JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1984, 17, 313–325 NUMBER 3 (FALL 1984)

INCREASING THE IMMUNIZATION OF PRESCHOOL CHILDREN; AN EVALUATION OF APPLIED COMMUNITY INTERVENTIONS

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We evaluated the relative impact of four procedures designed to encourage parents to obtain immunizations for their children. In a public health setting, the families of 1,133 immunization-deficient preschool children were randomly assigned to six conditions: (a) a general prompt; (b) a more client-specific prompt; (c) a specific prompt and increased public health clinic access; (d) a specific prompt and monetary incentives; (e) contact control; and (f) no contact control. All interventions, except the general prompt, produced some evidence of improvement when compared with the control groups. The monetary incentive group revealed the largest effect, followed by the increased access group, specific prompt group, and general prompt group, respectively. The data suggest that relatively powerful and immediate effects on preschoolers' clinic attendance for immunization may be produced by monetary incentives in conjunction with client-specific prompts. However, client-specific prompts alone appear to be the most cost-effective of the interventions.

DESCRIPTORS: behavioral community psychology, behavioral medicine, prevention, public health, children

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During the past decade, behavioral technology has been increasingly applied to socially significant community problems. Applications of this technology to conserve energy (Winett, Neale, Williams, Yokley, & Kauder, 1978–1979), decrease environmental pollution (Geller, Winett, & Everett, 1982), alter transportation practices (Everett, Hayward, & Meyers, 1974), and modify other community-based behaviors have demonstrated the efficacy of various prompts, feedback, monetary incentives, and other reinforcers.

More recently, behavioral technology has been successfully applied to promote preventive health behaviors in the community in such areas as smoking (e.g., Evans et al., 1981; Rosen & Lichtenstein, 1977), dental care (e.g., Iwata & Becksfort, 1981; Olson, Levy, Evans, & Olson, 1981; Reiss & Bailey, 1982; Reiss, Piotrowski, & Bailey, 1976), nutrition (e.g., Bunck & Iwata, 1978), infant mortality (e.g., Leodolter, 1980), X-ray exposure (e.g., Greene & Neistat, 1983), seat belt promotion (e.g., Geller, Paterson, & Talbott, 1982), and speeding (e.g., Van Houten & Nau, 1983). However, one target behavior that has received little research attention has been the promotion of inoculation for serious and potentially fatal childhood communicable diseases such as polio, diphtheria, pertussis (i.e., whooping cough), tuberculosis, tetanus, and rubella. According to the World Health Organization, each year these diseases are responsible for the deaths of over five million children under age five in the world ("Immunizations," 1981) and the permanent disability of an additional five million (Zahara, 1980). In the United States, approximately 10,000 cases of vaccine-preventable diseases were reported in 1982 ("Notifiable Diseases," 1983) and the Centers for Disease Control have warned that communicable disease rates will rise unless a sustained effort to vaccinate each new birth cohort every year is maintained ("Current Trends," 1983).

Existing U.S. public health regulations, which generally require proof of immunization on school entrance, leave preschoolers unprotected. Current research indicates that the later children begin inoculations, the greater their risk of not completing the immunization series by school entry, thus pos-

We express our appreciation to C. William Keck, Director of the Akron Department of Health, Thomas Duke of the B. F. Goodrich Company, and Roy Lilly, Chairman of the Department of Psychology at Kent State University, for their cooperation, consultation, and financial support of the project. David S. Glenwick is now at Fordham University. Requests for reprints should be sent to James M. Yokley, Department of Psychology, Kent State University, Kent, Ohio 44242.

ing a public health threat (Young, Halpin, Johnson, Irvin, & Marks, 1979), and reports of children in major U.S. cities being banned from school attendance because of their immunization delinquency continue to appear in the media (e.g., Maeroff, 1981).

In the 1960s, the United States Public Health Service began to encourage state and local health departments to institute programs of motivational mailings to the parents of infants, prompting immunization of their children (Byrne, Schaffer, Dini, & Case, 1970). To date, only three states (Kentucky, Ohio, and Rhode Island) have published examinations of this approach. The Rhode Island study used the entire population of parents of two-month-old infants (Byrne et al., 1970). A computer-generated motivational prompt "worded in a personal fashion" was mailed to half of this population (Byrne et al., 1970, p. 771). If no response was made after 30 days, a second "more emotional" mailing was sent, and if there was no response to this prompt, a telephone or house call was made (Byrne et al., 1970, p. 771). Results showed that lower and upper class experimental subjects displayed a significant 10% increase in immunization initiation over no-contact controls, whereas middle class subjects produced a nonsignificant 5% increase.

The Ohio Department of Health has reported favorable results using a single computer-generated prompt that does not specify the client's name or inoculations needed (Young, Halpin, Johnson, Irvin, & Marks, 1980). The prompt is routinely mailed to parents of children considered to be at risk for immunization deficiency according to sociodemographic correlates (parental education and family size) derived by Marks, Halpin, Irvin, Johnson, and Keller (1979). When compared to a no-contact "at-risk" control, this general prompt produced a significant 16% increase. These findings, however, were not supported by the Kentucky Health Department studies, which also used a single general prompt (Martin, Fleming, Fleming, & Scott, 1969; Martin, Scott, Underwood, & Thurber, 1967).

Nongovernmental immunization research has also been limited. In an informal field study, Indianapolis disc jockeys applied their public relations experience to motivate the inoculation of area school children (White, 1976). Prizes were offered to parents, school personnel, and pupils in a contest format. This format included a lottery for a week's vacation in the Bahamas (the winner drawn from signed inoculation permission slips) and group contingencies such as free radio station T-shirts for all students in classrooms returning 100% of their inoculation permission slips. By the end of the second day, 92.6% of the slips had been returned. Another project (Peterson, 1980) obtained a moderate immunization increase due to telephone contact but no effect when using a client-specific prompt (mailing).

In summary, behavioral community interventions using (a) multiple prompting and (b) lottery and group contingencies in combination seem effective in increasing immunization behaviors, whereas the effects of a single general prompt (the most popular health department approach) or a client-specific prompt remain unclear. No experimental examination of any of the aforementioned intervention techniques has been performed on a population known to be immunization deficient, and no attempt has been made to compare the techniques within a controlled experimental framework.

The purpose of this study was to evaluate the relative impact of four conditions for motivating the parents of an identified group of immunization-deficient preschool children to have their children inoculated. The conditions were: (a) a mailed general prompt, (b) a mailed specific prompt, (c) a mailed specific prompt plus expanded clinic hours (i.e., an increased clinic access, convenience condition), and (d) a mailed specific prompt plus a monetary incentive (i.e., a cash lottery).

Although the general efficacy of monetary incentives has been observed in preventive health field studies on infant mortality (Leodolter, 1980) and inoculation behavior (White, 1976), comparative evaluation in dental health research has revealed that the most powerful and immediate results appear to be elicited when a monetary incentive is offered together with an informational prompt (e.g., Reiss et al., 1976). Additionally, research on increasing attendance at mass immunization programs (Hingston, 1974) indicates that facilitating treatment access and convenience may be an important variable in health behavior promotion. Although no controlled study using a client-specific prompt to promote immunization has been conducted, a second specific prompt mailing has demonstrated a pronounced effect over a single, more general prompt in dental health promotion (Olson et al., 1981).

In light of the above data, it was expected that the monetary incentive/specific prompt combination would have the greatest impact on clinic attendance and child inoculation, followed in descending order by the increased access/specific prompt combination, the specific prompt alone, and the general prompt alone. All four procedures were expected to be more effective than either a telephone-contact control or a no-contact control condition, and telephone contact alone was not expected to produce significant effects.

METHOD

Children

The study was conducted on the entire population of immunization-deficient preschool clients of a public health clinic in a medium-sized Midwest city (population of approximately 300,000). As a matter of policy, all public health clinic files contain immunization information recorded at the first client visit regardless of the reason for that visit. The target population consisted of children 5 years of age or younger who needed one or more inoculations for diphtheria, tetanus, pertussis, polio, measles, mumps, or rubella. Immunization deficiency was defined by local health department criteria, which required that the first three DTP (dipththeria, tetanus, pertussis) and polio inoculations be administered 2 months apart (initiated at 2 months of age), the first DTP booster and polio booster 1 year after the third inoculation, and the second booster 2½ years after the first booster. Any combination of measles, mumps, and rubella inoculations (usually given together in one dose) were to be administered no earlier than at 15 months of age (no repetitions required).

Of the 2,101 preschoolers, 1,133 (53.9%) were found by medical records examination to be immunization deficient (i.e., in need of at least one of the above inoculations). Of the target population, 50% were male and 64% Caucasian; the mean age was 37.3 months ($SD = 18.2$). The mean number of inoculations needed, using immunization criteria based on client age (i.e., DTP and polio to be received at 2, 4, 6, 18, and 48 months of age; measles, mumps, and rubella to be received at 15 months of age), was 5.2. The mean latency to the most delinquent inoculation for each child was 24.4 months; the children most frequently needed both a DTP and a polio inoculation.

Procedure

Because medical records could not be removed from the clinic, research record cards (containing only patient medical record data directly relevant to the project) were constructed on immunization-deficient preschoolers by five project researchers who were receiving undergraduate credit for their participation in the study. These researchers were advised on the confidentiality of patient medical records and had signed behavioral contracts indicating that they understood the ethical constraints placed on them and would act accordingly.

To prevent confounding due to different types of prompts being mailed to parents with two or more immunization-deficient preschoolers, families—rather than individual children—were randomly assigned to one of six conditions (see *Experimental Treatments*). Prompts were constructed for each study child by project researchers based on information from the research record cards. Along with the prompts, all families in the four experimental conditions received a postage-paid postcard (addressed to the health department) for each target child, enabling parents to update their child's health clinic records easily if the inoculations needed had already been received. Letters addressed to James M. Yokley at two area public health clinics were mailed out with the prompts as a check to determine the first day of intervention.

Data were gathered on all dependent measures (see *Dependent Measures*) by recording the number and types of inoculations administered to study children from office records every clinic day (i.e., Monday and Tuesday) of each week for a period of 3 months. During the first week, additional data were gathered on Wednesday night and Saturday when the clinic was opened for increased public access.

After the first follow-up measure (i.e., 2 months), the lottery was drawn and the winning numbers were posted on a large sign at the clinic where the population was selected. The monetary incentives were then delivered directly to the winners at their homes. A second follow-up measure was recorded after 3 months.

The study dealt with the ethical issues involved in using control groups in immunization research by making control conditions essentially "delayed treatment" groups. Children in control conditions received motivational mailings after the study was completed.

Experimental Treatments

The general prompt group (n = 195) received a mailed prompt containing general inoculation information and instructions as follows: "Dear Parent: Unless your doctor decided differently, your child needs X doses of X vaccines at X ages. If your child is behind in any of them (the inoculations mentioned), I urge you to make an appointment and get your child caught up." This prompt contained the standard immunization schedule for the entire preschool age span and did not specify the inoculations in which the child was deficient. It was an exact duplicate of the state health department prompts mailed to high-risk children at 6 and 18 months of age, except that the immunization requirements were expanded to apply to preschoolers of all ages. The message was typed on local, not state, health department stationery and signed by the local, not the state, health department director.

The specific prompt group (n = 190) received a mailing that communicated client-specific inoculation information and instructions, i.e., naming the target child as well as the particular inoculations that the child needed and giving the clinic's location and hours: "To the Parents of (child's name), our records show that it is time for ______ to receive the following shot(s): . . . (specific list provided). . . . Shots may be obtained FREE of charge at the: . . . (specific clinic location, dates, and times)." This prompt was a modified version of the local health department's inoculation postcard.

The increased access group (n = 185) received the specific prompt as well as a second page that opened with the statement "ATTENTION: FOR YOUR CONVENIENCE, TWO SPECIAL 'OFF HOURS' CLINICS ARE BEING HELD AT THE (clinic name) CLINIC (clinic address)." This was followed by an announcement of the additional clinic hours (Wednesday from 5 to 10 p.m. and Saturday from 9 a.m. to 5 p.m.) with child-care facilities that included snacks, movies, and games. The message ended with the statement "Just sign all of your children in at the clinic and you may go out for the evening or day while we take care of them FREE of charge. Hope to see you there!"

The monetary incentive group (n = 183) received the specific prompt plus a second page that opened with the statement: "ATTENTION: IN AN EFFORT TO GET PARENTS TO HAVE THEIR CHILDREN IMMUNIZED AGAINST CHILDHOOD DISEASES, THE AKRON HEALTH DEPARTMENT WITH SUPPORT FROM B. F. GOODRICH IS GIVING AWAY $175.00 IN CASH PRIZES TO PARENTS WHO TURN IN THE TICKET ATTACHED TO THIS PAGE." Instructions for lottery eligibility were made further contingent on the child's clinic attendance for immunization by instructing parents receiving this mailing to bring their child into the clinic for inoculation, tear off their ticket stub, and deposit it in the clinic lottery box. Parents were informed that three monetary prizes ($100, $50, and $25) would be drawn in a lottery held subsequent to the intervention period. The message ended with the statement: "GOOD

LUCK! AND SEE YOU AT THE CLINIC," and a lottery ticket was attached to the bottom of the page.

The envelopes mailed to the above four experimental groups were addressed "To the Parents of (child's name)," had as a return address that of the local health department, and were stamped "Health Documents Enclosed."

The contact control group (n = 189) received a telephone contact (but no mailing) from us (in our capacity as local health department representatives) requesting basic inoculation/demographic information from the parents; no explicit prompt (i.e., information that their child was immunization deficient) was given in these phone contacts.

The no-contact control group (n = 191) received no contact during the study. Both control groups received the specific prompt (along with the records update postcard) by mail at the conclusion of the study.

Dependent Measures

A number of dependent measures were recorded during the experiment. For the purpose of this report, three measures considered most relevant to inoculation promotion were selected. They were: (a) the number of target children receiving one or more inoculations at the clinic, (b) the number of target children attending the clinic (for any reason), and (c) the total number of inoculations received by target children. The first variable was a dichotomous measure capable of demonstrating only the power of a given prompt through the frequency of children who had both attended the clinic and received one or more inoculations. Because some children arrive sick (inoculations are not normally administered to a child with a fever) or must be treated for more immediate health problems (and given time constraints, must return for inoculations later), the second dichotomous variable was provided as an absolute measure of the theoretical impact of the prompts on inoculation behavior if no practical difficulties were to arise. The third measure revealed the actual number of inoculations received as a result of a given prompt and, by definition, accounted for those children who attended the clinic with a practical problem but later returned to receive inoculations. These dependent measures were also recorded on nontarget children (i.e., neighborhood youngsters brought in by parents of target children) to investigate the intervention's potential secondary effects.

Because the instructions on the prompts for the increased access and monetary incentive groups were in effect only during the first 2 weeks of the study, the intervention's immediate impact on these three variables was measured after 2 weeks. The first follow-up measure of the intervention's impact was taken 2 months after the first day of intervention. Although a second follow-up measure was taken after 3 months, data gathered after 2 months must be evaluated with caution because some inoculations are required again after 2 months. This could introduce a confound into the experiment due to verbal (health clinic staff advice) and written (child inoculation cards given or updated) prompts given each clinic visit. Finally, because some of the experimental conditions were more expensive and time-consuming than others, experimental groups were compared on cost-efficiency after the first follow-up period.

Measure Integrity

For the dependent measures to reflect the relative impact of the various experimental conditions accurately, it was necessary for (a) target parents to indeed receive the prompts, i.e., for envelopes to have correct addresses and names, (b) the prompts to reflect reliably the inoculation information on the children's medical records, and (c) the inoculations listed on the prompts to be reliably administered by the clinic staff when the children arrived.

To examine researcher reliability in transcribing critical project information from children's medical records to the research record cards, a random sample of 10% was selected and all inoculation information contained in the research records, along with names and street addresses, were checked against the original medical records. Research record card transcription reliability was calculated by dividing the number of research card sample cases containing any name, address, or inoculation information mistake by the total number of research cards sampled.

Researcher reliability in transcribing critical project information from children's research record cards to their prompts was evaluated by selecting a random sample of 10% of the motivational mailings that were "returned to sender" (i.e., those with a high probability of a name or address mistake) and checking names and addresses typed on the envelopes along with all inoculation information contained in the prompts against the research record cards. Prompt transcription reliability was calculated by dividing the number of motivational mailings containing in any name, address, or inoculation information mistake by the total number of motivational mailings sampled.

Clinic staff inoculation reliability for the number of target children receiving one or more inoculations was calculated by dividing the number of target children receiving one or more inoculations at the clinic by the total number of target children attending the clinic. Clinic staff inoculation reliability for the total number of inoculations received by target children was calculated by dividing the number of inoculations recorded by the clinic staff as having been administered to target children attending the clinic by the total number of inoculations indicated as deficient on the research record cards of target children attending the clinic.

A final factor that may affect the experimental integrity of all independent (nongovernment) inoculation research projects is the fact that state health departments may be mailing prompts to the same people targeted for intervention by independent research endeavors. Because state prompts normally go out to all children at risk for immunization deficiency, the probability of independent research individuals receiving a state prompt would be equal for both treatment and control groups, thereby canceling any differential group bias. However, independent research results said to be produced by a single intervention could be contaminated by unrecorded state prompting of independent research study participants. This problem was addressed in this study by obtaining information from the state health department on study participants to whom the state had also mailed prompts just before or during the course of the study.

RESULTS

Measure Integrity

When research record card transcription reliability was computed, 93% of the sample evaluated revealed no errors in name, address, or inoculation information. No specific type of mistake was observed more frequently than others or found in more than 2% of the sample. Examination of prompt transcription reliability revealed a 100% agreement between the sample mailings and research record cards. The perfect correspondence found here was not surprising, as all motivational mailings were checked carefully prior to post office delivery. Clinic staff inoculation reliability for the number of target children receiving one or more inoculations was 84%, and clinic staff inoculation reliability for the total number of inoculations received by target children was 80%.

Examination of state health department computer records on general inoculation prompts routinely mailed at 6 and 18 months of age revealed that during the course of the project two 6-month-old study children were sent state health department prompts, both were in the no-contact control group, and one came into the clinic. Exact data were not available on the number of 18-month-old study children who received state health department prompts, but a close estimate is approximately four. The degree of overlap (i.e., double prompting) was not considered sufficient to warrant data adjustments. Our attempts to contact participants by telephone revealed that: 50 were reached by telephone, 41 could not be reached with five or more calls, 37 had the wrong number, 36 had no telephone, 21 were disconnected, and 4 said the child's family had moved.

Participant Attrition

Children from all six groups whose parents' motivational mailings were "returned to sender" (n =

354) were omitted from the data analysis. Although the omnibus chi-square indicated a significant difference in group frequencies of returned letters where both control groups exhibited greater frequencies of returned letters than the treatment groups, $\chi^2(5,\ N = 1{,}133) = 14.06,\ p < .05$, none of the nonparametric post hoc multiple comparison tests were significant. When these data were reanalyzed with a statistic allowing a less conservative post hoc evaluation, the omnibus *F* statistic again revealed evidence of a group difference in the number of returned letters, $F(5,\ 1{,}127) = 2.83$, $p < .05$, and LSD post hoc multiple comparisons revealed that the contact control group had a significantly greater number of returned letters than the monetary incentive, increased access, and general prompt groups.

When the postcard questionnaires returned by parents were examined, 64 parents who did not attend the clinic and indicated that their children's inoculations were up to date were also omitted from the analysis. There were no significant differences in the group frequencies of these children, $\chi^2(5,\ N = 206) = 6.38,\ p > .05$. Thus, analyses were performed on data from 715 children: 124 children in the general prompt group, 119 children in the specific prompt group, 125 children in the specific prompt + increased access group, 120 children in the specific prompt + monetary incentive group, 108 children in the contact control group, and 119 children in the no-contact control group.

Because the data analysis was performed on a population that was 36.9% smaller than the original subject pool, demographic characteristics across groups were examined for biasing effects. There were no significant between-group differences in the children's sex, $\chi^2(5,\ N = 715) = 5.98,\ p > .05$, age, $F(5,\ 709) = 0.90,\ p > .05$, or race, $\chi^2(5,\ N = 715) = 14.47,\ p > .05$. No groups had families with more than three immunization-deficient children (all groups had one such family), and there were no significant differences in the group frequency of families with more than one immunization-deficient child, $\chi^2(5,\ N = 630) = 1.04,\ p > .05$. There were also no significant differences in the number, $F(5,\ 709) = 0.38,\ p > .05$; type, DTP, $F(5,\ 709) = 0.52,\ p > .05$, Polio, $F(5,\ 709) = 0.42,\ p > .05$; MMR, $F(5,\ 709) = 0.78,\ p > .05$); or most frequently delinquent, $\chi^2(5,\ N = 715) = 0.14,\ p > .05$, inoculation across conditions.

Dependent Variable Examination

When between-group comparisons were examined on nonparametric dependent measures (i.e., frequency of children inoculated and frequency of children attending the clinic for any reason), the limited availability of appropriate nonparametric, multiple comparison statistics influenced the choice of a rather conservative method analogous to Scheffe's and Tukey's procedures for parametric tests, except that planned confidence intervals around contrast estimates as opposed to group means were used to estimate the magnitude of group differences (Marascuilo & McSweeney, 1977). A more liberal statistic (i.e., LSD post hoc test to Analysis of Variance) was selected for testing between-group differences of the parametric dependent measure (i.e., total number of inoculations received).

When the overall impact of the prompts was examined, significant group differences were revealed during the intervention period, where the monetary incentive group demonstrated the greatest impact, followed in decreasing order by the increased access, specific prompt, general prompt, and control groups (Table 1) on the frequency of children inoculated, $\chi^2(5,\ N = 715) = 30.21$, $p < .001$, the frequency of children attending the clinic, $\chi^2(5,\ N = 715) = 35.91,\ p < .001$, and the total number of inoculations received, $F(5,\ 709) = 4.63,\ p < .001$.

Treatment vs. control group comparisons on the intervention measure demonstrated the immediate significant impact of the specific prompt + monetary incentive across all dependent variables, whereas the specific prompt + increased access produced a significant effect on the number of inoculations received (Table 1). Between-treatment group comparisons revealed that the specific prompt + monetary incentive produced a signifi-

Table 1
Motivational Prompt Impact on All Dependent Variables Across Time Periods

	N	DV1	(A)	DV2	(A)	DV3	(A)
Intervention measure (after 2 weeks)							
General prompt	124	9	2.4	11	3.1	18	4.8
Specific prompt (SP)	119	12	5.2	13	5.2	21	8.0
SP + increased access	125	20	11.2	22	11.9	38	20.7*+
SP + monetary incentive	120	27	17.7*+	32	20.9*+	46	28.6*+
Contact control	108	4		5		8	
No contact control	119	7		8		14	
First follow-up measure (after 2 months)							
General prompt	124	14	1.6	18	3.1	29	4.4
Specific prompt (SP)	119	27	13.0	31	14.6	46	19.7*
SP + increased access	125	35	18.3*+	39	19.8*+	61	29.9*+
SP + Monetary incentive	120	37	21.1*+	44	25.2*+	64	34.4*+
Contact control	108	9		11		18	
No contact control	119	13		15		25	
Second follow-up measure (after 3 months)							
General prompt	124	20	2.9	25	3.9	42	9.6
Specific prompt (SP)	119	31	12.8	38	15.6*	58	24.5*
SP + increased access	125	36	15.6*	44	18.9*	67	29.4*+
SP + monetary incentive	120	37	17.6*	45	21.2*+	67	31.6*+
Contact control	108	11		15		20	
No contact control	119	19		22		35	

Dependent variables
DV1 = Frequency of target children attending the clinic and receiving inoculation(s)
DV2 = Frequency of target children attending the clinic for any reason
DV3 = Total number of inoculations received by target children
(A) = Percent increase of treatment groups over pooled control groups

Note. Because there were no significant control group differences across dependent measures and time periods, control groups were averaged (pooled) together for convenience in calculating treatment group impact (Column A).
* $p < .05$ (treatment group by contact control comparison).
*+ $p < .05$ (treatment group by no contact control comparison).

cantly higher frequency of children inoculated and attending the clinic for any reason than did the general prompt. Both the specific prompt + monetary incentive and specific prompt + increased access produced a significantly greater total number of inoculations than did the general prompt; the specific prompt + monetary incentive also produced a greater number of inoculations than did the specific prompt.

On the first follow-up measure, the overall group impact data remained statistically significant and in the same rank order as during intervention (Table 1) on the frequency of children inoculated, $\chi^2(5, N = 715) = 36.53$, $p < .001$, the frequency of children attending the clinic, $\chi^2(5, N = 715) = 41.16$, $p < .001$, and the total number of inoculations received, $F(5, 709) = 5.34$, $p < .001$.

The second follow-up measure revealed that group impact data continued to reveal significant group differences in the same rank order as during the intervention and first follow-up measure (Table 1) on the frequency of children inoculated, $\chi^2(5, N = 715) = 24.04$, $p < .001$, the frequency of children attending the clinic, $\chi^2(5, N = 715) = 29.46$, $p < .001$, and the total number of inoculations received, $F(5, 709) = 3.58$, $p < .01$. Treatment vs. control group comparisons on the second follow-up measure revealed that all group differences on the total number of inoculations re-

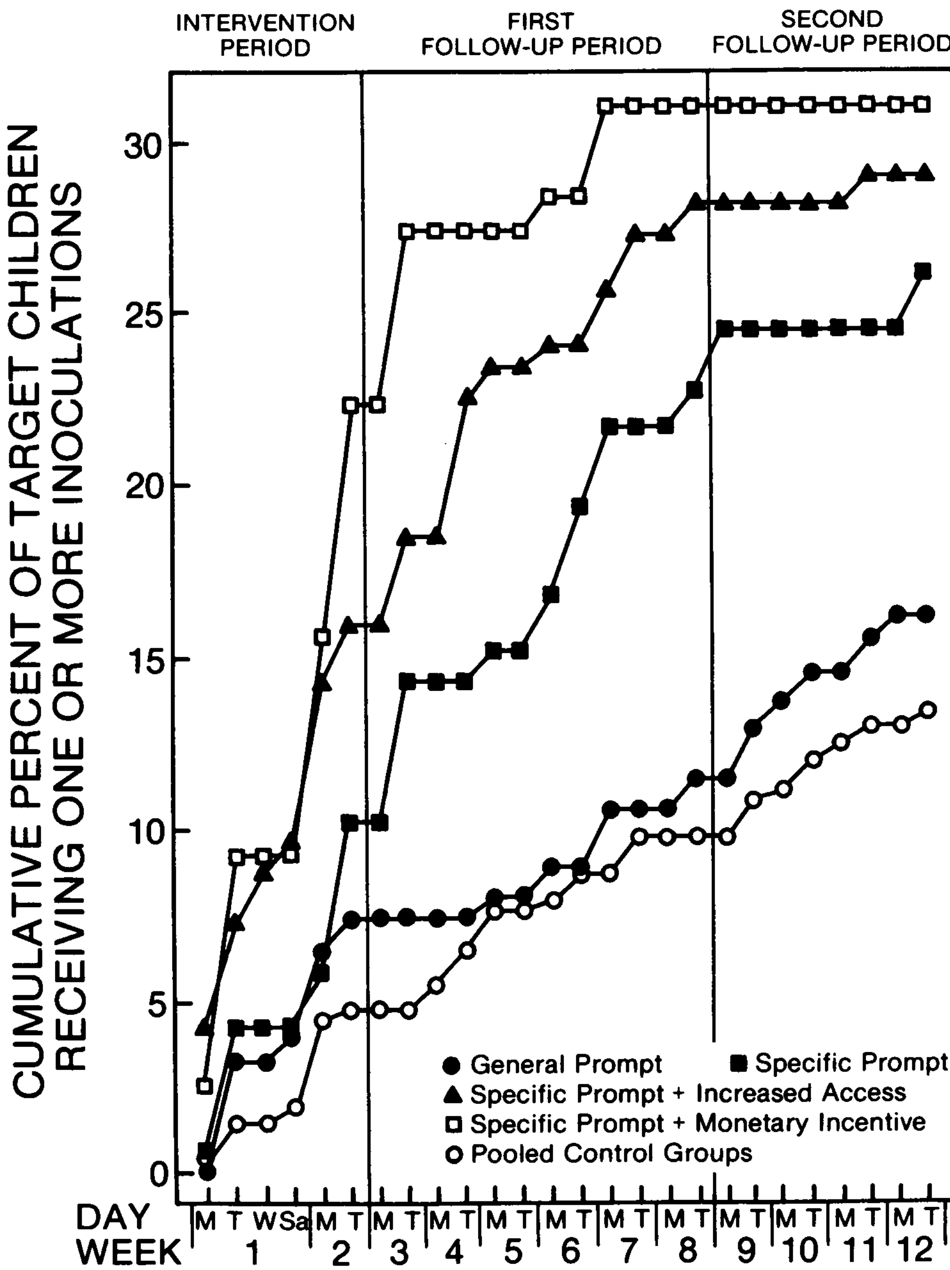

Figure 1. Cumulative percentage of target children receiving one or more inoculations across time periods.

ceived were maintained from the first follow-up measure (Table 1), whereas significant group differences on clinic attendance were only maintained by the specific prompt + monetary incentive group.

The general trend of these data were readily apparent even when the cumulative percentage of the most conservative dependent measure (i.e., target children receiving one or more inoculations) was plotted across time (Figure 1).

When the intervention's secondary effects were evaluated, it was determined that during the 3-month study period examined, parents brought

Table 2
Cost/Outcome Results

		Motivational mailing costs						
Group	*n*	Std. size paper (0.005 ea.)	Stamped envelopes (0.166 ea.)	Stamped post cds. (0.10 ea.)	Offset printing	Typeset post cds. (0.069 ea.)	Additional costs*	Total cost
GP	195	$0.98	$32.37	$19.50	$5.27	$13.46	$1.30	$72.88
SP	190	$0.95	$31.54	$19.00	$4.37	$13.12	$1.30	$70.28
SP + IA	185	$1.86	$30.71	$18.50	$9.26	$12.78	$152.89	$226.00
SP + MI	183	$1.83	$30.38	$18.30	$9.15	$12.64	$183.19	$255.49

	Cost per target child motivated to receive inoculation		
Group	After 2 weeks	After 2 months	After 3 months
GP	$8.10	$5.21	$3.64
SP	$5.86	$2.60	$2.27
SP + IA	$11.30	$6.46	$6.28
SP + MI	$9.46	$6.91	$6.91

Note. GP = general prompt; SP = specific prompt; SP + IA = specific prompt + increased access; SP + MI = specific prompt + monetary incentive.

* 13 hours registered nurse time—$143.06 (IA); food—$6.44 (IA); diapers—$2.09 (IA); lottery tickets—$1.65 (MI); lottery box—$5.24 (MI); lottery funds—$175.00 (MI); clerical materials—$1.30 (all groups).

189 target children into the clinic (154 were inoculated) along with 40 other (nontarget) children. This produced a secondary effect of an additional 21.2% in clinic attendance. Sixteen of the nontarget children received inoculations, producing a 10.4% secondary inoculation effect. However, there were no significant group differences in nontarget children inoculated, $F(5, 709) = 0.50$, $p > .05$.

Cost Outcome

Motivational mailing costs are presented in Table 2. The cost of time provided by the project researchers was not recorded. However, the time required to prepare the prompts for mailing was approximately equal for all groups (i.e., it takes less than 30 seconds to record inoculation data on each specific prompt); therefore, no additional staff would be hired to handle this task if the project were adopted by a public health agency.

The cost per target child receiving an inoculation consistently demonstrated the specific prompt to be the most cost-effective intervention across time (Table 2). Cost-outcome computations initially indicated that the specific prompt + increased access intervention was the least cost-effective after 2 weeks. However, the relatively powerful impact of that intervention was later reflected through improved cost-effect on both the 2- and 3-month follow-up measures, making the specific prompt + monetary incentive intervention the least cost-effective in the long run.

When the statistical significance of the various motivational interventions was considered (Table 1) along with their initial cost-effect (Table 2, after 2 weeks), the specific prompt + monetary incentive was the most cost-effective, significant intervention; in the long run (i.e., on both the 2- and 3- month follow-up measures), the specific prompt was the most cost-effective intervention capable of demonstrating some evidence of statistical significance.

DISCUSSION

We compared the impact of a number of different motivational procedures in a controlled experimental framework and on a population known to be immunization deficient (not simply "at risk" for immunization deficiency). Results showed the cumulative percentage of children receiving one or more inoculations and the latency to significant intervention impact followed the same general trend as the rank order of absolute group impact. That is, the specific prompt + monetary incentive intervention demonstrated the most rapid acceleration and shortest latency to significant impact, followed by the specific prompt + increased access, the specific prompt, and the general prompt interventions. Although all other interventions produced some evidence of efficacy, the single general prompt was not found sufficient to promote inoculation behavior. Although inconclusive due to a low contact rate, the results on telephone contact for inoculation information indicated that parent contact alone (i.e., without a motivational message) was not sufficient to motivate inoculation behavior.

When these findings are compared to previous research in the area, the relatively immediate and powerful effect of monetary incentives on inoculation behavior demonstrated in this study are consistent with White's (1976) findings regarding monetary reinforcement. Unfortunately, no inoculation studies where convenience variables are manipulated exist for comparison with the positive impact of the specific prompt + increased access group in this study. Although this approach has theoretical support (i.e., Rosenstock, 1966), replication is needed to substantiate our findings.

The efficacy of the specific prompt revealed itself in the long run; these results differ with those from a previous study (i.e., Peterson, 1980), which reported no impact on inoculation behavior by a single specific motivational mailing. This discrepancy may be due to the fact that Peterson reported no control group or statistical comparisons and sent motivational mailings only to subjects who could not be reached by telephone (creating a group selection bias).

Our finding that a single general prompt was not sufficient to motivate inoculation behavior is consistent with the Kentucky Health Department research (Martin et al., 1967, 1969), but conflicts with the Ohio Health Department findings (Young et al., 1980). The significant results reported by Young et al. (1980) may have been due to a combination of not sampling preschoolers of all ages and not sampling a population known to be immunization deficient. The latter possibility can be partially examined by comparing demographic characteristics in our study with the sample used by Marks et al. (1979) to formulate the "high risk" for immunization deficiency calculations used for subject selection by Young et al. (1980). The Marks et al. (1979) calculations indicated that larger families with lower parental education had higher probabilities of inoculation delinquency. When compared to the Marks et al. (1979) population, our population pool revealed 25% more families with at least three children, 17% more fathers without a high school education, and 21% more mothers without a high school education. Therefore, it is likely that the Young et al. (1980) study sampled a population having a higher socioeconomic status than that typically found to be immunization deficient. This sample difference made the Young et al. population less likely to be or remain immunization deficient.

When the practical applications of our findings were considered, examination of the state health department system revealed the existence of mechanisms for coping with certain crises (i.e., disease outbreak emergencies requiring mass media and immediate personnel attention) and health maintenance issues (i.e., using computer-generated general prompts to remind parents of children "at risk" for immunization deficiency of the need to inoculate their children). However, no approach to deal with urgent or routine immunization problems existed. When an immediate significant impact on a segment of the population is desired, the specific prompt + monetary incentive approach used in this study is a relatively cost-effective way to produce a 29% increase in the number of inoculations administered to immunization-deficient children. Where immunization needs are less urgent, the specific prompt intervention demonstrated superior cost outcome relative to all other treatments that demonstrated some evidence of a significant impact and it would be the inoculation maintenance tool of choice.

The necessity to compare procedures with a demonstrated impact as a first step in building a knowledge base in this area precluded an examination of several important issues. Given the resistance to consultation and innovation that tends to exist in the public health environment (Yokley & Glenwick, 1983), the results may be viewed out of context unless some attention is devoted to the issue of social validation. The acceptability of the inoculation interventions that were found to demonstrate a significant impact now needs to be evaluated from the perspective of health department administrators (i.e., assessment of social significance or likelihood of implementing the various procedures), the front line personnel (i.e., assessment of social appropriateness or personal reactions toward implementing the various procedures), and the target population (i.e., assessment of social importance or satisfaction of the consumers) (Wolf, 1978).

Inoculation research involving the use of prompts should be advanced along two basic lines of inquiry. Because implementing client-specific prompts requires additional personnel time, whereas computer-generated general prompts do not, the first line of research might answer the question "How specific does the prompt have to be to achieve practical significance?" Given that most health departments have "the record of every birth occurring within its jurisdiction, often readily available in computer data banks" (Byrne et al., 1970, p. 770), the effect of increasing the specificity of existing health department computer programs designed to generate motivational prompts can and should be examined. Several straightforward modifications could be made on computer-generated health department prompts to increase their specificity. For example, the computer can easily be programmed to print "To the parents of (child's name on birth certificate)" instead of "Dear Parent." In addition, the computer could be programmed to print the child's birthdate, use that birthdate to calculate individual age, and print the specific inoculations needed at that age. This would allow preschool children of all ages who are at risk for immunization deficiency to receive prompts as soon as their risk calculations were computed instead of at certain fixed ages when general prompts are mailed en masse. Another relatively simple modification that would make the computer prompt more specific would be to print the name, address, hours, cost of immunization services (or notification of free services), and telephone number of the public health clinic closest to the address of the target child in lieu of general statements such as "contact your local health department." These modifications would practically convert the computer-generated general prompt into the specific prompt evaluated in this study and would be expected to improve cost-effectiveness.

The effect of prompt repetition has not yet been systematically examined in current inoculation research. Motivational prompt research in inoculation (e.g., Byrne et al., 1970) and preventive dentistry (e.g., Olson et al., 1981; Reiss & Bailey, 1982; Reiss et al., 1976) has indicated that multiple prompting achieves a greater effect than a single prompt. Byrne et al. (1970) selected a 30-day interval prior to remailing their inoculation prompt, whereas Young et al. (1980) focused their delivery and repetition at ages thought to be times when children drop out of the immunization series (i.e., 6 and 18 months old). The results of our study indicate that the specific prompt + monetary incentive intervention reaches its maximum impact after 6 weeks and that the specific prompt + increased access intervention seems to reach its maximum impact after 8 weeks. However, no inoculation study to date has provided continuous impact data over a long enough period to determine when the specific and general prompt effects peak and fade with time. Thus, a second important research question in this area seems to be "How many repetitions of a given prompt and at what temporal intervals are needed to achieve a practical effect?" When these inoculation research questions have been answered, repeated mailings at critical intervals of computer-generated prompts made as specific as data constraints will allow may become the most cost-effective behavioral intervention in this area.

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Received August 22, 1983
Final acceptance April 9, 1984