

Biofeedback and Locus of Control: Some Considerations for Future Research

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Much recent research has focused on the relationships between biofeedback training and Rotter's construct of locus of control. Where locus of control has been used as the dependent variable, the efficacy of biofeedback training has been more clearly established than when locus of control has been as the independent variable. This paper reviews the literature on these relationships and suggest several areas for improving the methodology for future research.



The LOC Construct and BFT

Rotter (1954) postulated the basic formula of social learning theory to be the potential of a behavior occurring in a particular situation as a function of the psychological situation, expectancy, and reinforcement value. In other words, how people behave in a particular situation depends on how they perceive the situation, their expectations as to whether certain behaviors will result in certain outcomes (i.e., reinforcements), and the value of the reinforcements in that situation. Locus of control is a generalized expectancy construct; holding reinforcement value and psychological situation constant, "internals" believe that one's behavior controls one's outcomes while "externals" hold fate, luck, chance, or "powerful others" as primary determinants of outcome. Rotter (1966) developed the I-E Scale, a unidimensional measure of this expectancy (LOC) construct, as a means of determining the extent to which an individual espoused internal versus external beliefs.

One aspect of BFT would be to view it as a mechanism for controlling aspects of the autonomic nervous system previously thought to be involuntarily regulated (except by Hindu Yogis and Zen masters). As such, the concept of gaining control over these "involuntary" functions should be more intuitively appealing to internals than externals. One would thus hypothesize that internals would respond more successfully to an intervention such as BFT aimed at increasing self-control. This view would more typically endorse the concept of LOC as a relatively stable personality trait, which, according to Zimet (1979), would be unaffected by intervention.

Numerous studies have been done exploring the relationship between various forms of biofeedback training (BFT) and the internal-external locus of control (LOC) of reinforcement construct first espoused by Rotter (1966). These studies have recently been reviewed by Zimet (1979) and Qualls and Sheenan (1981). Most of these studies fall into 2 areas of examination: (1) where a measure of LOC was used as the independent variable to examine the differential effectiveness of BFT for individuals differing in LOC beliefs and (2) where LOC was the dependent variable to examine if there was a shift toward increased internality after BFT intervention. The purpose of this paper is to review the major literature exploring any relationship between BFT and LOC in each of the two focal areas and to suggest improvements in the methodology that may clarify the past differential findings for future research.

An alternative view would be that of LOC as a less enduring belief system that is amenable to change. This view would postulate that teaching self-control to externally controlled individuals would modify their beliefs/expectancies in a direction of increased internality.

Literature Review

LOC as the Independent Variable

It seems intuitively obvious that internals would be more successful in a self-control task, while the nonmodifiability of externality is one that is subject to debate.

The literature has failed to demonstrate conclusively the superiority of internals to succeed in BFT. As a whole, Zimet (1979) concludes that the research is contradictory and inconclusive, while Qualls and Sheenan (1981) feel that the efficacy of electromyographic (EMG) training has been established as more preferable for internals than relaxation training, particularly when the motivational factors are absent.

Within the review articles of Zimet (1979) and Qualls and Sheehan (1981) there are several studies cited that have demonstrated that internals are better able to lower muscle tension on EMG (Carlson, 1977; Fotopoulos & Binegar, 1977; Reinking, 1977; Reinking, Morgret, & Tamayo, 1976). Others were cited as having failed to find differences between internals and externals with EMG (Carlson & Feld, 1978; Herzog, 1976; Modell, 1977; Stephenson, Cole, & Spann, 1979; Stern & Berrenberg, 1977). Hall (1979) also found internals to be better able to gain mastery in EMG, but that externals could improve their performance when given specific relaxation instructions. With other types of BFT, the superiority of internals to increase heart rate (Schneider, et al., 1978), produce alpha (Greer, 1975), and control skin potential level (Volow, Erwin, and Cipolat, 1979) has also been found, while Dolecki (1976) found no difference between internals and externals in ability to increase alpha.

Ollendick and Murphy (1977) pursued the relationship between LOC and BFT one step further. They found that internals were better able to decrease heart rate when a cognitive relaxation procedure directed toward more self-control was used, while externals did better under muscular relaxation training (which placed more focus on the instructions from the experimenter). They concluded that the muscle relaxation training procedure was superior for externals since it encompassed a more externally imposed structure and guidance. Thus, as Zimet (1979) points out, it may be the instructional set, not the BFT itself, that is the key variable.

Zimet points out a salient criticism of much of the research comparing internals and externals. Most of the studies cited involved only three or four BFT sessions, thus the therapeutic value of BFT over an extended period of time has not had an effect. Zimet hypothesizes that over an extended training period any differences between internals and externals might disappear. This is consistent with social learning theory, since the effect of a generalized expectancy is posited to be greater in novel than in familiar situations.

LOC as the Dependent Variable

When LOC is used as the dependent variable, the literature more clearly points to the efficacy of BFT. Here the emphasis is on BFT as a means of teaching self-control, thus fostering internality beliefs.

With EMG training, numerous studies have demonstrated a pre-post shift in the Ss' LOC orientation toward internality (Carlson, 1977; Carlson & Feld, 1978; Cox, Freundlich, & Meyer, 1975; Kappes & Michaud, 1978; Stern & Berrenberg, 1977). Plotkin (1979) demonstrated similar results with alpha training, while Leigh (1978) found that borderline hypertensives who volunteered for BFT were more internal to begin with than nonvolunteer hypertensives.

In comparing thermal BFT, relaxation training, and autogenic training, Tindel (1978) found no change in LOC, while Reed and Saslow (1980) found the same lack of change with EMG training. However, Reed and Saslow did report an increase in internality after relaxation training.

Surprisingly, Holliday and Munz (1978) found no shift toward internality with a small group of psychosomatic Ss who received EMG training, but did find a shift toward internality with a nonpsychosomatic group. This raises an issue of the type of subject population for which there may be a shift toward internality.

However, as Zimet (1979) points out, "the rationale for attempting to modify externality is based on a proposed causative relationship between externality and certain behaviors, the existence of which has not been proven. Furthermore, the cause-effect relationship, if it does exist, may be quite complex, involving interactions with other variables. In reviewing the literature dealing with the use of biofeedback as a modifier of externality, the possibility exists that the modification of an external locus of control may be merely an exercise in futility" (pp. 873-874).

One additional issue which Zimet (1979) raises is the lack of follow-up testing done in most of the studies. While the efficacy of BFT for modifying externality has been shown to be immediately effective, the longer range effects remain unproven. Thus, Zimet states that the permanence of shifts toward internality remains unclear.

Areas of Methodological Improvement

Almost all of the studies cited have used Rotter's (1966) I-E measure of LOC orientation or some other unidimensional measure of this construct. However, Stern and Berrenberg (1977) question if LOC is in fact a unidimensional construct. They found that only Rotter's items that measured personal control were related to the effects of biofeedback, while other items and the total scale were not related.

The issue of LOC as a unidimensional construct was addressed by Levenson (1973) when she developed a multidimensional LOC scale. This set of scales has one scale for internality and two which assess external beliefs: chance and control by powerful others. By encompassing LOC within a multidimensional framework, there is more precise measurement of the relative extent to which an individual perceives personal control over his/her outcomes. This lack of precision in measurement with a unidimensional scale may explain some of the disparity in findings with BFT, and would suggest that future research would be better served by using a multidimensional measure of LOC.

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Even the use of a multidimensional measure may not explain all the disparity in the past research. Rotter's scale as well as Levenson's measure generalized expectancies. However, from a clinical standpoint, BFT is usually used with regard to the treatment of some health related problem. As such, more precise measurement would be gained from measuring a person's health expectancies rather than their generalized expectancies. This very issue was addressed by Wallston, Wallston, Kaplan, and Maides (1976) in their development of a health locus of control (HLC) scale where they stated, "It stands to reason that research whose aim is the prediction of behavior in specific situations could profit from the use of more specific expectancy measures" (p. 580).

The concept of a HLC scale was later revised by Wallston, Wallston, and DeVellis (1978) to incorporate Levenson's distinction between chance and powerful others externality in their development of the multidimensional health locus of control (MHLC) scales. Where health-related behaviors are key outcomes in the use of BFT, the disparity of much of the past research may be clarified by the use of a more goal specific measure such as the MHLC scales.

Going back to Rotter's original formulation of social learning theory, one important variable that has often been overlooked in much of the research is psychological situation (e.g., the person's perceptions of the BFT). One study which did examine this issue (Stern & Berrenberg, 1977) indeed found that the *Ss*' LOC beliefs were mediated by whether they attributed the EMG reduction to personal effort or properties of the task. Ollendick and Murphy (1977) worded their instructions for structured and nonstructured relaxation training so as to further exacerbate differential perceptions between internals and externals, and found those differential perceptions to be a key distinction. Thus, just because BFT is a means of teaching self-control, it does not mean that an external will perceive the self-control aspect and not attribute any gains to chance, the machine, or the experimenter/clinician. Future research (particularly when LOC is the dependent variable and externals are being examined for pre-post shifts toward internality) needs to focus more on the perceptions of the *Ss* and the attributions they make in the experiment. Where the BFT is used to intervene with a health-related problem, perhaps information about the relationship between BFT and the health problem may be a key intervening variable.

Another important variable in Rotter's original model, which much of the research has overlooked, is reinforcement value. In other words, what is the "payoff" to the *S* in the experiment? Where the *Ss* are college students participating in a research study for credit in a class, the reinforcement value of learning control may be minimal, thereby confounding any research using BFT with internals and externals. Thus, the type of *S* in the experiment (as Holliday and Munz, 1978 found) and, in particular, their motivations for participating in the study, may be an important consideration, particularly when the distinction is between such diverse groups as college students and clinical patients.

Even when the *Ss* are real patients being treated for a health-related problem, the issue of reinforcement value is still important, particularly in cases where LOC is used as the independent variable. Wallston and Wallston (1981) discuss the need to measure the value of good health as a reinforcer. Thus, there is no theoretical reason to expect HLC to predict health behavior, unless some measure of health value is

taken into account. In other words, if the Ss do not place a high value on health, why should they bother to learn biofeedback as a means of control over the health behavior?

This issue may explain why there has been so much disparity in the research where LOC has been used as the independent variable. Wallston and Wallston (1981) discuss the use of the MHLIC scale, and point out the power of using a regression model (rather than ANOVA) where the internal health LOC (IHLC) and chance health LOC (CHLC) scores have been standardized and combined with (e.g., multiplied by) a health value score to make more accurate predictions of health behavior.

In a recent article Carlson, Bridges, and Williams (1982) incorporated several of the above ideas in their research design. Surprisingly, they found that for individuals with high health value, HLC externals did better than HLC internals in a relaxation training task using both EMG and autogenic training. (For low health value the internals did do better than externals.) They hypothesized that their unexpected results for high health value internals may have been due to a higher generalized drive state for this group, which in turn produced greater muscle tension. Additional considerations could involve: (1) their use of students as subjects, who were not trying to alter a health behavior for clinical reasons, (2) the confounding of two types of relaxation-inducing procedures which may have differing effects for internals and externals (Ollendick and Murphy, 1977), and (3) the use of only two relaxation training sessions.

Hopefully, future research with BFT and LOC will address the issues raised in this paper. If so, perhaps the relationship between the two will become more clear, and greater strides can be made in understanding the complex interactions between individual differences and treatment approaches.

In summary, this paper reviews Rotter's LOC construct and its relationship to BFT when LOC is used as the independent and dependent variables. Issues raised in this paper include:

1. whether the LOC construct is unidimensional or multidimensional;
2. the specificity of LOC measurement in relationship in BFT;
3. the need to address the psychological situation of the Ss (e.g., the attributions they make to the biofeedback machine, the mode of training, the clinician, etc.); and
4. the reinforcement value of BFT, particularly in nonclinical Ss, but also the need to measure the health value of clinical Ss, particularly where health LOC is used as the independent variable.

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