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THEORETICAL ARTICLE

Observation, Language Learning, and Development: The Verbal Behavior Development Theory

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Abstract

A review of recent applied research in observation suggests researchers could profit from a new account of observational learning. Current research in the identification and establishment of verbal developmental cusps demonstrates the importance of the range of observational cusps necessary for the acquisition of language. These cusps encompass learning through imitation, duplication of outcomes, understanding consequences of observed behaviors, acquiring new reinforcers, incidental unidirectional and bidirectional naming, and more. This account offers solutions to bridge gaps in the literature and complements related research, providing a comprehensive understanding of observational learning processes. This updated account of observational learning is especially relevant when we consider its implications for human language acquisition. In this article, we emphasize that language acquisition is not solely an individual cognitive development, but a socially mediated process, where observation plays a fundamental role in linguistic growth and development.

Keywords Observation; language · Development · Verbal behavior · Bidirectional naming · Learning

An Earlier Perspective on Observation

In 2006, we published an article in the *International Journal of Psychology* on observational learning (Greer et al., 2006). ResearchGate reported that the article has over 21,000 reads as we write this article (www.researchgate.net). The interest in observational learning is especially important because of the critical role observation plays in a science of behavior for organisms that are verbal. Learning from observation was defined as acquiring (1) new operants; (2) "higher order operants" or relational responding; (3) respondents; or (4) reinforcers from observation. This includes not only visually observing stimuli within the environment but also actively using other approaches (e.g., listening, smelling, touching) to learn new information under the control of various stimuli.

In that article we argued four points based on the then-existing research. First, it is necessary to distinguish between *learning* from observation versus doing what one can already do, or what we called *performance*, as a function of observing others doing so. Second, learning or performing *as a result of* observing others are developmental cusps and are themselves learned. Third, conditioned reinforcers can also be learned from observation. Most important of all, verbal (i.e., communicative) behavior, including, but not limited to language, is learned by toddlers by observation.

Performance was defined as the emission of previously learned behavior resulting from observing others. For example, when children observe their peers raising their hands and receiving the teacher's attention, they are more likely to raise their own hands to gain the teacher's attention (Kazdin, 1973). In this scenario, children are demonstrating a pre-existing operant behavior (i.e., hand raising). We distinguished performance from instances when children learn new operants, respondents, or reinforcers as a function of observing others. An example of learning from observation occurs when a student learns to do long division as a result of observing the steps to do so from a teacher's instructions and demonstration or observing reinforcement or corrections delivered to a fellow student (Neu & Greer, 2019). In both cases the children learned new operants. Finally, we described research findings demonstrating that when children observe their peers receiving neutral stimuli that they

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are denied access to, those stimuli can be conditioned as reinforcers by observation.

We also noted in the 2006 article that, "There is amazing unanimity on the distinctions between: (a) behavior change that is attributed to direct contact by the organism with the contingencies of reinforcement and punishment, as differentiated from (b) behavior change that occurs through indirect contact that is attributed to observation (Catania, 1998; Skinner, 1938)" (p. 487). We went on to point out that there was no consistency in terms for behavior change resulting from observation. Terms such as modeling, imitation, copying, parroting, echoing, and the term observational learning itself are used interchangeably. We pointed out that this was the case in biology, physiology, anthropology, comparative psychology, and behavior analysis (p. 487). One of the objectives of that article was to propose some clarity. Related research has progressed significantly in the intervening years particularly with regard to the role of observation and language development and the relation of current findings to (1) the elementary principles of behavior as well as (2) current behavior science of language and complex behavior relations (Tarbox & Hayes, 2005).

An Updated Account of Verbal Behavior Development

Rosales-Ruiz and Baer (1997) introduced the notion that developmental cusps allow children to contact new contingencies in their environment, which enable them to learn things they could not learn before. Proponents of the *Verbal Behavior Development Theory* (VBDT; Greer & Keohane, 2005; Greer & Ross, 2008) further identified a series of developmental cusps necessary for language acquisition that built upon Skinner's (1957) theory of verbal behavior.

VBDT is influenced by and contributes to the theories and research of Skinner's work, the concept of development as behavioral cusp**s** (Novak & Pelaez, 2004; Rosales-Ruiz & Baer, 1996, 1997), and derived relational responding (Barnes-Holmes et al., 2020; Hayes et al., 2001; Sivaraman et al., 2023). VBDT research led to the modification of Rosales-Ruiz and Baer's cusp concept in that VBDT focuses on verbal development and nonverbal precursors for verbal behavior as well as the spoken language aspect of verbal behavior. The major tenets of VBDT are: (1) cusps are generic to all children's *verbal development* and not idiosyncratic to each child as proposed in 1996; (2) cusps are distinguishable from pivotal behaviors (Greer, 2020); (3) there are learning cusps that are not verbal developmental cusps; and (4) with regard to the last point the joining of print to existing verbal developmental cusps is a major learning cusp, but it is not itself a *verbal developmental* cusp because it is an extension of existing cusps to print (Ross & Greer, in press). It is important to note that the cusps represent not just behavior per se; rather the VBD cusps result from changes in environmental stimulus control for the child; that is, many cusps are the result of the onset of environmentally learned reinforcers (Baer & Sherman, 1964; Greer et al., 2017; Kleinert-Ventresca et al., 2023). Finally, as described in other parts of this article, all of the components of our enlarged class of observational learning and performance are key components of and critical milestones in children's language development.

Observation as a Larger Class of Behavior

The 2006 article built on Catania's (1998) definition of observational learning as changes in behavior as a result of observation of the consequences received by others, where, for example, he and we distinguished imitation from observational learning. However, now we include imitation as a member of the larger category of responses resulting from observing, as we shall describe. Nevertheless, the distinctions he made remain important as we shall also describe. He also did not distinguish learning from performance. However, the distinction between performing and learning is clearly necessary when the targets are the behaviors and learning of students as opposed to nonhuman animals (Engelmann & Carnine, 1982; Greer, 2002; Skinner, 1968). For example, Skinner (1968) found it necessary to include verbal corrections for teaching verbal beings when he introduced programmed instruction and the Teaching Machine (Skinner, 1968). Corrections were not part of the fundamental science in his *Behavior of Organisms* (1938) in which case the process of progressively reinforcing greater approximations of a target behavior result in a different perspective on learning. Verbal corrections are not possible with pigeons. Corrections are more efficient when teaching new operants and establishing derived relations with verbal organisms (Kristen & Stuart, 2022). Moreover, there are important distinctions between learning from observing or performing as a result of observation. Our 2006 treatment of observation no longer seems sufficient based on more recent research findings.

Observation and Language Development

Since publication of the 2006 article, more research is available on the following: (1) how language develops from observing environmental experiences; (2) how children come to contact observing certain experiences; (3) the role of, and distinction between, imitation and emulation relative to language and other behavior; and (4) discovery of how reinforcement can be learned from observation and denial conditions.

VBDT has focused on how operants, relational operants (Healy et al., 2000), respondents, and reinforcers are learned from direct and *indirect* (i.e., observation) environmental contact with the elementary principles of behavior and relational responding. We propose that this evidence suggests that observation, as a part of social contact, is a key component of verbal development. This led us to propose that the term observation needs to encompass a broader class of responding that is central to language development (Greer & Speckman, 2009; Pohl et al., 2020). Moreover, verbal development plays a crucial role in contemporary behavior science. It is closely intertwined with equivalence-based learning, where the presence or absence of specific verbal developmental milestones holds significant importance (Hranchuk et al., 2019; Sivaraman et al., 2022). These milestones of verbal development are identified in a behavior science of language development as verbal developmental cusps. Once a child acquires a particular developmental cusp, learning classes of verbal behavior as well as subsequent cusps of verbal behavior becomes possible (Rosales-Ruiz & Baer, 1996, 97; Greer & Ross, 2008). Observation is central to the acquisition of various types of stimulus control for verbal developmental cusps.

The term *verbal behavior* as set forth by Skinner (1957) and as updated to current usage is exchangeable with communicative behavior where language is one, but not all, of the ways of communicating. Moreover, verbal is not synonymous with vocal. In VBDT the multiple verbal developmental cusps associated with the functional communicative development *of language,* that is a subcomponent of verbal behavior, are classified into four broad classifications—(1) preverbal foundational cusps; (2) listener cusps associated with the acquisition of learning as a listener when no speaker responses are, or can be, learned by instruction or exposure; (3) speaker cusps associated with learning speaker operants when what is in repertoire as a listener is not fully available to one's speaker repertoire; and (4) the cusps associated with the joining of the listener to the speaker responses where the child demonstrates the social reinforcement control for complex human language (see Schmelzkopf et al., 2017). Observation is a necessary component of all the cusps under our expanded view of observation in behavior change and learning new operants, respondents, and reinforcers.

Of course, observational stimulus control is not only verbal in nature. However, our research to date suggests that the presence of most or all of these observational repertoires is either a prerequisite for or part of being verbal. Nevertheless, much of what students are taught is verbal and given the paucity of teacher feedback in typical classrooms, verbal observational learning is critical (Bahadourian et al., 2006; Keller, 1968). We and others speculate that the evolution of language built on learning and performing as a result of observing others, including communicative functions that predated language as a formal communicative vehicle (Culotta & Hanson, 2004; Skinner, 1989). The Homo sapiens species probably learned a great deal from observation prior to developing language for verbal functions because of the necessity and capacity to collaborate (Greer & Keohane, 2005; Skinner, 1986). All of this is built on social learning experiences where collaborative behavior and duplicative responding were and are fundamental to the survival of the species.

Before suggesting a revision of our 2006 perspective on observation, we provide a brief overview of research on observation across key journals in behavior analysis.

Observation Research in Recent Years

The review we conducted is not a meta-analysis nor a systematic review. We skimmed through a total of 175 research articles that contained the term "observational learning" across major behavior analytic journals since the publication of the 2006 article (Table 1). (1) We focused on how observational learning was tested as well as whether the findings contributed to learning or language acquisition for individuals with disabilities in the applied science. (2) We investigated how observational learning was described and measured in each article. (3) We also determined whether an intervention was implemented in order to establish an observational learning cusp. Out of 174 articles, only eight studies sought to *establish* observational learning for individuals through various interventions (Blowers et al., 2021; Delgado & Greer, 2009; DeQuinzio & Taylor, 2015; DeQuinzio et al., 2018; Lanter & Singer-Dudek, 2020; MacDonald & Ahearn, 2015; Rothstein & Gautreaux, 2007; Taylor et al., 2012). It is important to highlight that all the participants in the eight studies had autism spectrum disorder (ASD) or related disabilities. This suggests that individuals with autism may not possess the essential prerequisites and verbal developmental cusps to acquire new operants through observation (Catania, 1998; Greer & Ross, 2008).

Delgado and Greer (2009) taught two children with ASD to discriminate a peer model's correct and incorrect responses and to observe the consequences related to those responses. Following the peer-monitoring process, the participants acquired novel sight words from observation. Taylor et al. (2012) conducted a series of studies with modifications of Delgado and Greer's procedures in which they implemented a discrimination teaching procedure to teach children with ASD to sustain attention to models, imitate the model's responses, and discriminate the consequences the model received during observation; however, in the systematic replications few participants in the studies acquired novel operants during the generalization probe sessions, indicating the correct stimulus control for the observational cusps was missing after fading out the teaching (Blowers et al., 2021; DeQuinzio & Taylor, 2015; DeQuinzio et al., 2018; Taylor et al., 2012). Although most of the research

Table 1 Reviewed Article Selection Information

Journal	Web address	Search Term	Number of search results
Journal of Applied Behavior Analysis (2006–2022)	https://onlinelibrary.wiley.com/journal/19383703	Advanced search: "Observational Learning" (all content)	34
Journal of Behavioral Education (2006–2022)	https://www.springer.com/journal/10864	Regular search: "Observational Learning" (all content)	10
Journal of the Experimental Analysis of Behavior (2006–2022)	https://onlinelibrary.wiley.com/journal/19383711	Advanced search: "Observational Learning" (all content)	11
Journal of Positive Behavior Interventions (2006–2022)	https://journals.sagepub.com/home/pbi	Advanced search: "Observational Learning" (all content)	3
The Analysis of Verbal Behavior (2006–2022)	https://www.springer.com/journal/40616	New search: "Observational Learning" (all content)	8
European Journal of Behavior Analysis (2006–2022)	https://www.tandfonline.com/loi/rejo	New search: "Observational Learning" (all content)	11
Behavior Analysis in Practice (2006–2022)	https://www.springer.com/journal/40617	New search: "Observational Learning" (all content)	19
Behavioral Interventions (2006–2022)	https://onlinelibrary.wiley.com/journal/1099078x	Advanced search: "Observational Learning" (all content)	17
Behavior Modification (2006–2022)	https://journals.sagepub.com/home/bmo	Advanced search: "Observational Learning" (all content)	6
Educational Treatment to Children (2006–2022)	https://www.springer.com/journal/43494	New search: Observational Learning (all content)	8
Learning and Behavior (2006–2022)	https://www.springer.com/journal/13420	New search: Observational Learning (all content)	27
The Psychological Record (2006–2022)	https://www.springer.com/journal/40732	Advanced search: "Observational Learning" (all content)	21

articles on observational learning examined how individuals learn new operants through observation, only a few articles showed changes in momentarily or prolonged reinforcing properties of stimuli as a function of observation (Greer & Singer-Dudek, 2008; Leaf et al., 2012, 2016; Oblak et al., 2015; Schmelzkopf et al., 2017; Singer-Dudek & Oblak, 2013). These studies used an observational conditioning-by-denial procedure, first described in the 2006 article, detailed later in this article.

We also found a majority of the reviewed articles focused on analyzing the components within observational learning contexts, such as attending and imitation (Taylor et al., 2012), discriminating correct and incorrect responses (DeQuinzio & Taylor, 2015; DeQuinzio et al., 2018; Neu & Greer, 2019), and testing how these components affect the participants' accuracy of observation. For example, Neu and Greer conducted an experiment comparing the rate of learning of novel math operants by fifth graders as a function of observing reinforcement only versus corrective feedback only conditions. The results showed all participants learned the math operants faster when observing their peers receive correction procedures (i.e., the instructor modeled the correct response and the peers had to correct their responses) than when observing their peers being told their responses were correct. However, few research studies focused on establishing observational stimulus control for individuals so that they *could* learn new things, including reinforcers, through observation. Observational stimulus control herein refers to the phenomena in which an individual's responses come under the control of observing others responding to stimuli and contacting contingencies in the environment (Lanter & Singer-Dudek, 2020). In other words, once the observational stimulus control is established, individuals do not need additional prompting procedures to attend to critical and relevant stimuli when acquiring new operants through observation.

Our review had also shown that interbehavioral psychology attempted to offer a consistent approach when conceptualizing complex phenomena (e.g., observational learning) that affect one's learning (Fryling & Hayes, 2009; Fryling et al., 2011; Kantor, 1958). All philosophical assumptions must be derived through contacts with various factors including individuals, environmental stimuli, setting factors, and media of contact when analyzing observational learning (Fryling et al., 2011). The interbehavioral perspective provides empirical researchers a clear approach to naturalistically conceptualize observational learning.

Verbal development research from the CABAS (Greer, 2002) lab schools draws on the foundations of behavior selection incorporating interbehaviorism (Kantor, 1958). For example, the learning of any operant, reinforcer, or respondent is always seen in the context of the interaction between the teaching device or teacher, the learner, and the major surrounding environmental and phylogenetic context. Think of the operant chamber with the experimenter in the chamber under the same conditions as participant, whereas the context is the surrounding history and simultaneous events. An operant or a learned reinforcer takes place within the learner's setting at any given time (i.e., setting events) and is affected by two types of history. The first type is the learner's prior direct instruction whereas the second is the existing verbal developmental cusps (i.e., existing verbal stimulus control) as well as the range of derived relations. The third is the learner's phylogenetic endowment. These can be seen as interacting fields that may be sources of research under certain controlled conditions. Observational learning is likewise under these contextual conditions and is not possible unless the learner is under the stimulus control that makes the different types of observational learning possible.

We proposed that future empirical research on observational learning should prioritize establishing precise stimulus control and providing naturalistic consequences during skill acquisition through observation. Namely, future research should aim to ensure individuals can sustain relevant observing responses to target stimuli and contact reinforcement that maintains the ongoing "need to observe." We also found that the different measures used among reviewed articles have led to inconsistencies in fundamental methodologies and interpretation of results. Most of the reviewed articles did not distinguish between learning and performance. We urged the need to differentiate the two types of behavior, which will enhance our understanding of observational learning and facilitate the development of more effective educational strategies. Yet, a commonality among the studies is that imitative and emulative responses were frequently used when assessing observational learning, but without distinctions between the two types of observing responses.

Revised Categorization of Observational Cusps in Learning and Performance

Our synthesis suggests that acquiring developmental cusps, which encompass a diverse range of critical stimulus controls for learning to occur, holds significant importance. The following sections will delve into these developmental cusps, shedding light on their crucial role in observational learning. Here are the key developmental cusps and extensions of those cusps that we will explore:

1) see and do where the reinforcement stimulus control is topographical correspondence that is the *imitation cusp*;
2) observe (see, hear, smell, touch, taste) and produce corresponding behavior or product/outcome of behavior where the outcome itself is the reinforcement (not only the topography of the behavior) that is the *emulation cusp*;
3) change preexisting behavior as a result of observing the consequences received by others that is the *observational performance cusp*;
4) learn new operants or respondents as a result of observing the consequences received by others that is the *observational learning cusp*;
5) learn new reinforcers from observation/denial conditions that is the *observational conditioning-by-denial cusp*;
6) learn names of things as a listener and speaker from exposure to observing something and hearing its name that are the *Incidental Unidirectional Naming (Inc-UniN)* and *Incidental Bidirectional Naming ((Inc-BiN) cusps;*
7) learn each of these types of *Inc-BiN* with fewer observational experiences (Kleinert-Ventresca et al., 2023), as well as learning from Inc-BiN-by-exclusion (Greer & Du, 2015);
8) learn nonfamiliar and arbitrarily applicable relations without reinforcement or correction feedback as *extensions of Inc-BiN* (Kleinert-Ventresca et al., 2023).

Imitation and Emulation Components within Observational Learning

Imitation is a see–do relation that involves an observer emitting a response that has point-to-point correspondence with the physical actions of another, wherein the correspondence is itself the reinforcer (Catania, 2013; Paniagua & Baer, 1982; Zentall et al., 2018). These responses typically occur immediately following, or temporally close to, the observed model's behavior, but may be emitted at a later time. The term generalized imitation (GI) has been used in behavior analysis (Baer & Sherman, 1964) to refer to the emission of untaught motor movements in the absence of any contingencies outside of the observed modeled response, although Holth (2003) points out the word imitation is sufficient. Baer and Sherman suggested that it is the correspondence between what is observed and what is produced that is the reinforcer for imitative responses (and only emission of untaught responses in the absence of other contingencies can be considered generalized imitation). Therefore, the class of responding called imitation occurs when the correspondence for seeing and doing becomes the reinforcer.

Horne and Erjavec (2007) and Erjavec and Horne (2008) in repeated studies were not able to establish the class of imitation when they used stringent tests of generalization of imitative responses. They argued that Baer and Sherman's (1964) responses were too common to meet the criteria for testing the onset of a class of responding. However, Du and Greer (2014), using Erjavec and Horne's stringent tests, found that teaching imitative responding in front of a mirror did result in the class of imitative responding, presumably where the correspondence was the reinforcer. Hence the cusp was established. In imitation, imitative (performance) responses would consist of emitting responses that are in repertoire (e.g., clapping hands, waving bye) after observing another, whereas generalized (learning) responses might be acquiring a new dance step by observation, learning to mount a horse, or print a letter by point-to-point imitation.

Another cusp that involves observation is emulation. Emulation may not involve observation of another person but rather the outcome or product of another's behavior (Tomasello et al., 1993). The person who produced the model may no longer be present, and their behavior in creating the product is not observed necessarily. Reproduction of a finished product will likely involve a different series of steps or behaviors than the original model's; hence, it is not the same as imitation. An example of emulation is assembling a puzzle as a result of having seen the finished puzzle, in which case producing the outcome showing correspondence with what another did is the reinforcer. Printing a letter upon seeing the letter, without observation of others doing it, is another example in which case producing the letter with visual correspondence is the reinforcer. In other cases, the model's behavior may be observed, but what is produced does not have point-to-point correspondence with the model. The same outcome or product is obtained following a different series of behaviors. Again, the sameness or correspondence to the product or outcome is the reinforcement stimulus control for the cusp.

Emulation is not restricted to see–do responses, as is imitation; emulated responses may involve reproducing similar tastes or sounds to what was observed. It is emulation of human speech that is of interest in discussing language development. A lack of making this distinction is found in behavior analysis articles that use the term "vocal imitation" when referring to infants' production of speech sounds. If we are defining imitation as a see–do response, then production of speech sounds cannot be imitation because most of the motor movements involved in producing those sounds cannot be observed visually. Learning to reproduce spoken words involves prolonged trial and error responding involving motivating conditions where the child must be under deprivation of a speaker response to obtain something from a listener (see Ross & Greer, 2003, and Tsiouri & Greer, 2003, where use of intensive motivating conditions resulted in first mands for children). These experiments show the importance of distinguishing between emulation and imitation for producing speech; however, they also show how the independent classes of imitation and emulation can be expanded into a larger class of observing.

Nonverbal emulated spoken words or components of words, which are sometimes called canonical babbling or parroting (Skinner, 1957), are often emitted in the absence of the model (e.g., child is alone in her crib). As in imitation, however, it is the correspondence between what is heard and what is produced that is the reinforcer. Children will emit the sounds that are familiar to them, as familiarity, or correspondence, is the reinforcer as described above (see Gladstone & Cooley, 1975, and Zentall et al., 2018, for sameness as reinforcement). However, emulated speech sounds, in which the correspondence relation between the acoustical properties heard and produced is the reinforcer, have no verbal function. Later in development, mand and tact functions may be learned as certain responses are reinforced or mediated by listeners, including the learned reinforcers for adult attention (see Schmelzkopf et al., 2017, for procedures that conditioned social reinforcement, which then resulted in new verbal behavior). Parents and caregivers will reinforce certain sounds with certain stimuli (e.g., child says, "baba" and is given a bottle of juice or milk each time). The reinforcement function shifts from acoustical correspondence to correspondence between emitting the speech and receiving something from a listener, even if it is the attention alone of the listener. In the case where the spoken sound results in a listener delivering something (i.e., "pass the bread") the verbal behavior is a social con**tract** reinforcement relation, as is the case for the class of responding called mands. However, in the case where the reinforcer is either listener attention or affirmation of a word–object correspondence the type of verbal behavior may be more of a social con**tact** reinforcer.

When children come under the control of con**tract** reinforcement—reinforcement by mediation of a listener—they may learn new mand forms under motivating conditions in which they observe another receive an item that they desire and then emit the mand form themselves, followed by delivery of the item. Likewise, once the child comes under the control of con**tact** reinforcement—social listener reinforcement, in which a listener provides social approval, affirmation, or attention—they may learn new tacts when they observe another emit a tact, followed by social reinforcement, and then they in turn emit the same form and receive social reinforcement. Tacts are occasioned by the presence of a listener who has a history of providing attentional reinforcement (Eby & Greer, 2017; Schmelzkopf et al., 2017). Later, observation of another emitting a tact and contacting social reinforcement may result in acquisition of that tact operant through indirect reinforcement. Further, emitting a foreign language word with new phoneme and consonant sounds after observing another say the word, in which case emitting a new word with point-to-point correspondence with what was heard is the reinforcer, is another example of acoustical correspondence as reinforcement, whereas emulating the new language sounds in order to obtain or describe something would be an example of learning a new verbal speaker operant (Cao & Greer, 2019).

Observational Performance

We define observational performance as changes in existing behavior as a function of contingencies of reinforcement or punishment. This involves remote or indirect contact with the consequences that another is observed to directly contact. In a classroom setting, if a student is out of their seat and the teacher begins praising all the students who are in their seats, if that student then returns to their seat, we might say this is a function of "vicarious reinforcement," or observation of others receiving reinforcement. In fact, it is possible that it was denial of the teacher's attention, coupled with observation of contingencies of reinforcement being provided to others, that set the occasion for the student to return to their seat. As stated earlier, an example of a performance incidence consists of a student raising their hand for the teacher's attention as a result of observing the teacher respond to students who raise their hands for attention.

Bandura et al. (1961, 1963) conducted a series of experiments to examine the role of modeling and consequences on performance behaviors through observation among human subjects. The findings of these experiments showed that individuals respond consistent with what they observe others doing. It is likely that Badura's work involved performance and not learning because there are few, if any, cases where the responses tested were determined to not have been in the participants' repertoires prior to the experiment.

Observational Learning

We define observational learning as the acquisition of new operants as a function of observing another engaged in instruction where the consequences for that person's responses are also observed. An example of learning a new operant would be that after observing someone attempt to solve a calculation where the teacher corrects inaccuracies of the observed student's responses or reinforces correct responses, the observing student emits the correct response. We view observational learning as a cusp, which allows the individual to contact remote learning opportunities through observation. In some cases, it is new reinforcers that are learned through observation.

In 2013 Singer-Dudek et al. found that an observational conditioning-by-denial procedure resulted in the emergence of both observational performance and observational learning. This indicated that the three types of observational learning, later identified as developmental cusps, were related. This notion was further confirmed through Lanter and Singer-Dudek's (2020) study in which they found that observational learning, observational performance, and acquisition of conditioned reinforcement through observation were all established as a function of the observational conditioning-by-denial intervention. It is likely, then, that all three cusps come under the stimulus control related to observing the behavior of others, or the consequent stimuli others contact. Lanter and Singer-Dudek (2020), along with two unpublished dissertations (Baowaidan, 2016; Byers, 2017), found that peer observing responses were necessary prerequisites for any of the observational learning cusps.

Observational Conditioning-by-Denial

The 2006 conceptual article first described what we now call Observational Conditioning-by-Denial. The first empirical study to be published on the topic, by Greer and Singer-Dudek, appeared in the *Journal of the Experimental Analysis of Behavior* in 2008. In the original published study, researchers investigated performance (mastered operants) and learning (new) operants in preschoolers with language and developmental delays. Nonfood items, such as small plastic discs and pieces of string, were chosen due to their lack of inherent value (the participants had no prior history with either stimulus). In addition, no praise was delivered to the participants during any of the phases of the study; prior studies (Greer et al., 1991) had used praise and, in one case, tokens, in addition to peers. Preintervention tests confirmed that these stimuli did not function to reinforce responses to performance or learning tasks. The only consequence during the conditioning procedure was the delivery of the nonpreferred stimulus to a peer while the participant observed but was denied access to those stimuli. During the procedure, all overtures made by the participant to access the stimuli (e.g., whines, cries, mands, attempts to grab the stimuli) as well as other behaviors (e.g., throwing materials, falling out of the chair, putting head down) were ignored. Following several brief sessions of delivery to the confederate only, postintervention tests revealed that the previously neutral stimuli now reinforced both performance and learning responses. It is interesting that in their study on observational conditioning-by-denial, Greer and Singer-Dudek (2008) found that new responses were in fact learned when the unconditioned stimuli were delivered, because immediately following the intervention the participants' responses to many of the learning tasks were at or near mastery levels. Experimenters delivered corrections during the preintervention phases as well as delivered the neutral stimuli for correct responses. Although the participants did not respond under no-reinforcement conditions, they nonetheless learned the correct responses and thus demonstrated correct responding under conditions where reinforcement was present (once the stimuli had become conditioned). Zrinzo and Greer (2013) found the stimuli (metal discs) served as reinforcers for learning and performance several months later.

Several possible explanations for the results were proposed, resulting in a series of studies designed to isolate potential components responsible for the conditioning effects. Components within the observational intervention were systematically examined, such as the role of experimenter (Singer-Dudek et al., 2008; Zrinzo & Greer, 2013) and the role of peer confederate (Singer-Dudek & Oblak, 2013). Given the elimination of the conditioning effects resulting from the peers or the experimenter, one thing became clear: In all instances where the conditioning was successful, the participants observed their peer receive stimuli to which they themselves were denied access. It is likely that it is the denial condition embedded within the observation that is responsible for the effects we found. This is a cusp related to verbal development in that the demonstration of learning reinforcers under the observation and denial conditions indicates the presence of audience control that is key to social contact stimulus control (Skinner, 1957).

How Children Learn the Names of Things through Observation

VBDT researchers produced a body of research designed to determine whether children can acquire the names of things as a listener and as a speaker *from observation alone* (see Greer & Longano, 2010, for a review of the early work). This work also suggests how other relations accrue from exposure alone, and hence observation, such as the function of names and other properties of the stimuli observed along with the name (Kleinert-Ventresca et al., 2023; Pohl et al., 2020). Although the research on verbal development and the resulting theory incorporates the cusps and sequence of verbal cusps and verbal foundational cusps, the cusp that makes the learning of language from observation possible occurs at the point in children's development when the listener and speaker are joined. VBDT refers to the cusp for learning speaker and listener language from observation as Incidental Bidirectional Naming (Inc-BiN). A component of Inc-BiN is the learning of the listener responses alone which is called Incidental Unidirectional Naming (Inc-UniN). The listener is acquired first in typical development, and when this response joins the speaker the existing Inc-UniN responses are from listener to speaker where the responses are now bidirectional and both were acquired from observation, incidentally.

Inc-BiN (See Greer et al., 2005, for the first study) is a cusp involving the developmental joining of the listener and speaker (Lodhi & Greer, 1989) and is one of the types of bidirectional naming (Hawkins et al, 2018; Miguel, 2016). Inc-BiN is a critical observational learning and verbal developmental cusp and is treated in VBDT as one of the four cusps that result in *new ways to learn.* We distinguish these cusps from other cusps in that they are *new learning capabilities* (Greer & Speckman, 2009). Horne and Lowe (1996) introduced the term bidirectional naming focusing on the bidirectionality of listener and speaker relations relative to other derived relations (Horne et al., 2004). They suggested that research on how children come to learn the bidirectionality between listener and speaker needed to be done; however, they did not pursue this. Instead, this has been the focus of VBDT. The VBDT focus was informed by the Hart and Risley (1995) book**,** published a year prior to the Horne and Lowe article, that is the landmark descriptive study on children's development of language and one of their findings showed that parents did not use direct reinforcement. The Hart and Risley studies have been replicated in part and extended by others in subsequent years. The source of stimulus control for how children learn language from incidental exposure was not identified and remained a gap in the literature. It can be argued that this is the missing stimulus that Chomsky (1959, 1971) proclaimed in his notorious criticism of Skinner's (1957) book. A point of criticism that U. T. Place (1981a, 1981b, 1982, 1983, 1995/1996, 1998), a prominent linguist and advocate of Skinner's theory, gave credence only to this single point of Chomsky's criticism. We speculate based on VBDT research that the Inc-BiN cusp provides a likely source for the stimulus control for how children acquire names. We do so based on numerous studies with typically developing and atypically developing children where the Inc-BiN stimulus control was established in children who were missing that reinforcement stimulus control (see Longano & Greer, 2014, for the isolating conditioned reinforcers for Inc-BiN).

Extensions of Incidental Bidirectional Naming

A body of research exists devoted to identifying interventions to establish Inc-BiN cusp for children who do not acquire the cusp spontaneously (see Greer & Longano, 2010, for an early review of that research). These include children with autism or language delays (Fiorile & Greer, 2007; Greer et al., 2005; Olaff et al., 2017) and 24-month-old neurotypical children who had not yet demonstrated Inc-BiN (Gilic & Greer, 2011). The early interventions were multiple exemplar instruction across speaker and listener responses (MEI across listener and speaker; Greer et al., 2005) and the Intensive Tact Intervention (Greer & Du, 2010; Pistoljevic & Greer, 2006). Subsequent research (Kleinert-Ventresca et al., 2023; Longano & Greer, 2014) showed that the probable source was conditioned reinforcers. In the Longano and Greer experiment, the participants selected did not demonstrate Inc-BiN at the outset, but demonstrated reinforcement for choosing visual stimuli but not vocal (auditory) names for the stimuli or vice versa. After repeated pairings of the preferred stimuli with the nonpreferred stimuli resulted in reinforcement for both auditory and visual stimuli, the children demonstrated Inc-BiN. In a prior pilot study by Longano (2008), a preschooler, who did not demonstrate Inc-BiN after both MEI intervention and an echoic intervention, received edible pairings with visual stimuli until they were conditioned as reinforcers. The visual stimuli were then paired with hearing the spoken name until the both the visual stimuli and the spoken name selected out the child's observing responses. Following this intervention the child demonstrated Inc-BiN. Subsequent studies by Kleinert-Ventresca et al. (and based on findings from a dissertation by Lo, 2016) demonstrated advancements in the complexity of Inc-BiN with typical first graders as a function of repeated probes alone, where the active ingredient was the conditioning of reinforcers.

Related findings in relational frame theory (RFT) by Leader et al. (2000) and Leader and Barnes-Holmes (2001) with adults suggested that conditioned reinforcers were fundamental to the derived relations. Indeed, one of the early studies by Hayes et al. (2001) with adults suggested that reinforcers were key in the transfer of function for mutual and combinatorial entailment. In still other research under the derived relations umbrella, Shawler et al. (2022) established derived reinforcers via stimulus equivalence. Together these findings strongly suggest that the demonstration of derived relations by adults involves conditioned reinforcers. The research cited above on the acquisition of the Inc-BiN cusp shows how this stimulus control is acquired in children like those studied. This in turn shows the missing stimulus control for how at least some children learn the names of things.

Observation and Derived Stimulus Relations

Observation plays a critical role in derived stimulus relations. Fryling et al. (2020) points to three research articles that identify interventions employing observation as a means to teach or test the evocation of derived relations. Rehfeldt et al. (2003) demonstrated observation as an effective intervention to enhance or establish classes of reading skills in individuals with autism as did Ramirez and Rehfeldt (2009) for teaching Spanish vocabulary to typically developing children. Macdonald et al. (1986) had demonstrated earlier that adults (presumably under Inc-BiN stimulus control) demonstrated observational learning of derived relations. However, it needs to be emphasized that the cusps for Inc-BiN and Inc-UniN are themselves derived relations (Sivaraman & Barnes-Holmes, 2023; Sivaraman et al., 2021; Sivaraman et al., 2023). Moreover, Morgan et al. (2021) found a strong correlation between Inc-BiN and mutual and combinatorial relations for arbitrary applicable relations and, it should be noted, no correlation between Inc-BiN and nonarbitrary appliable relations. Research reported in a recent unpublished dissertation found a functional relation between the establishment of Inc-BiN and combinatorial and mutual entailment with four preschoolers (Friedman, 2020).

There appears to be a complementary relation between work on how verbal behavior develops and the complexities of language identified and explored in derived relations research. Exploring the interrelation between the development of all of the types of observational learning and how those relate to the range of applied work in derived relations is critical and advancing a more mature science of behavior that brings together the range of findings in 21st century basic and applied sciences of behavior (Fryling et al., 2020). One of the issues concerns the fact that much of the research on Inc-BiN has involved the presentation of the spoken word for the stimulus has not systematically involved a delay procedure that has been a key test of derived relations. However, Sivaraman et al. (2021) demonstrated the onset of Inc-BiN using a stimulus delay procedure providing a stronger affirmation of Inc-BiN as a derived relation. Advancing research in isolating the delay component is an example of how collaborative research might lead to a more solid foundation for a behavior science of language and other complex human behavior.

Continued research on Inc-BiN identified that this cusp, and maybe others, is a continuum of levels of complexity and difficulty. Other stimulus control associated with the incidental learning of names includes learning the function (Cahill & Greer, 2014), learning additional aspects of the stimulus (Frias, 2017; Lo, 2016), and differences in Inc-BiN for familiar stimuli and nonfamiliar stimuli (Kleinert-Ventresca et al, 2023; Lo, 2016; Morgan et al., 2021). Familiar stimuli are stimuli that a name learner had probable contact and experience with such as stimuli that reinforce or select out attention (Greer, 2020). These involve the emission of the symbolic word for familiar and common stimuli that are not themselves symbolic in nature (i.e., nonarbitrary stimulus relations). The presence of strong stimulus control for Inc-BiN with nonfamiliar stimuli correlates (Pearson r +.84) with the emission of derived relations for arbitrarily applicable relations with responding by 3- to 5-year-olds, whereas Inc-BiN for nonfamiliar stimuli does not correlate with arbitrarily applicable derived relations (Morgan et al., 2021). Of course, Inc-BiN with familiar or nonfamiliar stimuli is itself a type of derived relation; however, it is derived relations across speaking and listening or responding to the same stimuli as listener and speaker. Many arbitrarily applicable relations involve the same response to symbol-symbol relations such as the use of MTS responding.

Both VBDT and RFT researchers acknowledged that Inc-BiN can be categorized as a form of a relational framework. According to RFT, Inc-BiN entails a heightened level of complexity in the transformation of functions. This complexity allows a child not only to associate a name with a stimulus but also to vocally produce the corresponding sound in coordination with that stimulus (Luciano et al., 2007). In this regard, it is evident that RFT and VBDT share a consensus. More recent RFT research developed a multidimensional, multilevel (MDML) framework and differential arbitrarily applicable relational responding effects (DAARRE) model (Barnes-Holmes et al., 2021) in attempt to conceptualize psychological events. Combining the MDML framework with the DAARRE model highlights the restructuring of MDML's functions; it provides another way to understand language acquisition through complex relational networking. This new framework placed particular emphasis on the orienting and evoking functions of stimulus events, which carries significant implications for the application of RFT in the context of naming as described by Barnes-Holmes et al. (2021). Although space prohibits a detailed explanation, the interrelation of these complex stimulus control and relational networking calls for extensive and collaborative research.

The observation repertoire of Inc-BiN is one of the critical developmental attributes that determines the types of educational interventions students should receive. For example, Hranchuk et al. (2019) found that children who demonstrated Inc-BiN learned from the presentation of instructional trials that included exemplars and spoken instructions whereas children who did not demonstrate Inc-BiN did not benefit from antecedent information and demonstration; the latter children learned only from consequences. This was also found to be the case in a study that showed that typically developing first graders with weak stimulus control for Inc-BiN, who did not profit from instructional presentations and learned only from consequences, did learn from antecedents after strong stimulus control for Inc-BiN was established (Greer et al., 2011). Abdool-Ghany and Fienup (under review) found that children with only the listener component of naming (Inc-UniN) required different instruction than children who demonstrated Inc-BiN. Children who have the Inc-BiN cusp demonstrated derived responding for speaker responses if taught the listener responses; thus, teaching one response resulted in the emission of untaught responses, whereas children who demonstrated only Inc-UniN required the teaching of the speaker response as well as the listener. However, the demonstration of Inc-UniN did result in demonstrating the listener response if taught the speaker. If children do not demonstrate at least Inc-UniN they require instruction across both responses. This suggests that the effective implementation of equivalence-based instruction requires the presence of the observational cusps associated with Inc-BiN. These are just some of the potential interactions between the language learning cusps of verbal development and curriculum and pedagogy. Thus, this social learning repertoire appears critical and as such this type of stimulus control calls for research investments from multiple laboratories in the science of behavior and neuroscience.

Conclusion

The expansion of the research on observation and verbal development led us to propose a new perspective on the class of responding called observation. One aspect that is important about this work is that it, along with the research on relational responding in language and complex human behavior, provides the science of behavior with a presence in the study of social learning. It is striking that our work rests on the foundation of Skinner's identification of the reinforcer in the operant as well as his theory of verbal behavior. The difference is that we may begin to identify the kinds of complex reinforcers and the learning of those reinforcers from observation alone. We propose that our findings fill some gaps in the literature on language development as part of the growing contribution of the science of behavior to language and complex human behavior.

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