

Effects of Adult Verbal and Vocal Contingent Responsiveness on Increases in Infant Vocalizations

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The effects of adult vocal and verbal contingent social responsiveness on increases in infant vocalizations was examined in 22 studies including 214 infants and toddlers. The adult verbal and vocal behavior examined in the studies were verbal comments, imitating children's vocalizations, and predetermined nonverbal sounds as reinforcers. All three types of verbal and vocal behavior were related to increases in infant vocalizations from the baseline to conditioning phases of the studies, but that imitating an infant's vocalizations had larger sizes of effect compared to the other two types of reinforcement. Adult social concomitant behavior (smiling to or playing with a child) and eye contact with an infant while reinforcing the children's vocalizations had value-added effects. Implications for practice are described.

Adult contingent responsiveness to infant behavior, including responsiveness to infant vocalizations, functions as a reinforcer increasing the rate and strength of infant behavior (e.g., Soussignan, Nadel, Canet, & Gerardin, 2006). The particular adult contingent responsiveness behaviors that are associated with increases in infant vocalizations include imitating an infant's sounds (e.g., Gazdag & Warren, 2000), adult verbal comments (e.g., "that was good"; Ramey & Ourth, 1971), and pre-selected nonverbal sounds (e.g., "tsk, tsk, tsk"; Bloom, 1975). The effects of these vocal and verbal behavior are often examined in relationship to other adult social concomitant behavior (e.g., looking at, smiling, or touching the infants) to determine if they have value added effects (e.g., Masataka, 1993).

The main purpose of this research synthesis was to identify any differential effects of different types of adult contingent verbal or vocal responsiveness on infant vocalizations. Verbal responsiveness was defined as adult verbal comments spoken contingent upon an infant vocalizing. Vocal responsiveness was defined as imitating an infants' cooing or babbling sounds and the delivery of atypical sounds (but not words) in response to infant vocalizations. The second purpose was to evaluate whether other concomitant social behavior used with adult verbal and vocal behavior is related to increases in infant vocalizations. The synthesis was conducted using a characteristics and consequences framework (Dunst, Trivette, & Cutspec, 2007) for *unbundling* (Lipsey, 1993) and *unpacking* and *disentangling* (Dunst & Trivette,

2009) which characteristics under which conditions are related to the largest sizes of effect for increases in infant vocalizations. This type of practice-based research synthesis goes beyond assessing either efficacy or effectiveness (Flay, Biglan, Boruch, Castro, Gottfredson, Kellam, Moscicki, Schinke, Valentine, & Ji, 2005) to identifying the active ingredients of an intervention or practice that are associated with observed or measured effects.

SEARCH STRATEGY

Studies were identified using *infant* or *neonat** and *verbal** or *vocal** or *speech* or *pre-speech* or *coo** or *babbl** and *operant condition** or *operant learn** or *contingency* or *contin*-

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gent as search terms. Both controlled vocabulary and natural language searches were conducted (Lucas & Cutspec, 2007).

Psychological Abstracts (PsychoInfo), Educational Resource Information Center (ERIC), and MEDLINE were searched. These were supplemented by a Google Scholar search and a search of an extensive EndNote library maintained by our Institute.

Previously completed practice-based research syntheses of infant operant learning (Dunst, 2007; Dunst, Storck, Hutto, & Snyder, 2007; Hutto, 2007) as well as reviews of infant contingency learning studies (e.g., Hulsebus, 1973; Lipsitt, 1971; Sameroff & Cavanagh, 1979) were also examined. The reference sections of all retrieved articles, chapters, and books were examined to locate additional studies.

Studies were included if some type of adult verbal or vocal behavior was used as a reinforcement for increasing infant vocalizations. Studies, or conditions within studies, that used some type of nonhuman sound (e.g., door chime; Weisberg, 1963) as a reinforcer, and studies that used social behavior (e.g., touching; Haugan & McIntire, 1972) other than verbal or vocal behavior as the reinforcer, were excluded. A study by Schwartz, Rosenberg, and Brackbill (1970) was excluded because the baseline and conditioning phase measures of infant vocalization were not the same, and the effect sizes for the different between condition comparisons were exceedingly inflated.

SEARCH RESULTS

Twenty-two studies were located that included 214 infants and toddlers. In studies that included two or more comparative conditions, those conditions were considered separate studies for purposes of the research synthesis.

Table 1 shows the characteristics of the study participants. Fifteen of the studies were conducted with typically developing infants ($N = 177$) and six studies were conducted with infants and toddlers with disabilities or delays ($N = 26$). The typically developing infants were between 1 and 11 months of age, and the children with disabilities or delays were between 3 and 29 months of age. In those studies where gender was reported, 62% of the children were male and 38% were female.

Table 2 shows the research designs and experimental conditions in the studies. The studies had baseline (A) and experimental (B) conditions, baseline (A), experimental (B), and return to baseline (A) conditions, or ABAB conditions. Inasmuch as our main interest was the differential effects of type of adult vocal and verbal behavior on infant vocalizations, we focused on the experimental conditions and contrasts that permitted us to compare data between the baseline and conditioning phases of the studies.

The adult vocal or verbal behavior that was used to increase infant vocalizations are shown on Table 3. The table

also includes which concomitant social, visual, and tactile behavior occurred together with the adult vocal or verbal behavior. Fourteen studies or comparative conditions within a study included some type of verbal comment as the reinforcement (e.g., saying "Good girl"). Four studies or conditions within studies used imitation of the infants' vocalizations as the reinforcement. Three studies used pre-selected nonverbal sounds ("tsk, tsk, tsk") as the reinforcement.

The majority of the studies included one or more measures of adult social concomitant behavior. The most often used adult social behavior was smiling at the infants while delivering a reinforcement. Many of the studies included human eye contact with the infants during the delivery of reinforcement. A number of studies used photographs of faces or eyes to evaluate their concomitant effects. About half the studies included some type of light touch either on the infants' abdomen or chin/face while delivering the verbal or vocal reinforcement. The extent to which any of these adult social concomitant behavior had effects on infant vocalizations in addition to those for verbal or vocal reinforcements was examined as part of the synthesis.

SYNTHESIS FINDINGS

Cohen's d effect sizes for the differences in the baseline vs. conditioning phases of a study were used as the metric for evaluating the influence of type of adult verbal or vocal behavior on infant vocalizations. The effect sizes were computed by the difference in the mean scores for the two experimental conditions divided by the pooled standard deviations for the baseline and conditioning (intervention) phases of the studies (Dunst, Hamby, & Trivette, 2007). The effect sizes were calculated either for a group of participants or for individual children in the single participant design studies. The average effect sizes and their 95% confidence intervals (CI) were used for substantive interpretation. An effect size with the lower bound of a confidence interval not including zero indicates that the average size of effect is statistically significant at the .05 level (Hedges, 1994).

The 22 studies had a total of 61 contrasting conditions which was the number of effect sizes available for analysis. The average effect size for the group studies was 2.30 (95% CI = 1.63 – 2.97) and the average effect size for the single participant design studies was 1.88 (95% CI = 1.40 – 2.35). Both average sizes of effects were significantly different from zero, but did not differ significantly from each other, $F(1, 59) = 1.12, p > .25$. Because there was no difference in the sizes of effect for the two types of studies, the data were combined for all analyses.

Figure 1 shows the average effect sizes and 95% confidence intervals for the influence of the three types of adult verbal and vocal responsive contingent behavior. All three types of adult contingent vocal and verbal behavior were significantly related to increases in infant vocalizations. There

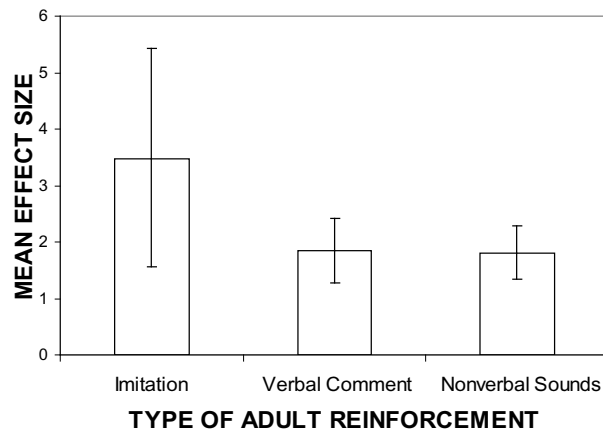


Figure 1. Average sizes of effect and 95% confidence intervals for the relationships between type of reinforcement and increases in infant vocalizations.

was, however, a significant between type of reinforcement difference in the average effect sizes, $F(2, 58) = 4.36, p < .02$. Post hoc Bonferroni tests for the pair wise differences between type of reinforcement showed that imitation differed significantly from both verbal comments ($p < .03$) and nonverbal sounds ($p < .02$). There was no significant difference between the sizes of effect for verbal comments and nonverbal sounds. These results highlight the potency of imitating an infants vocalizations as a reinforcement for increasing the rate of infant vocal behavior.

The extent to which the adult social concomitant behavior was associated with between study condition differences is shown in Table 5. (The particular social concomitant behavior that occurred concurrently with verbal or vocal reinforcement are shown in Table 3.) Both smiling at or playing with an infant and adult eye contact with a child while delivering a vocal or verbal reinforcement were significantly related to increases in infant vocalizations. When neither smiling or looking at an infant occurred concomitantly with verbal or vocal reinforcement, the average effect sizes were either not statistically significant or only marginally significant. This can be ascertained by the fact that the lower bounds of the confidence intervals of the average effect sizes include zero or were near to zero. Touching or not touching an infant while delivering a reinforcement were both significantly related to increases in infant vocalizations. This indicates that touching an infant while delivering a verbal or vocal reinforcement appears to have had no value-added effects.

Figure 2 shows the relationships between three different combinations of adult social concomitant behavior and increases in infant vocalizations. (There were too few effect sizes for the visual-tactile combination to compute an average effect size.) The average effect sizes for the two combinations including both adult smiling and eye contact with the infants while delivering a verbal or vocal reinforcer were

both statistically significant. The combination of adult social behavior and touch was not significantly related to increases in infant vocalizations as evidenced by the fact that the lower bound of the confidence interval includes zero.

There was a between type of concomitant behavior difference in the sizes of effect, $F(2, 48) = 6.98, p < .002$. Post hoc Bonferroni tests between the different combinations of concomitants showed that social-visual and social-visual-tactile did not differ from each other but that both differed significantly from the social-tactile concomitants ($ps < .05$). The findings indicate that adult social and visual behavior appear to have value-added effects for increasing infant vocalizations.

There was enough information in the original studies to evaluate the effects of child disability, experimental setting, and adult reinforcing agent as moderator variables. The results of these analyses are shown in Table 6. All of the average effect sizes except one were statistically significant. There was a significant between moderator group difference for child condition, $F(1, 59) = 4.42, p < .05$. The effects of vocal and verbal reinforcement were more pronounced for the study participants with disabilities compared to the infants who were typically developing.

There were no significant differences between the moderator group comparisons in any of the other analyses. This indicates that regardless of moderator, adult vocal or verbal contingent responsiveness was associated with increases in infant vocalizations. The studies that used tape recorded adult verbalizations as a reinforcement, where no adult was looking or interacting with a child, was not related to increases in infant vocalizations as evidenced by the fact that the lower bound of the confidence interval includes zero. This again suggests the relative importance of concomitant adult social and visual behavior when reinforcing infant vocalizations.

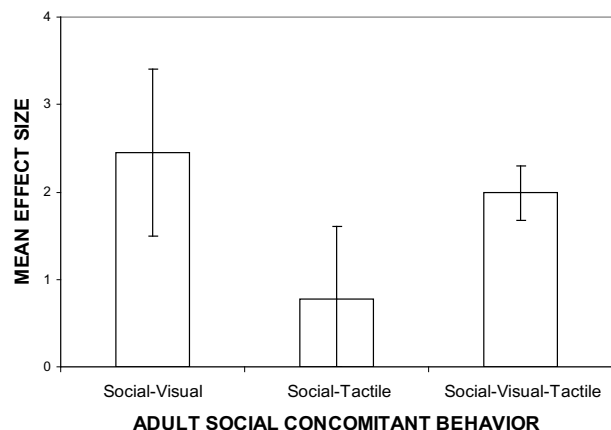


Figure 2. Average sizes of effect and 95% confidence intervals for the relationships between adult social concomitant behavior and infant vocalizations.

DISCUSSION

Findings showed that adult vocal and verbal contingent responsiveness to infant vocalizations was associated with increases in the targeted behavior, and that imitating infants' vocalizations was the most effective reinforcer for influencing changes in the number of infant vocalizations between the baseline and intervention phases of the studies. Results also showed that socially engaging and looking at the infants while reinforcing infant vocalizations was related to increases in child vocal behavior.

The majority of studies included in this research synthesis were conducted under controlled conditions where certain conditions would not easily translate into evidence-based practices (e.g., using “tsk, tsk” as a reinforcer). Even the results from the findings showing that imitation was most effective should not be interpreted to mean that this would be the “reinforcer of choice” for increasing infant vocalizations. Delivery of the same reinforcer in the same amount and manner repeatedly would likely result in infant habituation to the reinforcer and be related to decreases in vocalizations (Riksen-Walraven, 1978). Habituation would most likely occur after infant contingency detection and awareness occurred (Dunst, Trivette, Raab, & Masiello, 2008; Rochat, 2001; Watson, 1985) and where the vocal reinforcer was not changed.

The fact that there was no difference in the relationship between touching or not touching an infant and increases in vocalizations should also not be interpreted as meaning you do not need to engage in physical contact while attempting to affect increased infant vocalizations. The ways in which touch was administered in many of the studies was rather contrived. Touch is one way adults engage infants in interactions (e.g., Peláez-Nogueras, Gewirtz, Field, Cigales, Malphurs, Clasky, & Sanchez, 1996). Most parents, for example, touch their infants while going about everyday activities that involve mutual gaze and talking and vocalizing to a child (e.g., Hertenstein, 2002).

The implications of the synthesis results for practice are straightforward. Imitating an infant's vocalizations could be used to initially increase the number of infant vocal behavior followed by variations in adult responses (e.g., saying “da-da” in response to an infant saying “ba-ba”) interspersed with adult comments (e.g., “You're a good talker”). Alternatively, imitating an infant's vocalizations followed by elaborations, expansions, or delivery of a novel vocal or verbal reinforcement would likely maintain infant vocal responding (Dunst, Trivette, Raab, & Masiello, 2008). Varying the reinforcer would likely maintain child production of vocalizations for longer period of times (e.g., Bornstein & Tamis-LeMonda, 1994), and provide more opportunities for promoting production of different and more infant vocalizations (Kuhl, 2004).

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REFERENCES

- Banikiotes, F. G., Montgomery, A. A., & Banikiotes, P. G. (1972). Male and female auditory reinforcement of infant vocalizations. *Developmental Psychology*, 6, 476-481.
- Bloom, K. (1975). Social elicitation of infant vocal behavior. *Journal of Experimental Child Psychology*, 20, 51-58.
- Bornstein, M. H., & Tamis-LeMonda, C. S. (1994). Antecedents of information-processing skills in infants: Habituation, novelty responsiveness, and cross-modal transfer. *Infant Behavior and Development*, 17, 371-380.
- Dunham, P., Dunham, F., Hurshman, A., & Alexander, T. (1989). Social contingency effects on subsequent perceptual-cognitive tasks in young infants. *Child Development*, 60, 1486-1496.
- Dunst, C. J. (2007). *Social-emotional consequences of response-contingent learning opportunities* (Winterberry Research Syntheses Vol. 1, No. 16). Asheville, NC: Winterberry Press.
- Dunst, C. J., Hamby, D. W., & Trivette, C. M. (2007). *Guidelines for calculating effect sizes for practice-based research syntheses* (Winterberry Research Perspectives Vol. 1, No. 3). Asheville, NC: Winterberry Press.
- Dunst, C. J., Storck, A. J., Hutto, M. D., & Snyder, D. (2007). *Relative effectiveness of episodic and conjugate reinforcement on child operant learning* (Winterberry Research Syntheses Vol. 1, No. 27). Asheville, NC: Winterberry Press.
- Dunst, C. J., & Trivette, C. M. (2009). Using research evidence to inform and evaluate early childhood intervention practices. *Topics in Early Childhood Special Education*, 29(1), 40-52.
- Dunst, C. J., Trivette, C. M., & Cutspec, P. A. (2007). *Toward an operational definition of evidence-based practices* (Winterberry Research Perspectives Vol. 1, No. 1). Asheville, NC: Winterberry Press.
- Dunst, C. J., Trivette, C. M., Raab, M., & Masiello, T. (2008). Early child contingency learning and detection: Research evidence and implications for practice. *Exceptionality*, 16, 4-17.
- Flay, B. R., Biglan, A., Boruch, R. F., Castro, F. G., Gottfredson, D., Kellam, S., Moscicki, E. K., Schinke, S., Valentine, J. C., & Ji, P. (2005). Standards of evidence:

- Criteria for efficacy, effectiveness and dissemination. *Prevention Science*, 6, 151-175.
- Gazdag, G., & Warren, S. F. (2000). Effects of adult contingent imitation on development of young children's vocal imitation. *Journal of Early Intervention*, 23, 24-35.
- Goldstein, M. H., & Schwade, J. A. (2008). Social feedback to infants' babbling facilitates rapid phonological learning. *Psychological Science*, 19, 515-523.
- Gunn, P., Berry, P., & Andrews, R. (1979). Vocalization and looking behaviour of Down's syndrome infants. *British Journal of Psychology*, 70, 259-263.
- Haugan, G. M., & McIntire, R. W. (1972). Comparisons of vocal imitation, tactile stimulation, and food as reinforcers for infant vocalizations. *Developmental Psychology*, 6, 201-209.
- Hedges, L. V. (1994). Fixed effects models. In H. Cooper & L. V. Hedges (Eds.), *The handbook of research synthesis* (pp. 285-299). New York: Russell Sage Foundation.
- Hertenstein, M. J. (2002). Touch: Its communicative functions in infancy. *Human Development*, 45(2), 70-94.
- Hulsebus, R. C. (1973). Operant conditioning of infant behavior: A review. *Advances in Child Development and Behavior*, 8, 111-158.
- Hutto, M. D. (2007). *Latency to learn in contingency studies of young children with disabilities or developmental delays* (Winterberry Research Syntheses Vol. 1, No. 22). Asheville, NC: Winterberry Press.
- Kuhl, P. K. (2004). Early language acquisition: Cracking the speech code. *Nature Reviews Neuroscience*, 5, 831-843.
- Laub, K. W., & Dunst, C. J. (1974, May). *Effects of imitative and non-imitative adult vocalizations on a developmentally delayed infant's rate of vocalization*. Paper presented at the annual meeting of the North Carolina Speech and Hearing Association, Durham.
- Lipsey, M. W. (1993). Theory as method: Small theories of treatments. *New Directions for Program Evaluation*, 57, 5-38.
- Lipsitt, L. P. (1971). Infant learning: The blooming, buzzing confusion revisited. In M. E. Meyer (Ed.), *Second Western Symposium on Learning: Early learning* (pp. 5-21). Bellingham: Western Washington State College.
- Lucas, S. M., & Cutspec, P. A. (2007). *The role and process of literature searching in the preparation of a research synthesis* (Winterberry Research Perspectives Vol. 1, No. 10). Asheville, NC: Winterberry Press.
- Masataka, N. (1993). Effects of contingent and noncontingent maternal stimulation on the vocal behavior of three- to four-month-old Japanese infants. *Journal of Child Language*, 20, 303-312.
- Peláez-Nogueras, M., Gewirtz, J. L., Field, T., Cigales, M., Malphurs, J., Clasky, S., & Sanchez, A. (1996). Infants' preference for touch stimulation in face-to-face interactions. *Journal of Applied Developmental Psychology*, 17, 199-213.
- Poulson, C. L. (1983). Differential reinforcement of other-than-vocalization as a control procedure in the conditioning of infant vocalization rate. *Journal of Experimental Child Psychology*, 36, 471-489.
- Poulson, C. L. (1988). Operant conditioning of vocalization rates of infants with Down syndrome. *American Journal on Mental Retardation*, 93, 57-63.
- Ramey, C. T., & Ourth, L. L. (1971). Delayed reinforcement and vocalization rates of infants. *Child Development*, 42, 291-297.
- Riksen-Walraven, J. M. (1978). Effects of caregiver behavior on habituation rate and self-efficacy in infants. *International Journal of Behavioral Development*, 1, 105-130.
- Rochat, P. R. (2001). Social contingency detection and infant development. *Bulletin of the Menninger Clinic*, 65, 347-360.
- Routh, D. K. (1969). Conditioning of vocal response differentiation in infants. *Developmental Psychology*, 1, 219-226.
- Sameroff, A. J., & Cavanagh, P. J. (1979). Learning in infancy: A developmental perspective. In J. D. Osofsky (Ed.), *Handbook of infant development* (pp. 344-392). New York: Wiley.
- Schwartz, A., Rosenberg, D., & Brackbill, Y. (1970). Analysis of the components of social reinforcement of infant vocalization. *Psychonomic Science*, 20, 323-325.
- Simeonsson, R. J. (1972). Contingent social stimulation of infant vocalizations: Developmental deficit and mother-infant interaction. *Dissertation Abstracts International*, 32(07), 4263B-4264B (UMI No. 72-3835).
- Soussignan, R., Nadel, J., Canet, P., & Gerardin, P. (2006). Sensitivity to social contingency and positive emotion in 2-month-olds. *Infancy*, 10, 123-144.
- Todd, G. A., & Palmer, B. (1968). Social reinforcement of infant babbling. *Child Development*, 39, 591-596.
- Wahler, R. G. (1969). Infant social development: Some experimental analyses of an infant-mother interaction during the first year of life. *Journal of Experimental Child Psychology*, 7, 101-113.
- Watson, J. S. (1985). Contingency perception in early social development. In T. M. Field & N. A. Fox (Eds.), *Social perception in infants* (pp. 157-176). Norwood, NJ: Ablex.
- Weisberg, P. (1963). Social and nonsocial conditioning of infant vocalizations [Electronic version]. *Child Development*, 34, 377-388.
- Wiegerink, R., Harris, C., Simeonsson, R., & Pearson, M. E. (1974). Social stimulation of vocalizations in delayed infants: Familiar and novel agent. *Child Development*, 45, 866-872.

Table 1
Background Characteristics of the Study Participants

Study	Sample Size	Age (Months)		Gender		Population Description
		Chronological	Developmental	Male	Female	
Banikiotes et al. (1972)	16	3	—	8	8	Typically developing
Bloom (1974)	11	3	—	6	5	
Bloom (1975) (Study 2); Bloom et al. (1974)	3	3	—	Not reported	Not reported	Typically developing
Bloom & Esposito (1975) (Study 1); Bloom et al. (1974)	8	3	—	3	5	Typically developing
Gazdag & Warren (2000)	3	26-29	16-18	3	0	Cerebral palsy Developmentally delayed Down syndrome
Goldstein & Schwade (2008)	30	9-10	—	Not reported	Not reported	Typically developing
Gunn et al. (1979)	8	7-19	4-11	7	1	Down syndrome
Haugan & McIntire (1972)	8	3-6	—	4	4	Typically developing Adoption orphanage
Laub & Dunst (1974)	1	12	1	—	1	Microcephalic
Masataka (1993)	24	3-4	—	24	0	Typically developing
Poulson (1983)	4	3	—	3	1	Typically developing
Poulson (1988)	3	3-8	2-6	1	2	Down syndrome
Ramey & Ourth (1971)	15	3-9	—	Not reported	Not reported	Typically developing
Rheingold et al. (1959) (Study 1)	11	3	—	6	5	Typically developing Adoption orphanage
Rheingold et al. (1959) (Study 2)	11	3	—	6	5	Typically developing Adoption orphanage
Routh (1969)	20	2-7	—	12	8	Typically developing Living at home with parents ^a
Simeonsson (1971) (Group 1)	5	8-11	8-11 ^b	Not reported	Not reported	Typically developing
Simeonsson (1971) (Group 2)	5	11-22	8-11 ^b	Not reported	Not reported	Developmentally delayed language delayed
Todd & Palmer (1968)	16	3	—	Not reported	Not reported	Typically developing
Wahler (1969)	1	1	—	1	—	Typically developing
Weisberg (1963)	5	3	—	Not reported	Not reported	Typically developing Adoption orphanage
Wiegerink et al. (1974)	6	11-22	5-11 ^b	0	6	Developmentally delayed

^a Several of the children were residing in an orphanage awaiting adoption.

^b Estimated based on averages.

Table 2
Research Designs and the Study Experimental Conditions

Study	Research Design		Experimental Setting	Comparative Conditions
	Type	Condition		
Banikiotes et al. (1972)	Group	ABAB	Home	Number of infant vocalizations during baseline vs. audio taped condition
Banikiotes et al. (1972)	Group	ABAB	Home	Fundamental frequencies of infant vocalizations during baseline vs. conditioning
Bloom (1974)	Single	ABA	Home	Rate of infant vocalization during baseline vs. contingent reinforcement with clear, opaque, photo and gaze averted lenses
Bloom (1975) (Study 2); Bloom et al. (1974)	Single	AB	Home	Rate of infant vocalization during baseline vs. response dependent with and without eye contact
Bloom & Esposito (1975) (Study 1); Bloom et al. (1974)	Group	ABAB	Home	Rate of infant vocalization during baseline vs. contingent social stimulation
Gazdag & Warren (2000)	Single	Multiple baseline across children	Playroom at early intervention program, child's classroom	Number of child vocal imitation during baseline vs. intervention
Goldstein & Schwade (2008)	Group	ABA	Playroom	Number of infant vocalizations during baseline vs. contingent social response
Gunn et al. (1979)	Group	ABAB	Home-like room in university facility	Number of child vocalizations during baseline vs. child contingent condition
Haugan & McIntire (1972)	Group	ABA	Experimental room	Number of infant vocalizations during baseline vs. vocal reinforcement
Laub & Dunst (1974)	Single	ABAB	Experimental room	Number of infant vocalizations during baseline vs. contingent imitative and non-imitative reinforcement
Masataka (1993)	Group	AB	Home	Rate of infant vocalization during baseline vs. contingent social reinforcement
Poulson (1983)	Single	AB	Infant laboratory of a university research center	Rate of infant vocalization during differential of other-than-vocalization vs. continuous social reinforcement
Poulson (1988)	Single	AB	Infant laboratory of a university research center	Rate of infant vocalization during differential of other-than-vocalization vs. continuous social reinforcement
Ramey & Ourth (1971)	Group	ABA	Not reported	Number of infant vocalization responses during baseline vs. contingent social reinforcement
Rheingold et al. (1959)	Group	ABA	Orphanage	Number of infant vocalizations during baseline vs. contingent reinforcing stimulus
Routh (1969)	Group	AB	Home ^a	Number of consonants or vowels per day during baseline vs. social reinforcement
Simeonsson (1971) (Group 1 & 2)	Group	ABAB	Classroom and library of church day care center; evaluation room at an infant developmental evaluation clinic	Number of infant vocalizations during baseline vs. contingent social stimulation
Todd & Palmer (1968)	Group	ABA	Experimental room	Number of infant vocalizations during baseline vs. recorded verbal reinforcement with and without adult present
Wahler (1969)	Single Longitudinal	AB	Home	Rate of infant vocalization during baseline vs. attending to developing verbal behavior
Weisberg (1963)	Group	ABA	Orphanage	Number of infant vocalizations during baseline vs. contingent social reinforcement
Wiegerink et al. (1974)	Group	ABAB	Home	Number of child vocalization during baseline vs. contingent social reinforcement with a familiar and non-familiar adult

^a Several of the children were residing in an orphanage awaiting adoption.

Table 3
Characteristics of the Conditions Associated with Adult Contingent Responsiveness

Study	Adult Behavior				Relationship to Infant(s)
	Verbal/Vocal	Social	Visual	Tactile	
Banikiotes et al. (1972)	Audio taped male or female verbal statements like “Nice baby. Good baby. What a good baby you are.”	None	None	None	No adult present
Bloom (1974)	“tsk, tsk, tsk”	Smile	Eye contact (Wore glasses with clear lenses)	Touch infant’s face	Experimenter
Bloom (1974)	“tsk, tsk, tsk”	Smile	None (Wore glasses with opaque lenses)	Touch infant’s face	Experimenter
Bloom (1974)	“tsk, tsk, tsk”	Smile	Eye contact (Wore glasses with clear lenses)	Touch infant’s face	Experimenter
Bloom (1974)	“tsk, tsk, tsk”	Smile	Yes (Wore glasses with photographs of eyes)	Touch infant’s face	Experimenter
Bloom (1974)	“tsk, tsk, tsk”	Smile	No (Wore glasses with opaque lenses)	Touch infant’s face	Experimenter
Bloom (1974)	“tsk, tsk, tsk”	Smile	Yes (Wore glasses with photographs of eyes)	Touch infant’s face	Experimenter
Bloom (1974)	“tsk, tsk, tsk”	Smile	Yes (Wore glasses with photographs of eyes)	Touch infant’s face	Experimenter
Bloom (1974)	“tsk, tsk, tsk”	Smile	No ne (Wore glasses with photographs of eyes looking to the far right)	Touch infant’s face	Experimenter
Bloom (1975); Bloom et al. (1974)	“tsk, tsk, tsk”	Smile	Eye contact (Wore glasses with clear lenses)	Touch infant’s abdomen	Experimenter
Bloom (1975); Bloom et al. (1974)	“tsk, tsk, tsk”	Smile	None (Wore glasses with opaque shields)	Touch infant’s abdomen	Experimenter
Bloom & Esposito (1975); Bloom et al. (1974)	“tsk, tsk, tsk”	Smile	Face to face with eye contact	Touch infant’s abdomen	Experimenter
Gazdag & Warren (2000)	Imitation	Play	Yes	Not reported	Trainer
Goldstein & Schwade (2008)	Imitation repeated fully resonant vowels	Move closer Smile	Yes	Touch infant	Mother
Goldstein & Schwade (2008)	Speaking words with consonant-vowel alternation	Move closer Smile	Yes	Touch infant	Mother
Gunn et al. (1979)	“Good boy (girl)”	Smile	Eye to eye contact	None	Mother
Haugan & McIntire (1972)	Imitation	Smile (?)	Face infant	None	Experimenter
Laub & Dunst (1974)	“Good” “That’s a girl” verbalized at roughly the same length as infant’s vocalization	Smile (?)	Leaned over crib	None	Experimenter
Masataka (1993)	“Hi (baby’s name)”	Smile	Face to face with eye contact	Light touch on the abdomen	Mother
Poulson (1983)	Talk to infant	Presented toy to infant	Eye contact	Touch infant	Mother
Poulson (1988)	Talk to infant	Presented or showed toy to infant	Eye contact	Touch infant	Parent
Ramey & Ourth (1971)	“That’s a good baby”	Smile	Yes	Light touch to infant’s abdomen	Experimenter Mother was within infant’s view throughout

Table 3, *continued*

Study	Adult Behavior			Relationship to Infant(s)
	Verbal/Vocal	Social	Visual	
Rheingold et al. (1959)	"tsk, tsk, tsk"	Smile	In infant's line of vision	Light touch on the infant's abdomen Experimenter
Routh (1969)	"tsk, tsk, tsk"	Smile	Yes	Light pressure on the infant's abdomen Experimenter
Simeonsson (1971)	Phrases like "good baby, nice baby" "good boy (girl)"	Smile	Facing the infant	Light physical touch on infant's body Investigator
Todd & Palmer (1968)	Tape recorded female voice slowly saying "hello baby," "pretty baby," "nice baby"	None	Yes	None Experimenter
Todd & Palmer (1968)	Tape recorded female voice slowly saying "hello baby," "pretty baby," "nice baby"	None	None	None No adult present
Wahler (1969)	Nonspecific verbalization	Smile	Leaning over crib about 3 feet from baby's face	None Mother Experimenter behind mother in partial view of infant
Weisberg (1963)	"Yeah" sound	Smile	Yes	Rub infant's chin with thumb and finger Experimenter
Wiegerink et al. (1974)	Phrases like "good girl, good ____"	Smile	Yes	Lightly touches infant on chin or abdomen Mother (Familiar reinforcing agent)
Wiegerink et al. (1974)	Phrases like "good girl, good ____"	Smile	Yes	Lightly touches infant on chin or abdomen Experimenter (Novel reinforcing agent)

Table 4

Cohen's d Effect Sizes Associated with the Influences of Adult Vocal and Verbal Contingent Responsiveness on Increases in Infant Vocalizations

Study	N ^a	Adult Concomitant Behavior			Adult Reinforcer	Child Vocalization	Cohen's <i>d</i> Effect Size
		Social	Visual	Tactile			
Banikiotes et al. (1972)	16	No	No	No	Tape recorded verbal statement	Discrete voiced sounds	5.93
Banikiotes et al. (1972)	16	No	No	No	Tape recorded verbal statement	Discrete voiced sounds	0.29
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	0.94
Bloom (1974)	1	Yes	No	Yes	Tsk, tsk	Discrete voiced sound within a respiration	-0.09
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	3.14
Bloom (1974)	1	Yes	No	Yes	Tsk, tsk	Discrete voiced sound within a respiration	0.28
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	2.24
Bloom (1974)	1	Yes	No	Yes	Tsk, tsk	Discrete voiced sound within a respiration	1.38
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	2.15
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	0.46
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	1.43
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	4.01
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	2.61
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	2.72
Bloom (1974)	1	Yes	No	Yes	Tsk, tsk	Discrete voiced sound within a respiration	2.06
Bloom (1974)	1	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound within a respiration	2.10
Gazdag & Warren (2000)	1	Yes	Yes	Not reported	Imitation	Phonemes previously produced by child	4.79
Gazdag & Warren (2000)	1	Yes	Yes	Not reported	Imitation	Phonemes previously produced by child	6.51
Goldstein & Schwade (2008)	15	Yes	Yes	Yes	Imitation Vowels	Vocalization	0.84
Goldstein & Schwade (2008)	15	Yes	Yes	Yes	Verbalization Words	Vocalization	0.33
Gunn et al. (1979)	8	Yes	Yes	No	Verbal statement	Vocalization	3.15
Haugan & McIntire (1972)	8	Yes	Yes	No	Imitation	Vocalization	3.61
Laub & Dunst (1974)	1	Yes	Yes	No	Verbal statement	Any sound	0.81
Laub & Dunst (1974)	1	Yes	Yes	No	Imitation	Any sound	2.21
Masataka (1993)	24	Yes	Yes	Yes	Verbal statement	Discrete continuously voiced sound	1.04
Poulson (1983)	1	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	2.15
Poulson (1983)	1	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.54
Poulson (1983)	1	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.14
Poulson (1983)	1	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.10
Poulson (1988)	1	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.38
Poulson (1988)	1	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.68
Poulson (1988)	1	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.37
Ramey & Ourth (1971)	15	Yes	Yes	Yes	Verbal statement	Any sounds	2.01
Rheingold et al. (1959) (Study 1)	11	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound	2.11
Rheingold et al. (1959) (Study 2)	11	Yes	Yes	Yes	Tsk, tsk	Discrete voiced sound	1.80
Routh (1969)	10	Yes	Yes	Yes	Tsk, tsk	Consonant sound	3.42

Table 4, *continued*

Study	N ^a	Adult Concomitant Behavior			Adult Reinforcer	Child Vocalization	Cohen's <i>d</i> Effect Size
		Social	Visual	Tactile			
Routh (1969)	10	Yes	Yes	Yes	Tsk, tsk	Vowel sound	3.01
Simeonsson (1971)	5	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.50
Simeonsson (1971)	5	Yes	Yes	Yes	Verbal statement	Discrete voiced sound	1.10
Todd & Palmer (1968)	8	No	Yes	No	Tape recorded verbal statement	Vocalization	3.28
Todd & Palmer (1968)	8	No	No	No	Tape recorded verbal statement	Vocalization	1.35
Wahler (1969)	1	Yes	Yes	Yes	Verbalization	Babbling sound	2.00
Weisberg (1963)	5	Yes	Yes	Yes	Verbalization	Discrete voiced sound	1.39
Wiegerink et al. (1974)	6	Yes	Yes	Yes	Verbal statement	Vocalization	3.22
Wiegerink et al. (1974)	6	Yes	Yes	Yes	Verbal statement	Vocalization	2.29

Table 5

Effects of Adult Social Concomitant Behavior Occurring with Vocal or Verbal Reinforcement

Social Concomitants	Number of Effect Sizes	Mean	95% Confidence Interval
<i>Smiling</i>			
No	4	2.71	-1.23 - 6.65
Yes	54	1.95	1.57 - 2.33
<i>Eye Contact</i>			
No	14	1.14	0.12 - 2.17
Yes	47	2.27	1.89 - 2.65
<i>Touch</i>			
No	8	2.59	1.06 - 4.09
Yes	50	1.84	1.50 - 2.17

Table 6

Moderators of the Relationship Between Vocal and Verbal Reinforcement and Infant Vocalizations

Moderator	Number of Effect Sizes	Mean	95% Confidence Interval
<i>Disability</i>			
Yes	12	2.79	1.65 - 3.94
No	49	1.82	1.44 - 2.21
<i>Setting</i>			
Child's Home	37	1.91	1.42 - 2.40
Classroom	7	3.16	0.99 - 5.35
Laboratory	16	1.75	1.34 - 2.16
<i>Adult</i>			
Child's Parent	13	1.61	1.10 - 2.12
Investigator	45	2.10	1.64 - 2.55
Neither	3	2.52	-1.92 - 4.91