The Relationship Between Stimulus Equivalence and Verbal Behavior

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Despite the apparent similarity between stimulus equivalence and verbal behavior, these phenomena have been described in different terms. With different terminologies for each phenomenon, the precise nature of their relationship is difficult to determine. To explore this relationship, this paper first defines stimulus equivalence using a synthesis of the mathematical definition of the equivalence relation and Sidman and Tailby's (1982) definition. Selected examples of stimulus equivalence are then described as verbal behavior using Skinner's (1957) terminology. The paper then cites instances of verbal behavior that cannot be described as stimulus equivalence and considers whether there are instances of stimulus equivalence that cannot be described as verbal behavior.

Although verbal behavior and stimulus equivalence have evolved as separate areas within behavior analysis, there is an apparent similarity between their subject matters (Hayes & Hayes, 1989). This similarity is evident in early stimulus equivalence studies which used explicitly verbal tasks (e.g., Sidman, 1971; Sidman & Cresson, 1973; Sidman, Cresson, & Wilson-Morris, 1974). Findings from recent stimulus equivalence research also suggest a relationship between stimulus equivalence and verbal behavior. As Hayes and Hayes have noted, studies which unequivocally demonstrated stimulus equivalence have used verbal human subjects, whereas those which failed to obtain stimulus equivalence employed nonhumans or nonverbal humans.

Behavior analysts also study stimulus equivalence and verbal behavior for some of the same reasons. Work in both areas serves to counter the arguments of Chomsky and other linguists, who have claimed that behavioral theories cannot account for the acquisition and use of language, particularly behaviors which occur for the first time without direct training (i.e., "emergent relations"). Work in the areas of verbal behavior and stimulus equivalence counters these arguments by specifying the environmental determinants for language and emergent relations.

For instance, Skinner's (1957) book *Verbal Behavior* specifies the controlling variables for language and thus provides a functional alternative to the linguistic approach. In sections on abstraction, tact extension, minimal response repertoires, and manipulative autoclitic frames, the book also addresses emergent relations (cf., Alessi, 1987). A number of empirical investigations (e.g., Boe & Winokur, 1978; Braam & Poling, 1983; Carroll & Hesse, 1987; Chase, Johnson, & Sulzer-Azaroff, 1985; Hall & Sundberg, 1987; Lamarre & Holland, 1985; Lee, 1981; Lee & Pegler, 1982; and Sundberg, San Juan, Dawdy, & Argüelles, 1990) have studied the verbal relations and analyses presented in *Verbal Behavior*.

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Stimulus equivalence research has studied specific patterns of emergent relations using a conditional discrimination format and has begun to specify the controlling variables for those relations. As Sidman and Tailby (1982) have indicated, "Linguistic analysis has challenged functional behavioral analysis to account for new behavior that has no apparent reinforcement history . . . . The equivalence paradigm takes a short step in this direction by generating new and seemingly unreinforced matching to sample and oral naming" (p. 20).

Despite the apparent similarity between stimulus equivalence and verbal behavior, these phenomena have been described in different terms. Verbal behavior has been described primarily using Skinner's (1957) terminology, whereas stimulus equivalence has been described using Sidman and Tailby's (1982) conceptual system. With different terminologies for each phenomenon, the precise nature of their relationship is difficult to determine.

To explore the relationship between stimulus equivalence and verbal behavior, this paper will first define stimulus equivalence using a synthesis of the mathematical definition of the equivalence relation and Sidman and Tailby's (1982) definition. Then, selected examples of stimulus equivalence will be described as verbal behavior using Skinner's (1957) terminology. The paper will then cite instances of verbal behavior that cannot be described as stimulus equivalence and consider whether there are instances of stimulus equivalence that cannot be described as verbal behavior.

STIMULUS EQUIVALENCE DEFINED

Sidman and Tailby (1982) defined stimulus equivalence as a synthesis of reflexivity, symmetry, and transitivity, three properties taken from the mathematical definition of the equivalence relation. In the mathematical definition, relation R is an equivalence relation for set S if the properties of reflexivity, symmetry, and transitivity are satisfied for all members of S (Meserve, Pettofrezzo, & Meserve, 1964). The mathematical definition can be illustrated using an example.

Suppose relation R is "the same age as" and set S includes all the people in town X. Reflexivity is defined as: aRa. ARa states that any person (a) in town X is the same age as him or herself. Symmetry is defined as: if aRb, then bRa. If person a is the same age as person b, then b is the same age as a, for all persons a and b in town X. Transitivity is defined as: if aRb and bRc, then aRc. If person a is the same age as b, and b is the same age as c, then a is the same age as c, for all persons a, b, and c in town X. Since the above statements are true, and reflexivity, symmetry, and transitivity are all demonstrated, relation R is said to be an equivalence relation for set S.

Sidman and Tailby (1982) applied the mathematical definition of the equivalence relation to conditional discrimination performance in the typical stimulus equivalence task. In the context of this task, Sidman and Tailby defined reflexivity as generalized identity matching. When a novel stimulus is presented as a sample, the subject selects a formally identical comparison stimulus, without direct training. The upper left diagram in Figure 1 shows reflexivity with three formally different stimuli: A, B, and C. The diagram shows that when A, B, and C stimuli are presented as samples, the subject selects the same stimuli as comparisons, without direct training. The broken lines indicate that A-A, B-B and C-C are emergent relations.

The upper right diagram shows symmetry with the same stimuli. After prior training to select comparison B in the presence of sample A (an A-B relation), the subject then selects comparison A in the presence of sample B (a B-A relation), without further training. Also, after the B-C relation is trained, C-B emerges. The solid lines depict trained relations and the broken lines show emergent relations.

In transitivity (shown in the lower left diagram), two relations are trained and one emerges. After A-B and B-C are trained, A-C emerges.

When reflexivity, symmetry, and transi-

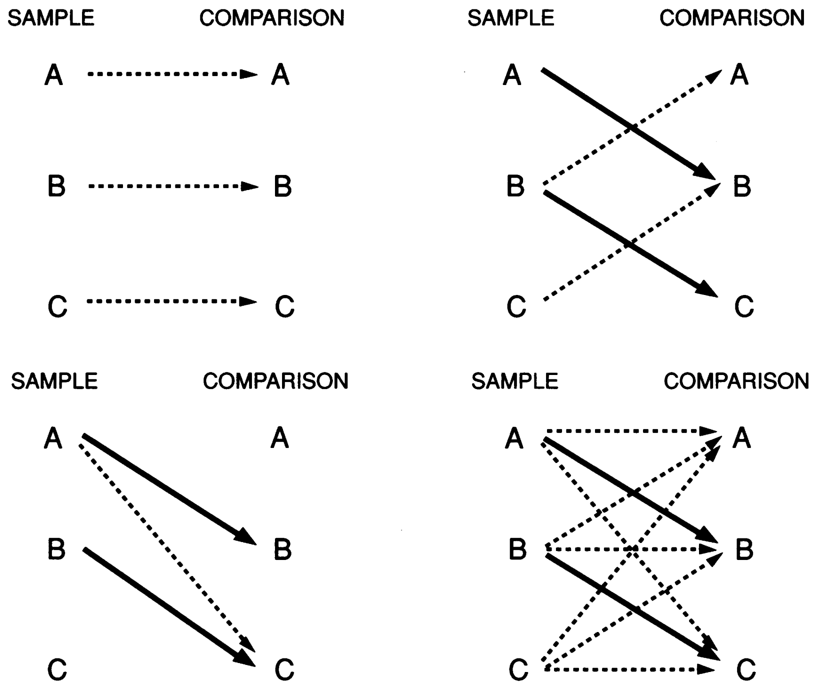


Fig 1. The four diagrams illustrate patterns of conditional relations that define reflexivity (upper left), symmetry (upper right), transitivity (lower left), and stimulus equivalence (lower right), according to Sidman and Taiby (1982).

tivity are all present, along with the C-A relation (which is symmetric with A-C and may emerge after A-C emerges), stimulus equivalence is demonstrated, as shown in the lower right diagram. This diagram shows that stimulus equivalence with three stimuli involves nine relations—two trained and seven emergent relations. After these relations are established, all stimuli, A, B, and C, are members of an equivalence class; that is, they are interchangeable as samples and comparisons with themselves and with one another, and all relations are bidirectional. A minimum of three stimuli is required for stimulus equivalence, but theoretically there is no maximum (although empirically, there might be).

The definition of stimulus equivalence used in this paper is a synthesis of the mathematical definition of the equivalence relation and Sidman and Tailby's (1982) definition of stimulus equivalence. In order to specify the elements of the present definition, it is necessary to identify certain key differences between mathematical equivalence and Sidman and Tailby's approach. These differences can be summarized as follows: (1) the task formats differ, (2) mathematical equivalence specifies the type of task (R) involved, whereas Sidman and Tailby's equivalence does not, and (3) mathematical equivalence seems to involve either conditional or discriminative relations, whereas Sidman and Tailby's equivalence involves only conditional relations. Each of these differences is explained below.

First, the task format specified by the mathematical definition differs from the task format specified by Sidman and Tailby. With the mathematical definition, the definitions of reflexivity, symmetry, transitivity, relation R, and set S are presented to an individual, who then states whether R is an equivalence relation for set S. In everyday terms, this might be called a "logical" task format. With Sidman and Tailby's approach, on the other hand, the subject is presented with sample stimuli and selects comparison stimuli, actually producing examples of reflexive, symmetric, and transitive relations. For example, if the subject is presented with sample A and selects comparison A (from several alternatives), the subject has produced an example of a reflexive relation. Like Sidman and Tailby's definition, the present definition focuses on the *production* of equivalence, which has been of greater interest to behavior analysts. (This is not to say that mathematics students do not actually produce examples of the equivalence relation when solving problems—they do. The point is simply that in mathematics, R may be an equivalence relation for set S regardless of whether subjects produce examples of the phenomenon.)

Second, mathematical equivalence specifies the type of task (R) involved, whereas Sidman and Tailby's version of equivalence does not. For instance, there are a variety of different tasks that satisfy the mathematical definition of the equivalence relation, such as "means the same thing as," "equals," "lives in the same town as," "is the same age as," etc. Sidman and Tailby's equivalence does not distinguish between these tasks; all seem to be included in a single category: "sample-comparison interchangeability." As in the mathematical definition, the present definition will specify the task (R) which relates the elements of set S to one another.

Third, the mathematical definition of the equivalence relation seems to include both conditional and discriminative relations, whereas Sidman and Tailby's definition includes only conditional relations. For the purposes of this paper, discriminative relations will be referred to as "topography-based responding" and conditional relations as "selection-based responding." Michael (1985) has distinguished between these two modes of responding. According to Michael, topography-based responding occurs when an individual emits a distinguishable topography in the presence of a discriminative stimulus or motivative variable. Saying "cat" in the presence of a cat or writing "5" in the presence of "2+3=" is an example of topography-based responding. In selection-based responding, an individual points to, touches, or otherwise selects a discriminative stimulus in the presence of a conditional stimulus or motivative variable. Pointing to the word "cat" in the presence of a cat or pointing to "5" (from several alternatives) in the presence of "2+3=" is an example of selection-based responding. The definition of stimulus equivalence used in this paper will be as broad as the mathematical definition, including both conditional and discriminative relations (i.e., selection-based and topography-based responding).

To summarize, the present definition focuses on the production of equivalence, but otherwise is similar to the generic mathematical definition. As mentioned earlier, Sidman and Tailby have applied the mathematical definition to conditional discrimination performance in the stimulus equivalence task. Nevertheless, the equivalence phenomenon does not appear limited to that context. It appears that any task (R) that satisfies the mathematical definition of the equivalence relation may be converted to a format in which subjects actually *produce* reflexive, symmetric, and transitive relations. Moreover, these forms of equivalence may be exemplified via either selection-based or topography-based responding.

AN EXAMPLE OF STIMULUS EQUIVALENCE THAT IS VERBAL

If equivalence includes topography-based as well as selection-based responding, a given example may involve verbal relations in which the subject produces a stimulus (a response-product) in the presence of another stimulus. Figure 2 shows an example of stimulus equivalence which involves topography-based verbal relations. In this example, relation R might be called "means the same thing as" and set S might include the spoken words "cat," "gato," and "chat," the English, Spanish, and French words for cat. As indicated by the headings, the elements of each relation are the stimulus and response-product.

In Figure 2, A-A, B-B, and C-C relations demonstrate reflexivity. The subject produces the spoken word "cat" in the presence of the spoken word "cat" (A-A), "gato" in the presence of "gato" (B-B) and "chat" in the presence of "chat" (C-C).

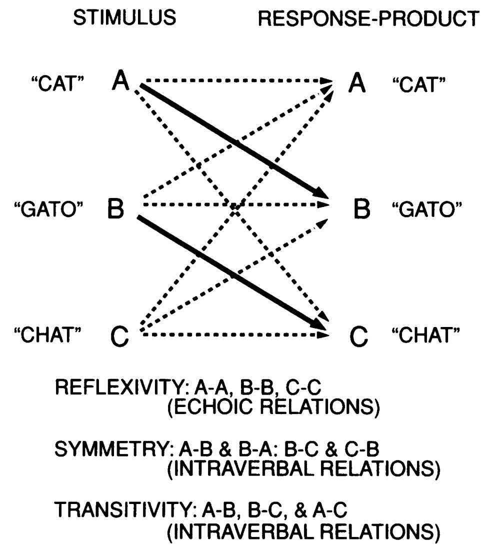


Fig 2. An example of stimulus equivalence which involves topography-based verbal relations.

According to Skinner's analysis of verbal behavior, A-A, B-B, and C-C are echoic verbal relations (sometimes called "verbal imitation"). In an echoic relation, the form of the response is controlled by a verbal stimulus, and the response generates a sound-pattern similar to that of the stimulus; that is, the stimulus and response-product have formal similarity.

Symmetry involves two pairs of relations: A-B and B-A; and B-C and C-B. In the A-B relation, the subject produces the spoken word "gato" in the presence of the spoken word "cat." According to Skinner's analysis, this is an intraverbal relation. In the intraverbal, the form of the response is controlled by a verbal stimulus, and the stimulus and response do not have formal similarity or point-to-point correspondence. (When a stimulus and response do not have point-to-point correspondence, each successive element of the stimulus does not control each successive element of the response.) In the reversed relation, B-A, the subject says "cat" in the presence of "gato." This also is an intraverbal. B-C and C-B show the same symmetric pattern as A-B and B-A. In B-C, the subject says "chat" in the presence of "gato." In the reversed relation, C-B, the subject says "gato" in the presence of "chat." Both of these relations are intraverbals.

Transitivity involves A-B, B-C, and A-C relations. A-B and B-C have already been described. In A-C, the subject says "chat" in the presence of "cat," which is an intraverbal. In C-A, which is symmetric with A-C, the subject says "cat" in the presence of "chat," which also is an intraverbal. Thus, the relations that make up this example of stimulus equivalence may be described as speaker relations; specifically, echoics and intraverbals.

It is important to note that when stimulus equivalence involves topography-based responding, as with the example in Figure 2, contextual stimuli are needed to evoke the appropriate relations. The experimenter might first present a contextual stimulus such as "means the same thing as" to specify the overall task to be performed (i.e., relation R). Then, more specific contextual stimuli also are needed to set the occasion for reflexive, symmetric, or transitive relations, within the overall task. For example, with reflexivity, the subject might be presented with the more specific contextual stimulus "same word" to evoke relations in which the stimulus and response-product are formally similar to one another. With symmetry, the more specific contextual stimulus "new word" might be presented in training the A-B relation, and "symmetric relation" in testing for the emergence of B-A. Finally, with transitivity, "new word" might be presented in training A-B and B-C relations, and "transitive relation" in testing for the emergence of A-C.

With selection-based responding in conditional discrimination tasks, the comparison stimuli serve this contextual function. For instance, suppose a subject with a history of reflexive responding has completed A-B training and is now being tested for the emergence of B-A (symmetry). In testing for B-A, it would be important to present comparisons to the subject that include A but *exclude* B. If both A and B were presented as comparisons, the task would be ambiguous; the subject could engage in either reflexive or symmetric responding. Thus, the presence of specific comparison stimuli serves a contextual function, indicating what type of relation will be reinforced.

VERBAL BEHAVIOR AND STIMULUS EQUIVALENCE AS CONCEPTS

Thus far, the relationship between stimulus equivalence and verbal behavior has been examined on the level of individual relations. The following section will describe larger units of verbal behavior as concepts and illustrate how these concepts may overlap with reflexivity, symmetry, and transitivity. Several analyses in this section are expanded in Hall and Chase (1989).

In defining concepts, Keller and Schoenfeld (1950) wrote: "When a group of objects gets the same response, when they form a class the members of which are reacted to similarly, we speak of a concept...generalization within classes and discrimination between classes, this is the essence of concepts" (pp. 154-155). Skinner (1957) used the term "abstraction" rather than "concept." According to Skinner, abstraction occurs when one or more properties of stimuli acquire control over responding—and those properties continue to exert control when they occur in novel contexts. In this paper, the terms concept and abstraction will be used interchangeably.

Perhaps the most familiar type of abstraction occurs in tacting. A tact is a verbal relation in which the form of the response is controlled by a nonverbal stimulus; it is roughly equivalent to naming. Saying "red" in the presence of a red book is an example of a tact relation. Abstraction is present when saying "red" is controlled not by a specific red stimulus (such as the red book), but by the property of redness. Then, when novel red stimuli are presented (such as a red truck, a red shoe, and a red pen, as shown in Figure 3), the speaker may say "red," without direct training. The broken lines indicate that these are emergent relations. Skinner has referred to abstract tacting under the control of all of the relevant features of stimuli as "generic tact extension."

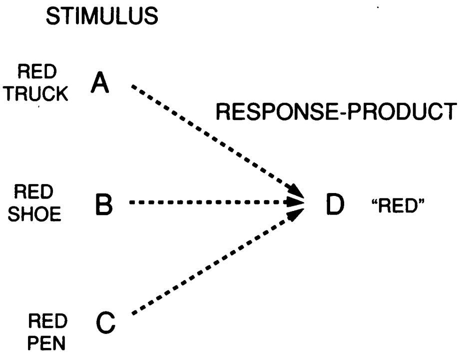


Fig 3. Abstract tacting: "Red."

Although abstract tacting may be the most familiar type of concept, Peterson (1978) has pointed out that the principles underlying tact extension seem applicable to the other verbal operants. Engelmann and Carnine (1982) also have provided a broad definition of concepts that includes relations other than tacting, and relations among relations. According to Engelmann and Carnine, "If a set of examples has an observed sameness, that sameness is a concept, the basis for a discrimination or a generalization" (p. 36). With this definition, the observed sameness in a set of examples may involve varying levels of abstraction, ranging from the relatively concrete to the highly abstract. Although highly abstract forms of sameness may be more difficult to identify, they are still based on stimulus properties that are common across a set of examples.

In the previous example of the abstract tact "red," the observed sameness in a set of examples involved a relatively low level of abstraction. All positive examples presented to the subject (e.g., red truck, red shoe, and red pen) were the same because they were red—an easily identified physical property. The same is true for other abstract tacts, such as "chair." In this case, all positive examples presented to the subject are the same because they contain the relevant features of a chair—relatively concrete physical properties.

Nevertheless, it is possible to have an observed sameness in a set of examples that involves a higher level of abstraction, and this observed sameness may control a consistent pattern of responding. These types of concepts may involve relations other than tacting and relations among relations, as are found in reflexivity, symmetry, and transitivity. When the consistent pattern of responding emitted by the subject does not involve tacting the observed sameness, an observer may have more difficulty specifying the stimuli to which the subject is responding. The following examples will illustrate higher levels of abstraction and show how concepts involving verbal behavior may overlap with reflexivity, symmetry, and transitivity.

One higher level concept involves echoic verbal relations. The echoic was defined earlier; saying "car" in the presence of the spoken word "car" is an example of an echoic relation. In abstract echoic behavior, sometimes called "generalized verbal imitation," the set of examples presented to the subject are novel vocal stimuli (e.g., "cat," "gato," and "chat," as shown in Figure 4). Although these stimuli are formally different from one another, they share a sameness at a higher level of abstraction: they are all vocal stimuli and they consist of a pattern of speech sounds. Subjects with appropriate learning histo-

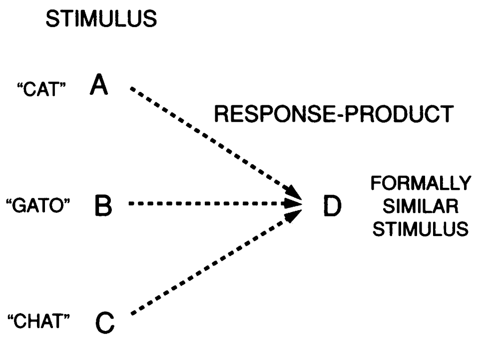


Fig 4. Abstract echoic behavior.

ries may come to respond in a consistent manner to stimuli with these characteristics. In the presence of each novel vocal stimulus (and appropriate contextual stimuli, as mentioned earlier), the subject may produce a formally similar vocal stimulus, without direct training.

As shown in Figure 5, abstract echoic behavior involves the same pattern of emergent relations as reflexivity: A-A, B-B, and C-C. Abstract echoic behavior therefore appears to be an example of reflexivity.

More complex types of concepts or abstractions may involve relations between two relations, such as a relation between two intraverbals in which the stimulus and

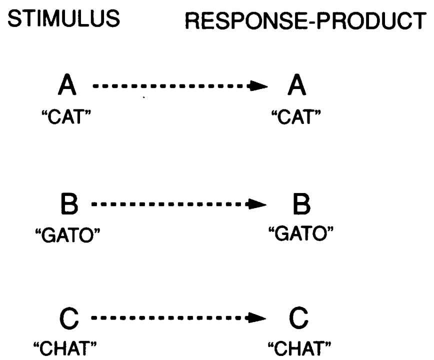


Fig 5. Abstract echoic behavior as reflexivity.

response-product are reversed. The intraverbal was defined earlier; saying "gato" in the presence of the spoken word "cat" is an example. In an abstract relation between two intraverbals, a novel intraverbal is trained and the reversed relation emerges, without further training. Forexample, a subject might be trained to say "gato" in the presence of the spoken word "cat" (and appropriate contextual stimuli). If the subject then says "cat" in the presence of "gato," without direct training, an abstract relation between two intraverbals is demonstrated.

Figure 6 shows a set of novel intraverbals that might be trained (Intraverbals 1A, 1B, & 1C) and the consistent pattern of responding that may occur. These trained

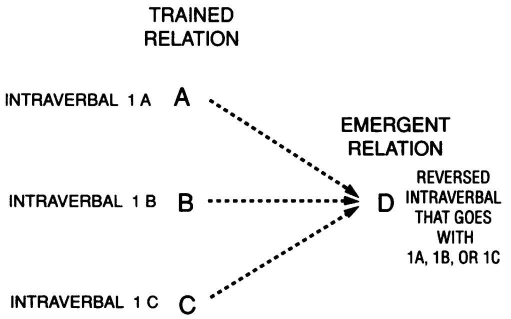


Fig 6. Abstract relation between two intraverbals.

relations are not formally similar to one another, but on a higher level of abstraction they are the same because they share the defining properties of intraverbals. With appropriate learning histories, subjects may come to respond in a consistent manner to this higher-order sameness. After each novel intraverbal is trained, the subject may produce a reversed relation, without additional training.

The abstract relation between two intraverbals that has been described appears to be an example of symmetry, as shown in Figure 7. After A-B (a novel intraverbal) is trained, B-A (the reversed relation) emerges without further training. The same symmetric pattern occurs with B-C and C-B relations.

Even more complex concepts may include an abstract relation among three intraverbals. In this relation, two novel intraverbals are trained, and a third may

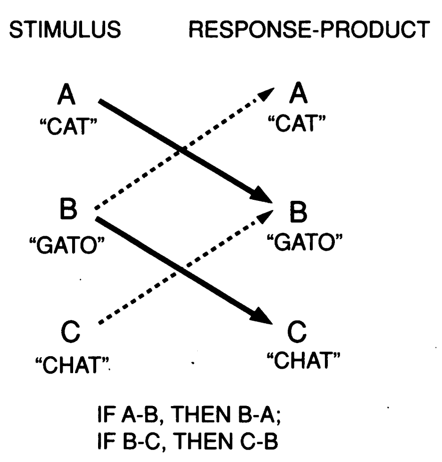


Fig 7. Abstract relaion between two intraverbals as symmetry.

emerge without direct training. For example, the subject might be trained to say "gato" in the presence of "cat," then "chat" in the presence of "gato." If the subject then says "chat" in the presence of "cat," without additional training, an abstract relation among three intraverbals is demonstrated. As with previous concepts that have been discussed, contextual stimuli would also need to be presented.

Figure 8 shows a set of novel intraverbal

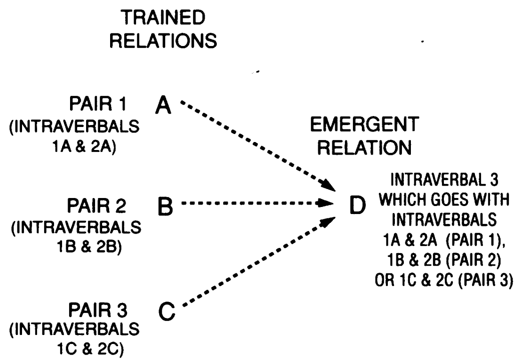


Fig 8. Abstract relation among three intraverbals.

pairs that might be trained (Pairs 1, 2, & 3) and the consistent pattern of responding that may occur. Although these pairs are formally different from one another, they share a higher-order sameness in that they are intraverbals, and, for each pair, the response-product in the first relation is the stimulus in the second. After each pair is trained, subjects with an appropriate learning history may produce a third intraverbal, without further training.

As shown in Figure 9, the abstract relation among three intraverbals that has been described appears to be an example of transitivity. After A-B and B-C relations are trained, A-C may emerge indirectly.

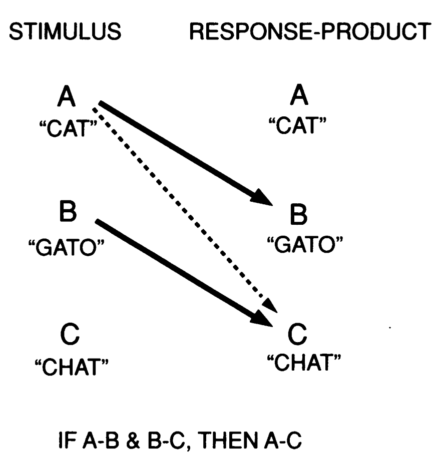


Fig 9. Abstract relation among three intraverbals as transitivity,

Thus, it appears that stimulus equivalence may overlap with topography-based verbal behavior on the level of both specific relations and concepts. The following sections will address whether some verbal relations are not stimulus equivalence and whether certain examples of stimulus equivalence are not verbal behavior.

VERBAL BEHAVIOR THAT IS NOT STIMULUS EQUIVALENCE

There appear to be many examples of verbal behavior (either topography-based or selection-based) that are not stimulus equivalence. All directly trained verbal relations fall in this category, because stimulus equivalence is a synthesis of concepts (specifically, reflexivity, symmetry, and transitivity). Emergent relations are necessary to demonstrate conceptual or abstract control. In addition, there are abstract verbal relations which do not represent stimulus equivalence. Abstract tacting, for example, is not stimulus equivalence. Abstract tacting and stimulus equivalence involve different patterns of relations. In abstract tacting (e.g., "red"), the subject says "red" in the presence of novel examples containing the abstract property of redness. These relations are unidirectional and the response is always the same (see Figure 3). In stimulus equivalence, the subject selects or produces each stimulus in the presence of itself and the all other stimuli in the set (see Figure 2). These relations are bidirectional. In general, any abstract verbal relation that does not involve the same pattern of relations as stimulus equivalence is not stimulus equivalence. To compare patterns of relations, it is simply necessary to diagram them (as shown in the various figures) and inspect them visually.

There is a specific pattern of relations that is not stimulus equivalence, but is frequently confused with it. This pattern is functional equivalence. According to Sidman (1986), functional equivalence occurs when "two or more stimuli control a common response." Saying "two" in the presence of both the Roman numeral "II" and the Arabic numeral "2" is an example of functional equivalence. Since both stimuli control the response "two," they have the same function and are thus substitutable for one another. Functional equivalence may involve either verbal or nonverbal relations and may or may not involve conceptual relations. Functional equivalence does not have to be a concept, because two or more stimuli may come to control a common response through direct training. To demonstrate conceptual or abstract control, emergent relations are needed.

Figure 10 compares functional equivalence and stimulus equivalence with a

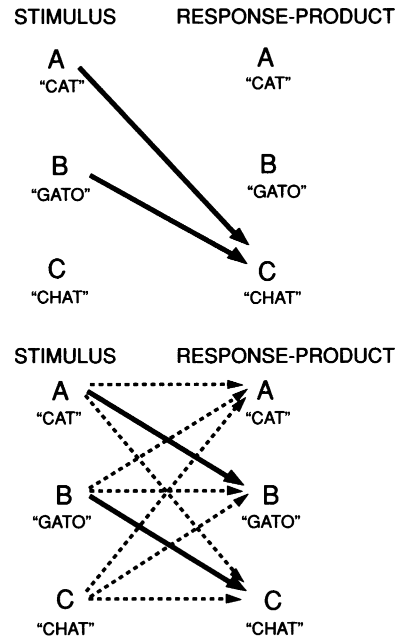


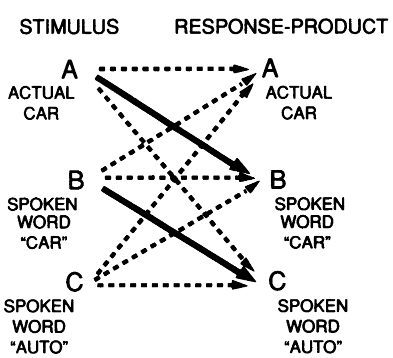
Fig 10. Functional equivalence (upper portion) and stimulus equivalence (lower portion) with a common set of stimuli and response-products.

common set of stimuli and response-products: A, B, and C. Again, these elements are the spoken words "cat," "gato," and "chat." Functional equivalence is shown in the diagram at the top of the figure. Functional equivalence with A, B, and C involves two relations, such as A-C and B-C, and it does not matter if they are trained or emergent. Although A-C and B-C are shown in the diagram, other pairs of relations, such as A-B and C-B, or B-A and C-A, also could illustrate functional equivalence with three stimuli. The diagram at the bottom of the figure shows an example of stimulus equivalence. In stimulus equivalence with A, B, and C, there are nine relations, two trained and seven emergent.

There appear to be two main differences

between functional equivalence and stimulus equivalence. First, functional equivalence does not have to be a concept and thus does not have to involve emergent relations. Stimulus equivalence, on the other hand, is a synthesis of three concepts (reflexivity, symmetry, and transitivity), all of which involve emergent relations. Second, the patterns of relations and functions of stimuli in the two types of equivalence are different. In functional equivalence, the elements A, B, and C are either stimuli or response-products, but not both; thus, the relations are unidirectional. In stimulus equivalence, A, B, and C are interchangeable with themselves and with one another as both stimuli and response-products; thus, the relations are bidirectional.

Figure 11 shows a pattern of speaker and listener relations which may seem to exemplify stimulus equivalence because all



TYPES OF RELATIONS:

A-A: IDENTITY MATCHING
B-B: ECHOIC BEHAVIOR
C-C: ECHOIC BEHAVIOR
B-C: INTRAVERBAL BEHAVIOR
C-B: INTRAVERBAL BEHAVIOR
A-B: TACTING
B-A: RECEPTIVE IDENTIFICATION
A-C: TACTING
C-A: RECEPTIVE IDENTIFICATION

Fig 11. Speaker and listener relations.

stimuli and response-products are interchangeable with themselves and with one another, and all relations are bidirectional. In this example, stimulus A is an actual car, B is the spoken word "car," and C is the spoken word "auto." Nevertheless, if the pattern is examined more closely, it does not appear that the mathematical definitions of reflexivity, symmetry, and transitivity are satisfied.

The first relevant pattern of relations is A-A, B-B, and C-C. Although these relations seem to be reflexive, it should be noted that the type of task (relation R) differs across these relations. In A-A, the task is to point to a formally identical nonverbal stimulus (identity matching), whereas in B-B and C-C, the task is to imitate a vocal verbal stimulus (echoic behavior). This difference in tasks poses a problem because the mathematical definition requires R to be the same for all members of set S. Since R differs across A-A, B-B, and C-C relations, reflexivity does not seem to be demonstrated. This is not to say that either of these tasks is inherently inappropriate to demonstrate reflexivity. The point is simply that R must be held constant across any given example of equivalence.

A similar problem exists with both the apparent symmetric and transitive relations. For example, in symmetry, A-B should involve the same R as B-A. Nevertheless, in A-B, the subject says "car" in the presence of an actual car, which is a tact, according to Skinner's analysis. In B-A, the subject points to an actual car in the presence of the spoken word "car," which is a listener relation. In A-B, the task might be called "naming," and in B-A, the task might be called "receptive identification." Because these reversed relations involve different tasks, they do not seem to demonstrate symmetry.

Thus, it is clear that verbal behavior does not overlap perfectly with stimulus equivalence. Certain examples of verbal behavior cannot be described as stimulus equivalence. A related question is whether certain instances of stimulus equivalence cannot be described as verbal behavior.

EXAMPLES OF STIMULUS EQUIVALENCE THAT ARE NOT VERBAL?

One possibility is that certain traditional stimulus equivalence tasks are not verbal. Although some stimulus equivalence studies have involved oral naming and have used explicitly verbal stimuli such as printed and auditory words, others have employed arbitrary visual stimuli, which might be considered nonverbal.

To determine whether such tasks are verbal, an overall definition of verbal behavior is needed. Skinner (1957) has defined verbal behavior as behavior which is effective only through the mediation of other persons (listeners), who have been specifically trained by the verbal community to provide reinforcement. A slightly different way of saying this is that in verbal behavior, the speaker produces or selects a stimulus (in the presence of a verbal or nonverbal stimulus or motivative variable) to which a trained listener responds.

In traditional stimulus equivalence tasks, subjects select stimuli (comparisons) in the presence of other stimuli (samples). In response to correct stimulus-selection, the experimenter mediates the subject's reinforcement by presenting chimes, pennies, praise, etc. After appropriate training has occurred, sample and comparison stimuli become interchangeable with themselves and with one another; they are said to become "symbols" for one another. This pattern of relations is established by arbitrary reinforcement contingencies which do not exist outside of the experiment, which could be considered a miniature verbal community. Thus, the traditional stimulus equivalence task appears to involve selection-based verbal relations and all stimuli are verbal, regardless of their specific forms. The relations involved also may be viewed as speaker relations. Selecting a verbal stimulus in the presence of a formally identical verbal stimulus appears to represent selection-based echoic behavior, and selecting a verbal stimulus in the presence of a formally different verbal stimulus constitutes selection-based intraverbal behavior.

Outside of the conditional discrimination task, one might ask if there are examples of stimulus equivalence which are not verbal. Although it is clearly impossible to examine all examples of equivalence which are topography-based, the possibility appears remote. Demonstrating all three properties of the equivalence relation would appear to be nonfunctional in the nonverbal environment; such contingencies do not seem to exist in nature. The equivalence relation appears to be most functional within a mathematical context; the mathematical verbal community has established these arbitrary contingencies to facilitate problem-solving (which involves both topography-based and selection-based responding).

LISTENER BEHAVIOR AS STIMULUS EQUIVALENCE?

A final question is whether listener behavior may involve stimulus equivalence. One type of listener behavior that has been associated with stimulus equivalence is rule-governed behavior. For instance, DeVaney, Hayes, and Nelson (1986) have suggested that a human might respond to the instruction "come here" not because of a direct history of reinforcement, but because stimuli such as "come here" (i.e., instructions) "participate in equivalence classes established by the verbal community" (p. 255).

In equivalence classes, however, all stimuli are interchangeable with themselves and with one another; that is, all relations are bidirectional. In rule-governed behavior, this interchangeability does not seem to be involved. If the relevant stimuli consisted of several different instructions, the subject would have to emit each instruction in the presence of itself and all the other instructions (thus engaging in echoic and intraverbal responding) to demonstrate stimulus equivalence. Such a pattern of relations appears unlikely. It is more plausible that a number of instructions would be trained to control rule-following behavior in general, as shown in Figure 12. This pattern of relations appears to represent functional equivalence. Then, if a novel instruction such as "come here" is presented that shares certain critical features with the previously-trained rules (a highly abstract observed sameness), the subject might be inclined to follow the new instruction, without explicit training.

Of course, it is also necessary to explain

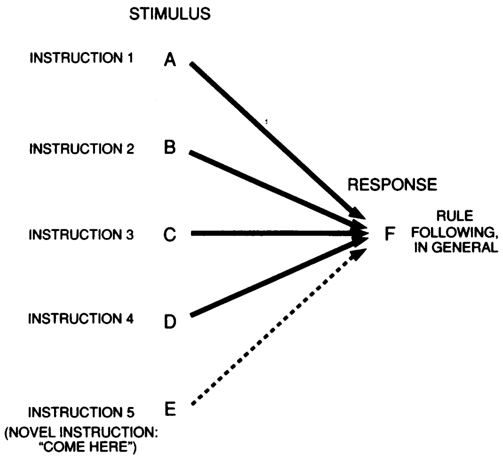


Fig 12. Emergent rule-governed behavior.

how the subject may respond to a novel instruction such as "come here," without direct training. Such emergent responding conceivably might result from an abstract relation between relations. For instance, the subject might acquire an abstract relation between manding (i.e., requesting) the behavior of others and following the instructions of others. Then, after "come here" is trained as a mand, the subject might respond to "come here" as an instruction, without further training.

SUMMARY

In summary, there is overlap between the subject matters of stimulus equivalence and verbal behavior, both on the level of specific individual relations and abstract relations (i.e., concepts). Although many examples of verbal behavior are not stimulus equivalence, it seems likely that all examples of stimulus equivalence are verbal. This conclusion is consistent with Skinner's assessment of abstraction. According to Skinner, "abstraction is a peculiarly verbal process because the nonverbal environment cannot provide the necessary restricted contingency." Since reflexivity, symmetry, and transitivity involve abstraction, it follows that stimulus equivalence is a verbal phenomenon.

An overlap between stimulus equivalence and verbal behavior may have implications for research in both areas. For instance, verbal behavior research has demonstrated the functional independence of verbal operants with naive subjects. Stimulus equivalence research which has failed to establish stimulus equivalence in nonhuman and nonverbal human subjects seems to replicate these findings. Perhaps procedures that have been successful in teaching concepts for the first time could be used in an attempt to establish reflexivity, symmetry, and transitivity in naive subjects.

Stimulus equivalence findings also suggest directions for future research in the area of verbal behavior. Stimulus equivalence research has studied emergent relations and the conditions under which they occur. A similar focus on emergent relations and abstraction may be desirable in the area of verbal behavior. Although different verbal relations may be functionally independent at the time of acquisition, abstract relations between relations are observed in mature speakers. Determining the controlling variables for these emergent relations would further counter the arguments of linguists, and demonstrate the viability of behavioral theories in accounting for complex human behavior.

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