush, 1987) and Longitudinal Multilevel Model (Goldstein, 1987).

From a somewhat different point of view, the model can also be considered as a special kind of factor analytic model, that is, a Structural Equation Model (Willett & Sayer, 1994). The parameters $ß_{x0i}$ and $ß_{x1i}$ are comparable to factor scores. According to this interpretation the first factor is called the *mean factor*, the second factor is the *linear change factor*. Note that the factors are not assumed to be independent, as is the case in the traditional factor analytic model.

The model is deceptively simple. Although the model contains linear coefficients, it describes nonlinear age-related changes in *individual* differences in maternal sensitivity. A little bit of algebra reveals that the (true) variance of the sensitivity scores X, at occasion t, is designated by:

$$Var(X_t) = \sigma_{x0}^2 + 2.\sigma_{x01}.Age_t + \sigma_{x1}^2.Age_t^2.$$

The development of the child's attachment behavior can be described similarly. The model is analogues to the model for maternal sensitivity. The major equation is:

$$Y_{ti} = ß_{y0i} + ß_{y1i}.Age_{ti} + e_{yti}$$

where Y refers to the intensity of the child's attachment behavior. The parameters $ß_{y0i}$ and $ß_{y1i}$ vary from child to child. Their respective variances are represented by σ_{y0}^2 and σ_{y1}^2, their common variance by covariance σ_{x01}. Similar to the model on the development of sensitivity, the model can be considered as a kind of factor analytic model, with a mean factor (factor scores $ß_{y0i}$) and a linear change factor (factor scores $ß_{y1i}$). If necessary, that is, if indicated by the data, the model can be extended by adding other coefficients to model nonlinear change.

The final step in creating the alternative model involves combining the equations that model the development of maternal and child behavior. The combined model should be able to answer the question: "How do the developmental change patterns of maternal sensitivity and child attachment behavior influence each other?" To simplify matters causal assumptions are disregarded. In addition, it is assumed that both the development of maternal sensitivity and child attachment behavior can be described by a mean factor and a change factor. In that case the combined model is as follows:

$$X_{ti} = ß_{x0i} + ß_{x1i}.Age_{ti} + e_{xti}$$

$$Y_{ti} = ß_{y0i} + ß_{y1i}.Age_{ti} + e_{yti}$$

where X and Y refer to maternal sensitivity and the child's attachment behavior. The developing relationships are described by the covariances of the random parameters that refer to the mean factors and linear change factors of maternal sensitivity and child attachment behavior:

	$ß_{x0i}$	$ß_{x1i}$	$ß_{y0i}$	$ß_{y1i}$
$ß_{x0i}$	σ_{x0}^2			
$ß_{x1i}$	σ_{x01}	σ_{x1}^2		
$ß_{y0i}$	σ_{x0y0}	σ_{x1y0}	σ_{y0}^2	
$ß_{y1i}$	σ_{x0y1}	σ_{x1y1}	σ_{y01}	σ_{y1}^2

In this covariance matrix σ_{x0y0} refers to the relationship between the mean factor of sensitivity and the mean factor of attachment behavior. The parameter σ_{x0y1} points to the covariance between the mean factor of sensitivity and the linear change in attachment behavior. The parameters σ_{x1y0} and σ_{x1y1} are interpreted in a similar way. Note that the latter parameter refers to simultaneous changes in sensitivity and attachment behavior.

Application of the model

The model was tested, using data from our own research on the development of mother-child interaction and attachment. The sample consisted of 64 mother-infant

dyads. Half of the infants was born with a cleft lip and palate; the other half was normal. A complete description of the sample and instruments can be found in Hoeksma and Koomen (1991).

The mother's sensitive responsiveness was measured with Ainsworth's sensitivity scale when the infants were three, six, nine and twelve months of age. The child's attachment behavior was measured using the Perceived Attachment Behavior Scale (PABS) (Hoeksma, Koomen & Koops 1987). This is a questionnaire consisting of 12 items measuring a child's attachment behavior in everyday situations. An example of an item is: When an unfamiliar person comes to visit you, how does your child react to him/her? (a) She is afraid of that person, or shy throughout the visit (score 2). (b) At first she does not respond, but later she approaches the stranger (score 1). (c) She is not afraid or shy, but approaches the stranger (score 0). (d) This situation has not yet occurred (score 0). The Perceived Attachment Behavior Scale was filled out by the mother, when the child was six, nine and twelve months of age. At three months of age the questionnaire was not used, because the child does not yet show secure base behavior by that age (see phases of Bowlby). The Perceived Attachment Behavior Scale is meaningfully related to Ainsworth and Wittig's Strange Situation. The 12-month correlations between PABS scores and ratings of child attachment behavior in the second reunion of the Strange Situation are: .57 for proximity seeking; .51 for contact maintaining; -.31 for avoidance and .19 for resistance. The multiple correlation between the PABS and attachment classifications is .33.

The model was tested using the EQS-program (Bentler, 1985). EQS is a flexible program for testing Structural Equation or Lisrel Models. The testing procedure proceeded in four steps. First, the development of maternal sensitive responsiveness was modeled. Second, the development of the child's perceived attachment behavior was modeled in a similar way. Next, the models for maternal and child behavior were combined into one model under the assumption that the development of mother and child behaviors are independent. In the final model the independence assumption was relaxed, that is, developmental changes in maternal and child behavior were assumed to be related.
Table 1 contains the fit statistics resulting from the four steps.

Table 1. Test-statistics of four models: Chi-square; degrees of freedom; descriptive level of significance and comparative fit index.

	Chi^2	df	p	fit
1. Sensitivity	4.98	4	.29	.97
2. PABS	6.21	3	.10	.94
3. 1+2 Independent	30.7	19	.04	.87
4. 1+2 Dependent	21.1	15	.13	.93

The mother's sensitivity was modeled by a third degree polynomial function indicative of a curvilinear developmental trend over age. It appeared that the mean level of sensitivity decreased somewhat from three to six months of age. Thereafter, it increased again. The total change, however, was less than half a scale point. The development of perceived attachment behavior was modeled by a linear function. The mean level of perceived attachment behavior increased dramatically from six to twelve months of age. For both developmental variables the variance of the

mean factor and of the change factor was significantly larger than zero (t-statistics, $p < .05$). The combined independence model (model 3) had to be rejected in favor of the dependence model. Only the latter model proved to have an acceptable fit (model 4).

Table 2 contains the variances and correlations of the ß-parameters (see previous section). The matrix contains two important (statistically significant) correlations. Both involve changes in Perceived Attachment Behavior (see bottom line of the matrix).

Table 2. Estimated variances and correlations of ß-parameters of the dependence model. Diagonal elements: variances of the parameters.

	$ß_{x0i}$	$ß_{x1i}$	$ß_{y0i}$	$ß_{y1i}$
$ß_{x0i}$	*.46*			
$ß_{x1i}$	-.12	*.01*		
$ß_{y0i}$	.16	-.15	*8.1*	
$ß_{y1i}$	-.47	.40	-.34	*.56*

First, it appears that the mean level of sensitivity ($ß_{x0}$) is negatively related (r=-.47) to changes in Perceived Attachment Behavior ($ß_{y1i}$). This implies that if a mother displays a relatively high level of sensitive responsiveness, the intensity of the child's attachment behavior will increase slowly and vice versa. The second correlation pertains to changes in sensitivity and change in the child's attachment behavior ($ß_{x1i}$ and $ß_{y1i}$). The positive correlation (r=.40) indicates that positive changes in sensitivity are accompanied by increases in attachment behavior and vice versa.

Discussion

The model presented allows for some interesting conclusions regarding the relationship between sensitivity and attachment. Before discussing these conclusions it should be noted that the model represents only a first step in our attempts to model the sensitivity-attachment hypothesis. Although we applied the model to questionnaire data on attachment behavior to illustrate the basic idea, observational data can be used as well. And finally, ex post facto explanations are sometimes easily made.

Nevertheless, the results seem to be in favor of the sensitivity-attachment hypothesis. The model parameters indicate that maternal sensitivity is primarily related to the *development* of, or *changes* in, the child's attachment behavior. First, it appeared that maternal degree of sensitivity and the child's changes in attachment behavior are negatively related. This is in accord with the expectation that children with a relatively sensitive mother need not develop intense attachment behaviors, because their mothers will induce a feeling of security most of the time. Similarly, the development of intense attachment behaviors may be adaptive in case of an insensitive mother, because they can compensate for this low level of sensitivity and result in proximity and contact.

The second substantial correlation pertained to the relationship between changes. Changes in one direction of maternal behavior appeared to be accompanied by changes in the same direction of the child's behavior and vice versa. Hence, decreasing or increasing attachment behavior is paralleled by decreasing or increasing sensitivity and vice

versa. This seems to reflect the fact that mother and child dynamically adapt their behavior to each other. An example of this would be a mother becoming more sensitive when the child starts to show separation anxiety. The latter effect should not be overestimated, however, because the changes in maternal sensitivity were rather small.

Whether these interpretations are valid or not is open to further testing. At least the interpretations make clear that the sensitivity-attachment hypothesis should be framed in developmental terms. In considering the relationship between sensitivity and attachment, one should not only refer to the degree of sensitivity and the quality of attachment behavior, but also to age-related changes in these behaviors (Van den Boom & Hoeksma, this volume).

The model presented is a so-called longitudinal Multilevel Model or longitudinal Hierarchical Linear Model. This class of longitudinal models meets the needs of developmental researchers very well (Bryk & Raudenbush, 1987; Hoeksma & Koomen, 1993). The model can also be considered to be a Structural Equation Model (Willett & Sayer, 1994). Considering the longitudinal Multilevel Model as a Structural Equation Model has several advantages. From a practical point of view, it may be noticed that because of algorithmic differences, computations are made much faster using programs for structural equation models. From a theoretical point of view, the main advantage is that Structural Equation Models can be expanded easily. At least in principle, it is a small step to include causal relations in the model. This offers the possibility to compare different causal assumptions. A next step then, in modeling the sensitivity-attachment hypothesis, is to compare models that incorporate one-sided causality (with either effects from mother to child or from child to mother) or that allow for mutual causality (with effects running in both directions). It should be noted, however, that these more complicated models require high quality measurements and sampling procedures.

The final point to be discussed is how the model presented contributes to solving the dilemma about the validity of the sensitivity-attachment hypothesis. It may be of interest at this point to cite Ainsworth et al. (1978), "...these first-quarter findings should suffice to suggest that the babies who later may be described as securely attached to their mothers have had a long history of interaction with their mothers in which they were more often positively responsive and less often distressed or unresponsive than were babies who later can be described as anxiously attached" (p.135). This citation indicates that the correlation between early sensitivity and later quality of attachment should be interpreted as reflecting the *developmental history* of mother and child. The advanced model patently conforms to this the developmental view. The model bridges the gap between early sensitivity and later attachment behavior by describing the developmental course of maternal and child behavior between measurements.

References

Ainsworth, M.D.S., Blehar, M.C., Waters, E. & Wall, S. (1978). *Patterns of attachment: A psychological study of*

the strange situation. Hilsdale NJ: Erlbaum.

Ainsworth, M.D.S., Bell, S.M. & Stayton, D.J. (1971). Individual differences in strange situation behavior of one-year-olds. In: H.R. Schaffer (Ed.), *The origins of human social relations*. London: Academic Press.

Baltes, P.B. & Nesselroade, J.R. (1979). History and rationale of longitudinal research. In J.R. Nesselroade & P.B. Baltes (Eds). *Research in the study of behavior and development*. New York: Academic Press.

Belsky J. & Cassidy, J. (1994). Attachment: Theory and evidence. In M. Rutter & D. Hay (Eds.). *Development through life: A handbook for clinicians* (pp. 373-402). Oxford: Blackwell.

Bentler, P.M. (1985). *Theory and implementation of EQS: A structural equations program*. Los Angeles: BMDP Statistical Software.

Bowlby, J. (1969/1984). *Attachment and loss (vol. 1)*. Harmondsworth: Pelican Books.

Bryk, A.S. & Raudenbush, S.W. (1987). Application of hierarchical linear models to assessing change. *Psychological Bulletin, 101*, 147-158.

Frodi, A., Bridges, L. & Grolnick, W. (1985). Correlates of mastery-related behavior: A short-term longitudinal study of infants in their second year. *Child Development, 56*, 1291-1298.

Goldsmith, H.H. & Alansky, J.A. (1987). Maternal and temperamental predictors of attachment: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 55*, 805-816.

Goldstein, H. (1987). *Multilevel models in educational and social research*. London: Charles Griffin.

Grossmann, K., Grossmann K.E., Spangler G., Suess G. & Unzner L. (1985). Maternal sensitivity and newborn's orientation responses as related to the quality of attachment in Northern Germany (pp. 233-356). In: I. Bretherton & E. Waters (Eds.) *Growing points of attachment theory and research. Monographs of the society for research in child development*, 50 (1-2, Serial No. 209).

Hoeksma, J.B. & Koomen, H.M.Y. (1991). *Development of early mother-child interaction and attachment*. Doctoral dissertation. Free University Amsterdam.

Hoeksma, J.B. & Koomen, H.M.Y. (1992). Multilevel models in developmental psychological research: Rationales and applications. *Early Development and Parenting 1*, 157-167.

Hoeksma, J.B., Koomen, H.M.Y. & Koops, W. (1987). Responsiviteit en hechting: een enquête bij ouders van kinderen met en kinderen zonder een schisis. (Responsivity and attachment; a questionnaire with parents and children with and without cleft lip and palate). *Nederlands Tijdschrift voor de Psychologie, 42*, 282-290.

Isabella, R.A., Belsky, J. & Von Eye, A. (1989). Origins of infant-mother attachment: An examination of interactional synchrony during the infant's first year. *Developmental Psychology, 25*, 12-21.

Koomen, H.M.Y. & Hoeksma, J.B. (1992). Maternal interactive behavior towards children with and children without cleft lip and palate. *Early Development and Parenting 1*, 169-181.

Lamb, M.E., Thompson, R.A., Gardner, W. & Charnov, E.L. (1985). *Infant-mother attachment: The origins and*

developmental significance of individual differences in strange situation behavior. Hilsdale NJ: Erlbaum.

Maslin, C. & Bates, J. E. (1983). *Anxious and secure attachments: Antecedents and consequences in the mother-infant system*. Unpublished manuscript, Indiana University, Department of Psychology.

Martin, J.A. (1989). Personal and interpersonal components of responsiveness. In M.H. Bornstein (Ed.), *Maternal responsiveness: Characteristics and consequences. New Directions for child development* (no. 43, pp 5-30), San Francisco: Jossey-Bass

Muthén, B.O. (1989). Analysis of longitudinal data using latent variable models with varying parameters. In: L.M. Collins & J.L. Horn (Eds.), *Best methods for the analysis of change: Recent advances and unanswered questions* (pp 1-17). Washington DC: American Psychological Association.

Van den Boom, D.C. (1994). The influence of temperament and mothering on attachment and exploration: An experimental manipulation of sensitiveresponsiveness among lower-class mothers with irritable infants. *Child Development, 65*, 1457-1477.

Van den Boom, D.C., & Hoeksma, J.B. (1994). The effect of infant irritability on mother-infant interaction: A growth-curve analysis. *Developmental Psychology, 30*, 581-590.

Van den Boom, D.C., & Hoeksma, J.B. (this volume). How is development conceptualized in mother-child interaction research? In W. Koops, J. B. Hoeksma & D. C. van den Boom (Eds.), *Early mother-child interaction and attachment: Traditional and non-traditional approaches*. Amsterdam, North-Holland.

Willett, J.B. & Sayer, A.G. (1994). Using covariance structure analysis to detect correlates and predictors of individual change over time. *Psychological Bulletin, 16,* 363-381.