Temporal Relationships in Therapy for Apraxia

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The purpose of this paper is to first draw upon similarities between learning of a stimulus or message and learning to produce speech responses. Secondly, the process of response differentiation will be outlined. Third, its application to developing responses in apraxia of speech will be suggested. Fourth, a task sequence minihierarchy of time intervals will be offered for training speech responses in apraxia.

Response differentiation, as described by Notterman and Mintz in 1965, provides an operational definition of events necessary for developing fine motor movements, such as those for speech. Events which take place when restoring verbal response patterns in rehabilitation of severe apraxia parallel the process of response differentiation. Here we are concerned with the programming or patterning of these fine motor movements so that speech responses can be evoked consistently with the same precise response characteristics.

To set the stage, let me take you back to a familiar paradigm, that of stimulus discrimination. The basis for response differentiation can be found in the stimulus discrimination process. Discrimination involves the repeated selective reinforcement of a response to specific properties of an external stimulus, such as an auditory message. Stimulus discrimination is the basic task which we use therapeutically in teaching discrimination, recognition or comprehension tasks involving visual or auditory messages. It is typically written as: S^D —— R —— S^R. For example, the person hears a stimulus (S^D) message, such as the word "cigarette", makes an appropriate response, (R), such as pointing, and then gets reinforced (S^R) if the response is correct. It has been suggested that response differentiation and stimulus discrimination were separate processes. It has now been demonstrated experimentally that the two processes are operationally the same. The difference between discrimination and differentiation lies in the classes of stimuli cuing the response. Keep in mind that in discrimination the stimuli are <u>exteroceptive</u>, and externally produced, such as hearing a word produced by another person.

Differentiation, such as the learner himself saying a word, involves repeated selective reinforcement of specific fine motor response characteristics. The forms of these fine motor responses are correlated with kinesthetic, auditory or proprioceptive feedback stimuli, or what we shall call motor response cues. These <u>internal</u> stimuli are created by the response. Since reinforcement is based on certain characteristics of the response, it is also based on the precise internal stimuli that occur with the response itself. The differentiation process might be represented as: $R_{\overline{S^{Di}}}S^R$. This shows that the response (R) and the response produced internal stimulus (S^{Di}), are necessary for reinforcement (S^R). Differentiation takes place through repeated selective reinforcement of certain precise internal motor response cues. In order to produce the response, the learner is discriminating internal, response produced cues which are associated with, and created by, a particular fine motor response. Thus when considering the response one can think of response produced cues or stimuli as necessary for reinforcement.

These motor response cues or internal stimuli acquire a "cuing" or discriminative stimulus function for successive responses. It is important to note that these motor response cues initially serve as internal discriminative stimuli for the next response and then for successive responses, in order for the client to learn to make the response consistently over a period of time.

To recapitulate then, stimulus discrimination involves discriminating exteroceptive stimuli such as a word produced by another person. Response differentiation involves discrimination of internal, response produced cues. The process is the same, the difference is whether the stimuli cuing the response are interoceptive; that is, created by the response, or exteroceptive; that is, externally produced.

In many communication situations, two discriminations are involved. Not only must the learner or patient come to discriminate those motor response cues associated with a specific verbal response in order to repeat; he must also learn to recognize or discriminate the exteroceptive cues or auditory messages that also call forth an imitative response. A fruitful area of research would be to develop a procedure which would indicate whether exteroceptive or interoceptive cues were of greater informative value to a particular brain damaged patient. (See "Rehearsal for naming in apraxia of speech" by L.R. Warren elsewhere in the Proceedings.)

Now, assuming that response differentiation is a specialized form of internal stimulus discrimination (as demonstrated in the experimental literature), then the behavioral laws applying to stimulus discrimination also should apply to response differentiation. Variables such as intensity, complexity, familiarity, and temporal relationships will affect learning of stimulus and/or response to varying degrees in a similar fashion.

For example, if it is initially easier to learn to discriminate stimuli which are grossly different in terms of their properties, then it should be easier to learn to produce responses that differ widely, than to learn to produce responses that are very similar and perhaps more difficult to discriminate. Severe apraxic patients are often more likely to make errors when two phonemes or words are produced in very much the same way, because the response-produced cues are also very similar. Learning to produce responses which differ widely should facilitate later learning of finer differences in responses. The point is that learning to produce a precise response is dependent upon learning to discriminate the particular response-produced cues associated with it. Whatever you can say about learning the stimulus you can say about learning the response. For example, if frequent rapid practice with continual feedback helps in faster learning of a stimulus, then frequent rapid practice will also have an effect on learning of a response.

Following the paradigm to application in the clinical setting, guidelines for therapy may be suggested. These are numerous, and some of them quite obvious. Perhaps less obvious are the effects of temporal relationships or time intervals between successive repetitions of words. I have observed the effects of delay intervals on attempts to imitate by three patients with severe apraxia.

Back to what we know about learning of a new stimulus so that we can relate this to learning the responses. The literature demonstrates that when learning a new response, if there is no time between the external stimulus and the response, then it is easier to respond. Secondly, as the time between occurrence of the stimulus and the opportunity to respond increases, it is more difficult to respond. Clinically, this is particularly important in

training a new stimulus or response and less important on a response which is being stabilized or can be rehearsed. This also applies to learning a verbal response.

We see that initially it is generally easier for the patient to say the word simultaneously with the clinician. This technique was suggested by Rosenbek and Wertz and others as an initial step in their treatment hierarchy. As a second step, the client says the word after the clinician. Thirdly, to further expand the Rosenbek hierarchy, a gradually increasing time interval may be inserted between the clinician's stimulus and the patient's opportunity to respond. This often makes it slightly more difficult to re-evoke the word. The patient has to mediate this time interval and still respond correctly. I have observed that many patients attempt to rehearse if they can, or just refuse to wait. As the patient acquires greater language facility or more skill with a particular response such as word or syllable, he is able to mediate the interval or delay more easily. Fourth, any interruption or distraction that occurs within this time interval may have a disruptive affect on the patient's ability to respond correctly. The distraction may result from externally produced activity or from internal response-produced activity. Response-produced distraction has the function of interfering with rehearsal and also creating a different set of response-produced stimuli within the interval.

Study Report

In order to examine the effects of time intervals on response accuracy during acquisition of imitation the following study was done. Subjects for this study were three (3) male residents in an extended care facility. All were aphasic with severe apraxia of speech as the primary symptom. They had received no previous speech and language treatment. All had unilateral left hemisphere lesions and right hemiplegia. One had a history of alcoholism and another of diabetes. Patients ranged from 8 to 18 months post onset. PICA overall percentiles ranged from 25 to 35.

Lists of 10 one-syllable words were trained briefly in imitation until the subject reached 70% correct. The list was then presented in the four conditions that follow. The order of presentation of the different conditions was counterbalanced and presented over two days.

I. Zero delay: The patient attempts to imitate the word immediately after the clinician.

II. Five second delay: The clinician says the word and then five (5) seconds later the patient attempts to imitate it.

III. Ten second delay: The clinician says the word and ten (10) seconds later the patient attempts to imitate it.

IV. Interpolated activity: With a fifteen (15) second delay procedure, the patient is asked to do a gestural imitation task as a distraction and then to say the word that he heard fifteen (15) seconds before.

Responses were scored in terms of whole accuracy. Results showed a decrement over delay in all patients and no ability to perform in the inter-

polated activity condition. Patient A, (PICA) 29%) repeated 45% of the words correctly in zero delay condition but only 15% of the words in the five (5) second delay. He was not able to perform in the other conditions. Patient B (PICA 35%) repeated 60% of the words correctly in zero delay condition, 25% in five second delay condition and 15% in ten second delay condition. He was not able to perform in the interpolated activity condition. Patient C (PICA 25%) repeated 50% of the words correctly in zero delay condition but only 20% in five second delay and 5% in ten second delay. He was not able to perform with interpolated activity.

Therapeutic Implications

Results from this small study are by no means definitive, but after observing these results on these few patients, it seemed worthwhile to suggest that time intervals may affect the severely apraxic patients's ability to say a word that he is in the process of acquiring. It is not known if delay intervals affect responses which are already stabilized. It is not known if higher level patients will also show the effects of delay. Since we cannot at this point accurately predict when delay intervals or distractions will affect performance, the clinician may want to do an informal assessment to find out if the patient is in fact affected by delay or distraction.

If it has been ascertained that a client's ability to reliably make a verbal response is affected by delay intervals, then a hierarchy can be constructed to expand the patient's ability to handle delay and still make the correct response. Remember that initially the motor cues created by the patient's first response will act as internal stimuli for the next time he makes the response. Delay will make the cues more remote. Rehearsal will re-create those stimuli.

A hierarchy of temporal relationships in this type of task would begin with evoking the response imitatively. Once the patient has made a correct response, the clinician allows the client to say the word or phoneme over and over in rapid succession without interruption. This facilitates learning of the pattern, because the response-produced stimuli are now cues for the succeeding responses which occur immediately thereafter. After the first step where the patient repeats the word over in quick succession, the client will be able to produce the response more consistently.

The next step is done to stabilize the newly acquired word. I use Base 10 data sheets to keep track of the words that are said consistently. In order to expand the use of these words over time, a small time interval or delay of a few seconds was inserted between successive repetitions of the word. The patient would say the word every time the clinician pointed to him. I will not suggest the amount of the delay intervals to you. That seems to vary with patients. You should determine this by noting how much of an interval the patient can tolerate.

The third step in the hierarchy is to gradually increase the time interval between successive, uninterrupted repetitions of the response. As the time interval is extended, the response becomes stabilized. The internal response-produced cues from the previous response are more remote in time from the present response. The "cues" from the previous response are thus faded, and not so immediate. I have observed that patients may attempt subvocal rehearsal when the interval between responses is increased. If this occurred then I remained at the interval until the patient could bridge the delay without

obvious rehearsal.

In the fourth step, distractions were added within the time interval between responses. Mildly distracting activity, such as shuffling things on top of the desk, asking the patient to pick up something, or asking the patient to imitate gestures were used. This use of distraction seems to be the most difficult step for all of the patients. By inserting the distractions within the delay, any attempt to rehearse was interrupted. In addition, the distraction may reduce dependency upon having said the word previously. The task becomes more like that of saying the word volitionally, without cues. With this distracting activity in the delay interval, some patients could not perform except on one or two familiar words. Furthermore, they could only perform if they were allowed to rehearse. If this occurred, and the patient could no longer progress, then several high-priority words received intensive drill and another mode of communication, such as gesture, was trained to be used in conjunction with, or in place of, the verbal mode.

To briefly review, then, the first step involves numerous quick repetitions of the target word. Second, a slight delay is inserted between successive uninterrupted repetitions of the word. Third, the amount of delay interval is increased and fourth, distractions are inserted within the delay intervals.

The small hierarchy offered to you is intended to be used when clients' performance is inconsistent and when their performance decreases over short delay intervals. These clients may need to develop rehearsal skills as well. The hierarchy is further intended to be incorporated within the task sequence that you are using, when appropriate. The primary function of gradually extending a delay interval is to stabilize a newly acquired response. Distractions also increase the patient's difficulty in maintaining a response. Delay intervals will affect different clients to varying degrees. Some higher-level patients may not show the decrement over time on a new task. It is important to remember that other variables will also affect performance and should likewise be controlled if possible. Lastly, by simply being sensitive to the possible effects of delay intervals, the clinician is more likely to observe subtle temporal changes in tasks that are causing difficulty.

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