



A Neurobehavioral Curriculum For Early Intervention[©]

Supporting the Neurobehavioral Organizational Development of Infants with Disabilities

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Primary Audience

The neurobehavioral assessment/intervention strategies and related materials included in this curriculum have been written for special educators, physical therapists, occupational therapists, communication disorder specialists, nurses, neonatologists, pediatricians, social workers, and infant developmental specialists. These materials may only be implemented by those individuals who have received prior instruction and certification in the administration of the Infant Behavioral Assessment (IBA[®]). As selection and implementation of the strategies is based upon the observational skills of the adult, it is imperative that training in all the neurobehavioral components of the IBA[®] have been successfully completed.

In addition, experience with neonates or young infants and knowledge of newborn medicine, infant development, and standardized testing is required. Training in the implementation of the neurobehavioral intervention/assessment strategies and related materials is best suited for clinicians who are already skilled in their own pediatric specialty and whose current practice includes intervention with high-risk, medically fragile, or disabled infants and their families.

As we are currently in the development process of this curriculum, these materials are intended for use by only those professional institutions/agencies that have been approved as sites replication. The enclosed material should not be shared with, or implemented by, other agencies or individuals without written permission from the author.

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The Newborn Individualized Developmental Care and Assessment Program (NIDCAP[®]) as developed by Als (1984, 1986, 1997a, 1997b) has served as the foundation from which the Infant Behavioral Assessment and Intervention Program[®] was conceived and developed. The NIDCAP[®] approach has provided the theoretical base and training model that has guided the development of the Infant Behavioral Assessment[®] (Hedlund & Tatarka, 1988) and the Neurobehavioral Curriculum for Early Intervention[®] (Hedlund, 1998).

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INTRODUCTION

INTRODUCTION

New curricula for infants born with very low birth weight (VLBW) or with severe disabilities should incorporate the new directions in service content and delivery that have been called for by those who have been developing and studying direct services over the past years (Bretherton & Walters, 1986; Cohen & Parmelee, 1983; Greenburg & Crnic, 1988; Heinicke, Diskin, Ramsey-Klee, & Oates, 1986; Holdgrafer & Dunst, 1986). These researchers have refocused our attention upon the ecological perspective (Bronfenbrenner, 1979, 1986; Garbarino, 1990) of infant development as a product of a continuous dynamic interaction between the child and the experience provided by his or her family and social context (Sameroff, 1993; Sameroff & Chandler, 1975). The social environment acts upon the infant's development through various systems, beginning with the parent-infant dyad (Belsky & Tolan, 1981). These dynamic interactions expand across time to include extended family members and friends as well as early intervention professionals and paraprofessionals who may be providing services to these infants and their families.

The increasing recognition of the importance of social and behavioral interaction in a child's development (Holdgrafer & Dunst, 1986; Piaget & Inhelder, 1969; Simeonsson, Bailey, Huntington, & Comfort, 1986; Tronick & Gianino, 1986) has dictated the need for interactional based curricula for infants with severe disabilities (Holdgrafer & Dunst, 1986; Mahoney, 1983) as well as for premature and at risk infants (Als, 1992; Als, Duffy, McAnulty & Badian, 1988; Beckman, Thiele, Pokorni & Balzer-Martin, 1986). The "goodness of fit" frequently described between parent and infant (Mahoney, 1983; Rauh, Achenbach, Nurcombe, Howell & Teti, 1986) has yet to be broadly applied to the early intervention professional and paraprofessional, whose interactional style and sensitivity have been shaped by the more traditional, direct instructional procedures, and the content curricula in which they have been trained. Only the recent focus on ecological programming has caused early interventionists to begin to examine their roles and to recognize that they may not in fact be facilitating the best developmental outcomes in infants. Intervention which recognizes and supports the neurobehavioral competence of the infant (Als, 1984, 1986, 1992; Lawhon, 1994), as opposed to those which attempt to control infant behavior, may better promote the integration of the affective, social, and cognitive domains (MacTurk, Hunter, McCarthy, Vietze & McQuiston, 1985).

As VLBW infants and infants with disabilities are discharged from hospital newborn intensive care units (NICUs), parents are confronting the long-term implications of their child's special needs. "Support and neurobehavioral intervention cannot end when the infant is discharged

from the NICU, but must systematically link families and infants to sound models of community-based supports that build on the neurobehavioral care and intervention provided in the NICU" (Als, 1992, p. 353). Intervention offered these infants and their families must capitalize on family strengths to help parents to support the neurobehavioral needs of their infants, create opportunities for parent-to-parent contact, focus intervention goals on parent-identified needs, and facilitate and support the development of mutually satisfying parent-infant interactions.

In view of the dearth of curricula in early childhood special education that address the neurobehavioral needs of infants with disabilities, the Neurobehavioral Curriculum for Early Intervention[©] makes a unique and important contribution to current practice. Currently, curricula for infants born with very low birth weight, severe disabilities, or at-risk have involved more traditional models of developmental and neurodevelopmental interventions or parent training in developmental activities. Few, if any curricula exist, that provide neurobehavioral training to early intervention professionals and paraprofessionals nor address the neurobehavioral needs of medically fragile or severely disabled newborn infants and their families.

In response to these needs, Hedlund (1986) developed the Transactional Family Systems Model (TFSM), a model demonstration project. The Infant Behavioral Assessment[©] (Hedlund & Tataraka, 1988), a neurobehavioral infant assessment, was developed as one of the components of this model. The Infant Behavioral Assessment (IBA[©]) provides a window into the infant's behavioral repertoire and results in specific recommendations for supporting the neurobehavioral competence of the infant. It assists early intervention professionals to recognize the infant's behavior as truly communicative and to support the infant in an appropriate responsive manner. This model was effective in both facilitating the infant's mental development and improving the quality of early social interactions between parent and child that are so critical to later infant and child competence (Hedlund, Bennett, & Booth, 1989). In 1989 and 1992 the Federal Office of Special Education Programs funded the NICU Transition and NICU Follow-Through Projects. These outreach grants trained medical and educational professionals in the administration of the IBA[©] and the Newborn Individualized Developmental Care and Assessment Program (NIDCAP[®]) as conceived and developed by Dr. Heidelise Als (1982,1984,1986, 1992).

The Neurobehavioral Curriculum for Early Intervention (NCEI[©]), is based upon the collective work of these grants and is centered on the principle of family-focused, relationship based, individualized neurobehavioral care and intervention (Als, 1997a, 1997b; Als & Gilkerson, 1997). The NCEI[©] provides specific neurobehavioral strategies for early intervention professionals to

integrate into the infant assessments and curricula that they are currently using. The focus of this curriculum is not "what to teach" (content curricula) but "how to teach," a process oriented approach. The capacity of the infant to learn requires an alert state, a graded presentation of stimuli, and a sensitivity to feedback signals indicating limits of tolerance (Papousek & Papousek, 1987, 1992). The NCEI[®] assists early intervention professionals to learn and implement specific neurobehavioral strategies that will facilitate these infants' learning prerequisites. In addition parents as well as paraprofessionals are assisted to recognize and support the neurobehavioral needs of these fragile infants. This is accomplished through three major components of the Neurobehavioral Curriculum for Early Intervention. These include:

1. Neurobehavioral Strategies for Intervention[®]. These strategies assist early intervention professionals to support the neurobehavioral organization of infants born with very low birth weight or severe disabilities during an assessment, intervention, or care giving session. The neurobehavioral strategies can easily be integrated within specific intervention goals and/or objectives identified for the infant as well as integrated into the Individualized Family Service Plan (IFSP);

2. Holding Parents Holding Their Baby[®]. Materials included in this manual assist early intervention professionals to recognize, value, and support the parental role. Based upon the work of D.W. Winnicott, these materials assist the professional to integrate and apply Winnicott's philosophical approach and tone in his/her work with families and their babies. Holding Parents Holding Their Baby[®] supports and validates parents in their observations and care of their baby and introduces them to strategies that they might consider to support their infant's neurobehavioral organization; and

3. Neurobehavioral Guide for Parents and Paraprofessionals[®]. This guide supports parents, as well as paraprofessionals, toward a greater understanding of the "communication avenues (i.e., autonomic, motoric, state, attention/interaction) available to the infant and the behaviors emanating from them (i.e., approach, self-regulatory, stress). The Neurobehavioral Instructional Guide[®] assists parents and paraprofessionals to better support the neurobehavioral organization of infants during their day-to-day interactions with them.

**NEUROBEHAVIORAL ASSESSMENT
AND INTERVENTION**

NEUROBEHAVIORAL ASSESSMENT AND INTERVENTION

The movements of expression in the face and body, whatever their origin may have been, are in themselves of much importance for our welfare. They serve as the first means of communication between the mother and her infant; she smiles approval, and this encourages her child on the right path, or frowns disapproval. The movements of expression give vividness and energy to our spoken words. They reveal the thought and intentions of others more truly than do words....

Charles Darwin, 1882

Neurosocial Behavioral Development

Infants develop the ability to fully participate in reciprocal social and/or environmental interactions gradually, and according to a developmental sequence. They need to attain a certain level of physiological homeostasis (or balance/equilibrium) before they can begin to seek out and respond to social interaction. Table 5 portrays the different levels of this process. Level I illustrates what Gorski, Davison, and Brazelton (1979) propose as the first step of neurosocial behavioral development or the period of physiological reorganization or “turning in.” At this level the infant is unable to participate in reciprocal social or environmental interactions until he has achieved a minimal capacity at Level II to maintain physiological homeostasis. The infant’s goal at this level is to protect himself from environmental and social input until he has attained some degree of physiological homeostasis. At level II the beginning of organized behavioral responsiveness or “coming out” is observed as the infant attempts to respond to and occasionally seeks out social interaction. At this level the infant’s goal is to explore the possibility for brief supported periods of social/environmental engagement. Levels III through VII exemplify stages of neurosocial behavioral development in which the infant engages in reciprocal social and environmental interactions with only temporary cost to his physiologic function and stability. The infant’s developmental goal is now to actively seek out, engage, and learn from his social and physical milieu.

Today many of the infants discharged from hospital NICUs continue to lack a well organized central nervous system which results in less control of sleep, arousal, alerting, attention, fussing, and feeding. Many of these infants have not yet attained a minimal degree of physiological homeostasis as illustrated in Level I. Their limited energy reserves are directed towards attempting to protect themselves from stimulation that may be inappropriate for their current level of neurophysiological functioning. Other infants may fluctuate between Levels I and II, or have attained Level II. These infants still require the sensitive grading of stimulation that may be offered to them as well as facilitation of their own self-regulatory strategies. Often times it may not be until three to six months after homecoming that these infants’ neurobehavioral organizational abilities begin to stabilize (Als, 1997; Gorski, 1984).

TABLE 6
Levels of Social Interaction

	INFANT LEVEL	DYADIC GOAL	CARE GIVER ROLE
LEVEL I	<p>physiologic instability lack of internal integrity disorganized state system immature motor responses diffuse behavioral cues in response to internal instability and external factors</p>	<p>maintenance of infant's physiologic stability</p>	<p>assistive support of infant during necessary medical and care giving procedures</p>
LEVEL II	<p>brief alertness emerging organization of sleep and wake states emerging self-regulatory capacities in all subsystems unpredictable and inconsistent behavioral cues</p>	<p>availability for brief attention while maintaining subsystem integrity</p>	<p>support of beginning attempts to alert facilitation of infant's emerging self-regulatory capacities during direct parental interactions (social, care giving)</p>
LEVEL III	<p>internal synchrony in physiology and state clear behavioral cues to availability smooth state transitions predictable state transition</p>	<p>synchronous phasing of participation and affect.</p>	<p>set state for social codes regulate own state and affect in response to baby cues use variety of communicative modalities</p>
LEVEL IV	<p>exogenous smile expansion of interactive alert state attention/response to stimulation beginning preferential response to care giver expansion of social capacities (vocal, facial, gestural postural)</p>	<p>mutual orientation and pleasure beginning vocal and motor play two-step chains of stimulus response</p>	<p>response to infant stimulation preferences (modalities, strategies)</p>
LEVEL V	<p>fill pauses build crescendo of play begins to combine modalities beginning content-mediated affect</p>	<p>reciprocal exchange expansion of chains affective, vocal and motor play beginning content-mediated interactions</p>	<p>interpret and respond to baby actions as communication maintain chains, alternate turns initiate reciprocal games (peek-a-boo, give-take) use elements of surprise, anticipation ("gonna get you," funny faces)</p>
LEVEL VI	<p>initiation of social games anticipation of outcomes intentionality differential response to completion/interference in games joy in mastery</p>	<p>engagement in infant initiated activities (social and other) reciprocity in alternation of roles easily attained dialogue</p>	<p>enter baby's activity follow baby's lead allow baby to initiate games complete games</p>
LEVEL VII	<p>curiosity/exploration of environment evaluation of interactive context</p>	<p>interaction around objects balance in who controls interactive bouts context-mediated dialogue</p>	<p>maintain balance between baby's and own control response to ongoing infant interaction in environment (follow gaze and name object of interest, etc.)</p>

(adapted from McCollum, 1982)

The Infant's Behavioral Story

Infants speak to us via the expression of approach, stress, and self-regulatory behaviors emanating from the four subsystems of communication (i.e., autonomic, motoric, state, attention/interaction). The neurobehavioral approach as advocated by Als (1984, 1985, 1986, 1992, 1997a, 1997b), Lawhon (1986, 1997), and Hedlund and Tatarka (1988, 1991) “postulates that the infant’s behavior provides the best information base from which to be continuously attuned to the infant” (Als & Duffy, 1983, page 154). Infants participate as active partners in their own developmental agenda in a continuous relationship with those caring for them and the current environment which contains or holds them. Each infant has his own unique behavioral story to tell, a story that speaks directly to his needs, wants, and developmental agenda that he is striving toward (Als, 1986, 1992). It is only through the direct observation of the behavioral repertoire of an infant that we can infer: 1) what goals the infant seeks to accomplish; 2) what strategies are being employed by the infant to accomplish these goals; 3) how effective these strategies are; and 4) what supports might be useful to facilitate the infant’s overall development and neurobehavioral organization (Als, 1986, 1992, 1997a, 1997b). Through direct observation of the behavioral expression of the infant and facilitation of his neurophysiological organization, early intervention professionals may better support the infant along his individual developmental trajectory (Als, 1997a).

Goals of Neurobehavioral Intervention

The Newborn Individualized Developmental Care and Assessment Program (NIDCAP[®]) as developed by Als (1984, 1986, 1996; 1997a, 1997b) has served as the foundation from which the Infant Behavioral Assessment and Intervention Program[®] was conceived and developed. The NIDCAP[®] approach has provided the theoretical base and training model that has guided the development of the Infant Behavioral Assessment[®] (Hedlund & Tatarka, 1988) and the Neurobehavioral Curriculum for Early Intervention[®] (Hedlund, 1998).

The neurobehavioral intervention as advocated by (Als, 1986, 1992, 1997a, 1997b) and our past and present work (Hedlund, 1998; Hedlund & Tatarka, 1988) addresses the needs of growing numbers of infants, newborn through six months developmental age, who are born with very low birth weight or at risk for poor long-term neurodevelopmental outcome. The main goals of this approach are to:

1. Support early intervention professionals to read and interpret the infant’s behavioral story. This is accomplished through training in the administration of the Infant Behavioral Assessment (IBA[®]). Through these clinical observations the infant’s neurobehavioral organization and self-regulatory competence is evaluated. Based upon these observations a determination is then made with respect to the degree and quantity of neurobehavioral support that the infant is eliciting and seeking (Vygotsky, 1930, 1960/1978; 1934/1986).

2. Translate the infant's behavioral story into appropriate neurobehavioral and developmental action by selecting and implementing the neurobehavioral strategies that best supports the infant along his individual developmental trajectory (Als, 1997a). The strategies assist professionals to conduct developmental assessments and implement therapeutic, educational, and care giving intervention that is sensitive to, and supports the neurophysiological state and organizational system of the infant. Through this process the infant is individually supported in his efforts to engage and be engaged by the environment, thus enhancing the child's growth and development.
3. Validate and support parental perceptions of their growing developing infant. The approach offered in Holding Parents Holding Their Baby © (Hedlund, 1998) significantly differs from the current "train the parent model" implemented in traditional early intervention programs today. Drawing upon the work of Winnicott (1964/1987; 1965/1994; 1966/1987) the materials included in this manual reflect a philosophy guided by the recognition of, and a respect for, what comes naturally to parents as they love and care for their baby. It serves to support parents as they continue to explore ways to adjust and adapt themselves to the neurobehavioral organization and self-regulatory competence of their infant.
4. Bring about a shift from protocol-based (i.e., curriculum bound) to process thinking (i.e., how to facilitate learning and social interaction), and from agenda oriented (i.e., mastery of developmental tasks/milestones) to relationship-based developmental intervention (Als, 1997a, 1997b; Als & Gilkerson, 1997; Gilkerson & Als, 1995).

Prerequisites to Using the Neurobehavioral Strategies

1. Training and certification in the administration of the Infant Behavioral Assessment© is required. As selection and implementation of the strategies is based upon the observational skills of the adult it is imperative that training in all neurobehavioral components of the IBA© have been successfully completed.
2. The neurobehavioral strategies were developed for use by special educators, physical and occupational therapist, communication disorder specialists, nurses, neonatologists, pediatricians, social workers, and infant developmental specialists. Experience with neonates or young infants and knowledge of neonatal medicine, infant development, standardized testing is required. Training in the implementation of the neurobehavioral strategies is best suited for clinicians who are already skilled in their own pediatric specialty and whose current practice includes intervention with high-risk, medically fragile, or infants with disabilities and their families.

Implementation of the Neurobehavioral Strategies:

Reading and Responding to the Infant's Behavioral Story

The capacity of the infant to learn requires an alert state, a graded presentation of stimuli, and a sensitivity to feedback signals indicating limits of tolerance.

Papousek & Papousek, 1987

The following steps have been developed to guide the early intervention professional in the implementation of the Neurobehavioral Strategies[®].

1. Assessment of the neurobehavioral repertoire of the infant must be completed prior to the initial implementation of the neurobehavioral strategies. It is recommended that the IBA[®] be administered over successive sessions to partially control for the variability of infant behavioral responses and the possible effect of external factors. The assessment requires the adult to be cognitively attuned to the interactional dyad (i.e., infant, and the interactional partner) throughout the course of the interaction (see IBA Training Manual[®]).

Administration of the IBA[®] affords the interventionist a window onto the behavioral repertoire of the infant by answering the following questions:

- a. At what neurosocial behavioral level is the infant currently functioning? Does he appear to be “turning in” as a means of neurophysiological reorganization? Are there glimmers of organized behavioral responsiveness or periods of “coming out” in which he is making initial attempts to respond to his physical and social environment? Or is he easily able to maintain physiological homeostasis and actively seeks and participates in mutual and/or reciprocal interactional exchanges?
- b. What self-regulatory strategies is the infant currently utilizing or attempting to use as a means to: 1) sustain attention and maintain an interaction (i.e., concentration); or 2) “hold on” or utilize self-regulatory strategies to “cope” with a more challenging interaction; or 3) return to subsystem stability (i.e., console).
- c. How effective is the infant in his efforts to use his self-regulatory strategies? Is he able to make use of his environment with little effort (e.g., searching and finding a surface to Brace against)? Or does he continue to make repeated, futile efforts which are often unsuccessful and usually result in exhaustion or upset?

- d. Is the infant receptive to support that is offered to him? Or does it take several efforts by the interacting adult to “fine tune” the support that he appears to be seeking?
 - e. Are his behavioral cues (i.e., Approach, Self-Regulatory, Stress) easy to read and interpret? Or are they diffuse and inconsistent?
2. Upon completion of the assessment the adult develops a descriptive narrative of the observational episode. The narrative includes discussion of pre-observation baseline data, environmental information, and the behavioral responses of the infant during the course of the interaction (see Infant Behavioral Assessment Training Manual[®]: Appendix B). It is through this dynamic process of: a) assessment, b) active reflection upon the observed interactional episode, and c) the development of the written narrative, that the infant’s behavioral story is revealed to the interventionist. This process guides the adult in the selection of a neurobehavioral strategy or strategies to be implemented with the infant.
 3. Selection of the neurobehavioral strategy(ies) is based upon the observed neurophysiological state and self-regulatory competence of the infant. After the assessment has been completed and the behavioral narrative written, the interventionist then turns to the selection of the strategy(ies) that would appear to facilitate the infant’s attempts to self-regulate over the course of an interaction.

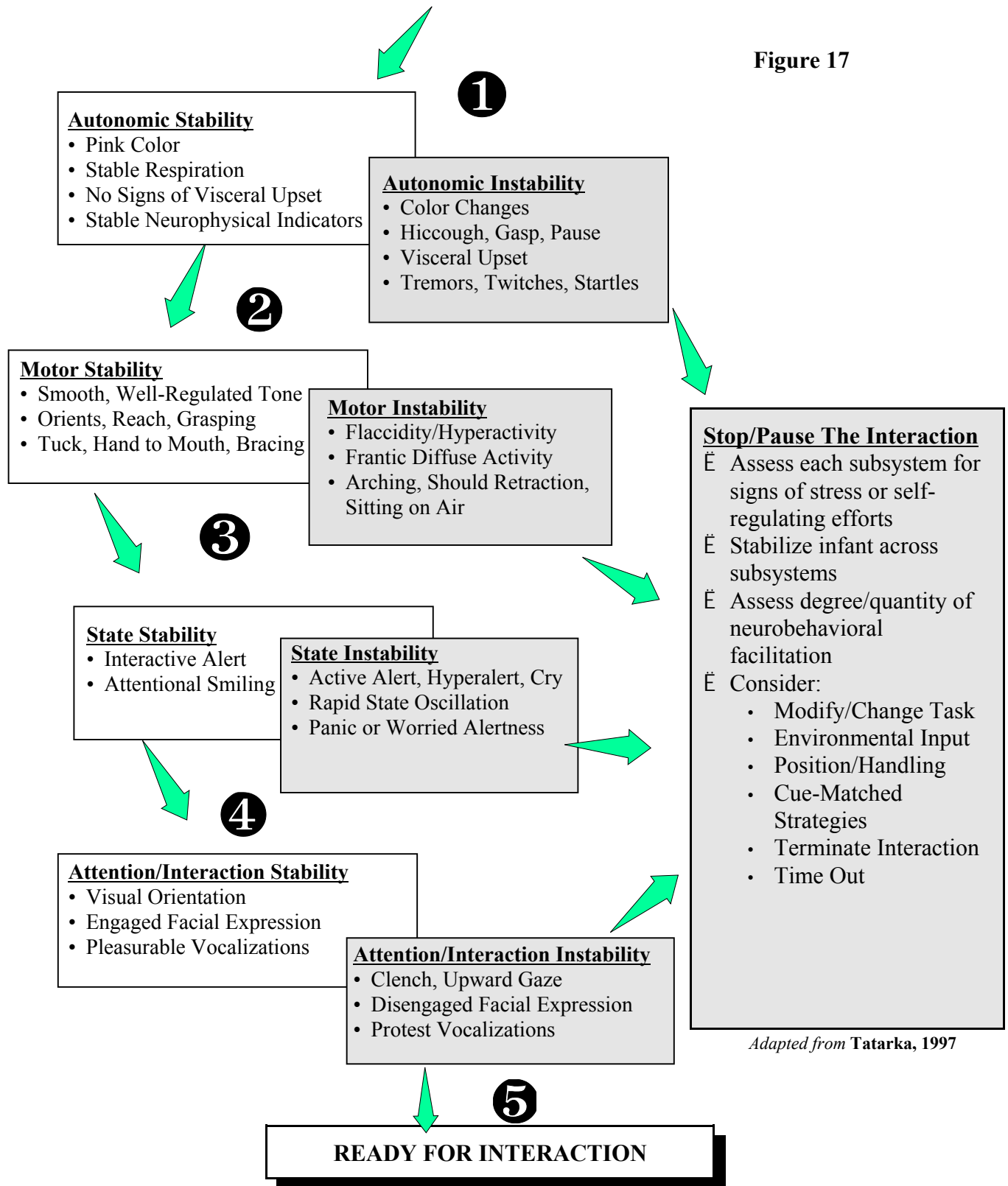
It is of paramount importance that the adult reads and contemplates the description of each category of Self-Regulatory Competence described in the section preceding the suggested strategies under levels of Support (see Organization of the Neurobehavioral Strategies). The interventionist must match the infant’s behavioral story with one or more of the five levels of Self-Regulatory Competence. The infant’s subsystem organization and self-regulatory competence may require different levels of support within each section of the strategies (i.e., Environment, Handling & Positioning, Cue-Matched). This is dependent upon the maturation/dysmaturation of the infant’s neurophysiological organization. Failure to do so may result in over/under regulation of the infant’s neurophysiological organization and self-regulatory capabilities and hinder the infant’s neurobehavioral, social, and/or developmental trajectory.

4. Once a specific strategy(ies) has been selected the process of dynamic assessment and intervention continues. During the next intervention the selected strategy(ies) is applied with the infant over the course of a developmental assessment or intervention session. The adult continually assesses the application of the strategy(ies) and the infant’s behavioral responses to it. The interventionist changes or maintains the degree and/or quantity of this neurobehavioral

facilitation; or re-evaluates the implementation of the chosen strategy, depending upon the infant's behavioral story.

Figure 17 illustrates a decision making model to guide the interventionist or care giver in responding to the infant during an interaction and is based upon the four principles of neurobehavioral intervention. While elements of this schematic might seem to suggest a step-wise or hierarchical approach, the numbered subsystems are meant to facilitate the full and systematic inclusion of all infant subsystems in ongoing reassessment throughout the interactional process.

Figure 17



This figure implies a circular checking and rechecking across systems as the interaction proceeds, and in practice is a continuous, seamless loop as the adult constantly examines the child's behavior and makes necessary adjustments.

Organization of the Neurobehavioral Strategies[®]

The neurobehavioral strategies are divided into three sections and accompanying subsections.

I. Environmental Facilitation

- A. Ambient Visual Environment
- B. Ambient Auditory Environment
- C. Temperature within the Environment
- D. Social Visual/Auditory Input

II. Motoric Facilitation: Handling & Positioning

- A. Supine: Upper/Lower Trunk and Extremities
- B. Prone: Upper/Lower Trunk and Extremities
- C. Sidelying
- D. Cradled in Arms
- E. Held at the Adult's Shoulder
- F. Held Face-to-Face on the Adult's Lap

III. Cue-Matched Facilitation

- A. Hand to Mouth, Sucking, and Mouthing
- B. Bracing and Foot Clasp
- C. Holding On
- D. Hand to Midline, Hand on Stomach, Self-Clasp

Each section begins with a general introduction pertaining to the specific area to be addressed (i.e., Environment, Handling and Positioning, or Cue-Matched Strategies). Each *subsection* defines the particular area, position, or cue-matched strategy (e.g., Ambient Visual Environment, Supine, or Hand to Mouth, Sucking, and Mouthing) that neurobehavioral strategies have been developed for. This is followed by a *Considerations* section. The *Considerations* section offers observations pertaining to selection and implementation of a particular neurobehavioral strategy.

The subsections are organized beginning with a description of the neurobehavioral organizational condition of the infant within the four subsystems (i.e., autonomic, motoric, state, attention/interaction) as well as the infant's self-regulatory competence. This is followed by neurobehavioral strategies that have been classified into 5 levels of support: 1) Minimal, 2) Low, 3) Moderate, 4) High, and 5) Terminate the Interaction (i.e., the infant's threshold for interaction has been exceeded). The level of support is determined by the neurobehavioral organization and self-regulatory competence of the infant (i.e., Optimal, High, Moderate, Low, and Minimal Self-Regulatory Competence). For example, an infant, for the most part, may appear to be well organized (i.e., High Self-Regulatory Competence) but may require a small amount of facilitation (i.e., Low Support) to maintain an Interactive Alert State. A detailed description of the levels of Self-Regulatory Competence follow in the next few pages to more fluidly describe the subsystem functioning of the infant within each of the five levels of Self-Regulatory Competence.

Levels of Self-Regulatory Competence

Optimal Self-Regulatory Competence

This describes the infant whose subsystem functioning is well integrated and modulated. The infant displays smooth respiration, good healthy color, and stable visceral and neurophysiological indicators. Good consistent tone throughout the body is observed as well as smooth well modulated movements. The upper/lower extremities smoothly cycle in and out of flexion and extension. The infant's arms/hands often come to rest upon his chest or stomach; his legs often assume a flexed tucked position with his feet coming to rest upon the supporting surface. The infant is predominantly in an Interactive Alert state as his face reflects a bright-eyed focused attention to the presented stimulus. His attention is of long duration.

Facilitation: Facilitation may occasionally be offered to the infant to support subsystem balance and/or self-regulatory efforts.

High Self-Regulatory Competence

The infant may at times display mild fluctuating color changes (e.g., Mottling): or a Yawn, Sigh, Burp; or facial Twitch or hand Tremor. His attention is of considerable duration as he remains in an Interactive Alert state, though at times his visual focus may “stray” to competing environmental stimuli (i.e., Alert state). For the most part, good consistent tone throughout the body is observed as well as smooth well modulated movements. His arms often cycle in and out of midline flexion and extension. Most of the time his upper extremities come to rest at chest/stomach level and this appears to assist him in maintaining subsystem balance. The infant may draw his lower trunk/extremities up into a tucked position or rest his feet upon the supporting surface. Occasionally mild subsystem disorganization may be observed (e.g., mild color, respiration, or visceral fluctuations; mild motor disorganization; or a momentary state change).

Facilitation: Low Support

The infant needs a mild degree of facilitation. Once applied the infant is usually able to regain subsystem balance and availability for attention/interaction.

Moderate Self-Regulatory Competence

The infant may display mild to moderate fluctuating color changes (e.g., Mottled, Pale); and/or at times uneven respiration with Yawns, Sighs, Coughs, or Burps. An occasional facial Twitch or upper/lower trunk and/or extremity Tremor may be observed as well. His attention is of moderate duration as he attempts to remain in an Interactive Alert state, though he often fluctuates between this and an Alert state. Moderate to considerable periods of well regulated tone throughout his body are observed as well as smooth movements of his upper/lower extremities. The infant may make attempts to Tuck his upper trunk and bring his arms and hands to midline in an attempt to either maintain or regain subsystem balance. At times he is successful. At other times his upper extremities may be positioned horizontally out upon the supporting surface, at his sides, or retracted with or without increased tone by his head. Or the infant may make attempts to tuck his lower trunk and utilize a supporting surface to rest his feet against. This appears to assist him to either maintain or regain subsystem balance. At times he is successful. At other times his lower extremities may extend out into midair or Straighten with Tension. Over the course of the interaction mild to moderate subsystem disorganization may be observed (e.g., mild to moderate color, respiration, or visceral fluctuations; mild to moderate motor disorganization; and/or state changes that may result in decreased availability for attention/interaction).

Facilitation: Moderate Support

The infant needs a moderate degree of facilitation. Once applied the infant is usually able to regain subsystem balance and may be intermittently available for attention/interaction.

Low Self-Regulatory Competence

The infant may display moderate to at times considerable patterns of fluctuating color changes (e.g., Mottled, Pale, Red); and/or moderate periods of uneven respiration with Yawns, Sighs Coughs, Hiccough, Burps, or Bowel Movement Grunts. Body Twitches, upper/lower trunk and/or extremity tremors, or a startle may be observed as well. His attention is moderately variable as he attempts to maintain an Interactive Alert state. The infant at other times may fluctuate between Interactive Alert and an Active Alert state as his motor activity increases; or his activity decreases as he at times attempts to move into the lower states (e.g., Drowsy, Light Sleep). Occasional periods of well regulated tone and or smooth movements are observed in his upper/lower trunk and extremities. At times he may make efforts to Tuck his upper/lower trunk and extremities in an attempt to either

maintain or regain subsystem balance. These maneuvers are often unsuccessful. The infant may more frequently Arch his trunk, position his arms horizontally out at shoulder level, extend his legs into midair, or Straighten them with Tension. Over the course of the interaction moderate to considerable subsystem disorganization may be observed (e.g., moderate to considerable color, respiration, or visceral fluctuations; or moderate to considerable motor disorganization; or state changes that may result in decreased availability for attention/interaction).

Facilitation: High Support

The infant needs a high degree of facilitation. Once applied the infant may be able to regain subsystem balance and may be available for brief, carefully graded periods of interaction.

Minimal Self-Regulatory Competence

The infant displays considerable to severe patterns of fluctuating color change (i.e., Mottled, Pale, Red, Dusky); and/or considerable periods of uneven respiration with Hiccough, Bowel Movement Grunts, Gasps, or Pauses. Upper trunk/extremity Tremors or Startles may be observed as well. The infant is unavailable. He fluctuates between the upper states, often culminating in the Cry state, as his motor activity increases with patterns of hyperextension or hyperflexion of the trunk/extremities; or his activity decreases, as he attempts to move down into the lower states (i.e., Drowsy, Light/Deep Sleep) and appears to assume an almost completely Flaccid posture. The infant is at the mercy of the stimulus and is unable to make use of any support that is offered to him. He is incapable of returning to even partial subsystem balance.

Facilitation: Terminate the Interaction

- Provide maximal support to assist the infant to return to subsystem balance. See: SOOTHING TECHNIQUES.
- Complete the reflection process outlined in EVALUATING THE SESSION.

Application of Levels of Facilitation:

Respecting the Behavioral Story of the Infant

The interventionist must be constantly vigilant in their observations and applications of the varying degrees and quantities of support provided to the infant. The neurophysiological and behavioral story of the infant guides the interventionist in the application of specific neurobehavioral strategies. The infant's neurophysiological level of homeostasis must be respected. The neurobehavioral strategies should not be utilized to engage an infant, if that child has not achieved a minimal capacity to maintain physiologic homeostasis. The strategies may be utilized to support and facilitate the infant's physiologic stability in the face of neurobehavioral disorganization. In this scenario they would not be utilized to elicit developmental objectives driven by an interventionist's agenda. The neurobehavioral strategies were developed to facilitate appropriate developmental and social interactional engagement with the infant. An appropriate interaction is based upon and guided by the infant's current subsystem organization and self-regulatory competence. This is discerned through the observation of the infant's individual behavioral responses to a specific interaction.

Dynamic Assessment and Intervention

The neurobehavioral strategies developed as part of this curriculum are critical to the facilitation of the neurobehavioral organization of an infant during an assessment or intervention session. Just as important, however, is how these strategies are clinically applied. Monitoring the degrees and quantities of facilitation offered to an infant (i.e., when and under what circumstances the facilitation should be increased or decreased) is of paramount importance in supporting the neurobehavioral organization of the infant. Dynamic assessment and intervention (Vygotsky, 1934/1986; 1978) serves as a core principle in the application of the neurobehavioral strategies.

The notion of dynamic assessment and intervention is based upon Vygotsky's (1934/1986; 1978) conceptualization of the "zone of proximal development" (ZPD). Vygotsky defined ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or mediation" (1978, p. 86). Simply stated, the "floor" of the ZPD is what the infant can do on his own; the ceiling is what he can do given a "reasonable" amount of restructuring or facilitation by the adult (Wertsch & Rogoff, 1984). The ZPD is different for each child; varies as a function of context and task; and changes constantly as the child learns new skills (Bodrova & Leong, 1996; Pressley, Hogan, Wharton-McDonald, & Mistretta, 1996). Some infants may require high support and make small gains, whereas other children will learn quickly with minimal assistance. The same child may

respond differently to various types of assistance and in various areas of development. The process of dynamic assessment and intervention requires the professional to identify how the infant independently attempts to achieve mastery on a task, and how the infant's performance can best be facilitated (Lidz, 1983) through the use of scaffolding techniques (Wood, Bruner, & Ross, 1976). Scaffolding describes the process where the adult continuously adjusts his/her interactions as a function the infant's changing needs for support.

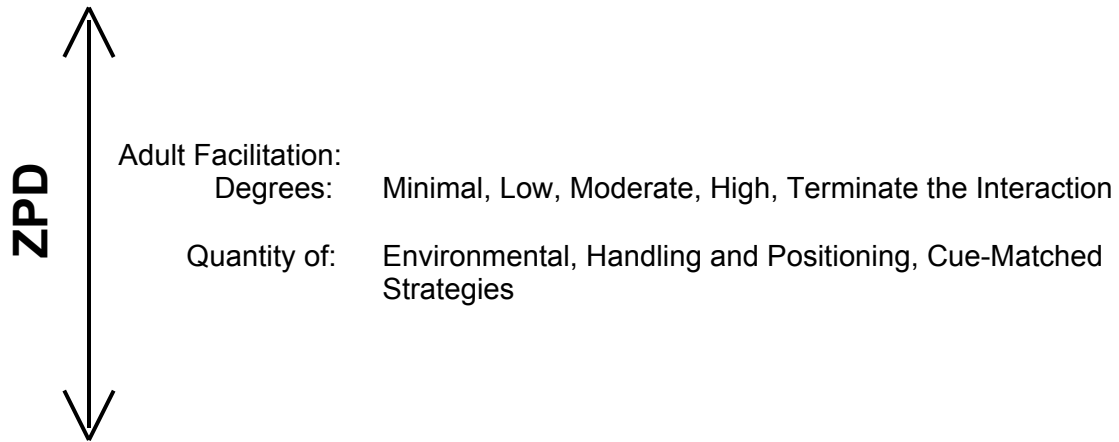
The principles of dynamic assessment and intervention can be elegantly applied to supporting the neurobehavioral organization of the infant. From this perspective the "zone of proximal development" (ZPD) is the distance between what the infant can do to stabilize or self-regulate himself (e.g., bringing his hand-to-mouth) when presented with a task during an assessment or intervention session; and what further neurobehavioral strategies are provided by an adult (i.e., co-regulation) to support the infant to accomplish the task (please see Figure 16). The degree or intensity of the neurobehavioral strategy may range from low support (e.g., positional adjustments to facilitate a tucked midline position) with minimal adult assistance to high support (e.g., the use of swaddling to maintain this position). The quantity or amount of neurobehavioral strategies that are offered to the infant may include positional adjustments to facilitate a tucked midline position and providing a pacifier for the infant to suck on.

Figure 16

Zone of Proximal Development (ZPD)

VYGOTSKY, 1929/1978

Level of Potential Neurobehavioral Organization and Development



Actual Neurobehavioral Organization and Development

Infant's Neurobehavioral Organization and Self-Regulatory Competence

- Optimal
- High
- Moderate
- Low
- Minimal

Through the process of scaffolding the degree and quantity of the neurobehavioral strategies, that are offered to the infant, are continuously assessed and modified depending upon the infant's behavior. Facilitation is gradually reduced as the infant's subsystem of functioning stabilizes and he is able to take on more of a self-regulatory role. The amount of neurobehavioral support provided to the infant should be inversely related to the infant's own organizational/ self-regulatory abilities and level of task competence.

Thus, there are degrees and quantities of neurobehavioral strategies within the infant's ZPD that one may clinically offer to the child. Facilitation is maintained at the present level, increased, or decreased depending upon the infant's response to either one, or both of these applications. The interventionist's ongoing assessment and scaffolding of these two applications (degree and quantity) of neurobehavioral strategies is critical to ensuring optimal infant interactions with his care givers and the environment at large.

Additional/Considerable to Substantial Facilitation

At the end of the suggested strategies found under Moderate and Low Self-Regulatory Competence (for each subsection), are suggestions for reflecting upon further facilitation that might be considered. These suggestions range from additional to considerable/substantial facilitation. They are provided to assist the interventionist to reflect upon additional strategies to support the infant during the course of an assessment or intervention session; or to assist the adult to help the child regain subsystem balance. These suggestions specifically address making modifications in the environment, positioning/handling, visual/auditory input, or the cue matched strategies.

Profile of Neurobehavioral Strategies[©]

A Profile of the Neurobehavioral Strategies[©] for each subsection is provided at the end of each set (e.g., Supine: Upper Trunk and Extremities) of suggested strategies. The Profile is organized from lower to higher levels of support depending upon the neurobehavioral organization and self-regulatory competence of the infant. The left hand side of the Profile, entitled **Self-Regulatory Competence**, provides a description of each level of neurobehavioral organization and the self-regulatory competence of the infant (i.e., Optimal, High, Moderate, Low, or Minimal Self-Regulatory Competence). The right hand side of the Profile, entitled **Facilitation**, describes the different levels of support to be utilized (Minimal, Low, Moderate, High, Terminate the Interaction), depending of course, on the self-regulatory ability of the infant. The suggested support is organized to correspond with the levels of self-regulatory competence of the child. An example of the suggested strategies for "Supine: Upper Trunk and Extremities" may be found in Appendix A. Its corresponding Profile may be found in Appendix B.

Each level of support is followed by a brief description of the suggested neurobehavioral strategies developed for that particular level. The Profile of Neurobehavioral Strategies was developed as a **reference guide**. Its purpose is to aid the early intervention professional in the recording of the degree and quantity of strategies utilized with a particular infant, onto that infant's IFSP Quarterly Progress Report (see below). The profile provides only a brief description of each of the neurobehavioral strategies. Therefore, the profile should not be used to determine specific neurobehavioral interventions. The professional must return to a specific subsection of the neurobehavioral strategies (e.g., Supine: Upper Trunk and Extremities) and carefully read the entire description of each strategy before it is implemented in an assessment/intervention session.

APPENDIX A

Supine: Upper Trunk and Extremities

A. Supine: Upper Trunk and Extremities

Definition

- Supine: Placement of the infant on her back.

Considerations

- The flat, unsupported position on the back may be particularly stressful for infants. Children often feel vulnerable in this position, with the ventral (stomach) surface exposed and unprotected.
- The flat supine position accentuates the influence of gravity and some tonic reflexes that are stimulated by this position. It is preferable to avoid an unsupported supine position unless the infant is quite competent and has good movement against gravity to bring Hands to Midline and Hands to Mouth.
- In general, support is provided to the infant to facilitate a midline flexed position. This may be achieved in a number of ways, including use of an infant seat, the care giver's hands, towel rolls, etc.
- Some children with chronic lung disease, heart problems, or any difficulty with respiration may not tolerate much flexion as it may make breathing more difficult. Watch for the individual infant's cues.
- Some children who are larger and heavier may also find that a position with a great degree of flexion inhibits their breathing. Again, watch for the individual infant's response.

IBA Profile:

Optimal Self-Regulatory Competence

When the infant is placed in supine her arms/hands often come to rest upon her chest or stomach; and/or her legs often assume a flexed tucked position with her feet coming to rest upon the supporting surface. Subsystem functioning appears, for the most part, to be well integrated and modulated:

- **Autonomic:** Pink, Stable respiration, and Stable visceral and neurophysiological indicators.
- **Motor:** Well-Regulated Tone, Smooth Movement of arms and legs.
- **State:** The infant is predominantly in an Interactive Alert state.
- **Attention/Interaction:** The infant maintains periods of sustained attention to the presented stimulus. Facing Gaze, Directed Gaze, Facial Brightening are often observed throughout the course of the interaction.

Minimal Support

Facilitation:

- Facilitation may occasionally be offered to the infant to support subsystem balance and/or self-regulatory efforts.

High Self-Regulatory Competence

IBA Profile:

The infant is placed in supine. Her upper extremities come to rest at chest/stomach level and/or her feet rest against the supporting surface. Most of the time she is able to maintain this position without additional support from the adult. Her efforts to self-regulate (e.g., Foot Clasp, Hand to Midline, Holding On) are most often successful. Brief periods of Squirm or Irregular respiration may occasionally be discerned. Over the course of the interaction mild subsystem disorganization may be observed:

- **Autonomic:** A mild color change (e.g., Mottling of the infant's arm or leg) may be observed; and/or Yawn, Sigh, or Burp; or perhaps a fleeting Tremor.
- **Motor:** An increase in movement or an occasional Squirm may be observed; Well- Regulated Tone and Smooth Movement of the arms and legs predominate. Attempts to self-regulate may be observed and these are most often successful.
- **State:** The infant maintains an Interactive Alert state, though at times the infant's visual focus may "stray" to competing stimuli (e.g., Alert).
- **Attention/Interaction:** Approach behaviors predominate (e.g., Facing Gaze, Directed Gaze, Facial Brightening); attempts to self-regulate (e.g., Gaze Aversion, momentary Animate/ Inanimate Locking, Hand Gaze) may be observed as well and these are most often successful.

Low Support - Upper Trunk and Extremities

Facilitation:

The infant needs a mild degree of facilitation when positioned in supine. Facilitation of Hands to Midline/Stomach appears to offer her the desired support. Once applied the infant is usually able to regain subsystem balance and availability for attention/interaction.

1. The infant's hand is placed in midline at chest/stomach level. The infant maintains her hand there. Occasionally the infant's arm may move and come to rest at her side; or she moves it to Airplane. Her hand is then repositioned back into midline. The infant maintains her hand there and may bring her other Hand to Midline as well.

OR

2. The adult's hand is placed at midline on the infant's chest/stomach. The infant tucks her trunk and brings her Hand(s) to Midline/Stomach.

OR

3. The adult's hand is placed at midline on the infant's chest/stomach while providing firm pressure. The infant tucks her trunk and brings her Hand(s) to Midline/Stomach.

OR

4. The infant's hand is placed in midline upon the adult's hand. The infant maintains her hand there by Groping or Holding On to the adult's hand or finger(s). Occasionally her arm moves to her side or is positioned out in Airplane. The infant's hand is then repositioned on top of the adult's hand. She maintains her hand there by Groping/ Holding On and may bring her other hand to midline as well.

OR

5. The infant's hand is placed in midline and it is held there by the adult. The infant may bring her other hand into midline as well.

OR

6. The infant's shoulders are "contained" using deep pressure applied to the upper and side regions of the shoulders by the adult's hands. The shoulders are rounded forward in this way to promote midline flexion and Hands to Midline.

Moderate Self-Regulatory Competence

IBA Profile:

The infant is placed in supine. Her self-regulatory efforts (e.g., Tuck, Bracing, Hand on Stomach) are at times successful. At other times signs of stress (e.g., Arching, Irregular respiration, Cough, Sigh) may appear and these may impinge upon other subsystems. Over the course of the interaction mild to moderate subsystem disorganization may be observed:

- **Autonomic:** Mild to moderate color change(s) and/or fluctuations in color (e.g., to Mottled or Pale); and/or Irregular respiration with Yawn, Sigh, Cough, or Burp. An occasional Twitch or Tremor may be observed as well.
- **Motor:** Some periods of Well-Regulated Tone and Smooth Movement interspersed with disorganized behaviors (e.g., Straighten with Tension, Shoulder Retraction). Self-regulatory efforts are occasionally successful (e.g., Tuck, Hand to Mouth, Arm over Face).
- **State:** The infant attempts to maintain an Interactive Alert state, though this often fluctuates with Alert and/or Diffuse/Active Alert.
- **Attention/Interaction:** Momentary periods of Directed Gaze or Facing Gaze may be observed; attempts to self-regulate (e.g., Animate/Inanimate Locking, Hand Gaze, Lip Compression) are occasionally successful.

Moderate Support - Upper Trunk and Extremities

Facilitation:

The infant needs a moderate degree of facilitation when positioned in supine. Midline flexion of her upper trunk and extremities appears to offer her the desired support. Once applied the infant is usually able to regain subsystem balance and may be intermittently available for attention/interaction.

1. Both of the infant's hands are positioned in midline. She maintains her hands in this position but occasionally her arms may move into Airplane, Shoulder Retraction, and/or Straighten with Tension. The infant's hands are then repositioned back into midline.

OR

2. Both of the infant's hands are positioned in midline upon the adult's hand. The infant maintains her hands there by Groping or Holding On to the adult's hand or finger(s). Occasionally her hands move away from this point of contact and are then repositioned back upon the adult's hand.

OR

3. The adult positions both of the infant's hands in midline and they are held in this position.

OR

4. The infant's shoulders are facilitated into flexion as the adult gently "rounds" her shoulders forward. This effectively brings the infant's hand(s) into a flexed midline position.

OR

5. The infant's shoulders are facilitated into flexion with the use of towel rolls placed at her sides and behind her shoulders. This effectively brings her hand(s) into a flexed midline position.

OR

6. The infant may be moved toward the vertical (upright sitting) position by placing the infant's head, shoulders and upper trunk on a small wedge.

OR

7. The infant may be positioned in an infant seat, with or without the use of towel rolls at the shoulder. This position promotes a flexed, midline posture.

OR

8. The infant may be partially swaddled by wrapping the upper part of her body with a receiving blanket. The blanket tucks the infant's shoulder toward the midline while keeping her arms flexed toward her face and her hands free.

OR

**Additional Facilitation for
Upper Trunk and Extremities**

- Additional facilitation may be required in an effort to assist the infant to regain subsystem balance and availability for attention/interaction. This may include:
 - Consider making further environmental modifications which may include decreasing the visual stimuli or sound level within the room. See: AMBIENT VISUAL/AUDITORY ENVIRONMENT.

OR

- Consider offering additional support based upon the behavioral expression of the infant (e.g., facilitate Hand to Mouth or Holding On). Carefully monitor the infant's responses. See: CUE-MATCHED STRATEGIES.

OR

- Consider giving the infant breaks from the interaction or decreasing the level of social input. Duration and frequency of breaks should be determined based upon the organizational needs of the infant. See: SOCIAL VISUAL/AUDITORY INPUT.

Low Self-Regulatory Competence

IBA Profile:

The infant is placed in supine. Her efforts to self-regulate (e.g., Hand to Stomach/Midline, Bracing) are often weak and unsuccessful. Increased signs of stress (e.g., Hiccough, Straighten with Tension, Active Alert) often appear and impinge upon other subsystems. Over the course of the interaction moderate to considerable subsystem disorganization may be observed:

- **Autonomic:** Moderate to considerable color change(s) and/or fluctuations in color (e.g., to Pale or Red); and/or moderate periods of Irregular respiration with Yawn, Sigh, Cough, Hiccough, Burp, or BM Grunt. Twitches, Tremors, and Startles may be observed as well.
- **Motor:** Periods of Well-Regulated Tone and/or Smooth Movement are rarely observed. Motor disorganization and ineffective attempts to self-regulate are most commonly observed (e.g., Shoulder Retraction, Arching, Straighten with Tension, Bracing, Foot Clasp).
- **State:** The infant's attempts to maintain or regain an Interactive Alert state are frequently unsuccessful. Increased subsystem disorganization may lead to fluctuations between Alert and Active Alert, and may escalate to Cry; or the infant may attempt to "escape" the interaction and move into Drowsy or Light Sleep.
- **Attention/Interaction:** The infant's attention is fleeting. Disorganized behaviors and/or ineffective attempts to self-regulate are most commonly observed (e.g., Grimace, Ugh/Cry Face, Tongue/Jaw Extension, Gaze Aversion, Animate/Inanimate Locking). Vocalizations are Undifferentiated and/or Protest.

High Support - Upper Trunk and Extremities

Facilitation:

The infant needs a high degree of facilitation when positioned in supine. Flexion and midline positioning of both her upper and lower trunk/extremities appears to offer her the desired support. Once applied the infant may be able to regain subsystem balance and may be available for brief, carefully graded periods of interaction.

1. The infant's upper/lower extremities are supported and maintained in flexion as she is swaddled in a light blanket. The adult holds her feet in his hand and/or provides a Bracing surface.

OR

2. The infant's upper/lower extremities are supported in flexion as she is cradled in the adult's arms. Her hands come to rest at midline and her feet come to rest and/or Brace against the inside surface of the adult's arm.

OR

3. The infant's shoulders and arms are maintained in flexion as she is swaddled in a light blanket and placed in the adult's lap. Her lower trunk and extremities are facilitated into a Tucked position as her feet come to rest and/or Brace against the adult's trunk.

OR

4. The infant's shoulders and arms are supported and maintained in flexion as she is swaddled in a light blanket and cradled in the adult's arms. Her lower trunk and extremities are facilitated into a Tucked position as her feet come to rest and/or Brace against the inside surface of the adult's supporting arm.

OR

5. The infant's shoulders and arms are supported and maintained in flexion as she is fully swaddled in a light blanket and cradled in the adult's arms. Her lower trunk and extremities are facilitated into a Tucked position as her feet come to rest and/or Brace against a towel roll. The towel roll is placed between the foot end of the swaddling blanket and the adult's supporting arm. This appears to increase the infant's ability to stabilize her feet by providing a more consistently firm surface to Brace against.

OR

- Considerable to substantial facilitation is required in an effort to assist the infant to regain subsystem balance and availability. Additional considerations that may need to be addressed include:
 - Consider repositioning the infant. This may include making further adjustments in the infant's current position or completely changing the position of the infant (e.g., from supine to sidelying; or held in the adult's arms). See: HANDLING/POSITIONING.

OR

- Consider making further environmental modifications which may include decreasing the visual stimuli or sound level in the room. Temperature modifications may also need to be considered. See: AMBIENT VISUAL/AUDITORY ENVIRONMENT and/or TEMPERATURE.

OR

- Consider offering additional support based upon the behavioral expression of the infant (e.g., facilitate Hand to Mouth or Bracing). Carefully monitor the infant's response. See: CUE-MATCHED STRATEGIES.

OR

- Consider giving the infant frequent breaks from the interaction or significantly decreasing the level of social input. Grade the duration and frequency of breaks as determined by the organizational needs of the infant. See: SOCIAL VISUAL/ AUDITORY INPUT.

Minimal Self-Regulatory Competence

IBA Profile:

The infant's efforts to self-regulate are fleeting and ineffective. She is unable to make use of any of the suggested facilitation strategies for the supine position. The infant displays severe disorganization and is incapable of returning to even partial subsystem balance:

- **Autonomic:** Severe color change(s) and/or fluctuations in color (i.e., to Pale, Red, or Dusky); and/or Irregular respiration with Hiccough, BM Grunt, Gasp, or Pause. Tremors, Twitches, Startles, or Seizures may be observed as well.
- **Motor:** Disorganized movement predominates (e.g., Arching, Flaccid, Straighten with Tension, Shoulder Retraction); few if any self-regulatory efforts are observed.
- **State:** Active Alert predominates, often culminating in Cry; or the infant attempts to "escape" the interaction by moving into Drowsy or Light/Deep Sleep.
- **Attention/Interaction:** The infant is unavailable. Potent stress cues are observed (e.g., Upward Gaze, Gape/Cry Face, Tongue/Jaw Extension). Protest vocalizations predominate.

Terminate the Interaction

Facilitation:

- Provide maximal support to assist the infant to return to subsystem balance.
See: SOOTHING TECHNIQUES.
- Complete the reflection process outlined in EVALUATING THE SESSION.

APPENDIX B

PROFILE OF NEUROBEHAVIORAL STRATEGIES

SUPINE: UPPER TRUNK AND EXTREMITIES

SELF-REGULATORY COMPETENCE

OPTIMAL

Autonomic: Pink. Stable: respiration, visceral, and neurophysiological indicators.

Motor: Well-Regulated Tone, Smooth Movement.

State: Predominately Interactive Alert.

Attention/Interaction: Maintains periods of sustained attention to the presented stimulus.

HIGH

Autonomic: A mild color change; and/or Yawn, Sigh, Burp; or perhaps a fleeting Tremor.

Motor: Increased movement or an occasional Squirm; Well-Regulated Tone/Smooth Movements predominate; attempts to self-regulate are most often successful.

State: Interactive Alert. Attentional focus may "stray" to competing stimuli (e.g., Alert).

Attention/Interaction: Approach behaviors predominate; attempts to self-regulate are most often successful.

MODERATE

Autonomic: Mild to moderate color change(s) and/or fluctuations in color; and/or Irregular respiration. An occasional Twitch or Tremor may be observed.

Motor: Some periods of Well-Regulated Tone/Smooth Movement interspersed with disorganized behaviors. Self-regulatory efforts are occasionally successful.

State: Attempts to maintain Interactive Alert; often fluctuates with Alert and/or Diffuse/Active Alert.

Attention/Interaction: Momentary periods of Directed Gaze or Facing Gaze; attempts to self-regulate are occasionally successful.

LOW

Autonomic: Moderate to considerable color change(s) and/or fluctuations in color; and/or moderate periods of Irregular respiration. Twitches, Tremors, and Startles may be observed as well.

Motor: Motor disorganization; ineffective attempts to self-regulate are most commonly observed.

State: Most often Alert, Active Alert and/or Cry; or attempts to move to Drowsy or Light Sleep.

Attention/Interaction: Fleeting. Disorganized behaviors and/or ineffective attempts to self-regulate are most commonly observed.

MINIMAL

Autonomic: Severe color change(s) and/or fluctuations in color; and/or Irregular respiration. Tremors, Twitches, Startles, or Seizures may be observed as well.

Motor: Disorganized behaviors predominate; few if any self-regulatory efforts are observed.

State: Active Alert predominates, culminating in Cry; or attempts to move into Drowsy or Light/Deep Sleep.

Attention/Interaction: Unavailable. Protest vocalizations predominate.

FACILITATION

MINIMAL SUPPORT

- Facilitation may occasionally be offered to the infant to support subsystem balance and/or self-regulatory efforts.

LOW SUPPORT

1. The infant's hand is placed in midline at chest/stomach level. She maintains her hand there and may bring her other hand to midline as well.
2. The adult's hand is placed in midline on the infant's chest/stomach. The infant tucks her trunk and brings her Hand(s) to Midline/Stomach.
3. The adult provides firm pressure with his hand as he places it in midline on the infant's chest/stomach. The infant tucks her trunk and brings her Hand(s) to Midline/Stomach.
4. The infant's hand is placed in midline upon adult's hand. The infant maintains this position by Groping/Holding On to the adult's hand/finger(s). She may bring her other hand into midline as well.
5. The infant's hand is placed in midline and held in this position. She brings her other hand into midline as well.
6. The infant's shoulders are "contained" using deep pressure applied to the upper and side regions of the shoulders. This promotes midline flexion and Hand(s) to Midline.

MODERATE SUPPORT

1. Both of the infant's hands are positioned in midline. Occasional facilitation of this position is necessary.
2. Both of the infant's hands are positioned in midline upon the adult's hand. She maintains them there by Groping/Holding On to the adult's hand/finger(s). Occasional facilitation of this position is necessary.
3. Both of the infant's hands are placed in midline and held in this position.
4. The infant's shoulders are facilitated into flexion as the adult gently "rounds" her shoulders forward. This supports Hand(s) to Midline/Hands on Stomach.
5. Towel rolls are used to facilitate shoulder flexion and to support Hand(s) to Midline/Stomach.
6. The infant may be moved toward the vertical (upright sitting) position with the use of a small wedge.
7. The infant may be positioned in an infant seat.
8. The infant may be partially swaddled by wrapping the upper part of the body with a receiving blanket.
 - Additional facilitation may be required. See: Ambient Visual/Auditory Environment; Cue-Matched Strategies; and/or Social Visual/Auditory Input.

HIGH SUPPORT

1. Swaddling is used to support and maintain upper/lower extremities in flexion. The infant's feet are held and/or she is provided with a Bracing surface.
2. Upper/lower extremities are supported in flexion as the infant is cradled in the adult's arms.
3. The infant is swaddled and placed in the adult's lap.
4. The infant is swaddled and cradled in the adult's arms.
5. The infant is swaddled and cradled in the adult's arm. A towel roll supports her Bracing efforts.
 - Considerable to substantial facilitation is required. See: Handling/Positioning; Ambient Visual/Auditory Environment and/or Temperature; Cue Matched Strategies; and/or Social Visual/Auditory Input.

TERMINATE THE INTERACTION

- Provide maximal support to assist the infant to return to subsystem balance. See SOOTHING TECHNIQUES.
- Complete the reflection process outlined in EVALUATING THE SESSION.

APPENDIX C

References

References

- Affonso, D. (1976). The newborn's potential for interaction. JOGN Nursing, 5, 9-13.
- Ainsworth, M. D. S., & Bell, S. M. (1974). Mother and infant interaction and the development of competence. In K.J. Connolly & J.S. Bruner (Eds.), The Growth of Competence. New York: Academic Press.
- Ainsworth, M. D. S., Bell, S., & Stayton, P. (1974). Infant-mother attachment and social development: 'Socialization' as a product of a reciprocal responsiveness to signals. In M. Richards (Ed.), The integration of a child into a social world. London: Cambridge University Press.
- Als, H. (1982). The unfolding of behavioral organization in the face of a biological violation. In E. Z. Tronick (Ed.), Social interchange in infancy: Affect, cognition, and communication. Baltimore: University Park Press.
- Als, H. (1984). Manual for the Naturalistic Observation of Newborn Behavior (Preterm and Fullterm Infants). Children's Hospital, Boston, MA 02115.
- Als, H. (1985). Patterns of infant behavior: Analogues of later organizational difficulties? In F. Duffy & N. Geschwind (Eds.), Dyslexia. Boston: Little, Brown & Co.
- Als, H. (1986). A synactive model of neonatal behavioral organization: Framework for the assessment and support of neurobehavioral development of premature infants and their parents in the environment of the NICU. In J.K. Sweeney (Ed.), Physical and Occupational Therapy in Pediatrics, 6, (3/4). New York: Haworth Press.
- Als, H. (1992). Individualized, family-focused developmental care for the very low birthweight preterm infant in the NICU. In Friedman and M. Sigman (Eds.), The psychological development of low birthweight children (pp. 341-388). Norwood, NJ: Ablex.
- Als, H. (1997a). Earliest intervention for preterm infants in the newborn intensive care unit. In M. J. Guralnick (Ed.), The Effectiveness of Early Intervention. Baltimore: Paul Brooks, pp. 47-76.
- Als, H., Lester, B., & Brazelton, T. (1979). Dynamics of the behavioral organization of the premature infant: A theoretical perspective. In T. Field, A. Sostek, S. Goldberg, & H. Shulman (Eds.), Infants born at risk. New York: Spectrum.
- Als, H., Lester, B., Tronick, E., & Brazelton, T. (1982). Towards a research instrument for the assessment of preterm infants' behavior (APIB), and Manual for the assessment of preterm infants' behavior (APIB). In

- H. Fitzgerald, B. Lester, & M. Yogman (Eds.), Theory and research in behavioral pediatrics: Vol. 1 (pp.35-63, 65-132). New York: Plenum Press.
- Als, H., Lawhon, G., Brown, E., Gibes, R., Duffy, F. H., McAnulty, G., & Blickman, J. G. (1986). Individualized behavioral and environmental care for very low birthweight preterm infants at high risk for bronchopulmonary dysplasia: Neonatal intensive care unit and developmental outcome. Pediatrics, *78* (6),1123-1132.
- Als, H., Duffy, F., McAnulty, G., & Badian, N. (1988). Continuity of neurobehavioral functioning in preterm and fullterm newborns. In M. Bornstein & N. Krasnegor (Eds.), Continuity in development. Hillsdale, NJ: Lawrence Erlbaum.
- Als, H. & Duffy, F. H. (1989). Neurobehavioral assessment in the newborn period: Opportunity for early detection of later learning disabilities and for early intervention. BD:OAS, *25* (6), pp. 127-152.
- Als, H., Lawhon, L., Duffy, F., McAnulty, G., Gibes-Grossman, R., & Blickman, J. (1994). Individualized developmental care for the very low-birth-weight preterm infant. Journal of the American Medical Association, *272* (11), 853-858.
- Barnard, K. (1978a). Nursing Child Assessment Satellite Training (NCAST): Learning resource manual. (Available from NCAST, University of Washington, Child Development and Mental Retardation Center, WJ-10, Seattle, WA 98195).
- Barnard, K. (1978b). Nursing Child Assessment Teaching Scales. (Available from NCAST, University of Washington, Child Development and Mental Retardation Center, WJ-10, Seattle, WA 98195).
- Barnard, K., & Blackburn, S. (1981). Features of the premature infant's animate and inanimate environment in relation to infant activity. Paper presented at the meeting of the Society for Research in Child Development, Boston, Massachusetts.
- Barnard, K. E., Booth, C. L., Mitchell, S. K., & Telzrow, R. W. (1983). Newborn Nursing Models Final Report. Grant # R0-NV-00719, Division of Nursing Bureau of Health, Manpower, Health Resources Administration, Department of Health and Human Services.
- Barnard, K., Bee, H., & Hammond, M. (1984). Developmental changes in maternal interactions with term and preterm infants. Infant Behavior and Development, *7*, 101-113.
- Barrera, M., Rosenbaum, P., & Cunningham, C. (1986). Early home intervention with low birth weight infants and their parents. Child Development, *57*, 20-33.

- Bayley, N. (1969). The Bayley Scales of Infant Development. The Psychological Corporation: San Antonio, TX.
- Beckman, P. (1983). Influence of selected child characteristics on stress in families of handicapped infants. American Journal of Mental Deficiency, 88, 2, 150-156.
- Beckman, P., Thiele, J., Pokorni, J., & Balzer-Martin, L. (1986). Stability of behavioral characteristics in preterm infants. Topics in Early Childhood Special Education, 6 (2), 57-67.
- Beckwith, L., Cohen, S. E., Kopp, C. Y., Parmelee, A. H., & Marcy, T. G. (1976). Caregiver-infant interaction and early cognitive development in preterm infants. Child Development, 47, 579-587.
- Beckwith, L., & Cohen, S. E. (1980). Interactions of preterm infants with their caregivers and test performance at age 2. In T. Field, S. Goldberg, D. Stern & A. Sostek (Eds.), High risk infants and children. New York: Academic Press.
- Beebe, B., Jaffe, J., Feldstein, S., Mays, K., & Alson, D. (1985). Matching of timing: The application of an adult dialogue model to mother infant vocal and kinesic interactions. To appear in T. Field (Ed.), Infant social perception. Norwood, NJ: Ablex.
- Belsky, J., & Tolan, W. (1981). Infants as producers of their own development: An ecological analysis. In R. Lerner, & N. Busch-Rossnagel (Eds.), Individuals as producers of their development: A life span perspective. New York: Academic Press.
- Bendell, D., Goldberg, M., Urbano, M., Urbano, R., & Bauer, C. (1987). Differential impact of parenting sick infants. Infant Mental Health Journal, 8, 28-36.
- Bennett, F. C. (1984). Neurodevelopmental outcome of low birthweight infants. In V. C. Kelley (Ed.), Practice of Pediatrics (pp. 1-24). Philadelphia: Harper & Row.
- Bennett, F. C. (1987). The effectiveness of early intervention for infants at increased biologic risk. In M. J. Guralnick & F. C. Bennett (Eds.), The effectiveness of early intervention for at-risk and handicapped children. Boston: Harcourt Brace Jovanovich, Publishers.
- Bennett, F. C. (1990). Recent advance in developmental intervention for biologically vulnerable infants. Infants and Young Children, 3, (1), 33-40.
- Behrman, R. (1985). Preventing low birth weight: A pediatric perspective. Journal of Pediatrics, 107, 842-854.

- Bernbaum, J., & Hoffman-Williamson, M. (1986). Following the NICU graduate. Contemporary Pediatrics, 3, 22-37.
- Blackburn, S. (1983). Fostering behavioral development of high-risk infants. Journal of Obstetrics and Gynecologic Neonatal Nursing, May/June (Supplement), 76-84.
- Blurton Jones, N. (1972). Characteristics of ethological studies of human behavior. In N. Blurton Jones (Ed.), Ethological studies of child behavior. Cambridge: Cambridge University Press, pp. 3-37.
- Blurton Jones, N. (1974). Ethology and early socialization. In M. P. M. Richards (Ed.), The Integration of a child into a social world. Cambridge: Cambridge University Press, pp. 263-295.
- Blurton Jones, N. (1976). Growing points in human ethology: Another link between ethology and the social sciences? In G. Bateson & R. A. Hinde (Eds.), Growing points in ethology. Cambridge: Cambridge University Press, pp. 427-451.
- Bodrova, E., & Leong, D.J. (1996). Tools of the mind: The Vygotskian approach to early childhood education. Englewood Cliffs, NJ: Prentice-Hall.
- Bowlby, J. (1969). Attachment. New York, New York: Basic Books.
- Brazelton, T. B. (1984a). Why early intervention? In J. D. Call, E. Galenson, & R. L. Tyson (Eds.), Frontiers of infant psychiatry, Vol. 11. New York: Basic Books, Inc.
- Brazelton, T. (1984b). The Neonatal Behavioral Assessment Scale. Philadelphia: J.B. Lippincott.
- Bretherton, I., & Walters, E. (Eds.) (1986). Growing points of attachment theory and research. Monographs of the Society for Research in Child Development, 50 (no. 12, Serial No. 209). Chicago: University of Chicago Press.
- Bronfenbrenner, U. (1979). The ecology of human development: Experiments by nature and design. Cambridge: Harvard University Press.
- Bronfenbrenner, U. (1986). Ecology of the family as a context for human development research perspectives. Developmental Psychology, 22, 723-742.
- Brown, J. M., & Bakeman, R. (1979). Relationships of human mothers with their infants during the first year of life: Effect of prematurity. In R. W. Bell & W. P. Smotherman (Eds.), Maternal influences and early behavior. New York: Spectrum, 1979.

- Brown, J. V., LaRossa, M. M., Aylward, G. P., Davis, D. J., Rutherford, P. K., & Bakeman, R. (1980). Nursery-based intervention with prematurely born babies and their mothers: Are there effects? Journal of Pediatrics, *97*, 487-491.
- Campbell, P. (1989). Dysfunction in posture and movement in individuals with profound disabilities: Issues and practices. In F. Brown and D. Lehr (Eds.), Persons with profound disabilities: Issues and practices. Baltimore: Paul Brookes.
- Campbell, P. (1991). Dysfunction in posture and movement in individuals with profound disabilities: Issues and practices. In F. Brown and D. Lehr (Eds.), Persons with profound disabilities: Issues and practices. Baltimore: Paul Brookes.
- Cohen, S., & Parmelee, A. (1983). Prediction of five-year Stanford-Binet scores in preterm infants. Child Development, *54*, 1242-1253.
- Cohn, J., & Tronick, E.Z. (1988). Mother-infant face-to-face interaction: Influence is bidirectional and unrelated to periodic cycles in either partner's behavior. Developmental Psychology, *24*, 3, 386-392.
- Cornell, E. H., & Gottfried, A. W. (1976). Intervention with human premature infants. Child Development, *4*, 32-39.
- Crawley, S., & Spiker, D. (1983). Mother-child interaction involving two-year-olds with down syndrome: A look at individual differences. Child Development, *54*, 1312-1323.
- Crnjic, K. A., Greenberg, M. T., Ragozin, A. S., Robinson, N. M., & Basham, R. B. (1983). Social interaction and developmental competence of preterm and full-term infants during the first year of life. Child Development, *54*, 1199-1210.
- Darwin, C. (1872). The expression of the emotions in man and animals. London: John Murray.
- De Carlos, J. A., & O'Leary, D. M. (1992). Growth and targeting of subplate axons and establishment of major cortical pathways. Journal of Neuroscience, *12*, 1194-1211.
- Denny-Brown (1962). The Basal Ganglia and their Relation to Disorders of Movement. Oxford: Oxford University Press.
- Diamond, M. C., Scheibel, A. B., Elson, L. M. (1985). The Human Brain. New York: HarperPerennial.

- DiVitto, B., & Goldberg, S. (1979). The effects of newborn medical status on early parent/infant interactions. In T. Field, A. Sostek, S. Goldberg, & H. H. Shuman (Eds.), Infants born at risk. New York: Spectrum.
- Dobbing, J. & Sands, J. (1973). Quantitative growth and development of human brain. Archives of Disabled Children, *48*, 757-767.
- Egeland, B., & Sroufe, L. A. (1981). Developmental sequelae of maltreatment in infancy. In R. Rizley & D. Cicchetti (Eds.), Developmental perspectives in child maltreatment (pp. 77-92), San Francisco: Jossey-Bass.
- Elmer, E., & Gregg, D. (1967). Developmental characteristics of abused children. Pediatrics, *40*, 596-602.
- Escalona, S. (1984). Social and other environmental influences on the cognitive and personality development of low birthweight infants. American Journal of Mental Deficiency, *88*, 508-512.
- Feuerstein, R. (1977). Mediated learning experience: A theoretical basis for cognitive modifiability during adolescence. In P. Mittler (Ed.), Research to practice in mental retardation, Vol II: Education and training (pp. 105-116). Baltimore: University Park Press.
- Field, T. (1977). Effects of early separation, interactive deficits, and experimental manipulations on infant-mother face-to-face interaction. Child Development, *48*, 763-771.
- Field, T. (1979a). Games parents play with normal and high-risk infants. Child Psychiatry and Human Development, *10*, 41-48.
- Field, T. (1979b). Interaction patterns of high-risk and normal infants. In T. Field, A. Sostek, S. Goldberg, & H. H. Shuman (Eds.), Infants born at risk. New York: Spectrum.
- Field, T. M. (1983). High risk infants "have less fun" during early interactions. Topics in Early Childhood Special Education, *3* (1), 77-87.
- Field, T. M. (1984). Follow-up developmental status of infants hospitalized for nonorganic failure to thrive. Journal of Pediatric Psychology, *9*, 241-256.
- Frodi, A. M., Lamb, M. E., Leavitt, L. A., Donovan, W. I., Neff, C., & Sherry, D. (1978). Fathers' and mothers' responses to the faces and cries of normal and premature infants. Developmental Psychology, *14*, 490-498.
- Garbarino, J. (1990). The human ecology of early risk. In S. Meisels, & J. Shonkoff (Eds.), Handbook of early childhood intervention (pp. 78-96). Cambridge, MA: Cambridge University Press.

- Gilles, F. H. (1983). Telencephalon medium and the olfacto-cerebral outpouching. In Gilles, F. H., Leviton, A., Dooling, E. D. (Eds.). The developing human brain (pp.316-320). Boston, MA: John Wright.
- Ghosh, A., & Schatz, C. J. (1993). A role for subplate neurons in the patterning of connections from thalamus to neocortex. Development, *117*, 1031-1047.
- Goldberg, S., Brachfeld, S., & DeVitto, B. (1980). Feeding, fussing, and playing: Parent-infant interaction in the first year as a function of prematurity and prenatal problems. In T. Field, S. Goldberg, D. Stern, & A. Sostek (Eds.), High-risk infants and children: Adult and peer interactions. New York: Academic Press.
- Gorski, P., Davison, M., & Brazelton, T. (1979). Stages of behavioral organization in the high-risk neonate: Theoretical and clinical considerations. Seminars in Perinatology, *3*, 61-73.
- Gorski, P. A. (1984). Experience following premature birth: Stresses and opportunities for infants, parents, and professionals. In J. D. Call, E. Galenson, & R. L. Tyson (Eds.), Frontiers of Infant Psychology, Vol. II (pp. 145-151). New York: Basic Books, Inc.
- Gorski, P. A., Hole, W. T., Leonard, C. H., & Martin, J. A. (1983). Direct computer recording of premature infants and nursery care: Distress following two interventions. Pediatrics, *72*, 198-202.
- Gorski, P. A., Huntington, L., & Lewkowicz, D. J. (1987). Handling preterm infants in hospitals: Stimulating controversy about timing stimulation. In N. Gunzenhauser (Ed.), Infant stimulation: For whom, what kind, and how much? (pp. 43-51). Skillman, New Jersey: Johnson & Johnson.
- Gottfried, A. W., & Gaiter, J. L. (1985). Infant stress under intensive care. Baltimore: University Park Press.
- Greenberg, M., & Crnic, K. (1988). Longitudinal predictors of developmental status and social interaction in premature and full-term infants at age two. Child Development, *59*, 554-570.
- Grunau, R. (1986). Education achievement. In G. Dunn (Ed.), Sequelae of low birthweight: The Vancouver study (pp. 179-204). Philadelphia: J. B. Lippincott Co.
- Grunwald, P., & Becker, P. (1990). Developmental enhancement: Implementing a program for the NICU. Neonatal Network, *9*, (6), 29-45.
- Guess, D., Mulligan-Ault, M., Roberts, S., Struth, J., Siegel-Causey, E., Thompson, B., Bronicki, G., & Guy, B. (1988). Implications of biobehavioral states for the education and treatment of students with the most profoundly handicapping conditions. Journal of the Association for Persons with Severe Handicaps, *13*, (3), 163-174.

- Guralnick, M. J., & Bricker, D. (1987). The effectiveness of early intervention for children with cognitive and general developmental delays. In M. J. Guralnick, & F. C. Bennett (Eds.), The effectiveness of early intervention for at-risk and handicapped children (pp. 115-173). Boston: Harcourt Brace Jovanovich.
- Hack, M., Hobar, J., Malsoy, M., Tyson, J., Wright, E., & Wright, L. (1991). Very low birth weight outcomes of the national institute of child health and human development neonatal network. Pediatrics, *87*, 5, 587-597.
- Hedlund, R. (1986). The transactional family systems model project: Project report. Unpublished manuscript (available from Child Development and Mental Retardation Center, WJ-10, University of Washington, Seattle, 98195).
- Hedlund, R. (1989). Fostering positive social interactions between parents and infants. Teaching Exceptional Children, *21*(4), 45-48.
- Hedlund, R., & Tatarka, M. (1988). Infant behavioral assessment. Publication available from Experimental Education Unit, CDMRC, WJ-10, University of Washington, Seattle, WA 98195.
- Hedlund, R., & Tatarka, M. (1991). The infant behavioral assessment training manual. Publication available from NTP, EEU, WJ-10, Seattle, WA 98195.
- Hedlund, R., Bennett, F., & Booth, C. (1989). Unpublished data. The transactional family systems model project. Seattle, WA: University of Washington.
- Huttenlocher, P. R., (1984). Synapse elimination and plasticity in developing human cerebral cortex. American Journal of Mental Deficiency, *88*, 488-496.
- Heinicke, C. M., Diskin, S. D., Ramsey-Klee, D. M., & Oates, D. S. (1986). Pre- and postbirth antecedents of two-year-old attention, capacity for relationships and verbal expressiveness. Developmental Psychology, *22*, 777-787.
- Holdgrafer, G., & Dunst, C. (1986). Communicative competence: From research to practice. Topics in Early Childhood Special Education, *6* (3), 1-22.
- Hunt, J. V., Cooper, B. A. B., & Tooley, W. H. (1988). Very low birth weight infants at 8 and 11 years of age: Role of neonatal illness and family status. Pediatrics, *82*, 596-603.
- Klaus, M., H., & Fanaroff, A. A. (1979). Care of the high-risk neonate. (2nd Ed.). Philadelphia: Saunders.

- Klein, N., Hack, M., Gallagher, J., & Fanaroff, A. A. (1985). Preschool performance of children with normal intelligence who were very low birthweight infants. Pediatrics, *75*, 531-537.
- Knobloch, H., Malone, A., Ellison, P. H., Stevens, F., & Zdeb, M. (1982). Considerations in evaluating changes in outcome for infants weighing less than 1501 grams. Pediatrics, *69*, 285-295.
- Kogan, K. (1980). Interaction systems between preschool aged handicapped or developmentally delayed children and their parents. In T. Field, S. Goldberg, D. Stern & A. Sostek (Eds.), High-risk infants and children: Adult and peer interactions. New York: Academic Press.
- Korones, S. B. (1976). Iatrogenic problems in intensive care. In T. Moor (Ed.), Report of 1969 Ross Conference on Pediatric Research. Columbus, Ohio: Ross Laboratories.
- Kraus, K. J. (1990). Fostering family integrity. In M.J. Craft & J.R. Denehy (Eds.), Nursing Interventions for Parents and Children. WB Saunders Company, 43-52.
- Lawhon, g (1986). Management of stress in premature infants. In Angelini, D., Knapp, C., & Gibes, R. (Eds.), Perinatal/neonatal nursing: A clinical handbook (pp. 319-328). Boston: Blackwell Scientific Publications.
- Lawhon, g (1994). Facilitation of parenting within the newborn intensive care unit. Doctoral dissertation. Seattle, WA: University of Washington.
- Lawhon, g (1997). Providing developmentally supportive care in the newborn intensive care unit: An evolving challenge. Journal of Perinatal Neonatal Nursing, *10*, (4), 48-61.
- Lawson, K., Daum, C., & Turkewitz, G. (1977). Environmental characteristics of a neonatal intensive care unit. Child Development, *48*, 1633-1639.
- Lidz, C. (1983). Dynamic assessment and the preschool child. Journal of Psycholo-educational Assessment, *1*, 59-72.
- Lidz, C.S., Bond, L. S., & Dissinger, L. (1991). Consistency of mother-child interaction using the Mediated Learning Experience Rating Scale. Special Services in the Schools, *6*, 145-165.
- Long, J. G., Philip, A. G. S., & Lucey, J. F. (1980). Excessive handling as a cause of hypoxemia. Pediatrics, *65*, 203-207.
- MacTurk, R., Hunter, F., McCarthy, M., Vietze, P., & McQuiston, S. (1985). Social mastery motivation in Down syndrome and nondelayed infants. Topics in Early Childhood Special Education, *4* (4), 93-109.

- Mahoney, G. (1983). A developmental analysis of communication between mothers and infants with Down's syndrome. Topics in Early Childhood Special Education, 3 (1), 63-76.
- Mahoney, G. (1988). Modifying parent-child interaction: Enhancing the developmental competence of handicapped infants. Journal of Special Education, 22, 82-96.
- McCullum, J. (1982). Social Interaction: A procedure for assessment and intervention (SIAI). Unpublished manuscript, University of Illinois, Department of Special Educations, Champaign-Urbana.
- McCullum, J., & Stayton, V. (1985). Infant/Parent Interaction: Studies and intervention guidelines based on the SIAI Model. Journal of the Division for Early Childhood, 9, 125-135.
- Miller, M. & Quinn-Hurst, M. (1994). Neurobehavioral assessment of high risk infants in the neonatal intensive care unit. American Journal of Occupational Therapy, 48 (6), 506-513.
- Minde, K., Whitelaw, A., Brown, J., & Fitzhardinge, P. (1983). Effect of neonatal complications in premature infants on early parent-child interactions. Developmental Medicine and Child Neurology, 25, 763-777.
- Nickel, R. E., Bennett, F. C., & Lamson, F. N. (1982). School performance of children with birthweights of 1000 grams or less. American Journal of Diseases of Children, 136, 105-110.
- Nurcombe, B., Howell, D. C., Rauh, V. A., Teti, D. M., Ruoff, P., & Brennan, J. (1984). An intervention program for mothers of low birth-weight infants: Preliminary results. Journal of the American Academy of Child Psychiatry, 23, 319-325.
- Office of Technology Assessment, (1987). Neonatal intensive care for low birthweight infants: costs and effectiveness.
- Palay, S.L. (1979). Introduction to the nervous system: Basic neuroanatomy. Lecture delivered at Harvard Medical School, 1979.
- Papousek, H., and Papousek, M. (1987). Intuitive parenting: a dialectic counterpart to the infant's integrative competence. In J. Osofsky (Ed.) Handbook of Infant Development, New York: John Wiley and Sons, Inc., 669-720.
- Papousek, H. and Papousek, M. (1992). Beyond emotional bonding: The role of preverbal communication in mental growth and health. Infant Mental Health Journal, 13 (1), 43-53

- Pederson, D. R., Jenkins, S., Evans, B., Chance, G. W., & Fox, A. M. (1985, April). Maternal responses to the birth of a preterm infant. Presented as a poster at the biennial meeting of the Society for Research in Child Development, Toronto.
- Piaget, J., & Inhelder, B. (1969). The psychology of the child. New York: Basic Books.
- Pipp, S., & Harmon, R. J. (1987). Attachment as regulation: A commentary. Child Development 58, 648-652.
- Pressley, M., Hogan, K., Wharton-McDonald, R., & Mistretta, J. (1996). The challenges of instructional scaffolding: The challenges of instruction that supports student thinking. Learning Disabilities Research and Practice, 11 (3), 138-146.
- Rakic, P. (1988). Specification of cerebral cortical areas. Science, 241, July 8, 170-176.
- Rakic, P. (1990). Principles of neural cell migration. Experientia, 46, 882-891.
- Rakic, P., J.-P. Bourgeois, & Goldman-Rakic, P. S. (1994). Synaptic development of the cerebral cortex: Implications for learning, memory, and mental illness. In J. van Pelt, M. A. Corna, H. B. M. Uylings, & P. H. Lopes da Silva (Eds.). The self-originating brain: From growth cones to functional networks. Elsevier Science BV.
- Rauh, V. A., Achenback, T. M., Nurcombe, B., Howell, C., & Teti, D. M. (1986). Overcoming the effects of neonatal adversity: Four-year results of an intervention for low-birthweight children. Unpublished manuscript.
- Rauh, V. A., Achenback, T. M., Nurcombe, B., Howell, C., & Teti, D. M. (1988). Minimizing adverse effects of low birthweight: Four-year results of an early intervention program. Child Development, 59, 544-553.
- Saigal, S., Rosenbaum, P., Stoskopf, B., & Milner, R. (1982). Follow-up of infants 501 to 1500 grams birthweight delivered to residents of a geographically defined region with perinatal intensive care facilities. Journal of Pediatrics, 100, 606-613.
- Sameroff, A. J., & Chandler, M. J. (1975). Reproductive risk and the continuum of caretaking casualty. In F. D. Horowitz, M. Hetherington, S. Scarr-Salapatek, & G. Siegel (Eds.), Review of child development research, Vol. 4 (pp. 187-224)
- Sameroff, A., & Fiese, B. (1990). Transactional regulation and early intervention. In S. Meisels & J. Shonkoff (Eds.), Handbook of early childhood intervention (pp. 119-191). Cambridge, MA: Cambridge University Press.

- Sameroff, A. (1993). Models of developmental risks. In C. Zeanah, Jr. (Ed.) Handbook of infant mental health (pp. 3-13). New York: Guilford Press.
- Sander, L. W. (1962). Issues in early mother-child interaction. Journal of Child Psychiatry, *1*, 141-166.
- Sander, L. W. (1964). Adaptive relationships in early mother-child interaction. Journal of the American Academy of Child Psychiatry, *3*, 232-264.
- Schaffer, H. R. (1984). The child's entry into a social world. London: Academic Press.
- Schatz, C. (1997). The White House Conference on Early Childhood Development and Learning: What New Research on the Brain Tells Us about our Youngest Children.
- Shore, R. (1997). Rethinking the brain: New insights into early development. Families and Work Institute. New York, New York.
- Sell, E. J. (1986). Outcome of very, very low birth weight infants. Clinics in Perinatology, *13*, 451-459.
- Simeonsson, R. J., Bailey, D. B., Huntington, G. S., & Comfort, M. (1986). Testing the concept of goodness of fit in early intervention. Infant Mental Health Journal, *7*, 81-94.
- Sroufe, L.A., & Waters, E. (1977). Heart rate as a convergent measure in clinical and developmental research. Merrill-Palmer Quarterly, *12* (1), 3-27.
- Stern, M., & Hildebrandt, K. (1984). A prematurity stereotype: The effects of labeling on adults' perceptions of infants. Developmental Psychology, *20*, 360-362.
- Taeusch, H. W., & Ware, J. (1987). Chronic lung disease of prematurity - is the veil lifting. Journal of Australian Perinatal Society, in press.
- Trevarthen, C. (1980). The foundations of intersubjectivity: Development of interpersonal and cooperative understanding in infants. In D. Olson (Ed.), The social foundation of language and thought (pp.1-34). New York: Norton.
- Tronick, E. Z., & Gianino, A. (1986). The transmission of maternal disturbance to the infant. In E. Z. Tronick & T. Field (Eds.), Maternal depression and infant disturbance (Vol. 34, pp. 31-47). San Francisco: Jossey-Bass.

- Tronick E., & Cohn, J. (1989). Infant-mother face-to-face interaction: Age and gender differences in coordination and the occurrence of mis-coordination. Child Development, 60, 85-92.
- Vandell, D. L., & Wilson, K. S. (1987). Infants' interactions with mother, sibling, and peer: Contrasts and relations between interaction systems. Child Development, 58, 176-186.
- VandenBerg, K. (1985). Revising the traditional model: An individualized approach to developmental interventions in the intensive care nursery. Neonatal Net Network: The Journal of Neonatal Nursing, April, 3 (5).
- Volpe, J. J. (1995). Neurology of the newborn. Philadelphia: W.B. Saunders Company.
- Vygotsky, L. (1978). Mind in society: The development of higher, psychological processes. Cambridge, MA: Harvard University Press.
- Vygotsky, L. (1986). Thought and language. (A. Kosulin, Ed. and Trans.) Cambridge: MIT Press. (Original work published in 1934.)
- Wertsch, J.V., & Rogoff, B. (1984). Editor's notes. In B. Rogoff & j. V. Wertsch (Eds.), Children's learning in the "zone of proximal development." (pp. 1-6). San Francisco, CA: Jossey-Bass.
- Wood, D., Bruner, J.S., & Ross, G. (1976). The role of tutoring in problem-solving. Journal of Child Psychology and Psychiatry, 17, 89-100.
- Yoos, L. (1989). Applying research in practice: Parenting the premature infant. Applied Nursing Research, 2, 1, 30-34.
- Zelle, R. (1976). Early intervention: A panacea or an experiment. Maternal and Child Nursing, 1, 343-349.

intervention group (n=25) received a weekly neurobehavioral intervention. early intervention (EI) services to infants and toddlers with or who are at risk for Phone: +1-857-2184354; Fax: +1-617-7300074; Email: .. parents and contribute to the limited literature regarding efficacy and best.Â 27,31 This is the ĩ-rst study to incorporate a neurobehavioral intervention into a state EI program curriculum. Previous research^{11,21} suggests that the traditional implementation of federal EI mandates by state EI programs is limited in its ability to adequately meet the needs of families of high-risk infants. Request PDF on ResearchGate | Feasibility study of early intervention provider confidence following a neurobehavioral intervention for high-risk newborns | Study purpose: Early intervention (EI) can ameliorate neurobehavioural difficulties and parental psychosocial distress. Often, EI service providers are not trained to address the unique needs of the high risk parentâ€™infant dyad. The purpose of this study was to describe...Â Study purpose: Early intervention (EI) can ameliorate neurobehavioural difficulties and parental psychosocial distress. Often, EI service providers are not trained to address the unique needs of the high risk parentâ€™infant dyad.