Bridges
Practice-Based Research Syntheses
Research and Training Center on Early Childhood Development

Volume 1, Number 4 June 2003

Social-Emotional Consequences of Response-Contingent Learning Opportunities

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The relationship between children's response-contingent learning opportunities and social-emotional responding was examined in 29 studies of infants without developmental delays and 13 studies of infants and older children with or at risk for developmental delays or identified disabilities. The studies of the typically developing children included 862 infants, and the studies of children with or at risk for developmental delays included 155 participants. Findings indicate that response-contingent learning opportunities, where the relationship between a child's behavior and the consequences of this behavior is clearly detectable, produce the greatest amount of positive social responding and attenuate negative social responding. A return-to-baseline condition or a violation of a response-contingent expectancy was almost always associated with heightened negative social responding. Implications for practice are described in terms of the environmental arrangements most likely to optimize the positive social-emotional consequences of response-contingent learning opportunities.

Purpose

The purpose of this practice-based research synthesis is twofold: (1) to ascertain claims about the social-emotional concomitants of response-contingent learning among young children and (2) to determine if different kinds of response-contingent learning opportunities produce like or unlike effects in terms of the social-emotional consequences of learning a contingency between a behavior and its environmental effects. Concomitant behavior refers to behavior manifested concurrently with the occurrence of operant responding and is not the target of conditioning.

The conduct of the synthesis is guided by a framework that focuses on the degree to which variations in response-contingent learning are associated with variations in the social-emotional responding of infants and young children (Dunst, Trivette, & Cutspec, 2002). A practice-based research synthesis differs from more traditional meta-analyses by systematically examining and unpacking the characteristics of practices that are related to differences in their outcomes or consequences. This type of analysis focuses more on an understanding of the conditions under which a practice exerts an observable effect and not solely on a statistical relationship among variables. The reader is referred to Tarabulsy, Tessier, and Kappas (1996) for a theory-based review of contingency detection studies and the influence of contingency awareness on social-emotional development in infancy.

Background

The terms infant operant learning, response-contingent learning, contingency learning, instrumental learning, and operant conditioning among others have been used to describe arrangements where a child's production of a behavior that initiates or elicits a reinforcing or interesting environmental consequence increases the child's rate, frequency, or strength of responding. Watson (1972; Watson & Ramey, 1972) noted that response-contingent learning opportunities provide infants a context for learning that the production of an interesting stimulus (i.e., reinforcement) is contingent upon a response emitted by a child. Young children's emerging understanding of the relationship between their behavior and its consequences is called "contingency awareness" (Watson, 1966) or "contingency detection" (Rochat, 2001) . The kinds of behaviors young children have been conditioned or "taught" to use to produce reinforcing effects include leg kicks, smiles,

Bridges is a publication of the Research and Training Center on Early Childhood Development, funded by the U. S. Department of Education, Office of Special Education Programs, Research to Practice Division (H324K010005). Copyright © 2003 by the Orelena Hawks Puckett Institute. All rights reserved. (www.puckett.org).

vocalizations, head turns, arm and hand movements, visual attention and orienting, and sucking.

More than 100 years ago, Baldwin (1895) noted that infants who come to “know” that their behavior is the “cause” of environmental effects often demonstrate increased behavioral responding in other areas, most notably social and emotional behaviors such as smiling, laughter, and excitement. Piaget (1936/1952) made similar observations based on the detailed study of his own three infants. Both Haith (1972) and McCall (1972) noted that an infant’s ability to understand that he or she is the agent of an environmental consequence produces social-emotional behavior because cognitive achievement is pleasurable. Watson (1972) in his seminal paper *Smiling, Cooing, and “The Game*,” described the importance of contingency learning and contingency awareness as determinants of both the likelihood and strength of the social-emotional concomitants of response-contingent learning (see also Watson, 2001). The importance of contingency perception, detection, and understanding as a condition contributing to infants’ healthy mental development was recently the focus of a special issue of the *Bulletin of the Menninger Clinic* (Allen & Gergely, 2001).

Description of the Practice

Response-contingent learning opportunities are characterized by behavior-based contingencies (Tarabulsy et al., 1996) where a child’s behavior either elicits a reinforcing consequence (e.g., swiping at a mobile, producing movement and auditory feedback) or his or her behavior is reinforced by another person (e.g., a parent tickling a child’s tummy each time she smiles or vocalizes). In learning situations of this sort, the availability of a reinforcement or the production of an interesting environmental consequence is *dependent* on the child’s actions and behavioral interactions. Many of these kinds of learning opportunities arise naturally as part of everyday experiences (e.g., Rochat, Querido, & Striano, 1999), or they can be arranged either as an experimental condition (e.g., Cavanagh & Davidson, 1977; Rovee & Rovee, 1969) or as an intervention practice promoting a child’s production of behavioral interactive competence (e.g., Dunst, 1981; Lancioni, 1980). The focus of this review is on studies where behavioral-based contingencies were deliberately manipulated or arranged and where either positive or negative behavior, or both, was observed or reported as concomitant responding.

Search Strategy

Search Terms

Identification of relevant studies was accomplished using response-contingent stimulation, response-contingent learning, contingency learning, operant learning, operant responding, instrumental learning, conjugate learning, conjugate conditioning, conjugate reinforcement, contingent responsiveness, contingency awareness, and contingency detection as search terms. The search was delimited by adding infants or toddlers or preschool children as a Boolean condition. The terms smiling, laughter, excitement, affect, emotion, social, social-emotional, socioemotional, and arousal were also used to further restrict the search.

Sources

The Psychological Abstracts (PsycINFO), Social Sciences Citation Index (SSCI), Educational Resources Information Center (ERIC) database, and Ingenta were the primary information databases searched for relevant studies. A secondary search was made of an EndNote bibliographic information database maintained by the Puckett Institute. In addition, hand searches were done of the reference sections of relevant journal articles, book chapters, and books to locate additional studies. Repeated sweeps of various electronic databases using newly identified search terms and the examination of study reference sections of newly identified publications was made until no further investigations were located.

Selection Criteria

Studies were included in the review if: (1) response-contingent learning was a focus of investigation, (2) the availability or delivery of a reinforcement was deliberately arranged or manipulated, (3) either the positive or negative consequences, or both, of contingency learning were measured or described in sufficient detail to ascertain the relationship between contingency learning and social-emotional responding, and (4) the observation, description, or measurement of social-emotional responding was done in the context of the response-contingent learning opportunities. Studies that examined the effects of response-contingent learning on subsequent social-emotional responding outside the learning contexts were excluded from the review (e.g. Dunham, Dunham, Hurshman, & Alexander, 1989; Sullivan, Lewis, & Alessandri, 1992).

Child age was another criterion used for study inclusion or exclusion. Studies were included if the ages of the children were entirely or mostly 2 to 10 months of age for children without apparent developmental delays, and 2 to 10 months developmentally for children who had identifiable disabilities or were at risk for one or more biological or environmental reasons. This age range was the focus of investigation because it is the time period during which infants learn and master everyday real world contingency relationships (e.g., Lamb, 1981; Piaget, 1936/1952; Watson, 1980). Studies of neonates (e.g., DeCasper & Carstens, 1981) and studies of children chronologically

or developmentally older than 10 months (e.g., Gunnar, 1980) were excluded.

Search Results

Forty two (42) studies were located in 34 research reports, 29 of which (69%) included children without any apparent developmental delays (typically developing) and 13 of which (31%) included children who were at risk for delays or children with identified disabilities. Table 1 shows selected characteristics of the study participants. Table 2 shows the research designs used in the studies, the characteristics of the response-contingent learning opportunities afforded the study participants, and the social-emotional concomitants constituting the focus of investigation or description.

Participants

The 42 studies included 1017 infants and young children. The majority of study participants were typically developing with no identified disability or delay, and 15% were delayed, at risk, or had an identified disability. The typically developing children had a median chronological age of about 3 months (Range = 2 to 12 months), and the median chronological age of the children with or at risk for delays or disabilities was about 8 months (Range = 3 to 120+ months).

Children's gender was reported in 31 studies (74%). These studies included 392 boys (53%) and 341 girls (47%). The percentages of boys and girls in the studies of typically developing children were 53% and 47% respectively, and the percentages of boys and girls in the studies of children with or at risk for delays were 59% and 41% respectively.

Research Designs

The majority of studies (74%) used either a between or within group design, or some combination of both, and 11 studies (26%) used single-participant study designs (Barlow & Hersen, 1984). With one exception (Etzel & Gewirtz, 1967), all the studies of children without delays or disabilities used some type of group design. Only three studies of children with identified disabilities or at risk for developmental delays used some type of group design (Alessandri, Sullivan, Imaizumi, & Lewis, 1993; Dunst, Raab, Parkey, Wilson, & Gatens, 1996; Dunst, Trivette, Parkey, & Gatens, 1995).

Group designs. Among the studies employing group designs, some variation of baseline (A), conditioning (B), and extinction (A) experimental arrangement was used in 13 studies (31%). A baseline (A) and conditioning (B) experimental design, or some variation of an AB design, was used in nine studies (21%).
There were 13 group design studies (31%) that compared the influences of contingent and noncontingent stimulation on operant and social-emotional responding, and five other studies (12%) included other contrast or comparison groups as control conditions (Brackbill, 1958; Sullivan & Lewis, 1988; Watson, 1972; Watson & Ramey, 1972; Weisberg, 1963). Nine (9) group design studies combined between group contrasts and within participant ABA or AB elements (21%).

Single-participant designs. Among the studies using single-participant designs, an ABA experimental design was used in four studies (36%), an AB design or a variation of the design was used in six studies (55%), and a multiple baseline design was used in one study. All but one single-participant design study included children with or at risk for delays or disabilities.

Response-Contingent Behavior

The majority of studies (76%) included the conditioning of nonsocial responses, seven studies (17%) focused on social responses as operant behavior, and three studies (7%) included the conditioning of a mix of social and nonsocial operant behavior. In all but one case (Ramey, Hieger, & Klisz, 1972), the studies investigating the conditionability of only social behavior were ones with typically developing children as participants.

The operant behaviors that were the focus of investigation included arm/hand movements or manipulations (36%), foot kicks (19%), head turns or presses (17%), visual fixation (7%), vocalizations (7%), and smiling (5%). In a number of studies, different participants learned different response-contingent behavior (12%), those most often selected were based on the child's capabilities to produce different behavior. These studies are identified in Table 2 as having *varied* operant behavior as the focus of investigation.

Reinforcers

Nonsocial reinforcers were used in 20 studies (48%), social or quasisocial reinforcers were used in five studies (12%), and a combination of social and nonsocial reinforcers were used in 17 studies (40%). Nonsocial reinforcers included the movement and sound of a mobile (31%), a combination of some type of auditory and visual stimulation (16%), or some type of visual display (7%). The social reinforcers included the presentation of a slide of a smiling face accompanied by music (24%), some type of *in vivo* social response (e.g., smiling, touching), or a combination of social responses (11%).

Type of reinforcement. Three different types of reinforcement were used in the studies: episodic (Watson & Ramey, 1972), synchronous (Ramey et al., 1972), or conjugate (Lipsitt, 1970). Episodic reinforcement is delivered discretely following the production of an operant behavior (e.g., saying "good baby" following a smile by

the infant). Synchronous reinforcement is made available continuously as long as the operant behavior is manifested (e.g., a visual display remaining “on” as long as a child is vocalizing). Conjugate reinforcement involves the presentation of a reinforcing event contingent upon a response where the amount or intensity of the reinforcement is proportional to the strength of operant responding (e.g., the harder a child kicks, the more movement and sound there is from a mobile).

Episodic or synchronous reinforcement was used in 29 studies (69%), conjugate reinforcement was used in eight studies (19%), and a combination of episodic or synchronous and conjugate reinforcement was used in five studies (12%). All but one conjugate reinforcement study involved foot kicks as the operant behavior and the movement and sound of a mobile as the reinforcement. The five studies using a combination of reinforcers all involved children with disabilities as participants.

Social-Emotional Concomitants

Positive social-emotional responding was measured or described in 33 studies (79%) and negative social-emotional responding was measured or described in 26 studies (62%). Both positive and negative social-emotional responding was measured or described in 17 studies (40%).

The positive social-emotional concomitants measured or described included smiling (48%), vocalizations (48%), interest and enjoyment (19%), laughter (18%), excitement (13%), surprise (11%), visual attention or orientation (9%), and positive-approach behavior (2%). Two or more positive social-emotional behaviors were measured or described in 31 studies (69%).

The negative social-emotional concomitants that were measured or described included crying or other negative vocalizations (42%), anger or frustration (18%), facial grimacing (16%), sadness (9%), and nonspecific, negative emotional responding (9%). Two or more negative social-emotional behaviors were measured or described in 12 studies (27%).

Synthesis Findings

Table 3 summarizes the findings from the studies for both operant learning and the social-emotional consequences reported or described by the investigators. The table also includes the type of measurement procedure used to assess social-emotional concomitants.

Child Learning

Learning was reported or could be determined for the majority of study participants in 35 of the 42 studies (83%) during a conditioning phase (compared to a baseline or extinction phase) or by comparison to a contrast or control group. In each of the single-participant design studies, the exact number of participants who demonstrated learning could be determined and is described in Table 3. In the different group design studies, this was not possible, except in cases where subgroups were constituted and differences in operant learning were evaluated in terms of subgroup performance. Differential patterns of learning are described in the table as well when this was possible.

Evidence from the majority of studies indicates that operant conditioning was demonstrated regardless of the type of operant or reinforcement or the child characteristics (typically developing vs. atypically developing). However, inspection of the rates and strength of operant responding indicate that despite the children’s acquisition of response-contingent behavior, those with disabilities or delays tend to display depressed levels of operant responding compared to children who are typically developing (e.g., Alessandri et al., 1993 [Sample 1 vs. Sample 2]; Watson, 1972 [Study 1 vs. Study 5]; Weisberg, 1963 vs. Ramey et al., 1972). Moreover, the more complex the children’s disabilities, the lower the level of operant responding (e.g., Dunst, Cushing, & Vance, 1985 vs. O’Brien, Glenn, & Cunningham, 1994).

Child learning was reported or could be determined for about half the study participants in one study (Sullivan & Lewis, 1988). In several other investigations, learning was demonstrated among older, but not younger, study participants (Mast, Fagen, Rovee-Collier, & Sullivan, 1980; Millar, 1988). Watson (1972) reported a failure to learn among infants where operant responding produced either of these alternating forms of reinforcement (Study 2) and where operant responding produced an *a periodic* reinforcement (Study 3). Measures of operant learning were not reported in two studies (Fagen & Ohr, 1985; Lewis, Alessandri, & Sullivan, 1990), but could be inferred from the violation of expectancy results.

Social-Emotional Consequences

Table 3 also shows the findings regarding the social-emotional consequences of response-contingent learning reported or determined from the research reports. Investigator observations or ratings of social-emotional responding were reported in 25 studies (60%), seven of which used Izard’s (1983) maximally discriminative facial movement coding system (MAX). Investigator descriptions or reports of social-emotional responding were found in 17 studies (40%).

Positive responding. Thirty three (33) of the studies (79%) included one or more measures or descriptions of positive social-emotional responding. Increases or changes in positive affective behavior were associated with contingency learning in 28 of these 33 studies (85%). In the six studies where positive social responding was not observed or reported, half included the use of a reinforce-

ment condition that made contingency detection difficult (Rovee-Collier & Capatides, 1979, Study 2; Watson, 1972, Studies 2 and 3). Only Millar (1988) and Sullivan, Rovee-Collier, and Tynes (1979, Study 2) reported no increases or changes in positive responding. Millar used an experimental arrangement that differed considerably from those employed in all other studies that may have accounted for the findings.

Negative responding. There were 26 studies (62%) that included one or more measures or descriptions of negative social-emotional responding. Increases in negative affect was reported or observed in all but one study (O'Brien et al., 1994) as the function of experimental conditions. In the 12 studies including an extinction or return-to-baseline experimental condition, negative responding increased when operant responding no longer produced a reinforcement. In a number of studies where negative responding was monitored following mastery of a contingency, negative responding tended to increase as a function of prolonged exposure to the learned contingency (Finkelstein & Ramey, 1977, Studies 1, 2, and 3).

Covariation in positive and negative responding. In 13 of the 17 studies (76%) measuring or reporting both positive and negative social-emotional behaviors, increases in positive affective behavior were demonstrated or reported during the contingency phase of the studies, and increases in negative affective behavior were more prominent during either an extinction or a violation of expectancy phase. In two of the 17 studies (Rovee-Collier & Capatides, 1979, Study 2; Watson, 1972, Study 3), increases in negative responding but no changes in positive social-emotional responding were reported. Only Millar (1988) reported no relationship between operant learning and social-emotional responding.

Relationship Between Learning and Social-Emotional Responding

The extent to which variations in learning were associated with variations in social-emotional responding could be determined by examining the findings of different sets of studies having the same or similar experimental conditions: (1) contingency vs. noncontingency control group studies, (2) studies including a violation of expectancy condition, (3) studies comparing learners vs. nonlearners, (4) single-participant design studies where differences in social-emotional responding could be mapped onto the experimental condition, (5) studies where the amount of operant responding was related to variations in child affective behavior, and (6) studies that used varying reinforcement schedules. Any one investigation could be examined in terms of two or more of the above six different ways of relating variations in learning to variations in social-emotional outcomes when they included multiple experimental conditions or when reviewer comparisons could be made that were not the focus of investigator analyses.

Experimental vs. contrast group studies. A number of different comparison group studies produced evidence indicating that contingency learning and awareness was associated with differences in social-emotional responding. In each of these studies, the social-emotional responding of experimental-group participants (where the infants' production of a reinforcement was contingent upon operant responding) was compared to comparison-group participants where the same type of stimulation was provided noncontingently. Overall findings showed that contingency-group participants produced more positive and less negative social-emotional behavior compared to the noncontingent-group participants during the conditioning phase of the studies. In studies including an extinction or return-to-baseline condition, the contingency-group participants almost always manifested more negative social-emotional responding when operant behavior no longer produced the reinforcement compared to noncontingent-group participants.

Learner vs. nonlearner studies. In studies where social-emotional responding of learners vs. nonlearners could be compared (Mast et al., 1980; O'Brien et al., 1994; Sullivan & Lewis, 1988), more positive responding was found among learners and more negative responding among nonlearners. In studies where greater amounts of learning was demonstrated among older compared to younger infants (Dunst & Lingerfelt, 1985; Mast et al., 1980), more negative responding was reported or demonstrated among older infants when operant behavior no longer resulted in an expected reinforcement.

Violation of expectancy studies. There were two types of violation of expectancy studies, ones that included extinction or return-to-baseline conditions and ones that altered the reinforcement after learning was demonstrated. In the studies that included a return-to-baseline condition, increases in negative responding was almost always reported or described during the extinction phase of the studies (Alessandri et al., 1990; Lewis, Sullivan, Ramsay, & Alessandri, 1992; Weisberg, 1963).

A number of investigators deliberately introduced violations of expectancies as an experimental condition explicitly for the purpose of determining study-participant responses (Fagen & Ohr, 1985; Mast et al., 1980; Singer & Fagen, 1992). In each of these studies, infants learned to control the movement of a mobile containing 10 objects. Following mastery of the contingency, the introduction of a reinforcement that differed from the one used during the learning phase of the study increased the likelihood of negative responding.

Single-participant studies. A number of investigators specifically mapped changes in social-emotional respond-

ing onto experimental conditions for the purpose of relating variations in learning to variations in concomitant behavior (Dunst, Raab, Wilson, & Parkey, 1997; Etzel & Gewirtz, 1967; Hanson & Hanline, 1985; O'Brien et al., 1994). In a number of other single-participant studies (Dunst et al., 1985; Haskett & Hollar, 1978; Ramey et al., 1972), sufficient information was provided in the research reports to relate variations in social-emotional responding to differences in experimental condition. In those studies where investigators explicitly mapped social-emotional responding onto experimental condition, more negative responding was reported during baseline and extinction phases compared to the conditioning phase, whereas the opposite was the case for positive responding. In the other studies, patterns of positive and negative responding were related in a similar way to differences in experimental condition.

Strength of responding studies. The extent to which variations in the degree of operant responding was associated with variations in social-emotional responding was explicitly examined by Dunst et al. (1996, 1995). Learning was measured in terms of the study participants' percentage of operant responses that were associated with the production of a reinforcement. The dependent measures included smiling, laughter, and generalized excitement. In both studies, there were linear increases in social-emotional responding as a function of the higher percentages of operant behavior associated with a reinforcement.

Variations of reinforcement schedule studies. There were a number of studies in which the *same* infants were exposed to contingent and noncontingent stimulation or contrasting types of stimulation in some type of alternating fashion (Peláez-Nogueras et al., 1997) or the reinforcement available to the infants was provided in other than a one-to-one ratio during the learning phase of the study (Watson, 1972, Study 2 and Study 3). In both types of studies, minimal amounts of positive social-emotional responding was reported or observed.

Rival Explanations

Possible threats to internal validity (Campbell & Stanley, 1963; Cook & Campbell, 1979) and rival explanations (Yin, 2000) for observed effects could be present for both the response-contingent learning reported or demonstrated in the studies and the social-emotional consequences associated with learning. Alternative plausible explanations for the learning effects are minimal or nonexistent for a number of reasons, as are rival explanations for the patterns of positive and negative social-emotional responding.

Learning. Neither history nor maturation seems plausible alternative explanations for learning in any study. In most studies of typically developing children, the experimental sessions were relatively short (5 to 20 minutes) and factors other than the introduction of the response-contingent learning opportunity were essentially nonexistent. In studies of children with disabilities, many had long histories of minimal response-contingent learning opportunities, and it wasn't until the opportunities were afforded the study participants that learning was demonstrated.

Factors such as testing and instrumentation don't seem possible explanations for observed effects, because observations and other nonintrusive measurement procedures were used to measure operant responding. Biases due to selection would seem minimal, because operant learning was demonstrated in numerous ways among children with and without disabilities. Subject attrition was present in many studies, but was almost always the result of excessive crying or other negative responding during return-to-baseline conditions. Participant loss for this reason is actually a proxy measure for inferring contingency awareness or detection.

The extent to which elicitation as opposed to conditioning constitutes a rival explanation for observed effects in response-contingent learning studies has been posited by a number of researchers (e.g., Poulson & Nunes, 1988), especially in studies of social operants using social reinforcements. In the latter type of study, one could reasonably argue that social stimulation operates as an elicitor rather than a reinforcement. In methodologically sound studies (e.g., Poulson, 1983; Sheppard, 1969), reinforcement rather than elicitation appears to be a more reasonable factor for explaining increases in operant responding.

Social-emotional concomitants. Validity threats and alternative explanations for the social-emotional responding observed in the studies may be ruled-out for a number of reasons. Neither history nor maturation seems plausible as explanatory factors for the same reasons given above for operant learning. Other threats such as selection bias seem minimal or nonexistent because the patterns of social-emotional responding were so similar regardless of research design, experimental arrangements, child characteristics, and other factors.

One validity threat that may be implicated as a rival explanation for the social-emotional responding results is instrumentation. For example, comparisons of studies in which social-emotional responding was measured vs. described, investigators employing the latter almost always seemed to report greater magnitudes of the concomitants compared to studies where the concomitants were objectively measured. Notwithstanding this observer effect, the patterns of findings were very much alike regardless of how social-emotional responding was measured. In studies employing objective measurement procedures and interrater reliability, display of positive affect was associated with operant learning and display of negative

affect was associated with violations of expectations. This makes contingency detection rather than instrumentation a more plausible explanation for the study findings.

Tarabulsy et al. (1996) provide an elegant description of why contingency detection rather than other factors is the mechanism for explaining the relationship between operant learning and social-emotional responding (see also Allen & Gergely, 2001). This contention is bolstered by the different sets of findings presented in this synthesis illustrating in multiple ways how operant learning is related to *differential* social-emotional responding.

Conclusion

Findings from this practice-based research synthesis indicate that response-contingent learning opportunities, where the relationship between an operant behavior and its environmental consequences is clearly detectable, increase the probability of enhanced positive social-emotional child responding and decrease negative social-emotional child responding. The contention that contingency detection or awareness is an important characteristic of social-emotional responding is supported by findings from studies that included experimental conditions where contingency detection was difficult or masked. In these instances, social-emotional responding was less likely to be reported or observed.

The patterns of findings from this synthesis are consistent with contentions made by Tarabulsy et al. (1996) regarding the relationship between response-contingent learning and social-emotional concomitants and bear directly on the role contingency detection and awareness potentially play in early mental health development (e.g., Allen & Gergely, 2001; Broucek, 1979; Tarabulsy et al., 1996). According to Tarabulsy et al., (1996), response-contingent learning opportunities are one kind of environmental experience contributing to infants' social-emotional development, and the characteristics of these experiences matter a great deal if contingency learning is to have positive benefits. As noted by a number of theorists (e.g., Bigelow, 2001; Broucek, 1979; Colombo, 2001; Rochat, 2001; Striano, 2001; Watson, 2001), infants' emerging understanding of social and nonsocial contingencies contribute to social-emotional development in ways highlighting the importance of contingency learning.

Whereas positive social-emotional responding was associated with contingency learning and detection, negative social-emotional responding was more likely to occur when there were violations of expectancies (e.g., Lewis et al., 1992; Mast et al., 1980) and prolonged exposure to the same response-contingent learning condition (Finkelstein & Ramey, 1977; Ramey et al., 1972). Negative responding associated with expectancy violations is an indication that infants learn to expect predictability in the consequences of their behavior (Lamb, 1981), and when their behavior does not produce expected consequences, a host of negative behavior is likely to be manifested. The prolonged exposure to a learned contingency indicates that when a response-contingent relationship is mastered, something akin to boredom ensues.

Implications for Practice

The findings from this research synthesis have two major implications for practice. First, the use of response-contingent learning opportunities as interventions for promoting acquisition of desired child behavior is strongly supported by available research evidence. This research indicates that response-contingent learning opportunities that provide children opportunities to produce behavior that has reinforcing consequences increase the rates and strength of operant responding. Second, the types of contingency opportunities that are most likely to enhance positive and attenuate negative social-emotional responding are ones where the relationship between a child's behavior and the consequences of this behavior are clear and unequivocal. In order for social-emotional responding to occur, a child must recognize and understand that he or she is the agent that produced the environmental consequence or effect. Research indicates that this is more likely to occur when the behavior-reinforcement sequence makes it possible for the child to detect this relationship and realize that he or she "made something happen."

Making something happen, rather than doing something to a child, is what distinguishes contingency learning from noncontingent stimulation. Response-contingent learning opportunities are ones where an adult deliberately responds to a child's behavior (e.g., tickling a child's tummy *in response* to the child looking or smiling at the adult) or where environmental conditions are arranged so that a child's behavior produces an interesting or reinforcing consequence (e.g., a child splashing in water *producing* movement, waves, sounds, etc.). While it is true that a child can be made to produce positive affective behavior as a result of noncontingent stimulation, a child "learns" something quite different when he or she is the agent of a social or nonsocial environmental consequence. Response-contingent learning opportunities provide the kinds of experiences that promote and strengthen a child's "sense making" about his or her capabilities and the predictability of controllable events. The "I did it" consequences of learning about and understanding one's capabilities and the social-emotional concomitants that accompany these accomplishments are indicators that a child has learned, mastered, and understood some aspects of his or her social or nonsocial environment.

Exactly how many contingency learning episodes are optimal and how much social-emotional responding will occur from response-contingent learning will depend

on both the child and the environmental characteristics. We know, for example, that children with disabilities often show a latency to learn and that it often takes extra opportunities before learning is demonstrated and social-emotional concomitants are manifested (Hutto, in press). We also know that the ways in which response-contingent learning opportunities are arranged, and the salience of the reinforcement, will influence both learning and social-emotional responding (see especially Peláez-Nogueras et al., 1997).

How can this synthesis be used to inform practice? Armed with knowledge about contingency learning and its social-emotional consequences, one can make an assessment of a child's everyday experiences and maximize the number of learning opportunities by rearranging these experiences or by making available new opportunities that provide a child large doses of response-contingent learning opportunities. Our own research-to-practice efforts use children's interests, preferences, and capabilities as the basis for deciding which everyday experiences need to be changed and what new opportunities need to be provided. This evidence-based approach to early intervention has proved highly effective in promoting children's contingency learning and increasing positive social-emotional consequences.

To assist practitioners in implementing this practice, a *Bottomlines* (Vol. 1, No. 4) report that describes the major findings from this practice-based research synthesis in nontechnical, user-friendly language has been developed. The *Bottomlines* summarizes what we know about contingency learning practices specifically for parents and practitioners. Also included is a lively vignette illustrating what the practice looks like for a young child and her parents.

Both the *Bridges* and *Bottomlines* reports are being used to produce practice guides that take a user step-by-step through the process of developing and implementing contingency learning games. These guides will be available to readers in either electronic versions at our website (www.researchtopractice.info) or written versions that can be obtained by writing us at our Research and Training Center address. Practice guides are developed by our staff when research evidence supports the use of a particular practice.

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Acknowledgments

Appreciation is extended to Dale Farran, Ph.D., and Kathy Stremel, M.A., for their comments and suggestions on an earlier version of the paper. The opinions expressed in the paper, however, are solely those of the author and do not necessarily reflect those of the reviewers or the U.S. Department of Education.

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Table 1
Characteristics of the Study Participants

Study	Sample Size	Child Age (months)	Child Gender: Male	Child Gender: Female	Child Diagnosis
Alessandri et al. (1990)	80	2-8	40	40	None
Alessandri et al. (1993) (Sample 1)	36	4-8	-[a]	-	None
Brackbill (1958)	8	3.5-4.5	6	2	None
Dunst & Lingerfelt (1985)	18	2-3	-	-	None
Etzel & Gewirtz (1967)	2	1.5-5	2	0	None
Fagen & Ohr (1985)	110	3-4	65	45	None
Finklestein & Ramey (1977) (Study 1)	10	9	3	7	None
Finklestein & Ramey (1977) (Study 2)	12	6	8	4	None
Finklestein & Ramey (1977) (Study 3)	12	4.5	7	5	None
Lewis et al. (1985)	60	2.5-6	30	30	None
Lewis et al. (1990)	80	2-8	40	40	None
Lewis et al. (1992)	48	2-8	24	24	None
Mast et al. (1980)	30	2.5-4	16	14	None
Millar (1988)	48	7-10	30	18	None
Peláez-Nogueras et al. (1996)	10	1.5-3.5	6	4	None
Peláez-Nogueras et al. (1997)	12	2-4.5	5	7	None
Rovee-Collier & Capatides (1979) (Study 1)	20	3	10	10	None
Rovee-Collier & Capatides (1979) (Study 2)	5	3	2	3	None
Singer & Fagen (1992)	48	3-4	22	26	None
Sullivan & Lewis (1988)	18	12	-	-	None
Sullivan & Lewis (1989)	20	4-6	10	10	None
Sullivan et al. (1979) (Study 2)	24	3	12	12	None
Uzgiris & Hunt (1970)	15	1-3	7	8	None
Watson (1972) (Study 1)	18	2	-	-	None
Watson (1972) (Study 2)	14	2	-	-	None
Watson (1972) (Study 3)	12	2	-	-	None
Watson (1972) (Study 4)	19	2	-	-	None
Watson & Ramey (1972)	40	2	-	-	None
Weisberg (1963)	33	3	-	-	None
Alessandri et al. (1993) (Sample 2)	36	4-8	-	-	Cocaine exposed
Brinker & Lewis (1982)	9	3.5-4.5	3	6	Down's syndrome, severely disabled, multiply disabled
Dunst et al. (1985)	6	24-36	6	0	Profoundly retarded, multiply disabled
Dunst et al. (1995)	19	27-120	12	7	Multiply disabled
Dunst et al. (1996)	22	12-108	14	8	Multiply disabled
Dunst et al. (1997)	3	34-52	1	2	Multiply disabled
Hanson & Hanline (1985)	3	8-25	1	2	Moderate to severe developmental delays
Haskett & Hollar (1978)	4	>110	4	0	Profoundly disabled

Table 1, continued

Study	Sample Size	Child Age (months)	Child Gender		Child Diagnosis
			Male	Female	
O'Brien et al. (1994)	7	3-48	5	2	Various disabilities
Ramey et al. (1972)	4	7-14	1	3	Failure to thrive, congenital heart disease
Sullivan & Lewis (1990)	40	2.5-15.5	-	-	Down's syndrome, developmentally delayed
Sullivan et al. (1995)	1	42	0	1	Rett syndrome
Watson (1972) (Study 5)	1	8	0	1	Severely disabled

[a]Not reported

Table 2
Characteristics of the Response-Contingent Learning Opportunities and Social-Emotional Concomitants

Study	Research Design[b]	Response-Contingent Opportunity			Social-Emotional Concomitants	
		Operant Behavior	Reinforcement	Type[c]	Positive	Negative
Alessandri et al. (1990)	ABAB C vs. NC (G)	Arm pulls	Slide of a smiling face and the sound of music	E	—[d]	Frustration
Alessandri et al. (1993) (Sample 1)	ABAB (G)	Arm pulls	Slide of an infant's smiling face and the sound of music	E	Interest, joy, surprise	Anger, sadness, fear, fussing/crying
Brackbill (1958)	ABA G_1 vs. G_2	Smiling	Smiling, speaking softly and holding the child	E	—	Crying, fussing, gaze aversion
Dunst & Lingerfelt (1985)	$A_1A_2BA_1A_2$ (G)	Foot kicks	Mobile movement	C	—	Protest
Etzel & Gewirtz (1967)	ABA (S)	Smiling	Adult vocalizations	E	—	Crying, fussing, frowns
Fagen & Ohr (1985)	AB_1AB_2 (G)	Foot kicks	Mobile movement	C	—	Crying
Finklestein & Ramey (1977) (Study 1)	ABA C vs. NC (G)	Arm pulls	Slide of a female face and the sound of music	E	—	Restlessness
Finklestein & Ramey (1977) (Study 2)	ABA C vs. NC (G)	Lever pressing	Visual display and music	E	Vocalizations, visual attention	Gaze aversion
Finklestein & Ramey (1977) (Study 3)	AB C vs. NC (G)	Vocalizations	Slide of a female face and the sound of music	E	—	Aversion
Lewis et al. (1985)	C vs. NC (G)	Arm pulls	Slide of an infant's happy face and the sound of music	E	Smiling, visual fixation	Fussing/frets
Lewis et al. (1990)	ABAB C vs. NC (G)	Arm pulls	Slide of an infant's happy face and the sound of music	E	Interest, surprise, joy	Anger, sadness, crying/fussing, fear
Lewis et al. (1992)	BAB (G)	Arm pulls	Slide of a smiling infant and the sound of music	E	Interest, joy	Anger, sadness
Mast et al. (1980)	ABBBA (G)	Foot kicks	Mobile movement	C	—	Negative vocalizations
Millar (1988)	ABA C vs. NC (G)	Manipulative touch response	Brief interaction with mother	E	Smiling, vocalizations	Negative vocalizations
Peláez-Nogueras et al. (1996)	ABA vs. BAB (G)	Visual fixation	Smiling, cooing, and touching vs. smiling and cooing	E	Smiling, vocalizations	Grimacing, crying
Peláez-Nogueras et al. (1997)	$B_1B_2B_1B_2$ (G)	Visual fixation	Systematic stroking vs. tickling and poking	E	Smiling, vocalizations	Protesting, crying
Rovee-Collier & Capatides (1979) (Study 1)	AB_1B_2 C vs. NC (G)	Foot kicks	Mobile movement	C	Cooing, smiling	Fussing
Rovee-Collier & Capatides (1979) (Study 2)	$AB_1B_2B_1$ (G)	Foot kicks	Mobile movement	C	Cooing	Fussing
Singer & Fagen (1992)	$AB_1B_1B_2$ (G)	Foot kicks	Mobile movement	C	Interest, surprise, enjoyment	Anger, sadness
Sullivan & Lewis (1988)	AB (G) Learners vs. nonlearners	Movement of a manipulanda	Slide of a smiling infant and the sound of music	E	Enjoyment, interest, excitement, vocalizations	Fussing
Sullivan & Lewis (1989)	ABBB C vs. NC (G)	Arm pulls	Slide of a smiling infant and the sound of music	E	Enjoyment, excitement, interest, surprise	Fussing, fear
Sullivan et al. (1979) (Study 2)	ABA (G)	Foot kicks	Mobile movement	C	Visual attention, vocalizations, smiling	—
Uzgiris & Hunt (1970)	B_1 vs. B_2 (G)	Visual fixation	Familiar and novel visual patterns	C	Cooing, laughter	—

Table 2, continued

Study	Research Design[b]	Response-Contingent Opportunity: Operant Behavior	Reinforcement	Type[c]	Social-Emotional Concomitants: Positive	Negative
Watson (1972) (Study 1)	C vs. NC vs. Control (G)	Head presses on pillow	Mobile movement	E	Cooing, smiling	—
Watson (1972) (Study 2)	C vs. NC (G)	Head presses on pillow	Mobile movement	E	Cooing, smiling	—
Watson (1972) (Study 3)	PC vs. NC (G)	Head presses on pillow	Mobile movement	E	Cooing, smiling	Negative emotional response
Watson (1972) (Study 4)	ABB (G)	Head presses on pillow	Mobile movement	E	Cooing, smiling	—
Watson & Ramey (1972)	C vs. NC vs. Control (G)	Head presses on pillow	Mobile movement	E	Smiling, cooing, and laughter	—
Weisberg (1963)	C vs. NC vs. Control (G)	Vocalizations	Chime or adult social stimulation	E	—	Pouting, whining
Alessandri et al. (1993) (Sample 2)[a]	ABAB (G_1) vs. ABAB (G_2)	Arm pulls	Slide of an infant's smiling face and the sound of music	E	Interest, surprise, joy	Anger, sadness, fear, fussing/crying
Brinker & Lewis (1982)[a]	AB vs. BA (S)	Varied	Auditory, visual, or tactile stimulation	M	Smiling, vocalizations, laughter	—
Dunst et al. (1985)[a]	ABA (S) or $AB_1B_2B_3AB_4A$ (S)	Head turns	Visual light display	E	Positive social responses	—
Dunst et al. (1995)[a]	$B_1B_2B_3$ (G)	Varied	Varied	M	Smiling, laughter, excitement	—
Dunst et al. (1996)[a]	$B_1B_2B_3$ (G)	Varied	Varied	M	Smiling, laughter, excitement	—
Dunst et al. (1997)[a]	Multiple baseline (S)	Varied	Varied	M	Smiling, laughter, excitement	—
Hanson & Hanline (1985)[a]	ABA (S) or ABABA (S)	Varied	Varied	M	Smiling, vocalizations	—
Haskett & Hollar (1978)[a]	$AB_1B_2B_3$ (S)	Lever presses	Varied	E	Smiling, vocalizations	—
O'Brien et al. (1994)[a]	ABBB (S)	Movement of a particular body limb	Rotating smiley face and nursery rhymes	E	Smiling, visual attention	Crying
Ramey et al. (1972)[a]	ABAB (S) or AB (S)	Vocalizations	Slide of brightly colored geometric shape	E	Vocalizations, body tone	Crying
Sullivan & Lewis (1990)[a]	B_1B_2 (S)	Arm pulls, foot kicks	Activation of a toy	E	Enjoyment	—
Sullivan et al. (1995)[a]	AB_1B_2 (S)	Switch pressing	Musical toys, auditory stimulus	E	Smiling, laughter, excitement, vocalizations	—
Watson (1972) (Study 5)[a]	ABB (S)	Head presses	Mobile movement	E	Smiling, cooing	—

[a] Studies of children with disabilities or delays or children at risk for developmental delays

[b] A = Baseline or extinction phase of a study, B = Conditioning phase of a study, C = Contingently presented stimulation, NC = Noncontingently presented stimulation, PC = Partially contingently presented stimulation, (G) = Group design, (S) = Single-participant design, and the subscripted A or B phases of a study indicate different baseline/extinction or experimental conditions respectively

[c] Type of reinforcement: E = Episodic or synchronous, C = Conjugate, and M = Mix of episodic, synchronous or conjugate

[d] Not measured or described

Table 3
Operant and Social-Emotional Responding Findings

Study	Operant Responding	Social-Emotional Behavior		
		Measure[b]	Positive Behavior	Negative Behavior
Alessandri et al. (1990)	Arm pulling increased during both conditioning phases in the contingency, but not the comparison group.	O		Frustration-like responses manifested during extinction phase in the contingency group.
Alessandri et al. (1993) (Sample 1)	Arm pulling increased during the conditioning phase.	O	Positive responding (interest, joy, surprise) increased during the conditioning phases.	Negative responding (anger, sadness) increased during the extinction phase.
Brackbill (1958)	Operant smiling increased during the conditioning phase and decreased during extinction.	O		Protests decreased during the conditioning phase, and gaze aversion and protests increased during the extinction phase.
Dunst & Lingerfelt (1985)	Foot kicks increased during the conditioning phase for all infants, but were greater for older infants.	R		Protest behavior was reported for one third of the infants during the extinction phase.
Etzel & Gerwirtz (1967)	Operant smiling increased during the conditioning phase.	O		Crying decreased as operant smiling increased for both infants, and crying increased during the extinction phase for one infant.
Fagen & Ohr (1985)	Degree of learning not reported (inferred from violation of expectancy results)	R		Crying increased among half the infants when an expectancy was violated.
Finklestein & Ramey (1977) (Study 1)	Arm pulls between contingent and noncontingent group conditions differed, favoring the contingency group.	R		Repeated exposure to a learned contingency elicited infant restlessness and fidgety behavior.
Finklestein & Ramey (1977) (Study 2)	Lever pressing between contingent and noncontingent group conditions differed, favoring the contingency group.	O	Vocalizations (but not visual fixation) occurred more often in contingency group.	Repeated exposure to a learned contingency attenuated visual attention in the contingency group.
Finklestein & Ramey (1977) (Study 3)	Vocalizations between contingent and noncontingent group conditions differed, favoring the contingency group.	R		Repeated exposure to unavailability of stimulation became aversive to the infants.
Lewis et al. (1985)	Arm pulls were greater in the contingent compared to noncontingent groups.	O	Rate of smiling was higher in 2 of the 3 contingency groups.	Fussing occurred more often in noncontingent groups.
Lewis et al. (1990)	Degree of learning not reported (inferred from violation of expectancy results)	MAX and O	Positive responding increased in the contingency group during the learning phase.	Negative responding increased in the contingency group during the extinction phase.
Lewis et al. (1992)	Increase in arm pulls was related to the availability of the reinforcement during the conditioning phase.	MAX and O	Interest was higher during the learning and relearning phases.	Negative responding increased during the extinction phase.
Mast et al. (1980)	Foot kicks increased during the conditioning phase for the older, but not the younger, participants.	R		Negative vocalizations increased in response to a violation of an expectancy.
Millar (1988)	Operant responding increased during the conditioning phase for the older, but not the younger, infants.	O	Positive social affective responding was unrelated to contingency condition.	Negative responding was almost absent during the experimental sessions.
Peláez-Nogueras et al. (1996)	Visual fixation increased during the conditioning phase.	O	Positive responding increased during the conditioning phase.	Negative responding increased during the extinction phase.

Table 3, continued

Study	Operant Responding	Social-Emotional Behavior		
		Measure[b]	Positive Behavior	Negative Behavior
Peláez-Nogueras et al. (1997)	Operant visual fixation was longer with a stroking compared to tickling/poking reinforcement.	O	Positive responding was higher for the stroking reinforcement condition.	Negative responding was higher for the tickling/poking reinforcement condition.
Rovee-Collier & Capatides (1979) (Study 1)	Foot kicks increased during the conditioning phase.	O	Positive responding increased during positive contrast condition for half the infants.	Negative responding increased during negative contrast condition.
Rovee-Collier & Capatides (1979) (Study 2)	Foot kicks increased during the conditioning phase for most infants.	O	No changes in vocalizations noted for any infant.	Violation of an expectancy increased negative responding.
Singer & Fagen (1992)	Foot kicks increased during the conditioning phase.	MAX and O	Positive affect decreased in response to violation of an expectancy.	Negative responding increased as a function of violating an expectancy.
Sullivan & Lewis (1988)	Ten of the 18 infants learned to produce the operant behavior.	MAX and O	Learners showed more enjoyment, interest, and excitement compared to nonlearners.	Nonlearners fussed more than learners.
Sullivan & Lewis (1989)	Infants provided contingency experiences increased their arm pulls relative to a noncontingency group.	MAX and O	Infants in contingency group showed more positive expressions of excitement and enjoyment.	Fear was expressed less often among infants in the contingency group.
Sullivan et al. (1979) (Study 2)	Foot kicks increased during the conditioning phase.	O	Frequency of smiles and vocalizations was generally unrelated to experimental condition.	
Uzgiris & Hunt (1970)	Infants' kicking increased when the behavior resulted in movement of a visual stimulus.	R	Cooing and laughing were reported only among infants controlling movement of a visual reinforcment.	
Watson (1972) (Study 1)	Head presses increased among infants controlling a reinforcement compared to infants having no control over a stimulus or the absence of a reinforcement.	R	Mothers of the infants in the contingency group reported increases in smiling and cooing on the third or fourth day of the study.	
Watson (1972) (Study 2)	Head presses did not increase when different reinforcers were delivered contingently or noncontingently in an alternating manner.	R	No increases in smiling or cooing were reported.	
Watson (1972) (Study 3)	Head presses did not increase when a periodic reinforcement was provided contingent on the operant responding (partial reinforcement).	R	No increases in smiling or cooing were reported.	Infants exposed to partial reinforcement "sensed confusion" throughout the study.
Watson (1972) (Study 4)	Head presses increased among infants provided with a learning situation where there was a clear contingent relationship between the children's behavior and its consequences.	R	Vigorous infant smiling and cooing was reported 3 to 5 days after exposure to the response-contingent learning opportunity.	
Watson & Ramey (1972)	Head presses increased among infants controlling a reinforcement compared to infants having no control over a stimulus or the absence of a reinforcement.	R	Mothers of infants exposed to response-contingent stimulation reported increases in their children's social-emotional responding.	
Weisberg (1963)	Infants' vocalizations increased as a function of contingent social stimulation.	O		Protest behavior increased when an expectancy was violated among "learners."
Alessandri et al. (1993) (Sample 2)[a]	Infants exposed to cocaine demonstrated the learning of a response-contingent behavior at a level lower than control group participants.	MAX and O	Infants showed moderate increases on some measures of social-emotional responding during the contingency phase.	Infants showed increased fussing/crying, fear, and sadness during the extinction phase.

Table 3, continued

Study	Operant Responding	Social-Emotional Behavior		
		Measure[b]	Positive Behavior	Negative Behavior
Brinker & Lewis (1982)[a]	The majority of children demonstrated learning during the contingency phase.	R	Positive social-emotional responding was reported for several of the children as a function of a learned contingency.	
Dunst et al. (1985)[a]	Response-contingency learning was demonstrated among all six children.	R	Incidental observations indicated that social-emotional responding was manifested by some of the children when contingency awareness was mastered.	
Dunst et al. (1995)[a]	All children demonstrated learning when a reinforcement was contingent upon operant responding.	O	Amount of social-emotional responding was positively correlated with the amount of operant responding.	
Dunst et al. (1996)[a]	All children demonstrated learning when a reinforcement was contingent upon operant responding.	O	All the children showed increased positive social-emotional responding as contingency learning was demonstrated.	
Dunst et al. (1997)[a]	All three children demonstrated increased operant responding during the conditioning phase.	O	Amount of social-emotional responding was positively correlated with the amount of operant responding.	
Hanson & Hanline (1985)[a]	All three children demonstrated response-contingent learning.	O	Two children demonstrated increased smiling and vocalizations during the conditioning phase.	
Haskett & Hollar (1978)[a]	Three of four participants demonstrated operant learning.	O	Smiling and vocalizations increased for two of three "learners" during the conditioning phase	
O'Brien et al. (1994)[a]	Five of seven children demonstrated learning during the contingency phase.	MAX and O	Increased smiling was observed among the infants who demonstrated response-contingent learning.	Visual attention decreased among the "learners" during the extinction phase. Little or no crying was reported among any children in any phase.
Ramey et al. (1972)[a]	Children's vocalizations increased during the conditioning phases.	R	Quality of infant vocalizations and body tone improved for the two infants diagnosed with failure to thrive.	Violation of an expectancy increased crying behavior in one infant diagnosed with failure to thrive.
Sullivan & Lewis (1990)[a]	All but one child showed evidence of learning control over one or more toys.	R	Majority of mothers reported that their children displayed joy during the contingency activities.	
Sullivan et al. (1995)[a]	Switch activation increased "dramatically" during the conditioning phase.	R	Positive emotional responses were reported after the child learned the contingency behaviors.	
Watson (1972) (Study 5)[a]	Head presses increased from 3 to 12 times per minute when a visual reinforcement was associated with operant responding.	R	Vigorous and prolonged smiling and cooing was observed during the contingency phase.	

[a]Studies of children with disabilities or delays or children at risk for developmental delays

[b]O = Investigator observation or ratings of social-emotional responding, R = Investigator description or report of social-emotional responding, and MAX = Izard's (1983) facial coding system