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COMMUNICATION FOR TECHNOLOGY TRANSFER IN AGRICULTURE

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THE APPLICATION OF BEHAVIOR ANALYSIS TO AGRICULTURAL TECHNOLOGY TRANSFER

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Communication for Technology Transfer in Agriculture
(CTTA Project)

The CTTA Project is an AID-funded five-year worldwide project to develop innovative approaches for the use of multichannel communication, especially mass media, to support agricultural extension in developing countries. Honduras is the primary project site, and collaborating sites will be established in up to eight other countries in Latin America, Asia and Africa.

The Project will typically focus on technology transfer objectives within a "lead" or pilot region to introduce and test improved multichannel communication strategies and methods. Some assistance will be provided in strengthening centralized capacity and institutionalizing the improved strategies and methods, and in extending them to other regions of the country.

CTTA will also selectively undertake less comprehensive technical assistance missions and can provide team members to participate in appropriate project development activities.

Conferences, seminars, workshops, magazine and journal articles, newsletters, and extensive interinstitutional and interprofessional contacts will be used for worldwide diffusion of project experience and results. This paper is one of a series of issue and professional communication papers to be distributed as a part of these diffusion activities.

The Academy for Educational Development is prime contractor for the CTTA Project, with Cornell University and Applied Communication Technology (Evaluation) as subcontractors. Needham Porter Novelli (Social Marketing), the University of Wisconsin, Iowa State University and Virginia State University are collaborating institutions.

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THE APPLICATION OF BEHAVIOR ANALYSIS TO AGRICULTURAL TECHNOLOGY TRANSFER

I. The Concept

Agricultural practices are often passed on from one generation of farmers to another. They are supported by deeply held beliefs and reinforced over the years by practical experience. To change these practices require not only a sensitive understanding of farmer beliefs systems, but a careful analysis of the practices themselves, how they are triggered and how they are reinforced. Behavior analysis is the study of the environmental events which maintain and change behavioral patterns. It rests on two fundamental assumptions or beliefs:

1) Behavior is shaped by its consequences.

2) Behavior is amenable to change if the appropriate approach or behavioral technology is employed. Modifiable behavior includes concepts such as "attitude", "prejudice", and "motivation" which are inferred from observed behaviors, as well as overt actions such as changes in agricultural practices.

Behaviorists stress the importance of understanding the full context in which a new behavior will occur. Most importantly, they seek to identify positive consequences which will follow the behavior and avoid punishing results.

The term "behavior analysis" is being used more and more to describe the methodology of behavioral psychologists, a methodology that helps to define the factors which should be considered in planning a project in attitude or behavior change and which suggests steps that could be followed in the implementation of a program. Behavior analysis can contribute to various steps of planning and implementation through:

- providing a method of determining what factors should be considered and what data collected in planning a program of social change;

- helping to specify the observations that should be made before, during, and after an intervention for purposes of designing, monitoring and evaluating a program of change;

- identifying which actions and procedures bring about change;

- encouraging the assessment of outcomes and helping to specify the means of assessment.

Behavior analysis has been applied to a wide range of applied problems, including heart disease prevention, seat belt use, dietary management, smoking cessation, and, recently, diarrheal disease control. It should be emphasized, however, that this form of analysis does not substitute for the insights of other disciplines nor does it preclude methodologies that depend on the services of agronomists, economists, physicians, and so on.

The systematic application of behavior analysis enhances programs in three ways. It helps to

- promote effective first trial of beneficial new practices,
- increase the accuracy of behavior change, and
- ensure long term maintenance of new behaviors.

Perhaps the primary contribution of behavior analysis to technology transfer has been its focus on the behavioral specifics of each new technology: What events or antecedents, in the environment, trigger a given practice; What are the salient characteristics of the behavior itself which make it more or less difficult to perform and; What consequences follow the behavior which reward or punish the individual. The study of antecedents, behavior, and consequences constitute the fundamental basis for most behavior analysis activity.

II. Application of Behavioral Analysis to Agricultural Practices

Behavior analysis can make contributions to many stages of the process of introducing and altering agricultural practices. For example, the individual farmer is faced with numerous decisions such as:

- What to plant?
- How to control weeds?
- How best to fertilize?
- How to address pest problems?
- How to market the crop?
- How to compensate, if possible, for unpredictable events in the agricultural cycle such as high cost inputs, vagaries of the weather, credit shortages.

Each management decision suggests a complex set of behaviors and consequences. New practices require new responses, many of which are not well understood, not believed in, or simply not

practiced. The role of behavior analysis in this context is to probe the reasons why a given practice continues; how a new practice might be introduced; and how such a practice can be configured, presented, and used to ensure its maintenance over time.

Early in the change process, experts are usually asked to identify practices which, if successfully introduced, would have a significant impact on the problem at hand. At this point, through a detailed examination of the behaviors involved, behavior analysis can help to pinpoint potential difficulties because of problems in establishing incentives, teaching the required performance, or assuring its maintenance over time. This behavioral reality check can help to guide the collection of relevant field data from local informants, suggest modifications of the recommended practices, and help to direct project goals towards realistically attainable behavior change.

It may be possible at this point to decide whether there are sufficient resources to accomplish the desired goals. More typically, however, the answer depends on the collection of further information about current practices, educational levels, political considerations, and economic realities of the target population, and on assessment of the likelihood that new practices can be maintained once external support has been removed.

Behavior analysis can make two major contributions in the design and execution of improved communication programs. It can help planners to select better messages to promote, and ensure effective learning once messages are selected.

A. Selecting Better Messages

Not all practices which look promising in the laboratory or experimental plots are beneficial in real life. In addition to the environmental, economic, and technical difficulties encountered in moving a new agricultural technology from the lab to the farm, there are a number of behavioral considerations which influence the farmer's willingness and ability to adopt new practices.

The experimental analysis of behavior suggests six circumstances which may contribute, singly or in combination, to the absence of desirable behavior:

- <u>Necessary skills or knowledge may be absent</u>. For example, farmers may know that a new fertilizer is good, but they may not understand that it can damage seed germination if applied improperly.

- Discriminations which identify when to use the behavior may be lacking. Farmers may know that the fertilizer is good, but not when or how to apply it.

- Necessary materials or implements may be unavailable. For example, the farmer may not be able to obtain seed of a new variety or fertilizer.

- There may be no positive consequences for engaging in the behavior. Results of most agricultural behaviors, although they may beneficial in the long run, are often not evident immediately.

- There may be positive consequences for engaging in incompatible behavior. An example would be applying all fertilizer in one application because it is easier, when it should be split into two or more applications.

- There may be punishing consequences which discourage the desired behavior pattern. For example, the high cost of fertilizer may discourage adequate use.

Behaviorists seek to identify positive consequences which will follow the behavior and to avoid punishing results. While there are many means of provoking a new behavior pattern, positive consequences are essential to maintain it. Ignoring the element of positive or negative consequences for the farmers who actually engage in the behavior leaves to chance the likelihood of long term continuation.

The behaviorist strategy is to try to identify existing behaviors which are compatible with the new ones; to look to existing practices for those which are similar to the new behaviors; to evaluate the real costs and benefits, social and economic, of adopting a new behavior; and to judge whether the frequency and persistence with which a new behavior must be practiced is realistic in the rural context. All of these elements are weighed against the anticipated impact of adoption on agricultural success. Clearly, some behaviors would have much greater impact than others.

To help select and analyze specific behaviors, these variables have been structured into the nine-item behavior evaluation scale shown in Figure 1. Each item is assigned a value ranging from a negative value of 0 to a positive of 5. Individual messages in evaluation, behavior modification, campaign design, and anthropology are considered by a team of raters which includes an agronomist, behaviorist, communicator, and anthropologist. The team provides not only the needed detail, but the contextual framework of the agronomist and the professional experience of a trained behaviorist. This multidisciplinary team is key to successful analysis.

Figure 1

BEHAVIORAL EVALUATION CRITERIA

Agricultural Impact of the Behavior:
0. No impact on agriculture problem
1. Little impact
2. Some impact
3. Significant impact
4. Very significant impact
5. Eliminates the problem

Positive Consequences of the Behavior:
0. None which farmer could perceive
1. Little perceptible consequences
2. Some consequences
3. Significant consequences
4. Very significant consequences
5. Major perceptible consequences

Cost of Engaging in the Behaviors:
0. Requires unavailable resource or demands unrealistic effort
1. Requires very significant resource or effort expenditure
2. Significant resources or effort
3. Some resources or effort
4. Few resources or little effort
5. Requires only existing resources

Compatibility with Existing Practices:
0. Totally incompatible
1. Very significant incompatibility
2. Significant incompatibility
3. Some incompatibility
4. Little incompatibility
5. Already widely practiced

Approximations Available:
0. Nothing like this is now done
1. An existing practice is slightly similar
2. An existing practice is somewhat similar
3. An existing practice is similar
4. Several existing practices are similar
5. Several existing practices are very similar

Complexity of the Behavior:
0. Unrealistically complex
1. Involves a great many elements
2. Involves many elements
3. Involves several elements
4. Involves few elements
5. Involves one element

Frequency of Behavior:*
0. Must be done at unrealistically high rate to achieve any benefit
1. Must be done hourly
2. Must be done several times each day
3. Must be done daily
4. May be done every few days
5. May be done occasionally and still have significant value

Persistence:
0. Requires compliance over an unrealistically long period of time
1. Requires compliance over a very substantial period of time
2. Requires compliance for a week or more
3. Requires compliance for several days
4. Requires compliance for a day
5. Can be accomplished in a brief time

Observability:
0. Cannot be observed by an outsider
1. Is very difficult to observe
2. Is difficult to observe
3. Is observable
4. Is readily observed
5. Cannot be missed

* Actual intervals would vary from one agricultural practice to another.

The steps involved in using the evaluation scale include:

- identifying the general behavioral parameters of the agricultural problem;
- conducting field investigations, particularly on-site structured observation, and reviewing existing data to determine current patterns of behaviors and their environmental context;
- developing a list of possible new practices which would contribute to the agricultural objectives;
- measuring each behavior against the above criteria, emphasizing its consequences, performance costs, and compatibility with existing behavior;
- constructing a program designed to instruct and motivate the target audience.

Figure 2 expands the categories suggested in Figure 1 to include factors external to the behavior itself which are also critical to the viability of adoption. Using a 1-10 difficulty scale, seven agricultural technologies potentially appropriate for Honduran farmers were rated by one of the authors, a behavioral analyst, working with an agricultural scientist.

These items were selected tentatively because each agricultural technology shows promise and, with one exception, is not too complex for widespread use. Some possibilities were rejected because important factors were thought to be difficult to mitigate or alter. Red bean production was selected, despite the high political, marketing and behavioral scores, because of its potential importance and because it provided the opportunity to try the new technology on marketing and political factors which are traditionally intractable.

This exercise demonstrates the potential of behavioral analysis to discriminate between possible interventions. As illustrated, it also points out areas where further investigation is needed and highlights areas of potential difficulty in promoting widespread adoption of new behavior. The approach is useful not only as a selection device but, more importantly to illustrate where instructional and behavioral change emphasis should be placed in dealing with different agricultural technologies.

Figure 2

AGRICULTURAL TECHNOLOGY LEVEL OF DIFFICULTY

Serious Constraints

Some Obstacles

Positive Opportunities

TECHNOLOGY	COMPLEXITY OF AGRICULTURAL TECHNOLOGY	FINANCIAL COST/ CREDIT	DIFFICULTY OF BEHAVIOR/ PRACTICE CHANGE	IMPORTANCE OF MARKETING FACTORS	IMPORTANCE OF POLITICAL CONSIDERATIONS
MINIMUM CONTOUR PLOWING	Some Obstacles		Some Obstacles	N/A	N/A
BEAN SLUG	Serious Constraints	Serious Constraints	Some Obstacles	N/A	
CITRUS PLANTING					
RED BEAN PRODUCTION		N/A	Serious Constraints	Serious Constraints	Serious Constraints
HYBRID MAIZE		Serious Constraints			N/A
HIGH LYSINE MAIZE	Some Obstacles		Serious Constraints	Some Obstacles	N/A
BLACK BEAN PRODUCTION				Serious Constraints	Serious Constraints

B. Ensuring Effective Learning

Once selected, messages and practices must be taught to farmers. Principles derived from the experimental analysis of behavior offer methods which can improve instruction and communication messages as well as the selection of target behavior. Behavior analysis has provided the empirical basis for a functional, almost an engineering, approach to solution of problems in human learning (Skinner 1978). In this context, training is necessarily only one element in a coordinated plan to modify behavior patterns. The farmer's lack of seed of a new variety can be viewed simply as a problem of absent behavior. The solution to the problem is the widespread competent distribution of seed supplies to points accessible to the farmers.

Our task in arranging adoption of such innovations in developing countries involves eliminating some common behavior patterns, and establishing and maintaining others. Simply put, the objective is to change what people do when they choose a seed variety, for example. This requires that farmers do things that are well within their capacities, but which are most unlikely without training and incentives.

It should be remembered that training people gives them the ability to engage correctly in a particular behavior. Incentives may provoke behavior, but positive consequences which follow the behavior are what strengthen and maintain the use of the new skills. In the absence of reinforcing consequences, newly learned behavior will fall into disuse almost immediately.

Although ignorance is only one reason for the absence of desirable behavior, communication programs are traditionally designed to deal only with ignorance. Educators may produce effective instructional programs which impart knowledge, but fail to change behavior. Experimental analyses have repeatedly shown that even well-learned behaviors are not likely to be adopted when incentives are absent or negatively arrayed. In training agricultural extensionists, the CTTA Project must consider the social and physical environments in which the extensionists will have to perform, their access to materials and information, the skills which they must possess in order to do what is needed, and their motivation to perform. Even with very limited resources, significant change in agricultural practices can be assured through careful, coordinated efforts which address all of these elements.

If the premise that the purpose of training is to change behavior is accepted, then all of the reasons for absent behavior--not just ignorance--must be addressed. CTTA will address training as an agent of behavior change, not an end in itself.

1. What to teach: Selecting and specifying training objectives

While the selection of what to teach and the methods for teaching it may appear obvious to some, this will likely not be the case. The results of field research in the AID-supported Mass Media and Health Practices projects in Honduras and The Gambia, for example, suggest that a detailed analysis of the behavior patterns which may be instilled--and of those which currently exist--is not only helpful, it is essential.

The first step is to identify in great detail the behaviors which constitute competent and effective practice, with each component specified so that it is measurable and observable. Breaking the task into behavioral objectives provides a target for training. Behavioral objectives are nothing more than descriptions of what the farmer will be able to do if training is successful.

Two difficult processes are involved in this step. First, a consensus must be achieved among the intervention team with regard to every element of the innovation in each context where training will take place. Second, field investigation is needed to identify current practices, sources of information, and available resources. One possible outcome is the determination that different curricula must be prepared to deal with intranational variations in language, culture and geography. In countries like Honduras, cultural variations may be minimal. In others such as Ecuador, training must be carried out in several different languages. Extensionists who are going to train farmers must themselves be trained in instructional procedures. Field research will reveal whether this role is a familiar or foreign one, and what practices are currently employed.

Effective and empirically verifiable training must be built on behavioral objectives and accurate information about current practices. A multidisciplinary team can best put together these specifications. An inevitable outcome of this convocation of specialists is a list of target behaviors which vastly exceeds the realistic scope of training. What not to teach thus becomes as important as what to teach.

2. Whom to teach: Selecting the target audience

Identifying the individuals at the top of the decision-making structure within communities, and understanding who is respected and who influences decisions, are critical. Farmers, while the principal audience, are not a single entity. An analysis of early adopters, resisters, and positive deviants (those who

already have been highly successful) can lead to important decisions on whom to train and what techniques are best to use.

Some selections of training targets are readily made because few options are available, given the outcome of field research. In cases where there are many options, selections are based on such behavior modification criteria as performance cost, likelihood of positive consequences, relevant disincentives, compatibility with existing behavior patterns, and observability.

3. How to teach: Selecting teaching methods

Some of the relevant principles which should guide training are:

- Give reasons to care about what is learned. Principles and rationale should precede instruction in procedures.

- Provide a model to be observed and imitated. Teach primarily by example, using lecture only to provide rationale and explanation. Make sure that each trainee actually performs all of the elements of the new technology under supportive supervision.

- Gradually eliminate prompts until the trainee carries out the entire performance unaided. Initially, the trainee imitates the trainer. Then, the trainer stops modeling but provides verbal prompts. Next, the trainer drops the verbal prompts, but provides positive feedback at each step taken independently and executed correctly. Finally, the supervisor provides positive feedback only after the trainee has completed the entire performance independently.

- Analyze the task by its component parts. This is to assure that nothing is overlooked, and because learning each component is much easier than attacking the process as a whole.

- Use positive reinforcement and avoid errors. The task analysis should make each step in the learning process so small that trainee success is virtually assured from the outset. Reward each successful approximation with praise. Train extensionists to teach in small steps and use positive reinforcement when training farmers.

- Use uniform words, phrases, and formulations throughout. Make sure that instruction is coordinated internally, and that it is consistent with radio messages, posters, and written instructions; with what agronomists tell their clients; and with any other sources of

information about the new technology.

- Make the learning situation as realistic as possible. Use locally available materials during practice and training sessions.

The empirical validity of training is assured when it is required to produce directly observable behavior in every trainee. Pilot testing will reveal any gross inadequacies. Subsequent problems can usually be worked out by trainers in the field.

4. Stabilizing and improving a correct performance

How you learn and what happens immediately after you learn has a profound influence on how well you remember and execute a newly acquired skill. CTTA's long term training goals include continued competent performance for years, and the ability to carry out new technologies in any environment where they are needed--not just in the training environment. Therefore, training must continue beyond the point at which trainees acquire initial competence.

Newly learned skills are fragile, somewhat clumsy, and subject to disruption by change of setting. With only a small added effort, training can produce a fluent, stable, replicable performance. The keys are discrimination between competent and incorrect execution, acquisition of the ability to execute the procedures quickly and accurately, and the ability to carry through the procedures outside the training environment. The following guidelines are useful in stabilizing and improving acquisition of new skills.

- Change the performance from the model and determine whether the change is detected. A correct model is presented repeatedly during initial training; then the trainees are asked to identify a change in the performance which is an error of omission or commission. This process will help to establish the discriminations which let the trainee recognize whether each step is or is not performed correctly. This skill will allow them to maintain their own performance, and to recognize competence in those whom they instruct.

- Teach trainees to perform at a rate which approximates that of a well-practiced individual. Rate of execution (how long it takes to calibrate a sprayer, for example) provides an index of expertise. We call it fluency, something that comes with practice. Training is often terminated while the trainee is still slow and clumsy in his or her execution. But it should be continued

until the trainee is somewhat fluent.

- Give homework. Send the newly-trained people back to their base of operations with an injunction to practice the new behavior at the first opportunity. Assure that as little time as possible elapses before the trainee puts the newly acquired skills to work in the field. Trainers should tour field sites, if possible, to provide positive support and to aid in solving problems.

5. Incentives to learn and execute the new agricultural practice

Novelty and individualized attention to the trainees will result in enthusiastic participation unless the instructional program produces confusion or embarrassment, or is demeaning. Unfortunate outcomes are well known in field training, but not in well-conceived, pilot-tested programs.

The incentive to carry out the new technique day after day, month after month, year after year, must come from sources extrinsic to the training exercise. Training can make new training patterns available, but can do little toward motivating people to use them. Well-conceived training sensitizes the trainees to existing reinforcing conditions to which they might otherwise be insensitive. During the planning stage, the intervention team must take into account the issue of what consequences will support the new behavior.

III. In Closing

The techniques of behavior analysis offer the Communication for Technology Transfer in Agriculture Project an opportunity to have major impact on the complexities of agricultural technology transfer. While experience in applying systematic behavior analysis techniques to agricultural communication is scanty, many of the principles discussed in this paper have proved successful in excellent programs in other content areas. For example, the Agency for International Development has successfully applied behavior analysis to the problems of health care.

The individual principles by themselves are neither novel nor esoteric; many have emerged as the products of common sense and practical experience. Now, however, there is a solid theoretical basis for understanding why they work, and how to improve and extend their impact.

References Cited

Skinner. 1978.