Efficiency Is Everything: Promoting Efficient Practice by Harnessing Derived Stimulus Relations

Thomas S. Critchfield¹

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Abstract

A pivotal skill of practice involves engineering emergent learning. Toward this end, graduate training in applied behavior analysis must emphasize concepts of and research on stimulus relations in order for practitioners to develop these skills.

Keywords Stimulus equivalence · Derived stimulus relations · Emergent learning

Graduate training programs in applied behavior analysis (ABA) vary widely in terms of goals, staffing, institutional context, and student characteristics, but they all have something in common: Time available for training future practitioners is finite, and the repertoires practitioners need to function optimally are essentially unbounded. It is never possible to teach all that students will one day need to know, and thus judicious decisions are required about what to teach in the available time.

Intelligent people can, and do, disagree as to what specific content areas must be part of a graduate curriculum, what seminal sources students should read to address those areas, and the extent to which a practical focus should be supplemented by attention to fundamentals, such as basic principles (Sidman, 2011) or research experience (Dixon, Reed, Smith, Belisle, & Jackson, 2015). But to my way of thinking, such discussions come close to missing a critical, and more general, point: Because it is impossible to teach everything that students need to know, the best any graduate program can hope for is to establish *pivotal skills* (e.g., Koegel & Frea, 1993) that have a good shot of applying to many different practical challenges and thus will support future professional development.

Decisions about how to structure graduate training therefore must begin with a thoughtful analysis of the environments that ABA graduates someday will inhabit. These environments can vary along many dimensions,

but they have one thing in common: Time available for changing behavior is finite, and the client repertoires that must be built up in order to achieve optimal functioning are essentially unbounded. It is therefore of paramount importance that ABA graduate training emphasize skills that will help future professionals make the most of the very limited time they will have to work with their clients.

If we can teach only a few things during ABA graduate training, then it makes sense to emphasize skills that can be expected to yield the maximum bang for the clinical-hour buck. Efficiency in practice can be promoted by focusing on either the numerator or the denominator in the ratio of

$$\frac{\text{amount client learns}}{\text{amount of client and effort invested}}.$$

Importance of the denominator is widely appreciated, as evidenced by such steps as selecting potent reinforcers and basing interventions on a thorough functional analysis. These procedures help to assure that what is taught is learned as quickly as possible. Focusing *only* on the denominator, however, opens the door to what might be called “100% blinders.” Typically, we declare ABA practice to be a success if clients learn most or all of what is directly taught, but this is a rather unambitious standard.

Given the immense time constraints that always exist in practice, why limit our goals to what there is time to directly teach? There is usually an implicit assumption that we do not. In college teaching, for instance, instructors often congratulate themselves on how their students will one day “apply what was taught” to their college experiences after college. A foundational premise of early intensive behavioral interventions is

✉ Thomas S. Critchfield
tscritc@ilstu.edu

¹ Department of Psychology, Illinois State University, ISU Campus Box 4620, Normal, IL 61790, USA

that teaching selected skills will alter developmental trajectories long after the intervention has ceased. Such postintervention benefits, when they occur, can be called *emergent learning*, and they are desirable because they address the numerator of the efficiency ratio described previously. The basic idea is that directly teaching a few things will cause other, untaught abilities to arise—and thus in the long run, more learning benefits will occur per unit time of intervention.¹

Unfortunately, to borrow a phrase from Stokes and Baer, in standard practice emergent learning remains primarily a matter of “train and hope” (1977, p. 351). Very rarely does ABA practice target specific hoped-for emergent abilities, establish the conditions that should spawn them, and measure to verify that they actually emerged. Under these conditions, emergent learning is essentially an unfalsifiable notion: At some unspecified point in the future, emergence might or might not occur, and we probably will never know the outcome. If an individual does, at some future moment, exhibit interesting and valuable new behavior, there is no verifying that it originated in particular prior clinical experiences (Critchfield & Twyman, 2014).

What is really needed in ABA practice is a *technology* of emergent learning that can specify, with precision, what kinds of current experiences will reliably yield what kinds of emergent abilities. Technologies are easiest to devise when we have a solid understanding of the processes that create desired outcomes, and Critchfield and Twyman (2014) have argued that, outside of behavior analysis, the development of such a technology has been slowed by unclear ideas about mechanism. In cognitive psychology, for example, there has been a tendency to assume that emergent learning is the result of a (presumably uniquely human) learner-initiated process of “meaning making” that learners superimpose upon their past learning experiences. Bruner (1973) famously wrote of learners creatively “going beyond the information given,” through a process of combining and critiquing existing knowledge, to arrive at untaught insights.

One need not debate the ontological status of cognitive acts of meaning making to determine that they make a poor basis for technology development (Critchfield & Twyman, 2014). Even if learners occasionally reflect on what they have learned and figure out how to creatively extend it, this has nothing to do with technology or professional practice because, should emergent learning be observed, credit for it belongs solely to the initiating learner. The therapist or teacher has done nothing to make this happen. And should emergent learning *not* occur, the therapist or teacher quite conveniently bears no responsibility for this.

Effective technologies both make implementers responsible for arranging the necessary conditions of learning and empower them to do this. Efficiency in practice, therefore, requires mastery of the principles that make emergent learning possible, as well as skill in harnessing those principles in practical settings. Fortunately, behavioral research has revealed a variety of ways in which emergent learning can be produced; Balsam, Deich, Ohyama, and Stokes (1998) provide an excellent summary of some of these that should be required reading in every ABA training program. However, in most cases, the available literature describes mainly basic research. A clever practitioner might be inspired by this research to devise many useful strategies, but we are a long way from having technologies of emergent learning that can be widely disseminated.

An emerging exception to this state of affairs can be found in the literature on derived stimulus relations, which includes stimulus equivalence (Sidman, 1994) and other types of interconnected repertoires of conditional discriminations (e.g., Stewart & Roche, 2013). In service of brevity I will refer the reader to outside sources regarding the “what” of derived stimulus relations. Unfortunately, there is no single best point of entry into this topic area, although collectively the sources shown in Table 1 provide relatively nontechnical introductions to the relevant concepts. Also recommended is a soon-to-be-published (2018) special issue of *Perspectives on Behavior Science* (formerly *The Behavior Analyst*), which will explore many of the implications of derived stimulus relations for understanding complex behavior.

In roughly the past two decades, interventions based on stimulus relations have been devised to efficiently establish an impressive array of behavioral repertoires (see Rehfeldt, 2011). All of the relevant work meets the core requirement of arranging the preconditions for emergent learning. A few carefully chosen abilities are directly taught to yield the emergence of other, specifically targeted, but—importantly—*untaught* abilities. Thus, the amount learned is always greater than the sum of what is directly taught, and the overall constellation of skills is a matter of engineering rather than happenstance. Most directly to the point, amount learned per unit time is increased above what may be accomplished by teaching everything directly (for quantitative demonstrations of this effect, see Fienup & Critchfield, 2011, and Zinn, Newland, & Ritchie, 2015).

Nevertheless, the relevant work does not quite constitute a technology. As Rehfeldt (2011) has observed, too much of the applied research on derived stimulus relations still takes the form of demonstration-of-concept exercises, conducted in laboratory-like settings, that show how socially important behaviors can be established on a small-scale basis. Very recently, however, we have seen interventions intended specifically for field settings, addressing larger scale learning objectives, with attention to ease of implementation (e.g.,

¹ The assumption that learning can extend beyond what direct experience teaches is not unique to behavior analysts. Educator John Dewey (e.g., 1933), the Gestalt psychologists (e.g., Kohler, 1927), cognitive psychologists (e.g., Bruner, 1973), and even Aristotle all have commented on the capacity for emergence.

Table 1 Some introductory sources on derived stimulus relations

Sources	Comment
Critchfield and Fienup (2008); Critchfield and Twyman (2014)	Relatively nontechnical introductions to stimulus equivalence in and illustrations of the applied potential of engineering emergent learning
Hayes, Barnes-Holmes, and Roche (2001)	Delineates various types of nonequivalence relations (Chapter 2) and provides an introduction to the process of transformation of function, which is an important component of emergent learning (Chapter 3)
Stewart and Roche (2013)	An introduction to the influential relational frame theory account of stimulus relations
Dougher (1998)	A clear, early explanation of the importance of transformation of function to clinical problems
Dymond and Rehfeldt (2000)	An accessible, if slightly dated, review of the literature on transformation of function
Barnes-Holmes, Finn, MacEntegert, and Barnes-Holmes (in press); Stewart (2017)	Nice introductions to derived stimulus relations, although later sections, which focus on advanced theoretical issues, may be harder for nonexperts to digest
Dougher, Twohig, and Madden (2014)	A brief survey of basic and translational research on stimulus relations
Rehfeldt and Barnes-Holmes (2009)	One of the first published attempts to systematize the possibilities of harnessing stimulus relations in behavioral programming for persons with developmental disabilities

Critchfield & Fienup, 2010; Fienup & Critchfield, 2011; Walker & Rehfeldt, 2012). Such instances provide encouragement that genuine technologies based on stimulus relations can indeed be developed.

For present purposes, it is worthwhile to reflect briefly on why full-blown technologies of derived stimulus relations are not already at hand. I can suggest four relevant factors. First, research in this area first arose in the basic laboratory, and bench-to-bedside translation usually unfolds sluggishly. Second, the number of individuals who are actively engaged in derived stimulus relations work has been fairly small, meaning that there are relatively few vectors of dissemination. Third, dissemination may be further slowed by the fact that the relevant literature can be quite difficult for nonexperts to consume. The procedures that are involved have many working parts (not all details of which can be anticipated based on familiarity with other areas of behavior analysis), and the language through which derived stimulus relations are discussed is unfamiliar, often relying on symbolic notation that many behavior analysts find confusing. Fourth, training procedures for derived stimulus relations can be quite effortful to devise. Although the yield of learning is great, the behavioral engineer's up-front investment can be sizeable. Collectively, these factors help to explain why, as we approach the 50th anniversary of the first behavior-analytic stimulus equivalence study (Sidman, 1971), we continue to talk more about the *promise* of derived stimulus relations technology than about technological accomplishments.

But there is yet another reason for slow technological development, one that bears directly on the message of the present essay. Those who are best positioned to do the developing—practitioners—tend to be late adopters. If they receive any exposure to concepts of and research in derived stimulus relations, this often happens fairly deep into graduate training. As a result, what is sadly missing in ABA is consistent *fluency* with concepts and procedures that would underpin emergent-learning technological development. Well-practiced skills become “automatic” and less effortful. Thus, an early and thorough grounding in derived stimulus relations would mitigate many of the aforementioned impediments to dissemination. Every kind of intervention is hard to do well, but for things that have become familiar, the effort is reduced.

So now imagine what might happen if ABA graduate programs unleashed an army of practitioners with deep fluency in the foundations of emergent learning. Each would know how to devise interventions to meet the unique needs of individual clients, who of course would benefit greatly in light of their unlimited need to learn but limited time and access to services. More importantly, members of this “derived stimulus relations army” also would be capable of building comprehensive emergent-learning *curricula* that could be used by *any* decently trained practitioner and would be readily transportable to a variety of settings. These curricula would have the ease of implementation and near-guaranteed success of *Toilet Training in Less Than a Day* (Azrin & Foxx, 1989) and *Teach Your Child to Read in 100 Easy Lessons* (Englemann,

Haddox, & Bruner, 1986), with all of the benefits of planned emergent learning.

A few sources of inspiration for the needed process of development already exist. These include the Headsprout® learn-to-read system (e.g., Layng, Twyman, & Stikeleather, 2004) and the PEAK Relational Training System® for establishing social and verbal skills (e.g., Dixon, 2015, 2016). The PEAK system is particularly exciting because of a growing body of peer-reviewed literature demonstrating its effectiveness (Dixon et al., 2017). Given that five decades have elapsed since behavior analysts first began to study derived stimulus relations, it is a shame that these are isolated examples. My modest proposal is that, due to the ever-present need to teach as much as possible as quickly as possible, stimulus relations interventions should pervade all of ABA—and therefore be integral to the training of all applied behavior analysts.

A small but symbolically important sign of progress came with the 2017 release of the Behavior Analyst Certification Board's (BACB's) Fifth Edition Task List, item B-15, which indicates that an applied behavior analyst should be able to “define and provide examples of derived stimulus relations” (<https://bacb.com/wp-content/uploads/2017/01/170113-BCBA-BCaBA-task-list-5th-ed-english.pdf>, emphasis added). According to the BACB, all trainees must now be exposed to stimulus relations concepts, which is a step in the right direction. But this is a far cry from assuring that trainees are fluent in this area and have experience translating concepts into interventions and curricula.

To return to my opening point, if we can work with ABA trainees for only a limited amount of time, we should build skills that will take them, and the people they will work with, absolutely as far as possible. Emergent learning generally and derived stimulus relations concepts specifically provide a launchpad for this and should be a serious focus of any ABA graduate training program. But as with all efforts to unpack nature's secrets, there are nuances and complexities to contend with, not to mention the practical challenges of bench-to-bedside translation. Students will not master the concepts or become proficient at designing and implementing emergent-learning interventions based on one course unit or even one full course; rather, in the interest of fluency and of shedding our 100% blinders, derived stimulus relations concepts and interventions should pervade ABA graduate training so that, someday, they can pervade all areas of practice.

Compliance with Ethical Standards

Ethical Approval This article does not contain studies conducted with any member of Animalia, Plantae, Fungi, Protista, Bacteria, or Archaea, so oversight by an institutional research ethics committee is not applicable.

Informed Consent Because no primary empirical data were collected from human participants, informed consent is not applicable.

Conflict of Interest The author declares no conflicts of interest with respect to this article.

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