

Instructional Control: Developing a Relational Frame Analysis

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ABSTRACT

The aim of this article is to provide a functional analytic approach to the experimental analysis of instructional control and to the 'specifying' properties of instructions. The primary theoretical attempts to provide a technical definition of instructions or rules are first outlined, and it is argued that these attempts have not provided clear functional-analytic criteria on which to establish a technical definition of an instruction. The empirical work that has been conducted on instructional control is then considered and the lack of an agreed technical definition of an 'instruction', and especially the ill-defined nature of the term 'specify', are considered. Finally, current theoretical and empirical work on Relational Frame Theory is used to construct a technical definition of 'specify' on which to base a functional-analytic approach to instructions and instructional control.

Key Words: Instruction, rule governed behavior, contingency specifying stimuli, derived stimulus relations, Relational Frame Theory, relational network, Relational Evaluation Procedure

RESUMEN

El propósito de este artículo es presentar una aproximación analítica-funcional al análisis experimental del control instruccional y de las propiedades "especificativas" de las instrucciones. En primer lugar se señalan las primeras propuestas teóricas para definir técnicamente las instrucciones y reglas, y se argumenta que dichas propuestas no han proporcionado claramente los criterios analíticos-funcionales sobre los que establecer una definición técnica de una instrucción. Pasamos después a considerar el trabajo llevado a cabo sobre control instruccional, así como la falta de acuerdo para una definición técnica de la instrucción y la naturaleza indefinida del término "especificar". Por último, se utiliza la actual investigación teórica y empírica de la Teoría de los Marcos Relacionales para construir una definición técnica de "especificar" sobre la que basar la aproximación analítica-funcional a las instrucciones y el control instruccional.

Palabras clave: Instrucción, comportamiento gobernado por reglas, estímulos que especifican contingencias, teoría de los marcos relacionales, red relacional, procedimiento de evaluación relacional.

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A FUNCTIONAL ANALYTIC APPROACH TO INSTRUCTIONAL CONTROL: BEING SPECIFIC ABOUT 'SPECIFYING'

There is a considerable body of empirical research on the effects of instructions on human behavior. Indeed, research on instructional control can be traced to Ayllon and Azrin (1964), who used instructions in a clinical setting, and Kaufman, Baron and Kopp (1966), who compared the effects of different instructions on responding to a VI 60s schedule. Numerous further studies have analyzed various aspects of instructional control including the facilitation of behavior (Baron, Kaufman & Stauber, 1969; Weiner, 1970), the relative insensitivity of behavior under the control of instructions (Harzem, Lowe & Bagshaw, 1978; Leander, Lippman & Meyer, 1968; Lowe, Harzem & Bagshaw, 1978; Lowe, Harzem & Hughes, 1978; Matthews, Shimoff, Catania & Sagvolden, 1977; Shimoff, Catania & Matthews, 1981), and the variables that may control such sensitivity (Barrett, Deitz, Gaydos & Quinn, 1987; Catania, Matthews & Shimoff, 1982; LeFrancois, Chase & Joyce, 1988).

The theoretical basis for much of this work was provided by Skinner (1969). Specifically, Skinner distinguished between behavior controlled by instructions (rule governed behavior), and behavior that was established by direct exposure to contingencies (contingency-shaped behavior). Skinner suggested that rule governed behavior was controlled by "rules derived from the contingencies in the form of injunctions or descriptions which *specify* occasions, responses and consequences" (Skinner, 1969 p. 160; emphasis added). In short, Skinner observed that the change in the behavior of the listener was in accordance with the particular contingency specified by the rule. Consequently, Skinner defined rules or instructions as contingency specifying stimuli and despite considerable debate over this definition (e.g., Chase & Danforth, 1991; Hayes & Hayes, 1989; Schlinger, 1993; Zettle & Hayes, 1982), it remains perhaps the most influential within behavior analysis.

One possible shortcoming of Skinner's account is that he did not explain how an instruction, which is essentially a series of arbitrary stimuli (usually sounds or written words), comes to *specify* a contingency. We have come to believe that the lack of a clear functional definition of specification has had serious implications for the conceptual and experimental analysis of instructional control, which we will consider subsequently. The key point here is that a technical definition of 'specify' should provide the functional criteria that are necessary to distinguish instructional from other forms of stimulus control. The current article aims to supplement Skinner's description of instructions by providing such functional criteria.

The current article aims to provide a functional analytic approach to the experimental analysis of instructional control and in particular to the 'specifying' properties of instructions. In the first part of this article, we will briefly review the primary theoretical attempts to provide a technical definition of instructions or rules. We will then demonstrate that these approaches have not provided clear functional-analytic criteria on which to establish a technical definition of an instruction. Specifically, we will focus on the lack of a functional-analytic approach to the contingency 'specifying' properties of instructions. In the second part of this paper, we will consider some of the

empirical work that has been conducted on instructional control to date. A consideration of this work will illustrate that the lack of an agreed technical definition of an 'instruction', and especially the ill-defined nature of the term 'specify', has impeded the development of a coherent and systematic experimental analysis of instructional control. We will then draw on current theoretical and empirical work on relational frame theory, and especially on the concept of the relational network, in order to propose a technical definition of 'specify' on which to base a functional analytic approach to instructions and instructional control. Finally, we will outline the preliminary procedures that we are currently developing to establish 'specifying' properties in previously neutral stimuli.

Before continuing, however, we should explain why we will avoid using the terms 'rule' and 'rule governance.' An unfortunate aspect of the theoretical literature on instructions and instructional control concerns the lack of rigor in the use of the terms 'rule', 'rule-governed behavior', 'instruction' and 'instructional control'. Not only have the terms 'rule' and 'instruction' been used interchangeably within the theoretical literature, but the term 'rule' has also been used to refer to both antecedents of behavior (e.g., Open the door) and descriptions of past behavior (e.g., When he gets to the door, he opens it) (O'Hora & Barnes-Holmes, 2001; Reese, 1989). Indeed, some researchers have suggested that the term 'rule' in particular has too great a variety of meanings in everyday usage to be useful as a technical term (Catania, 1989; Vargas, 1988; Ribes-Inesta, 2000). Consequently, we will use the term 'instruction' to refer solely to verbal *antecedents* of the type used in the empirical literature on instructional control and rule governance. The term 'instructional control' will refer to the predictable patterns of responding that occur in the presence of 'instructions'. It is hoped that these preliminary topographical definitions will delineate sufficiently the performances that must be accounted for by the functional-analytic approach to instructional control that will constitute the focus of the current paper (cf. Catania, 1984).

THEORETICAL APPROACHES TO INSTRUCTIONS AND INSTRUCTIONAL CONTROL

Definitions of instructions and instructional control within the theoretical literature may be divided into two different types. Some researchers have suggested that instructions are contingency specifying stimuli and have focused on the effects of such stimuli on human behavior. We will consider the definitions of instructions proposed by Skinner (1969), Cerrutti (1989), and Schlinger (1993) as representative of this approach. Other researchers have focused on those response classes that may be described as under instructional control (e.g., pliance, tracking, and augmenting) and have suggested that instructions be defined as those stimuli that occasion such behavior (Zettle & Hayes, 1982). An examination of these theoretical approaches will illustrate the pivotal nature of the term 'specify' in the definition of instructions and will underline the necessity of a functional-analytic account of instructional control that provides an explicit technical definition of this term.

Instructions as Contingency Specifying Stimuli

The most widely accepted theoretical account of instructional control was provided by Skinner (1969). Initially, Skinner pointed out that instructions had similar effects to discriminative stimuli (i.e., they changed behavior in a predictable fashion), but that the effects of instructions were established in different ways (p. 138). Skinner also observed that the change in the behavior of the listener was in accordance with the contingency specified by the instruction (p. 139). For instance, given the instruction "If you *carry the bags*, I will tip you", the listener is likely to *carry the bags* because a contingency has been *specified* between carrying the bags and receiving a tip. Skinner concluded, therefore, that instructional control was the result of the contingency specifying properties of instructions. This definition provided a starting point for the experimental analysis of the complex effects of instructions on human behavior that had been demonstrated at that time by researchers such as Ayllon and Azrin (1964), and Kaufman, Baron, and Kopp (1966). Moreover, Skinner's (1969) work encouraged behavioral researchers to examine examples of complex human behavior that underlined the utility of behavior-analytic principles in domains that were dominated by non-behavioral approaches to psychology.

Skinner's (1969) account suggested that instructions allowed for the transmission of discriminative stimuli (p. 138). An unfortunate side-effect of this description of instructions was that some researchers approached instructions as verbal discriminative stimuli. Although some instructions (e.g., "Stop", "Press fast") may function as discriminative stimuli, and there is empirical evidence to suggest this type of control (Galizio, 1979; Okouchi, 1999), it is not clear how such an analysis could fully explain the effects of novel instructions in the absence of a direct history of reinforcement for following such instructions. However, one attempt to address this aspect of instructional control was provided by Cerrutti (1989).

Instructions as Sequences of Discriminative Stimuli

Cerrutti (1989) addressed the problem of control by novel instructions by pointing to the combination of previously established discriminative stimuli in novel sequences. Imagine, for example, that a history of explicit reinforcement is provided for following the two instructions 'pick up the ball' and 'look at the dog'. If the listener is then presented with the novel instruction 'pick up the dog', an appropriate response may follow because the novel instruction is simply composed of parts of the two previously reinforced instructions (cf. Barnes-Holmes et al, 2000). According to this logic, instructions that control novel behavior would seem to be nothing more than sequences of discriminative stimuli, and thus a complete behavioral explanation of instructional control is possible without requiring a separate functional definition of 'specification'. Indeed, this argument may be particularly seductive, largely because discriminative stimuli are precisely defined (Michael, 1980) and have a long history of empirical and theoretical utility in both basic and applied research. In Cerrutti's words; "Skinner's functional definition of [instructed] behavior as an example of discrimination supplants in its

greater generality, structural definitions based upon particular classes of responses and stimuli" (p. 261).

Unfortunately, control by sequences of previously established discriminative stimuli fails to explain certain vital aspects of instructional control. First, it is unclear how such an account deals with the fact that an instruction need not directly occasion a response (Schlinger, 1993). The instruction "When the bell rings leave the room", for example, alters the function of the bell such that the bell rather than the instruction occasions leaving the room. Second, stimuli that have never formed part of an explicitly reinforced interaction can control responding as part of an instruction. Let us consider an extension to the situation described in the previous paragraph in which a child is given a dog for Christmas and is told 'The dog's name is Fluffy'. If the child is then immediately asked to 'Pick up Fluffy', we would assume that the child would pick up the dog. In this case, however, the word 'Fluffy' has never participated in an instruction that has been explicitly reinforced, and so the verbally established responses to this final instruction cannot be explained in terms of discriminative control as traditionally defined. Indeed, explanations of instructional control in terms of discriminative stimuli seem to require discriminative control to occur in the absence of a history of explicit reinforcement. As a result, if such responding was to be explained in terms of discriminative control, we would require a new definition of the discriminative stimulus itself. Thus, in order to preserve our rigorous functional-analytic definition of discriminative control, new functionally defined terms are required to account for such performances. We suspect that it was this very problem that lead Schlinger (1993) to propose an alternate approach to instructional control.

Schlinger's Approach to Instructions and Instructional Control

Schlinger (1993) suggested that we need to distinguish between the type of control exerted by discriminative stimuli and by complex instructions. In order to elucidate this distinction, Schlinger analyzed the instruction suggested above: "When the bell rings, stand up and walk out of the room" (p. 10). Schlinger proposed two reasons why this statement is not a discriminative stimulus for the appropriate behavior. Firstly, the statement does not evoke or set the occasion for the specified response. Rather, it is the bell that occasions the response. Secondly, Schlinger pointed out that "we cannot be sure that the statement has been used in the discrimination training that we would normally associate with stimuli that we would call Sds" (p. 10). That is, the responses (i.e., standing up and walking out) may not have been reinforced more frequently in the presence of the statement than in the absence of the statement, as would be the case if the statement were a discriminative stimulus (Michael, 1980). Moreover, the control of responses by novel instructions precludes the possibility that such responses have been established by the type of training that establishes the function of discriminative stimuli.

Schlinger proposed, therefore, that instructions could be described as function altering stimuli. Function-altering operations, such as respondent or operant conditioning, are those that alter the behavioral functions of particular stimuli. Specifically, Schlinger

suggested that

"Verbal FASs can alter several behavioral functions, including (a) the evocative functions of stimuli that mimic the evocative effects of discriminative or motivational events, (b) the evocative functions of stimuli that mimic respondent conditional stimuli, and (c) the reinforcing or punishing functions of stimuli that mimic the same effects that result from nonverbal procedures." (p. 12)

Although Schlinger outlined the above effects, he admitted that the "necessary and sufficient properties of stimuli that make them [function altering stimuli] are not clear" (p. 12). Indeed, Schlinger attempted to set out more explicit criteria; "a function-altering [contingency specifying stimulus] must name at least two events" (p.12), but offered the following caveat; "in sophisticated speakers it is not uncommon for a single word to have function-altering effects" (p.12). As a result, Schlinger suggested that "irrespective of the form of the verbal stimulus, if it is function altering, then we may speak of it as a [instruction]" (p.12). Critically, in the current context, however, he did not propose a history of reinforcement that would establish such function altering properties. As such, although Schlinger pointed out quite succinctly the problems with Skinner's approach to instructions and instructional control, he did not provide an alternative account in terms of a particular history of reinforcement. Schlinger's excellent critique of Skinner's position, therefore, did not provide the explicit function analytic criteria required to define and thus identify instructional control.

Pliance, Tracking and Augmenting

We have now considered a number of attempts to develop a functional-analytic approach to instructions and argued that these definitions are incomplete. Critically, these accounts do not address how or why 'contingency specifying stimuli' effect behavior. Zettle and Hayes (1982), however, suggested an alternative approach to behavior under instructional control. Specifically, these authors suggested that "[instructed] behavior is behavior in contact with two sets of contingencies, one of which includes a verbal antecedent", and that these "verbal antecedents are [instructions]" (p.78). Furthermore, they suggested three main functional units of listener behavior; these are pliance, tracking and augmenting. Pliance is instructed behavior under the control of apparent speaker-mediated consequences for a correspondence between the instruction and the relevant behavior (p.80), tracking is behavior under the control of the apparent correspondence between the instruction and the way the world is arranged (p.81), and augmenting refers to instructed behavior under the control of apparent changes in the capacity of events to function as reinforcers or punishers (p.81). Zettle and Hayes, therefore, point to three ways in which verbal stimuli can control behavior. More importantly, they describe explicitly histories of reinforcement that may control responding to such stimuli. As such, Zettle and Hayes do provide a functional approach to the types of performances that may be occasioned by instructions. According to our view, however, their account is also incomplete in that they do not address the 'contingency specifying' aspect of

instructions to which both Skinner (1969) and Schlinger (1993) drew attention.

In fact, Zettle and Hayes (1982) explicitly avoided "the thorny problem of what it means to 'specify' contingencies" (p. 78) in order to focus on the histories of reinforcement that control responding in accordance with instructions. However, as Skinner and Schlinger pointed out, the 'specifying' or referential aspect of instructions seems central to the explanation of the control of responses by verbal stimuli. Consider, for example, one of the instructions suggested earlier: "If you *carry the bags*, I will tip you". This phrase transforms the events that are *specified* by it, in that a *carry* response is more likely in the presence of *the bags*. Zettle and Hayes do not suggest a history of reinforcement that accounts for the control of this response (carrying) by a particular stimulus (the bags) based on a series of arbitrary sounds (i.e., the instruction). This is a critical aspect of instructional control. In short, although Zettle and Hayes (1982) did provide a convincing description of the maintenance of instructed performances once they have been established, this account did not address the effect of novel instructions on behavior.

The attempts to develop a functional definition of instructions and instructional control by Skinner, Cerrutti, Schlinger, and Zettle and Hayes have helped to delineate the types of performances that we describe as under instructional control. We have also argued that these approaches do not provide complete functional analytic accounts of instructional control. More specifically, they fail to specify precisely the stimulus events that we may describe as instructions or the response events that we may describe as under instructional control. In the following section, we will consider the consequences that this lack of a complete functional analytic approach to the study of instructions and instructional control has had on empirical research in this field.

CONCEPTUAL AMBIGUITIES IN THE EXPERIMENTAL ANALYSIS OF INSTRUCTIONAL CONTROL.

In the previous section, we considered the foremost approaches to instructions and instructional control in the theoretical literature and we concluded that none of the foregoing approaches addressed the issue of what it means to 'specify' a contingency. In this section, we consider how the lack of a functional approach to the specifying properties of instructions has affected the empirical literature on instructional control. We will first draw attention to the various topographical stimulus presentations that have been used as instructions in the literature. Focusing on those stimulus presentations, we will consider whether conclusions from the empirical literature on instructions may have been limited by the use of *functionally distinct* instructions across studies. We will then focus on characteristics of the approach to the experimental analysis of instructional control and suggest that this approach is unusual within behavior analysis. The final part of this section will contend that the limitations of the current empirical literature stem directly from the lack of a coherent functional analytic approach to instructional control that provides functional criteria for the identification of instructions.

Topographically Distinct 'Instructions' in the Empirical Literature

The instructions used in the empirical literature vary greatly: "Press 3 and you will lose 17 points" (Schmitt, 1990), "You must choose one of the three bottom figures that is the most different with respect to the top one" (Martinez-Sanchez & Ribes-Inesta, 1996 p.308), "Go fast" (Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986), a small dot that denoted the correct character's position (Danforth, Chase, Dolan, & Joyce, 1990 p. 100). All of these instructions conform to varying degrees to Skinner's definition of instructions as contingency specifying stimuli. Yet, these instructions are also remarkably different. The instruction presented by Schmitt (1990) is a paradigmatic example of a contingency specifying stimulus, in that a behavior and its consequence are directly specified in the instruction. The instruction presented by Martinez-Sanchez and Ribes-Inesta (1996) prescribes a behavior but does not prescribe a consequence. The instruction to which subjects were exposed in the Hayes et al. (1986) study prescribes the rate of behavior for the duration of a session without prescribing a particular response or consequence. Finally, correct responses on a keyboard were denoted by a dot next to a character in a similar position on a computer screen in the Danforth et al. (1990) study. The dot functioned as an instruction to the extent that it 'prescribed' the correct response.

Topographically different stimuli have been used as instructions based, presumably, on the assumption that 'contingency specifying stimuli' constitute a functional stimulus class. However, as we argued in the previous section, the term 'specify' has not been defined in a precise way. Consequently, studies on instructional control have been based on a poorly defended assumption (i.e., that 'contingency specifying stimuli' constitute a functional class). This fact may explain the wide variety of stimuli and procedures that have been used to study instructional control in the laboratory. Because we do not appear to have a clear functional-analytic definition of 'specify', there is still no clear basis on which to include or exclude stimuli or procedures in the study of instructional control. Thus, although all of the instructions used in the various empirical studies on instructional control may be called 'contingency specifying stimuli', it is surely possible that at least some of those stimuli were different functionally in perhaps very important ways.

Functionally Distinct 'Instructions' in the Empirical Literature

We can identify topographical characteristics that vary across studies in order to evaluate the assertion that topographically different 'instructions' have been used in the empirical literature. Such an assertion is thus immediately verifiable. When we consider whether or not *functionally* different instructions have been used in studies on instructional control, we cannot be so certain. In order to establish whether or not functionally different instructions have been used we must consider the behavioral history that gives rise to the performances that we observe. When we start to consider this issue, an interesting conceptual double-bind develops.

On the one hand, we may assume that the behavioral history of subjects within

a particular verbal community are similar and thus that similar instructions will have similar effects. Indeed, it seems that such an assumption is necessary if such instructions are to be used as independent variables in the first place. However, in the foregoing section, we pointed to the wide topographical variety of the stimulus presentations used in such research. Thus, the topographical differences in stimulus presentations across studies that we have previously pointed out may be functionally significant. Moreover, empirical evidence for the functional significance of topographical differences in instructions is demonstrated by the documented effects of the accuracy or inaccuracy of instructions (e.g., deGrandpre & Buskist, 1991; Newman, Hemmes, Buffington & Andreopoulos, 1994). To accept this position, therefore, is to admit that the instructions used may have been functionally distinct across studies.

On the other hand, if we acknowledge that the behavioral history of subjects within a particular verbal community may be quite different then we must accept that we do not have access to those histories that established the controlling properties of the instructions used. From this position, it is then difficult to generalize from one participant's performance to another within studies because we are not sure of the history that gives rise to each individual subjects' behavior (see Schoenfeld & Cumming, 1963). Furthermore, consideration of the variation in subjects' behavioral histories in the verbal community is emphasized by the "enormous inter-subject variability in this area" (Newman et al, 1994) that results from participants responding differently to the same natural language stimuli (e.g., Galizio, 1979; Hayes, Brownstein, Haas & Greenway, 1986; Newman et al, 1994). Thus, this argument implies that instructions may have functioned differently not only across studies, but also within studies.

Critically, the apparent lack of clarity within the empirical literature on instructional control within and across studies may hinder progress towards an important scientific goal, the construction of general conclusions based on the findings of multiple studies. In the next section, the reasons for the foregoing conceptual limitations will become clearer as we compare the experimental analysis of instructional control to other empirical literature within behavior analysis.

The 'Unusual' Approach to the Analysis of Instructional Control

We previously suggested that empirical researchers have attempted to analyze instructional control by adopting Skinner's (1969) assumption that 'contingency specifying stimuli' constitute a functional class. As an unfortunate result, the vast majority of studies in the empirical literature have examined instructions as stimuli with special properties (e.g., contingency specifying properties) that are explained in terms of the subject's ill-defined pre-experimental history. Moreover, we have yet to provide an experimental history in a laboratory setting that leads to 'specifying' of contingencies by stimuli or, in other words, to the establishment of previously neutral stimuli as instructions. At the present time, therefore, we cannot provide a clearly defined generic behavioral history that generates the 'specifying' properties of an instruction that can be distinguished functionally from, for example, basic discriminative or respondent stimulus properties.

Suggesting a technical term without specifying a particular behavioral history that gives rise to the performance denoted by the term would not normally be accepted within behavior analysis. Let us consider the literature on discrimination training or respondent conditioning as examples of typical behavioral research. In these areas, previously neutral stimuli are included in controlled histories of reinforcement and after exposure to these histories of reinforcement, we then measure changes in responses to these previously neutral stimuli. In this way, we can attribute the observed effect to the history of reinforcement in the laboratory and thus predict and control that effect on the basis of that experimental history. However, in the literature on instructional control, the stimuli used (instructions) are not initially neutral, but rather are assumed to have particular effects based on ill-defined pre-experimental histories. In short, an experimental preparation can readily be used to establish either discriminative or eliciting properties for a neutral stimulus, but as yet it is unclear how a previously neutral stimulus might acquire the 'specifying' properties of an instruction.

The implications arising from this unusual approach to the empirical investigation of instructional control are quite serious. First, if we attribute control in experiments on instructions to a pre-experimental history, we cannot change that history in order to achieve prediction and control of behaviors occasioned by instructions. Second, because we cannot alter the pre-experimental history in order to demonstrate an effect (except in rather crude ways, e.g., using preverbal infants), whatever effect we may observe will thus be 'explained' in terms of an inaccessible source of control. Third, if we continue to explain the results of empirical research on instructional control in terms of an ill-defined pre-experimental history, we are failing to address a core issue in the experimental analysis of human behavior (i.e., the technical definition of 'specify' that will allow for a functional-analytic approach to instructions).

THE PROPOSED FUNCTIONAL ANALYTIC APPROACH TO INSTRUCTIONAL CONTROL

In the previous section, we suggested that the various definitions of instructions in the current theoretical literature have allowed for a wide range of methodologies in the analysis of instructional control that have been largely unconstrained by agreed functional-analytic criteria. We also suggested that previous approaches to instructional control have not clearly addressed how an instruction 'specifies' a contingency. One solution might be to interpret 'specify' as 'specify verbally', but this then requires a clear functional definition of 'verbal'. As will be argued subsequently, Skinner's (1957) approach to verbal behavior explicitly did not address the issue of specification or reference. This fact led Parrott (1987), over fifteen years ago, to point out that if "verbal stimuli are not regarded as having a referential quality in the context of verbal behavior, how is it that they can have this character in the context of rule governance?" (p. 276). The current absence of a functional approach to instructions or instructional control may be traced, therefore, to the lack of a clear functional definition of specification or reference. At this point, we should tackle the functional definition of verbal behavior, and more importantly specification, before dealing directly with instructions.

Verbal Behavior

In 1957, Skinner published his famous behavioral interpretation of human verbal behavior. Although this text was widely condemned by nonbehavioral psychologists and psycholinguists (e.g., Chomsky, 1959), it was generally accepted, within the behavior-analytic community, as a valuable contribution to the study of human language. However, in the early 1970's the seminal work of Murray Sidman on equivalence classes provided a different approach to the study of language to that outlined in Skinner's (1957) *Verbal Behavior*. Although Sidman's work was not designed to undermine Skinner's earlier work, some have interpreted the concept of stimulus equivalence as constituting a threat to Skinner's (1957) account of verbal behavior (e.g., see Sidman, 1994, pp. 562-573). With the emergence of Relational Frame Theory (RFT) (e.g., Hayes, 1991; Hayes & Hayes, 1989), the perceived gap between Skinner's treatment of verbal behavior and the study of equivalence classes and related phenomena widened. Certainly, some RFT researchers criticized certain aspects of Skinner's work (e.g., Hayes, 1994; Hayes & Wilson, 1993). Nevertheless, a synthesis of Skinner's *Verbal Behavior* with RFT has recently been offered (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000). Specifically, these authors proposed that combining Skinner's (1957) work with RFT will help to develop a modern, functional-analytic treatment of human language and cognition that makes contact with Skinner's *Verbal Behavior* and the study of derived stimulus relations.

Based on earlier work by Chase and Danforth (1991), Barnes-Holmes et al., (2000) adopted a definition of verbal relations that was consistent with Skinner's (1957) analysis, but added one critical feature. Chase and Danforth (1991) defined verbal behavior as a relation in which:

- a. A response is emitted by an individual;
- b. The critical consequence is provided by the behavior of another individual (the listener);
- c. The listener's behavior is explicitly conditioned to respond to the stimuli produced by the first individual;
- d. and the explicit conditioning of the listener involves conditioning to arbitrary stimulus relations, probably conditioning to relational classes, for example, equivalence classes (1991, p. 206).

The authors pointed out that, feature 'a' distinguishes behavior from nonbehavioral events, feature 'b' distinguishes social behavior from nonsocial behavior, and feature 'c' specifies the requirement that the listener's behavior be conditioned to the stimuli produced by the speaker in order for the listener to consequte reliably the speaker's behavior. Feature 'd' was added to Skinner's definition for two main reasons. First, most if not all social behavior involves the qualities described in features 'a', 'b', and 'c', and thus at least one other defining feature is needed if verbal behavior is to be distinguished from virtually all other forms of social behavior. Second, examples of behavior that are often described as verbal, include a symbolic or referential quality (Barnes & Holmes, 1991; Hayes, 1991; Hayes & Hayes, 1989; Skinner, 1986), or generalized relations among arbitrary stimuli (Hayes, 1994; Hayes & Hayes, 1989; Skinner, 1986; see also

Barnes-Holmes & Barnes-Holmes, 2000). By adding feature 'd', therefore, Chase and Danforth (1991) concluded "that verbal behavior involves arbitrary, social or culturally determined relations among events in the world, symbols, pictures, gestures and sounds." (p. 206). The core argument we wish to make here is that feature 'd' helps provide the functional-analytic definition of 'specify' that was missing in Skinner's earlier work. In other words, when an instruction *specifies* a contingency, functionally this means that the instruction participates in a relational network with particular events in the world (see next section). In adopting this approach to instructional control, we will propose a definition of what constitutes an instruction that both incorporates Skinner's position and takes advantage of recent research into instructional control and derived stimulus relations. In particular, the definition we propose draws heavily on research into Relational Frame Theory (Barnes & Holmes, 1991; Hayes & Hayes, 1989, 1992; Hayes, 1991; Hayes, Barnes-Holmes & Roche, 2001), and thus a brief introduction to this approach is necessary.

Relational Frame Theory

Both humans and nonhumans can respond to a wide variety of nonarbitrary stimulus relations (e.g. Reese, 1968). Relational Frame Theory argues, however, that at least some organisms can learn to respond to arbitrary stimulus relations and that performances such as stimulus equivalence, some forms of exclusion, and verbal behavior itself can be analyzed as instances of such responding. More specifically, given a sufficient history of training in nonarbitrary relational responding (e.g., discriminating stimuli based on physical magnitude), these relations may be applied arbitrarily to any novel set of stimuli in an appropriate context. In effect, RFT argues that nonarbitrary relational responding can become generalized such that it is arbitrarily applicable to any set of relata.

Let us consider, as an example of the foregoing, a person with an appropriate history of responding to nonarbitrary "greater than" relations. In the context of size, this person will respond to a nickel as "greater than" a dime. With continued training of this type, across multiple exemplars, the relational repertoire (i.e., responding according to a "greater than" relation) will generalize further such that it is applicable to events that are unrelated along physical continua. Thus, when the comparison relation is arbitrarily applied (e.g., in the context of value) this person may respond to a dime as "greater than" a nickel (i.e., a dime is of greater *arbitrary* value). These types of arbitrary relational responses are controlled by contextual features additional to the formal properties of the stimuli being related (e.g., value rather than coin size). In this sense, such responses are arbitrarily applicable; and the relations that define this application are called relational frames.

Relational frames show the contextually controlled qualities of mutual entailment, combinatorial entailment and transformation of function. Mutual entailment occurs when a specific relation in one direction entails a relation in the other (e.g., A is *greater* than B entails that B is *less* than A). Combinatorial entailment refers to the combination of derived stimulus relations (e.g., if A is *greater* than B and B is *greater* than C, then C

is *less* than A and A is *greater* than C by combinatorial entailment). Transformation of function occurs when the stimulus functions of one event in a relational network alter the functions of another according to the derived relation between the two events (e.g., if A actualizes a fear response and A is *greater* than B, then B will actualize *less* fear than A).

The transformation of function provides the cornerstone of the RFT account of verbal behavior and instructional control, in that it shows how an arbitrary stimulus (e.g., a word) can acquire the properties of another stimulus. Hayes et al. (1998) proposed the following example to illustrate this point (see Figure 1). A child is trained that the written word C-A-N-D-Y is called ‘candy’, and that the written word also goes with actual candy. In other words, the child has two relations directly trained: C-A-N-D-Y → ‘candy’, and C-A-N-D-Y → candy. When this child eats candy for the first time and enjoys it, candy may become a discriminative stimulus for approach and an eliciting stimulus for salivation and emotional responses through direct operant and classical

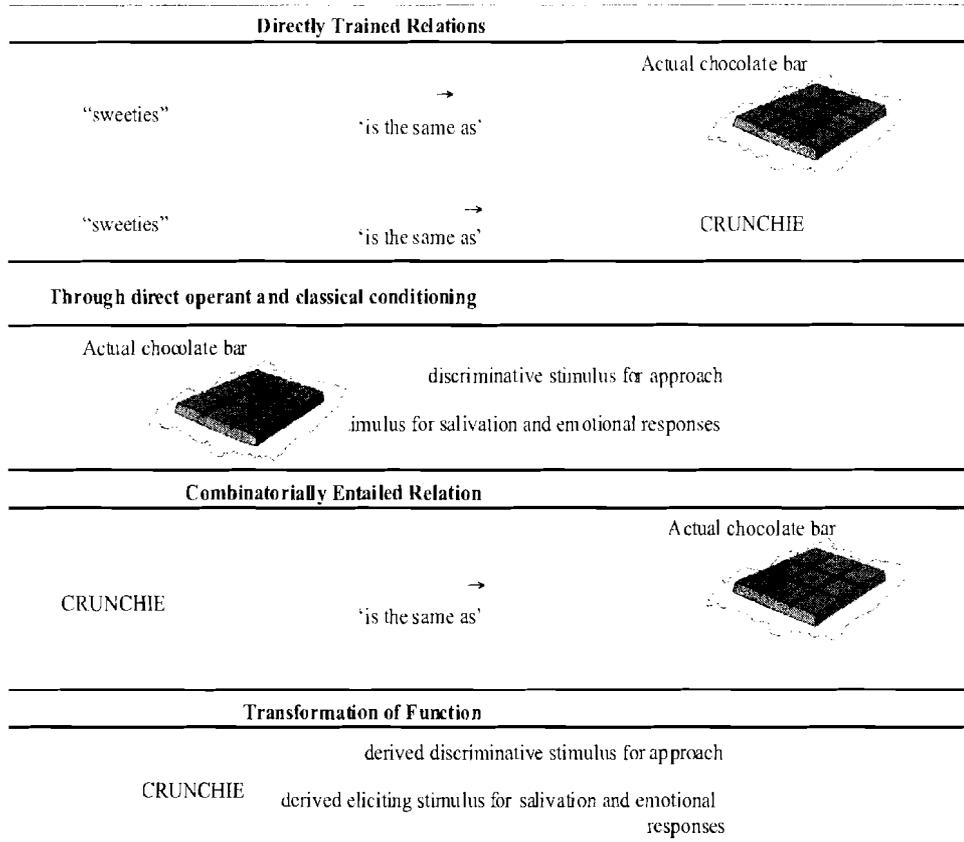


Figure 1: Transformation of stimulus functions in accordance with a combinatorially entailed relation

conditioning. Now, upon hearing his mother say 'candy' from another room, this child may smile, begin to salivate, and go to the other room even though (a) candy is not visible, (b) the child has no direct history of reinforcement for approach in response to the word 'candy', and (c) 'candy' has never been a conditioned stimulus in classical conditioning. The word 'candy' has acquired some of the functions of the actual candy (e.g., approach, salivation, smiling) not through a direct history, but indirectly through its participation in a learned pattern of relating events to one another (see Figure 1).

The key point here is that the transformation of function in accordance with derived stimulus relations constitutes, from the relational frame perspective, a technical or functional analytic definition of specification or reference. In other words, for a behavioral event to be classified as verbal specification, it must possess to some degree the properties of mutual entailment, combinatorial entailment and transformation of function. This definition readily provides the basis for constructing a functional definition of instructions based on the transformations of functions in accordance with multiple stimulus relations, or relational networks and it is to that issue that we now turn.

Relational Frame Theory and Instructional Control

From the perspective of Relational Frame Theory, an instruction is comprised of transformations of function in accordance with multiple stimulus relations. In this way, the current approach directly addresses the 'specifying' nature of instructions in order to provide a more complete behavioral approach to instructions and instructional control. From the RFT perspective, a prototypical instruction may be interpreted as a complex relational network that includes relational frames of co-ordination (that allow arbitrary stimuli to 'specify' other events) and "If...Then" or "Before... After" relational frames that transform the functions of the events in terms of those frames.

To appreciate the functional definition of instructions being offered here, consider the following illustrative example from Hayes et al. (1998). A person says, "I'm going on vacation in two weeks and will be gone for a month. If you water and mow my lawn each week I am gone, the following month I will pay you \$100." This is a thoroughly specified contingency. It alters the functions of calendar time, the grass, and the implements needed to mow and water the lawn. It specifies all the major elements of a contingency: a temporal antecedent, topographical form and the context within which it should occur, and the nature and delay of a consequence. The contingencies that are specified could not be effective through direct training, in part because greatly delayed consequences are simply not effective in the absence of verbal instructions.

The interpretation of this instruction in RFT first requires the examination of the specific relational frames and the cues that occasioned them, and then the functions of the events that are transformed in terms of these relations and the cues that occasioned these transformations. Several core relational frames seem necessary for understanding this instruction. Some terms (e.g., grass) need to be in frames of co-ordination (sameness) with classes of physical events. Before-after relational frames, made more specific by numerical temporal terms, are used to specify a temporal antecedent and a consequence (e.g., begin mowing *after* 2 weeks). If-then relational frames are used to specify the

contingent relations (e.g., *if* you mow and water weekly for 4 weeks, *then* you will receive \$100). Terms like 'mow' alter the behavioral functions of the grass, and the transformation of stimulus functions provides these actions and contexts with some of the features of the specified consequence (e.g., approach).

The complexity of the foregoing example renders it a clear instance of instructional control. In such cases, the relational frame interpretation would appear to be immediately useful, in that it provides a technical language for describing and potentially explaining how such complex verbal sequences control the behavior of listeners across such large temporal gaps. When verbal antecedents are somewhat simpler, however, the relational frame interpretation of instructional control seems less important. On the one hand, following the simple instruction 'Press Fast', used in some schedule experiments, may involve behavioral processes similar to those outlined in the previous example (i.e., if 'Press' and 'fast' both participate in derived stimulus relations). On the other hand, this type of behavior is clearly less complex than the earlier example and similar forms may be readily established through a direct history of explicit reinforcement (e.g., providing points in a behavioral experiment for rapid pressing in the presence of the words 'Press fast'). We do acknowledge, therefore, that the RFT approach may be less useful when the relational networks and the transformations of functions are limited, and in this case the basic FFT concept of the "verbal stimulus" would seem to be sufficient (see Barnes-Holmes, et al., 2001).

The RFT approach to instructional control aims to develop new and possibly fruitful areas of research in behavior analysis, while conserving the rigorous functional analytic science that Skinner founded in the first half of this century. As a first tentative step towards developing these areas, in the next section of this article we will describe an empirical model of the RFT interpretation of instructional control.

FROM THE THEORETICAL TO THE EMPIRICAL: ESTABLISHING 'SPECIFYING' PROPERTIES IN PREVIOUSLY NEUTRAL STIMULI

In an earlier section, we suggested that previous theoretical approaches did not suggest experimental preparations that would establish the functions of an instruction in previously neutral stimuli. In contrast, we have begun to take the first steps, within the context of the current RFT interpretation, towards generating instructional control by providing a controlled behavioral history in the laboratory. In order to facilitate this enterprise, recent methodological advances in the area of derived stimulus relations have been utilized. Specifically, the Relational Evaluation Procedure (REP; see Barnes-Holmes, et al., 2001; Hayes & Barnes, 1997) has been used to establish repertoires of complex relational responding and we have taken advantage of this procedure in order to analyze instructional control using previously neutral stimuli.

For the purposes of the current model of instructional control, we assumed that an instruction, in its simplest form, consists of a relational network of equivalence and before/after relations. This model was based on the following example provided by Hayes and Hayes (1989), "When the bell rings, then go to the oven and get the cake".

| | | |
|-------|----------------|--|
| Bell | <i>Same as</i> | Sound of bell  |
| Then | <i>Same as</i> | <i>Before</i> |
| Go to | <i>Same as</i> | Approach  |
| Oven | <i>Same as</i> | Actual Oven  |
| And | <i>Same as</i> | <i>Before</i> |
| Get | <i>Same as</i> | Get  |
| Cake | <i>Same as</i> | Actual Cake  |

Figure 2: Relational network interpretation of the rule “When the bell rings, then go to the oven and get the cake” (Hayes & Hayes, 1989)

As illustrated in Figure 2, this sentence can be conceptualized as an instruction insofar as some of the words participate in equivalence classes with actual events (i.e., the word “bell” with actual bells, the word “oven” with actual ovens), and other words function as relational cues for before and after relations (i.e., “when”, “then” and “and” establish the sequence; bell BEFORE oven BEFORE cake, or by mutual entailment; cake AFTER oven AFTER bell). We recognize that this interpretation may be somewhat simplistic and, in its current form, would not capture the many and varied subtleties of instructional control in the natural environment. Nevertheless, we believe that it has served as a useful starting point for the analysis of instructional control as a form of derived relational responding.

Modeling Instructional Control

A simple instruction may therefore involve responding in accordance with the derived relations of Same, Different, Before, and After. The research that we are currently conducting consists of two stages –a pretraining stage and a test for instructional control. The pretraining stage involves establishing the functions of Same, Different, Before and After for four abstract stimuli (e.g., !!! as Same, %%% as Different, etc.) using a complex computer-based pre-training procedure (Dymond & Barnes, 1995; Steele &

Hayes, 1991).

Participants are then exposed to a test for instructional control. In the test for instructional control a sequence response is specified by a relational network that includes the previously established contextual cues for Same, Different, Before and After. A prototypical test probe is presented in Figure 3. Each test probe consists of a visual presentation including nonsense syllables, colored squares and contextual cues (i.e., !!!, %%%, etc., are represented in the boxed area of Figure 3 by the uppercase words SAME and BEFORE). Specifically, the test probe in Figure 3 may be described as follows: C1 Before C2 Before C3 Before C4, where C1 is the same as B1, and B1 is the same as A1 (green); C2 is the same as B2, and B2 is the same as A2 (red); C3 is the same as B3, and B3 is the same as A3 (yellow); and C4 is the same as B4, and B4

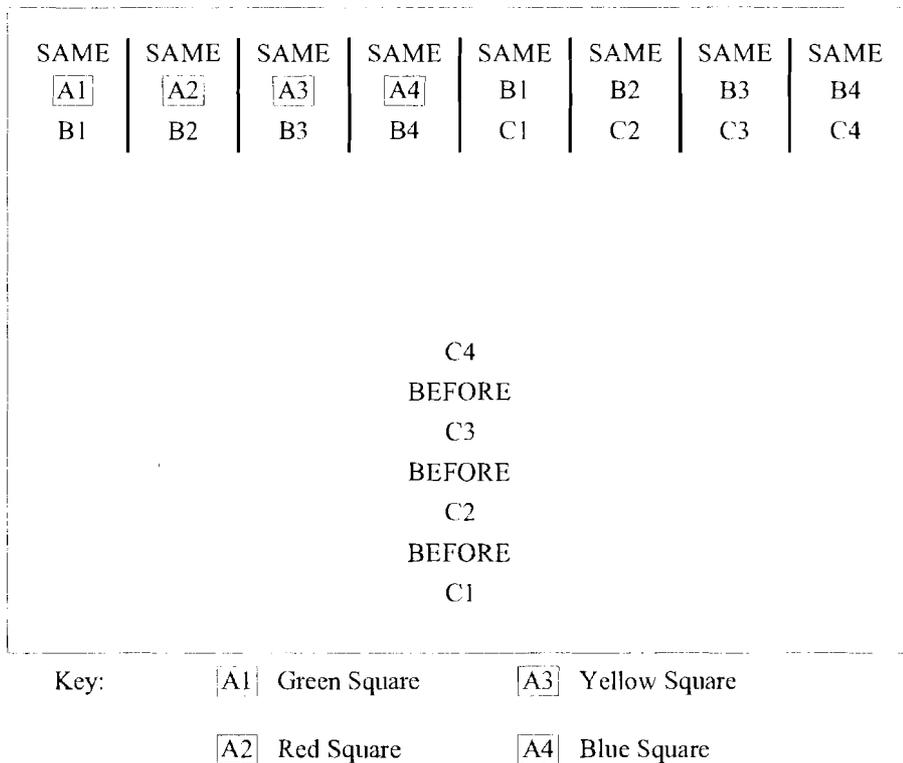


Figure 3: Example of a test probe from the test for instructional control. For each test probe, a particular four key response constituted a correct response. In the above probe, C1 is 'before' C2, C3 and C4, and C1 is the same as B1, and B1 is the same as A1 (green), and, thus, subjects should press the green key first. Working similarly for C2, C3, and C4, subjects were expected to complete the following four key sequence: Green Red-Yellow Blue. There was no contingent reinforcement for responses to probes in this test.

is the same as A4 (blue). Four colored response keys (green, red, yellow, and blue) on the computer keyboard are available to the participant, and responding is predicted based on the presented network of Before and Same relations. The predicted sequence response in this case is Green→Red→Yellow→Blue. From an RFT perspective, such performances constitute a basic model of instructional control in that response sequences are verbally *specified* in accordance with *derived* Same relations between A and C stimuli, and *derived* Before relations among A stimuli.

In the Maynooth laboratory, a number of subjects have demonstrated the expected performances when exposed to the above procedure. We now hope to take advantage of this work in order to examine some of the many effects reported in the literature on instructional control. For example, the often reported 'insensitivity to contingencies' effect may be modeled in the laboratory by providing relational networks that specify sequence responses that are then either not reinforced or explicitly punished. Insofar as a subject continues to demonstrate responding in accordance with the relational networks (i.e., demonstrating a lack of control by differential consequences for sequence responding), this may be seen as an empirical analog of the insensitivity phenomenon. The current model of instructional control allows us to approach such effects in the context of a precisely defined and tightly controlled behavioral history. Of course we recognize the instructional control observed in our studies likely depends on the pre-experimental verbal histories of our adult human participants. Nevertheless, one of the aims of the current program of research is to model these pre-experimental verbal histories and thus contribute towards an understanding of instructional control and human language and cognition more generally.

CONCLUSION

Skinner described an instruction or 'rule' as a contingency specifying stimulus and we have suggested one way in which instructions may specify contingencies, in functional terms. The approach to instructional control suggested herein marries the approach to instructions proposed by Skinner, Cerrutti, and Schlinger with the approach to instructional control by Zettle and Hayes. In addition, we take advantage of some of the more recent work on equivalence classes and derived stimulus relations (e.g., Barnes & Keenan, 1993; Barnes & Roche, 1997; Dymond & Barnes, 1995; Hayes, Kohlenberg, & Hayes, 1991; Roche & Barnes, 1996; Sidman, 1971; Sidman & Tailby, 1982; Steele & Hayes, 1991). In so doing, the current approach addresses the 'specifying' nature of instructions, a critical aspect of any approach to instructions and instructional control. According to the current approach, an instruction may be understood as a complex relational network that includes relational frames of co-ordination (that allow arbitrary stimuli to 'specify' other events) and "If...Then" or "Before... After" relational frames that transform the functions of the events in terms of those frames (e.g., *Do A Before Do B*). This approach constitutes our attempt to both supplement previous theoretical approaches and also to provide a functional-analytic basis for further empirical investigation of instructions and instructional control.

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