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Infant and Parental Pathways to Pre-School Cognitive Competence

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In a longitudinal study, 62 parent–child dyads were seen during the second year of life and at 4 years of age. At 12 months, measures included parental sensitive responsiveness during free play, knowledge of cognitive–communicative development in infancy, and level of exploration and disinhibitedness of the infant. At 16 and at 20 months, parental responsiveness and directiveness and infant task mastery behaviour were assessed in constructive play. Quality of verbal guidance of the parent was assessed in a joint attention situation. At 48 months of age, the McCarthy Scales of Children's Abilities were administered at home, together with dyadic tasks. A path analysis revealed a model in which both verbal abilities and perceptual performance outcome measures were well predicted by the quality of parental verbal guidance in the second year. The latter measure was shown to be independent of the socioeconomic status of parents in the group, but was significantly related with knowledge of infant cognitive–communicative development. Of the measures at the outset of the second year, only socioeconomic status remained as having a direct path at pre-school age. The consistency of the model with other empirical findings underscores parental verbal scaffolding as an important shaper of cognitive development.

Key words: Exploration, mastery behaviour, parent–infant interaction, cognitive competence, responsiveness, scaffolding.

The transactional perspective on development (Sameroff, 1975; see also Sameroff and Fiese, 1990) and the replacement of unitary concepts of cognitive competence by more functional and specific concepts (Graham and Harris, 1989) have suggested differentiated pathways for the study of parental influences on child competence in early childhood. For example, maternal overcontrol, restrictiveness and intrusive directiveness have been found to strongly relate to non-verbal aspects of intelligence development (Hatano *et al.*, 1980; Jennings and Connors, 1989; Olson *et al.*, 1984). Unsupportive and restrictive parents may indeed impede sensorimotor learning in the infant and in the long term hinder motivational development and the mastery of non-verbal skills.

Supportiveness and unintrusiveness are aspects of parental sensitivity that are related to but still different from other parental qualities of guidance that revolve around mediated learning. The concept of verbal scaffolding (Wood, 1980), based on a Vygotskian perspective, suggests that the proper (verbal) guidance of exploratory and task behaviour not only stimulates communicative development but also provides ideal prerequisites for promoting mental skills and for enhancing autonomous learning

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in the child. Parental behaviour that has a mediating function in learning, by verbal elaboration and by presenting semiotic challenges for the child, can provide the most important pathway both for verbal and non-verbal cognitive competence (Olson *et al.*, 1984; Sarfi and Hartmann, 1991), and can be termed a 'catalyst' for mental development (Vyt, 1989).

Different kinds of scaffolding have been demonstrated (e.g. in language stimulation, Wood, 1980; in constructive play, Heckhausen, 1987a; and in socialization practices, Holden and West, 1989). The consequences of individual differences in the quality of verbal scaffolding for cognitive competence beyond the first years of life, however, have been insufficiently studied. One basic assumption in the present study is that verbal guidance in the second year of life—a crucial period for cognitive growth—is a behavioural prototype of sensitive parenting in promoting communicative and cognitive development. It might form a major predictor of both verbal and non-verbal cognitive competence over and above the contribution of relevant infant behavioural precursors. Behaviour that aims at expanding the child's verbalizations and that tends to elaborate upon the child's actual experience meets the growing need of the toddler to process information at a semiotic–symbolic level (Vyt, 1989). Prediction of the child's cognitive performance through maternal verbal interaction behaviour obviously is predestined to become weaker as the child grows older and school influences start to overshadow parental ones. However, a recent study indicated that even at the first year of basic school the level of cognitive–linguistic competence can be more adequately forecast by the level of maternal verbal proactive stimulation in toddlerhood than by the actual development of the child 4 years earlier (Gonzalez and Palacios, 1992).

Based on the transactional idea of development being a dynamic process, research on precursors and predictors of cognitive competence has to focus on heterotypical forms of continuity, both for child and for parent behaviour. This means that continuity is very likely to be found between behaviour of different age periods without the two kinds of behaviour necessarily being of the same phenotype or 'mode'. A non-verbal behaviour like habituation or information-processing speed in infancy seems to predict verbal intelligence at 6 years of age (Bornstein and Sigman, 1986), and infant visual recognition memory has been found to be associated with later comprehension and expressive language in pre-school age (Rose *et al.*, 1991a). Language acquisition, communicative development and cognitive performance might all be promoted by efficient basic attentional processes.

A series of studies published throughout the last decade have provided a growing body of evidence for the predictive power of such information-processing abilities in infancy (e.g. Rose *et al.* 1991b). These studies reinstated the belief that the roots of cognition lie in the first years of life, and overruled the disappointing history of prior research which had led to the inference of a barrier in intelligence prediction between infancy and later childhood (McCall, 1981). Some other specific infant markers with a certain amount of stability and salience, such as 'proneness to communicate' and sociability, disinhibitedness (Kagan *et al.*, 1989; Rothbart, 1988), and mastery motivation (Morgan and Harmon, 1984) of the toddler, may also have predictive value for later competence. These factors not only constitute direct organismic precursors but also incorporate a potential for influencing parental behaviour, which in turn shapes the developmental course of the child. For example, the child's level of communicative development as an organismic variable has an impact on maternal verbal interventions (Heckhausen, 1987b), but also non-linguistic child behaviours may influence quality of maternal speech. Temperament measures of activity level, task persistence and affect were found to influence the use of directives and attention-getting devices (Smolak, 1987).

A certain quality of parenting style may also have a different impact on further development depending on the infant's current age and developmental status. With regard to mediated learning, it seems reasonable to assume that the content of parent–infant communication can only play an important role when the infant's language understanding has reached a certain level. As the toddler matures, the conscious effort of the parent to scaffold the child's cognitive mastery by means of verbal communications probably takes over from other forms of intuitive parenting which, in the first year of life, primarily involve formal and temporal aspects of subconscious behavioural patterns (Papoušek and Papoušek, 1989). The study of Olson *et al.* (1984) was one of the first attempts to put the heterotypical continuity in parental scaffolding in perspective. Their path analysis revealed that a 6-month warm, stimulating interaction predicted later competence not because the parenting style at that age made unique contributions to the variance in competence outcomes, but because warm and stimulating mothers with a 6-month-old infant proved to become educationally

active mothers with 13-month infants and verbally stimulating mothers with 24-month infants.

Finally, from a transactional perspective, perceptions, interpretations and stereotypes are hypothesized to be of substantial influence in the process of parent–infant interaction. Parental cognitions, expectations and perceptions may very well prove to be particularly consistent and pervasive, and can shape developmental paths in very significant ways. In terms of parental perception of developmental processes, the second year is a particularly important period. During this year the child is set to meet the expectancies of the parent regarding 'walking and talking' standards.

Parental perceptions of cognitive competences have only recently been introduced as shapers of parent–infant interactions or predictors of child cognitive development (Biringen, 1990; Olson *et al.*, 1989; Sabatier, in press). Maternal perception of their child's level of motivation has been shown to influence parental behaviour during task situations (Jennings and Connors, 1989; Sigel, 1985). Accurateness in estimating what to expect from a young infant in general can also set the basic standards to which parental behaviour is geared. Underestimation versus overestimation of children's capacities can be a source of inappropriate parental styles—thus indirectly influencing the development of child competence.

In studies with older children, accuracy in estimating the child's abilities has been found to relate positively to the child's performance (Hunt and Paraskevopoulos, 1980; Miller *et al.*, 1991). According to the 'match hypothesis' (Hunt and Paraskevopoulos, 1980), accurate knowledge of the child's abilities enhances the match between the parent's teaching efforts and the child's developmental level, and would thus foster further development. Causal inferences on this issue, however, again must be made with great care as different pathways of influence can be hypothesized. Possibly parents who have a more accurate estimation of what their child is able to perform also have a more accurate knowledge of child development in general. Or possibly parents who have a more accurate knowledge have better performing children because they share intelligence, and some correspondence in performance is obviously to be expected in any study in which both parent and child respond to cognitive items. It may even be that high-ability children are simply easier to judge than children of a lower ability (Miller *et al.*, 1991).

There is a need to introduce different so-called 'distal' variables (e.g. SES and parental perceptions or cognitions) in multivariate longitudinal designs with assessments of the child's abilities at different ages. Social circumstances have been shown to relate to parental behavioural styles and child competence in different studies (e.g. Farran and Ramey, 1980; Hartmann *et al.*, 1989; McGowan and Johnson, 1984; Olson *et al.*, 1984). In particular, verbal responsiveness has been found to be affected by socioeconomic status and level of formal education (Feiring and Lewis, 1981; Richman *et al.*, 1992), at least in the US literature.

The advent of structural equation modelling made it possible to perform path analyses in which the interrelations between distal and proximal variables and the direct and indirect effects could be assessed within one model. Apart from child behavioural precursors and proximal parental variables of responsiveness, directiveness and verbal guidance, our study on predictors of child competence included two 'distal' variables, namely (a) the socioeconomic status of the parent as based on parental education and professional status, and (b) parental knowledge of cognitive–communicative development in infancy. The influence of socioeconomic status would be apparent especially in the verbal component of child cognitive development. Because of the fact that the sample in the study covered a substantial range in socioeconomic status but did not include social risk families, verbal guidance was considered to be only moderately related to differences in socioeconomic status. Instead it should be very much predicted by individual differences in parental knowledge and perceptions of infant development.

METHOD

Subjects

Out of a sample of 66 children recruited via day care centres, 62 infants and their primary caregiver were observed during their second year in a laboratory play room (at 12, 16, and 20 months of age), and were seen again with their parent at 4 years of age in their homes. Two dropouts were due to health problems of the child, and two families dropped out because of marital problems. All 62 children were seen within 10 days before or after the respective measurement points in the second year, and within 2 weeks before or after their fourth birthday. Families from different socioeconomic levels were represented (from unskilled workers to major professionals), with a mean SES index of 3.98

(middle class, Hollingshead, 1975). All children were first- or secondborn, with a normal birth history. All parents were (at least part-time) working outside the home but were spending more than 25 hours per week with their child. In this way, any confound between the socioeconomic status and the amount of educational interaction children can profit from in their home is minimized. As the mother was in these families the primary caregiver, all sessions included mother and child.

Procedure

Assessments at the Beginning of the Second Year

At 12 months of age, children were videotaped with their mother in a 20-minute free play situation in a laboratory room with a cupboard filled with different toys (such as cars, puppets, a phone, balls, and different sets of building blocks). Two weeks before, children were visited at home for the administration of some scales and questionnaires. Individual socioeconomic status of the primary caregiver was assessed by the raw compound score on the Hollingshead Four Factor Scales of Social Index (Hollingshead, 1975), based on professional status and educational level of the parent. The latter was represented by six levels of qualification (ranging from junior high school with vocational training to specialized postgraduate university training).

Knowledge of infant cognitive–communicative development

Via 10 items from the subscale 'Norms and milestones' from the Knowledge of Infant Development Inventory (KIDI; MacPhee, 1981), parents gave their age expectations for specific cognitive–communicative abilities in the period of infancy. The selected items of this scale included identification of basic mental abilities ('An infant of 12 months can remember toys that are being hidden', 'Five-month-olds know what "no" means'), communicative abilities ('A baby of 6 months will respond to someone differently depending on whether the person is happy, sad or upset', 'The baby usually says the first real word at 6 months', 'An infant will begin to respond to name-calling at 10 months', 'Babbling begins around 5 months', and 'Two-month-olds can tell some speech sounds apart'), and also higher mental abilities (logical reasoning, knowing right from wrong, and the ability to tell the difference between a make-believe story and a true one). Mothers indicate in this inventory whether they agree with a proposed age level or locate the ability at a younger or older age. Alpha reliability of the KIDI scale has shown to be high for parents (0.82, see MacPhee, 1981). In our sample, the alpha coefficient for the subscale with the selected milestone items was 0.73. The computation of correct reponses on these items yielded scores of accurate knowledge between 1 and 9 (see Table 2 for descriptive statistics).

General sensitive responsiveness

By means of this seven-point sensitivity subscale (Ainsworth *et al.*, 1978) the frequency and quality of response to the infant's behaviour in the 20-minutes' natural free play situation was evaluated by a trained observer. Interobserver reliability on this measure, based on 24 subjects, was 0.87 (Pearson correlation).

Infant exploratory level

At home, a set of 15 items from the Bayley Scales of Infant Development (out of the range between item 95 and item 125; Bayley, 1969) were administered that assess development of intentional visual–motor exploration and constructing abilities typical for the beginning of the second year according to the indicated age spans. Items included: unwrapping a cube from a facial tissue, holding a crayon adaptively, pushing a car along, putting three cubes in a cup, opening a box to get a toy, turning pages of a book, patting a whistle doll in imitation, dangling a ring by a string, putting beads in a box, putting pegs in a peg-board, removing pellets from a bottle, placing a round block in a round opening on a board, building a tower of two cubes, scribbling spontaneously on a piece of paper, and imitating a crayon stroke. Scores were computed based on the number of items passed. This subset of items was chosen instead of the full Bayley developmental index because of the history of rather poor long-term predictiveness of general developmental quotients, except in pre-term babies and infants at risk (e.g. Langkamp and Harris, 1992).

Infant disinhibitedness

Exploratory behaviour in the first 10 minutes of the free play session was assessed as being 'impulsive' or 'inhibited' with a seven-point rating scale, referring to motor arousal and the latency to approach novel objects (Kagan *et al.*, 1989; Rothbart, 1988). Infants who energetically searched in the cupboard, who rapidly switched over from one toy to another, and who showed a high amount of motor involvement in their play were rated as disinhibited. Infants who sometimes waited for a prompting of the parent to explore, who displayed

bouts of visual inspection of toys before manipulating them, and who showed balanced sequences of visual attention and concentrated play were rated as inhibited. The observer rated the child on the basis of relevant behaviours every minute and calculated the average score. Interobserver reliability on this scale, based on 24 subjects, was 0.85 (Pearson correlation).

Assessments During the Second Year

At 16 and at 20 months children were seen in a semi-structured play setting, involving an attention task and some construction tasks. In one construction task, various rings with different hole sizes had to be put over a stick. A second task involved three possible sorting tasks: a peg-board with three basic forms to be fitted in cutaways, a block sorting box (in which eight different blocks of four different shapes could be put through the corresponding lid openings), and a wooden puzzle-board with eight different figures to be fitted in the corresponding slots. Parents could switch from one to another sorting task, depending on the child's level of experience with the respective materials, in order to match performance difficulty across subjects. The duration time of the two kinds of construction tasks, used for derivation of measures of directiveness, responsiveness and task mastery, was limited to the first 3 minutes.

In the joint visual attention task, parents then were asked to let their child watch a TV screen where 11 toy objects consecutively appeared for 10 seconds each, without sound or movement. The objects had been chosen in order to elicit verbal behaviour from the parent. Some objects needed interpretation because of their abstract character (e.g. a wooden triangle with three red balls attached to it could be seen as a Christmas tree as well as a jet plane), and other objects appeared in series with subtle changes (such as changes in colour) upon which the attention could be focused. From this task a measure of parental guidance behaviour was obtained.

Parent directiveness and responsiveness

A coder first segmented parental behaviour in the construction tasks by identifying behavioural units (turns). Sequences of interventions (verbal as well as non-verbal) that were separated by less than 2 seconds were counted as a single unit. Interventions were then rated by another coder as controlling when they showed the direct potentiality to alter, start or stop infant behaviour by giving suggestions, prohibitions or directives beyond attention-focusing signals. Modelling without verbal command was not rated as controlling. Interventions were rated as responsive when they involved a description or interpretation of a behaviour of the child, a vocal imitation, or a logically connected response to a child's request, within a time-frame of 2 seconds. Turns can thus be responsive, controlling, or both at the same time, depending on the interventions involved (e.g. 'Doesn't it work out? Try the other one here', while mother is pointing to the correct slot, is one turn consisting of a responsive behaviour immediately followed by a controlling verbal and non-verbal intervention, and so the turn is both controlling and responsive). Both a frequency score (mean rate of responsive and of controlling turns per minute) and a proportion score (number of responsive or controlling turns over total number of turns) were derived as measures of responsiveness and directiveness. Interrater kappa reliability coefficients of categorizations of pre-segmented turns in 12 subjects ranged between 0.65 and 0.86 for directiveness and between 0.67 and 0.82 for responsiveness.

Toddler mastery behaviour

Mastery behaviour of the infant was measured as the frequency (rate per minute) of occurrence of task attempts in the construction tasks (putting rings on stick, fitting blocks into slots). Every new move of the child in trying to combine objects with slots or rings with the stick in a functional way was scored as an attempt. Every other move or manipulation with the toys (e.g. banging, turning) was considered as exploration. By ignoring differences between successful and unsuccessful attempts, the mastery behaviour tapped a motivational component rather than an ability component (Morgan and Harmon, 1984). Kappa coefficients of categorizations of moves as exploration versus task attempts in 12 subjects varied between 0.73 and 0.92.

Parental verbal guidance

Quality of verbal guidance was derived from the verbalizations of the parent during the joint attention task. The measure consisted of the number of TV images during which the parent used elaborated verbalizations (other than just naming the object or simply using attentional directives in the form of 'Look' or 'What's that?') to direct or maintain the infant's attention. These verbalizations can be descriptions, interpretations, or relating the object to other experiences. They are essentially responsive to what is in the visual attention of the child. Kappa coefficients of classification of parental behaviour as including elaborated verbalizations or not, based on 12 subjects, were 0.81 or above.

Follow-up Measurements at 4 Years

As outcome measures of cognitive skills in the pre-school period, the cognitive subtests of the McCarthy Scales of Children's Abilities (MSCA; McCarthy, 1972) were administered to the children at home by two undergraduates who were unaware of results from earlier data collecting and who were blind to the hypotheses. From the MSCA, three subscale indices of mental development were used: verbal ability, perceptual performance, and memory abilities.

Immediately following the test administration, mothers were asked to let the child perform some additional tasks. These tasks were chosen because of their difficulty and their ambiguity, so that the mother's help was needed in most cases. In a coloured cards sorting task, parents were asked to let their child sort out 20 different cards with coloured designs according to their main colour. Most of the cards could be classified under more than one main colour, and as more cards were being sorted, parental guidance involved checking whether the child was focusing on the right original basic colour instead of making seriations. In a second task, nine different mazes of increasing difficulty had to be solved by the child under guidance of the mother and four different cartoon story-boards (each consisting of four pictures) had to be arranged in the right order. Finally, parents were asked to read a picture-book together with their child.

The videotaped recordings of the task situations were rated on level of verbal–cognitive stimulation via a seven-point rating scale, according to the Vygotskian scaffolding principle of stimulating the child to verbalize steps in problem-solving (e.g. by questioning an action of the child) and of eliciting verbal behaviour (e.g. by involving the child in story-telling). Interrater reliability for this scale, based on 24 subjects, was 0.87 (Pearson correlation).

RESULTS

Inspection of the marginal distributions of the variables and pairwise scatterplots yielded no outliers to be eliminated and suggested that the data met the requirements regarding multivariate structural equation modelling assumptions (see Table 2 for descriptive statistics).

Stability in Behaviour

Frequency and proportion of parental directiveness during play, and verbal guidance during the visual attention task were significantly stable across this 4-month period, showing Pearson coefficients of respectively 0.39, 0.41 and 0.55 ($p<0.001$). Frequency and proportion of responsive turns of the parent and task mastery behaviour of the child were moderately stable (0.26, 0.31 and 0.28, respectively). The 16- and 20-month scores were combined into scores for 16/20 months, to be used in further path analyses with 12-month and 48-month measures. A reason for combining the scores was to compensate for accidental low or high scores on one occasion and to highlight children and parents who had consistently low or high scoring on these aspects.

Correlations between the different parental behaviours and background variables are shown in Table 1. In the long term, considering the proximal variables on the parents' side, a high continuity in parental scaffolding was found ranging from 12-month responsiveness, over responsiveness and verbal guidance in the second year, to verbal–cognitive stimulation in the pre-school period.

Knowledge of Infant Cognitive–Communicative Competences

Inspection of the correlations between parental behaviours and background variables in Table 1

Table 1. Correlations between parental behaviours and background variables ($N=62$)

	Parental SES	1	2	3	4	5	6	7
1 Knowledge of infant development	0.12							
2 12-month sensitive responsiveness	0.14	0.48**						
3 Verbal guidance in second year	0.11	0.50**	0.47**					
4 Responsiveness in second year (fr.)	0.32*	0.29	0.18	0.35*				
5 Directiveness in second year (fr.)	0.03	−0.10	−0.21	−0.09	0.39**			
6 Responsiveness in second year (pr.)	0.22	0.30*	0.27	0.37*	0.65**	−0.28		
7 Directiveness in second year (pr.)	−0.11	−0.23	−0.27	−0.24	−0.15	0.55**	−0.17	
8 Verbal–cognitive stimulation at 4 years	0.26	0.49**	0.74**	0.67**	0.25	−0.30*	0.43**	−0.30*

fr., frequency measure; pr., proportion measure.
*$p<0.01$; **$p<0.001$, one-tailed significance.

Table 2. Correlations between infancy measures and pre-school outcomes ($N=62$)

	M	SD	MSCA Verbal abilities	MSCA Perceptual performance	MSCA Memory abilities
Background variables					
Parental socioeconomic status	43.58	14.57	0.62**	0.37**	0.34*
Family socioeconomic index	3.98	1.08	0.49**	0.29*	0.53**
Parent measures					
Knowledge of infant development	5.29	1.58	0.27	0.25	0.23
Sensitive responsiveness at 12 months	4.82	1.72	0.34*	0.21	0.13
Responsiveness in second year (frequency)	4.30	1.44	0.34*	0.32*	0.28
Responsiveness in second year (proportion)	0.41	0.10	0.33*	0.19	0.19
Directiveness in second year (frequency)	6.36	2.21	−0.10	−0.01	0.07
Directiveness in second year (proportion)	0.60	0.11	−0.25	−0.23	−0.02
Verbal guidance at 16–20 months (proportion)	12.85	3.85	0.38**	0.39**	0.33*
Verbal–cognitive stimulation at 4 years	4.77	1.32	0.55**	0.36*	0.29
Child measures					
Level of exploration at 12 months	9.56	3.60	0.09	0.14	0.08
Disinhibitedness in play at 12 months	4.84	1.68	0.09	0.04	−0.06
Task mastery motivation in second year	4.53	1.46	0.16	0.27	0.23

*$p<0.01$; **$p<0.001$, one-tailed significance.

shows that accurate knowledge of cognitive–communicative competences in infancy was not correlated with the socioeconomic status of the mother. This absence of a link with SES in this sample was also observed for most of the other measures of parental behaviour. The only measure that was significantly related with SES seemed to be the frequency of responsiveness in the second year.

Although parental accuracy of knowledge was not related with socioeconomic background of the parent, it showed a strong relation with sensitive responsiveness at 12 months, verbal guidance in the second year, and also with the proportion measure of responsiveness at this age. Additionally, a negative relation with directiveness (although not significant) was found. From the table, it can be inferred that the proportion measures of responsiveness and directiveness show more pronounced relations in the expected direction as compared to the frequency measures. The proportion score of directiveness, for instance, was more clearly negatively linked to parental accuracy of knowledge.

Relation Between Children's Competences and Parental Guidance Behaviours

Three scale indexes of the MSCA were used as outcome variables: verbal ability ($M=52.15$; $SD=5.75$), perceptual performance ($M=50.87$; $SD=5.21$) and memory abilities ($M=53.15$; $SD=5.38$). Zero-order Pearson correlations between 4-year competence outcome measures and predictors in the infancy period (see Table 2) suggest the importance of responsiveness and verbal guidance, especially for verbal and perceptual performance. Socioeconomic status of the primary caregiver appeared to have a very large influence, above all on verbal abilities, while the combined family socioeconomic index was shown to be especially predictive for memory abilities. Probably the latter SES measure taps to a higher degree the hereditary endowment of the child, by genetic transmission of both parents.

Verbal ability at 4 years was significantly correlated with 12-month parental sensitive responsiveness, and with both frequency and proportion measures of responsiveness in the second year. Perceptual performance correlated significantly with frequency of responsiveness. Directiveness was negatively related to verbal and perceptual competence, albeit not significantly. Of all parental behaviours, verbal guidance in the second year and verbal–cognitive stimulation at 4 years proved to be the best predictors.

By means of LISREL (Jöreskog and Sörbom, 1989a,b), we performed a path analysis with verbal guidance in toddler age as an important parental pathway to verbal and non-verbal cognitive competences. For the final solution of the model, parameters were *a priori* fixed at zero on conceptual grounds and on the basis of poor initial correlations. A cut-off point of 1.96 for *t*-values of parameter estimates was used as a criterion to set the parameter to zero (see Saris and Stronkhorst, 1984), except when the conceptual validity of the relation forced us to retain the path in the model. Clearly,

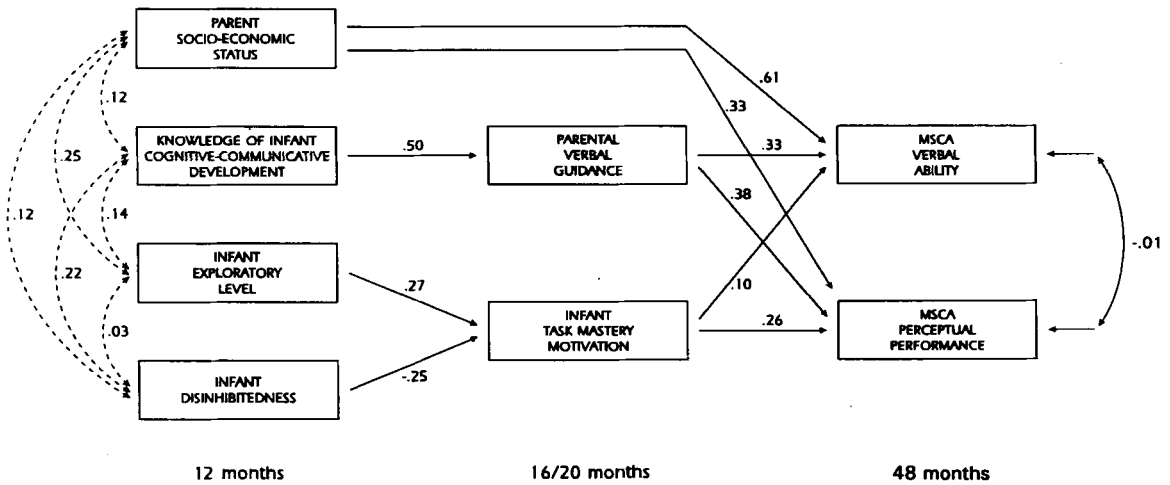

Figure 1. Path analysis model for verbal abilities and perceptual performance. All path coefficients retained in the tested model are displayed. $N=62$. Dashed lines represent zero-order correlations between the explanatory variables.

most lagged measures are conceived to be of unidirectional influence. That is, verbal ability of a child at 4 years, for example, cannot be entered as a causal variable for task mastery motivation in the second year, or for maternal behaviour in this age period. A relation between task mastery and verbal guidance of the parent was practically absent in the initial coefficient estimations, plausibly on account of the 'context independence' of the latter and the fact that these measures were collected in a different context, so that this path was set to zero also. For the final outcome variables at 4 years, a correlation between error terms from the MSCA scale indices was entered as these scales showed a zero-order correlation of 0.38 (Pearson correlation). This resulted in a model with 14 free parameters to be estimated and the remaining parameters fixed at zero. The standard solution of the model that was tested is depicted in Figure 1. The path diagram of the multivariate multiple regression analysis consists of an incomplete recursive system with four jointly dependent variables and four explanatory variables.

The model yielded a χ^2 measure of 4.91 (with 12 df). The adjusted goodness-of-fit index for this model was 0.942, indicating a good fit. Squared multiple correlations for the dependent outcome variables reached 0.51 (verbal ability) and 0.36 (perceptual performance). In the fitted model, the coefficient of covariation between error terms of the final outcome measures turned out to be practically zero (−0.01).

SES provided a strong direct path of influence to child verbal competence and in a much lesser degree to non-verbal performance. The effect of the other background variable, parental accuracy of knowledge of infant cognitive–communicative development, was of an indirect nature via the verbally responsive behavioural style of the parent. In the present paths, the long-term predictive value of the verbal guidance measure, while unrelated to concurrent task mastery behaviour of the child, was abundantly present for the development of both verbal and non-verbal competence.

A direct positive predictive path in the second year originating from level of exploratory competence at 12 months was practically absent but proceeded indirectly via task mastery motivation at 16–20 months. Task mastery motivation in the second year of life proved to be a predictor of perceptual cognitive performance at 4 years, and a poor predictor of verbal ability. A substantial negative relation was found between disinhibitedness at 12 months and task mastery behaviour some months later, while disinhibitedness showed no relation with concurrent exploratory status, possibly indicating some kind of heterotypical continuity between inhibitedness and later task mastery behaviour.

DISCUSSION

Given the limitations of model solutions that still require replication on a separate sample, and given the number of subjects included, the restrictions on generalizability should be evident. However, given the conceived barrier in prediction between infancy and childhood cognitive measures in a non-risk

population, the amount of predictiveness accounted for in the model with such a limited number of variables is satisfying.

The path analysis revealed, however, that effects of the distal background variables were not exclusively indirect via parental behaviour; that is, their effect could not be fully accounted for by their relation with the proximal parental behaviour in the model. Instead, parental SES as a compound measure continued to have a direct influence mainly on verbal ability, probably not as any long-lasting effect of early environmental settings but rather in the wake of a continuous effect of other proximal variables related to SES. This was in contrast to the findings from Olson *et al.* (1984), who found distal SES influence to be dissipated to a large extent into similar proximal parent-infant interactional variables to those used in the present study. Their outcome measures were, however, taken at the end of the second year. It might well be that SES has its main influence during the toddler and pre-school years in terms of general home environment and peer relations, and that during infancy the primary caregiver, for obvious reasons, exerts the greatest developmental influence as the 'primary' incarnation of SES.

Our findings about continuous influence of SES match with other recent findings (e.g. Jennings and Connors, 1989). Specifically, our path model seems to underscore the common finding that verbal competence in particular is influenced by this background variable. If one considers verbal guidance to be brought about by emotional acceptance and general sensitivity, the model also meshes with previous findings that a warm mother-child interaction is positively associated with the development of verbal abilities (Gottfried, 1984; Hatano *et al.*, 1980; Jennings and Connors, 1989) and with more general or composite indexes of child competence (e.g. Olson *et al.*, 1984). In sum, our path model stresses the importance of verbal scaffolding behaviour in the infancy and toddler period—provided there is a continuity into early childhood—for the development of both verbal and non-verbal cognitive abilities. This is in agreement with the study of Heinicke and Lampl (1988), who found that verbal-cognitive stimulation from the parent was even more strongly associated with task orientation than with verbal expressiveness of the child at pre-school age.

Verbal guidance has a greater positive effect on non-verbal performance in the long term than the negative effect of directiveness. A high amount of control and directiveness in the toddler period where autonomous learning should be promoted tends to be counterproductive for later cognitive competence, although some studies suggest that overcontrolling maternal behaviour would not be as strongly negatively related to later dyadic problem-solving efficiency (Frankel and Bates, 1990) as is commonly accepted. The fact that sensitive attention-focusing and controlling-intervening behaviours do appear to facilitate learning and to enhance attentional capacity indeed cannot be denied, as is documented in other research (e.g. Wertsch *et al.*, 1980; Heckhausen, 1987a). In fact, it can be argued that verbal responsive guidance is an unassertive and sensitive way of control and directiveness, structuring the infant's actions, frequently by means of indirect suggestions and questionings to which the infant becomes more and more susceptible as his symbolic processing matures. In socialization practices this strategy is known as 'pro-active' control, which avoids possible 'clashes of wills' (Holden and West, 1989).

The results of the path analysis concerning parental accuracy of knowledge are also consistent with recent work emphasizing the importance of parental attitudes towards child competences, child-rearing practices and own perceived competence in influencing the course of development (e.g. Sigel, 1985; Goodnow and Collins, 1990). Mothers who have a more accurate knowledge also tend to use verbal guidance as a soft way of controlling infants' attention and at the same time provide the infant with cognitive information. Effects of cognitive variables of the parent on child cognitive competences are most plausibly of an indirect nature via behavioural components. Direct paths from parental knowledge to child behaviours were not retained in the model. A direct path from parental knowledge of infant cognitive-communicative abilities to later child competence is, of course, only statistically meaningful when assuming this knowledge to be related to an intelligence factor. The low association with individual SES scores of the mother suggests that this is not the case. Measurement of a cognitive variable at an earlier time lag also does not necessarily imply the variable is a causal predictor for parental behaviour measured later on. The variable 'knowledge of infant cognitive-communicative competence' could eventually be considered as the result of an underlying variable which can be called 'parental sensitivity' and which also determines the quality of verbal guidance.

With regard to the child, task mastery behaviour in constructive play during the second year seemed to be predictive primarily of non-verbal perceptual performance. Instead of being an index for an ability

in solving such tasks, the mastery measure mainly concerns a motivation for task persistence, of which resistance to frustration and concentrated task effort constitute core characteristics. It stands to reason that these characteristics play an important role in testing situations where 'giving up' due to lack of motivation is scored by the examiner as a failure, or in non-verbal performance subtests where time constraints are built in. Disinhibitedness in play, involving frequent shifts in attentional focus, in this way can be well conceived as a negative predictor of concentrated task behaviour.

In sum, when comparing child and parent variables, it seems that the quality of parental guidance across the age span of this study can account for at least as much continuity in infant cognitive development as the selected infant cognitive predictors themselves. The finding in this model that parental behaviour with a mediating function is a stronger predictor of child performance than early infant abilities and characteristics agrees with other recent findings (e.g. Gonzalez and Palacios, 1992; Olson *et al.*, 1984; Sarfi and Hartmann, 1991), although further efforts in a transactional perspective are required, looking for other specific infant variables which can complement the already established predictive value of information-processing variables.

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