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Why We Are Still Not Acting to Save the World: the Upward Challenge of a Post-Skinnerian Behavior Science

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Abstract Basic research on derived stimulus relations reveals many effects that may be useful in understanding and resolving significant and complex societal problems. Applied research on derived stimulus relations has done little to fulfill this promise, focusing instead mainly on simple demonstrations of well-known phenomena. We trace the research tradition of derived stimulus relations from laboratory to wide-scale implementation, and put forward several suggestions for how to progress effective and impactful research on derived relational responding to issues of immense social importance. To advance a science of behavior from relative social obscurity to the developing world-saving technologies, we must evaluate our own behavior as scientists in the grander social context.

Keywords Stimulus relations · Relational frame theory · Verbal behavior · Social behavior

Skinner (e.g., 1953), among his many contributions to the field of behavior science, put forward the position that those who engage in a science of behavior have not only the potential to save the world, but also an obligation to do so. With the publication of *Science and Human Behavior* (1953), Skinner espoused a technology for predicting and

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controlling human behavior that evolved directly from his findings in basic animal laboratories, emphasizing the role of operant conditioning in the development of simple human capacities such as ratio/interval motor performances, to complex human abilities such as problem solving and thinking. Amidst criticisms of this approach from notable figures in philosophy and psychology suggesting that this account was too simplistic to explain the complexities of the human condition, Skinner (1957) published *Verbal Behavior*, a purely operant account of language. Three decades later, Skinner would despair over the limited impact behavioral analyses had had on solving the world's most pressing problem. In a paper titled, "Why we are not acting to save the world," Skinner (1987) described a world "in serious trouble" (p. 1), on the precipice of a nuclear winter, and experiencing overpopulation and mass resource depletion.[1] The solutions were simple: "Destroy all nuclear weapons, limit family size, and adopt a much less polluting and less wasteful style of life" (Skinner, 1987, p. 1). Each of these solutions involved changing human behavior – the subject matter that the science of behavior was intended to explain. According to Skinner, the root of the problem was not to be found in any shortcoming of our own science or theory, but rather in a failure of society to embrace our scientific knowledge and apply the relevant principles at a large scale. The reason for this failure was that people tend to assume that behavior will change when the populace properly understands the prevalence and severity of the problems that we face. Skinner, of course, maintained that solutions were to be found in the operant contingencies controlling destructive behavior, rather than our knowledge about or worry over future affairs.

In the present paper, we put forward an alternative account of "*why we are still not acting to save the world*" that does not place blame on society's failure to adopt exclusively operant principles. Instead, our position is that behavior science has been limited by failing to translate post-Skinnerian theoretical advances and laboratory discoveries that emphasize derived stimulus relations to scaled-up, impactful, and evidence-based technologies for use by members of the society. First, we describe derived relational accounts of language and cognitive development as a contemporary alternative to Skinner's theories that could have greater utility in effecting the social changes sought by Skinner himself. Second, we explain that although basic experimental work has validated the principles in derived relational accounts, the applied wing of behavior science has not built on these advances by developing and empirically evaluating large- technologies suitable for addressing society's large-scale problems. Finally, we suggest three potential strategies that, if embraced, may improve the likelihood that technologies emphasizing derived stimulus relations, can accomplish Skinner's dream of saving the world through a science of human behavior.

Verbal Stimulus Relations: A Post-Skinnerian Account

Rule-Governance and Stimulus Relations

Behavioral description, prediction, and control of language events was first made possible in a systematic way by Skinner's (1957) account in *Verbal Behavior* (Dymond,

[1] These world issues are a still present concern, as we are again witnessing nuclear threats, resource depletion now carries the added concern of short and long term environmental sustainability, and the global population continues to rise.

O'Hora, Whelan, & O'Donovan, 2006). Early empirical studies based on the analysis showed how language events could be manipulated, much as nonverbal behavior is, but these studies were largely focused on the most basic types of verbal operants (e.g., echoics, tacts, and mands) as acquired and demonstrated by people with intellectual or developmental disabilities (see Dixon, Small, & Rosales, 2007) or nonhumans (e.g., Pepperberg, 1981). - An important advance took place just over one decade after the publication of *Verbal Behavior* when Skinner (1969) introduced his conceptual analysis of *rule governed behavior*. Skinner defined rule-governed behavior as a contingency specifying stimulus, although the concept has been expanded and updated over the past four decades (Hayes, Brownstein, Zettle, Rosenfarb, & Korn, 1986; Hayes, Zettle, & Rosenfarb, 1989; Zettle & Hayes, 1982). Overall, the emergence of an account of rule governed behavior was significant because it contributed to the understanding of how language develops and how it can influence all other aspects of human responding (e.g., Hayes, 1989).

Accounts of rule-governed behavior sparked several basic laboratory studies detailing how rules can interact with changing contingencies, producing behavior that is not under the exclusive control of immediate environmental consequences (e.g., Catania, Matthews, & Shimoff, 1982; Matthews, Shimoff, Catania, & Sagvolten, 1977; Shimoff, Catania, & Matthews, 1981). The core finding was that rules, both externally delivered and self-generated, could establish behavior that either mimicked or countermanded the behavior patterns normally expected under schedules of reinforcement. Put another way, these studies suggest that language renders an analysis based purely on operant contingencies incomplete (Hayes, Rosenfarb, Wulfert, Munt, Korn, & Zettle, 1985; Hayes & Wolf, 1984; Rosenfarb & Hayes, 1984; Zettle & Hayes, 1982).[2]

Also shortly after the publication of *Verbal Behavior*, a stimulus relations account of language development emerged that did not rely on a direct history of reinforcement and could explain the emergence of rule-governed behavior. Sidman (1971) demonstrated that some verbal events are not acquired via direct contact with contingencies but rather are derived from prior reinforced relations through stimulus equivalence. Early discoveries showed that after conditionally relating dictated names to corresponding pictures and words, participants with language delays read words, named pictures, and matched pictures to words and words to pictures, in the absence of explicit instruction (Sidman & Tailby, 1982; Sidman, Kirk, & Willson-Morris, 1985; Sidman, Willson-Morris, & Kirk, 1986).[3] These individuals behaved as though the stimuli were functionally substitutable, or equivalent to one another (Sidman, 1986). Related stimuli were said to combine to form an *equivalence class*, and the transfer of stimulus function[4] from one class member

[2] As a point of clarification, we are not proposing that contingencies, immediate and delayed, do not influence behavior of verbally sophisticated humans, as recent research has shown that quantitative contingency-based models (e.g., matching law) predict several instances of human behavior (Hantula & Crowell, 2016; Hantula, Brockman, & Smith, 2008); rather, that both contingency governance and rule-governance must both be considered for a complete account (see Belisle, Paliliunas, Dixon, & Speelman, in press, for a study with recreational gamblers that synthesizes matching and derived rule following).

[3] As noted by Hayes and Sanford (2014), over 25 years of research on equivalence responding in animals has failed to find systematic and replicable evidence that non-human animals can demonstrate symmetrical or transitive relational responding, which can be readily demonstrated by human infants, suggesting that language defined consistent with this and related accounts (RFT) describe a potentially exclusively human behavior.

[4] Also referred to as *transformation* of function (e.g., Dymond & Rehfeldt, 2000), for reasons that will be addressed shortly.

to related class members created functional substitutability of stimuli. Such findings showed that a history of direct reinforcement was not necessary to explain every discriminated operant response.

A further advance in the understanding of the nature and implications of derived stimulus relations was the development of Relational Frame Theory (RFT; Hayes, Barnes-Holmes, & Roche, 2001). RFT made clear that there are *many* ways, in which people can relate non-identical stimulus events, including: coordination (identity), distinction (difference), comparison (difference along a specific dimension), opposition (opposites), deictic (relative to the current status or situation of the "speaker"), and hierarchical (membership in a category)[5] (Hayes et al., 2001). Studies of these types of relations made clear that stimulus functions do not simply "transfer" to among related stimuli; rather the function of all class members is transformed consistent with their relationship to other class members (Dougher, Augustson, Markham, Greenway, & Wulfert, 1994; Dougher, Hamilton, Fink, & Harrington, 2007). This ability, according to RFT, is not something that emerges spontaneously in humans as they develop across the lifespan. Rather, each "frame family," or type of relation, and the ability to entail emergent (untrained) relations based on it, is a high-order generalized operant much like motor imitation, that once learned, may be topographically boundless (Barnes-Holmes & Barnes-Holmes, 2000; Healy, Barnes-Holmes, & Smeets, 2000).

Advances in stimulus equivalence and RFT expand considerably the complexity of behavior analytic theories, and we argue, could have utility in solving the types of complex problems described by Skinner in 1987 and experienced by us now. These accounts are not without controversy; indeed, perhaps no other advancement in behavior science has received as much critical attention (e.g., Palmer, 2004). But that is perfectly appropriate, because if RFT is correct then descriptions of human behavior based strictly on control by reinforcement contingencies, as per Skinner (e.g., 1953, 1957) are incomplete. This is, in fact, the core assumption of the present article. As a preliminary matter, however, it is important to emphasize that a massive empirical literature now documents derived stimulus relations effects and, in the process, supports theoretical accounts like RFT. A very quick synopsis helps to make the point.

Early research showed that stimulus classes could incorporate many members (Saunders, Wachter, & Spradlin, 1988), including complex stimuli with compound (Markham & Dougher, 1993; Debert, Matos, & McIlvane, 2007) or cross modal features (Lane, Clow, Innis, & Critchfield, 1998), and could span a variety of nodal distances[6] (Fields, Adams, Verhave, & Newman, 1990; Spencer & Chase, 1996). This research showed that stimuli sharing common members could spontaneously merge to form even larger classes (Saunders, Saunders, Kirby, & Spradlin, 1988). Other research explored relationships between derived stimulus classes and private events (Arntzen & Steingrimsdottir, 2017; DeGrandpre, Bickel, & Higgins, 1992; Dougher et al., 1994; Haimson, Wilkinson, Rosenquist, Ouimet, & McIlvane, 2009; Schlund, Cataldo, &

[5] With this expansion came a change in vocabulary. Sidman (e.g., 1994) had referred to such phenomena as *symmetry* (when two stimuli can be identified as "going together" regardless of which is presented) and *equivalence* (as described above). In RFT these are replaced by *mutual entailment* and *combinatorial entailment*, terms that are more readily adaptable to a variety of types of derived stimulus relations; for further explanation see Hayes, et al. (2001).

[6] In effect, "degrees of separation," defined as the number of steps of direct experiential association separating indirectly-associated stimuli.

Hoehn-Saric, 2008). But arguably the most important contribution of early research, as suggested above, is the often-replicated finding that stimulus functions, both operant (Tonneau & Gonzalaz, 2004) and respondent (Dougher et al., 1994), can propagate through stimulus classes (transformation of function), creating behavioral functional relations that are not the direct product of reinforcement contingencies.

Basic experimental research inspired specifically by RFT has further shown how derived stimulus relations alter the basic conception of learning as behavior analysts conceive of it. For example, the standard behavior analytic conception of conditioned consequences holds that formerly neutral stimuli acquire consequential functions through direct pairing with already-effective consequences (Catania, 2013). Yet stimuli never paired directly with an already-effective consequence can become reinforcers and punishers through transformation of function via frames of coordination and opposition (Whelan & Barnes-Holmes, 2004). Similarly, the traditional view is that stimuli can acquire avoidance functions through direct pairing with already-aversive stimuli (Catania, 2013). Yet stimuli never so paired can become avoided through transformation of functions through frames of coordination and distinction (Dymond, Roche, Forsyth, Whelan, & Rhoden, 2007).

RFT-inspired research has also illuminated the role of derived stimulus relations in complex language based events such as reasoning through analogy (Stewart, Barnes-Holmes, Roche, & Smeets, 2002; Ruiz & Luciano, 2011), self-discrimination of relational responses (Dymond & Barnes, 1995), and the formation of false memories based on the semantic relatedness of relational network stimuli (Guinther & Dougher, 2010). Other examples include hierarchical transitive class containment (a categorization effect), which can be examined as an operant class (Slattery, Stewart, & O'Hora, 2011), and the fundamental attribution error, which can be created as a product of deictic relational responding (Hooper, Erdogan, Keen, Lawton, & McHugh, 2015). Phenomena like these have been well described by scholars outside of behavior science but, prior to RFT, were not systematically addressed by behavior analysts.

Finally, basic research inspired by RFT has helped to shed light on everyday phenomena that are well-documented but contribute to global suffering. Examples include racism, bias, and stereotypes (Barnes-Holmes, Murphy, Barnes-Holmes & Stewart, 2010), obesity (Lillis, Hayes, Bunting & Masuda, 2009), anxiety reduction (Arch, Eifert, Davies, Vilardaga, Rose, & Craske, 2012), posttraumatic stress disorder (Walser & Hayes, 2006) and depression (Forman, Herbert, Moitra, Yeomans, & Geller, 2007). To illustrate, consider an example from our own research program. Immediately following 2001 World Trade Center terrorist attacks, we conducted a series of studies to determine the role of relational networks in both terrorist behavior and unwarranted fears directed toward Middle Eastern people. In 2003, we published a conceptual paper (Dixon, Dymond, Rehfeldt, Roche, & Zlomke, 2003) discussing how prejudice and terrorism could result from derived relational responding, and put forward descriptions of potential cultural interventions based on RFT that could be implemented in the United States and abroad. Between 2006 and 2009, we published a series of studies showing how prejudice toward Middle Eastern people as terrorists could be developed and dismantled, all using RFT technologies (Dixon, Rehfeldt, Zlomke, & Robinson, 2006; Dixon, Zlomke, & Rehfeldt, 2006; Dixon & Lemke, 2007; Dixon, Branon, Nastally, & Mui, 2009). The following illustrates the flavor of these analyses.

> Take for example a relatively young Middle Eastern male [who] begins to struggle with how he will earn a living and make ends meet. Perhaps he just has learned that he will need to go hungry for the next few days because food is not available in his town. Let's call his current state of economic affairs and hunger, "A." [The man] is outraged by his never ending struggle for food and money. Let's call this outrage, "B." Yet, who should our young man be outraged at? … One day upon a trip to the downtown area he overhears a group of other men speaking about how it is "America's fault" that there is no food. It is "America's fault" that everyone is so poor. (Dixon et al., 2003, p. 135)

In this example of transformation of functions, C will now evoke emotional responses formerly restricted to A, even though the man has never directly experienced an American. Now, imagine that the man's town acquaintances are Taliban, and they appear to be materially better off than he is. Let us call their relative well-being "Y," and it is

> …Opposite to our young man's state of affairs…. Also opposite of our young man's state of affairs is a feeling of happiness and pride in himself. Let's call these feelings, "Z." Now, through a similar transfer of stimulus functions, our young man begins to believe that feelings of happiness and pride are equivalent with joining the Taliban army. In notation, if A is opposite of Y and A is opposite of Z, then Y is the same as Z. (Dixon et al., 2003, p. 136)

Collectively, the research on derived stimulus relations is important because it expands the scope of behavior theory, in particular with respect to the extent to which it supports prediction and control of the behavior of very sophisticated organisms and explains some of the complicated behavioral phenomena associated with them (Sidman, 1994; Tonneau, 2001). The fact that verbally competent humans[7] show the emergence of any number of untaught relations following an operant history for relating stimuli in arbitrarily applicable and arbitrarily applied ways that is contextually controlled has proved to be a useful paradigm for understanding many key aspects of human behavior (see Barnes & Holmes, 1991).

Thirty Years of Application Stagnation

To summarize thus far, theoretical advances in equivalence and RFT have provided the infrastructure for a robust research agenda that both supports the theory and provides insights into various aspects of complex human behavior. Unfortunately, no accompanying revolution has been seen in applied behavior analysis. Basic researchers have long discussed the implications of phenomena such as rule-governed behavior for solving complex problems outside the

[7] Whether presumably nonverbal nonhumans show any of these effects is a matter still under debate; see Galizio (this issue) for a representative discussion.

domain of disability treatment (Catania, Shimoff, & Matthews, 1989; Dixon, 2000; Guinther & Dougher, 2015; Malott, 1993; Skinner, 1977; Zettle, 1990). Yet while they were talking, a cognitive revolution took place (Miller, 2003; Sperry, 1993) in which, from the perspective of laypersons and mainstream psychologists, behavior analytic approaches were supplanted by those looking "inside the mind" to find solutions to human problems. The response of behavior analysts has been primarily to ruminate over the logical shortcomings of cognitivist accounts (O'Donohue, Ferguson, & Naugle, 2003; Faux, 2002; Skinner, 1977), but ever so steadily, during the past four or five decades, cognitively-oriented researchers (often bearing the moniker of "cognitive-behavioral") have amassed considerable evidence for the effectiveness of their approaches in addressing a range of human problems (Butler, Chapman, Forman, & Beck, 2006). One wonders what might have been achieved by behavior analysts during the same interval had advances in derived stimulus relations research been systematically applied in the same way.

Rehfeldt (2011) summarized the history of publications on derived stimulus relations, including stimulus equivalence, through 2009 in the *Journal of Applied Behavior Analysis* (*JABA),* which often is considered the premier outlet for applied behavior research. Achievements were found to be quite limited; here we will cite three important examples. First, nearly all of the studies focused on establishing relations of sameness or equivalence. Since 2009, 12 additional studies have been published in *JABA* that targeted relations of sameness, compared to only 2 targeting other relations. This is a stunning lack of attention to the sizeable literature explicating other kinds of relations, which encompasses literally hundreds of supporting basic studies (Hayes et al., 2001). Since 2009 alone, nearly 200 studies referencing RFT have been published in other behavior science journals. It is not clear why *JABA* is different. Perhaps applied investigators are simply unaware of this literature or lack the skills to understand it. Perhaps reviewers in a journal that is considered to be "Skinnerian" are reluctant to accept work reflecting other theoretical frameworks and unfamiliar methods (e.g., Critchfield & Reed, 2017). Another possibility that we have often heard mentioned is that RFT researchers grew impatient with that journal's theoretical perspective and found alternative outlets for their work. Whatever the case, a near-exclusive focus on sameness relations omits much that makes human behavior interesting, and thereby ignores a host of possible tools for addressing human problems.

Second, Rehfeldt (2011) found that nearly all applied studies on derived stimulus relations took place in highly controlled, laboratory-like environments. For any behavioral technology to have an impact that our discipline can be proud of, it must be implemented in the environments where human problems occur and evidence must be obtained showing long lasting, practically significant gains. As noted by Marr (2017), a speciated behavior science, one in which basic and applied efforts unfold relatively independently, is not sustainable. Likely consequences to the field include a narrow range of applications and isolation from the mainstream of society. Skinner (1987), of course, described a risk to the survival of our species should we fail to apply the most

recent advances in behavior science to solving real and broad problems. The domain of derived relational responding is one such advance.[8]

Third, Rehfeldt (2011) found almost no attention to what may be called dissemination research (e.g., Fixsen & Blase, 1993), which addresses the variables that influence intervention acceptability, implementation integrity, and, ultimately, effectiveness in the field. Consider, for instance, that research has shown that staff are unlikely to implement behavior programs that are too tedious, time-consuming, or impractical to implement and therefore compete with other job requirements (Sugai & Horner, 2006). As traditionally structured, however, applications based on derived stimulus relations are regarded as rather cumbersome to design and implement (e.g., see Critchfield & Twyman, 2014; Fienup, Hamelin, Reyes-Giordano, & Falcomata, 2011; Fienup, Mylan, Brodsky, & Pytte, 2016). This is unsurprising given that, as Rehfeldt (2011) pointed, most existing applications based on derived stimulus relations are demonstration-of-concept exercises that were designed in service of experimental designs rather than of implementation at scale in natural environments. Most would not, therefore, be expected to be practitioner friendly. Rehfeldt called for the creation of practitioner-oriented manuals to help others implement derived stimulus relations protocols (for a recent example, see the PEAK Relational Training System; Dixon, 2014a, 2014b, 2015, 2016). As we will discuss in greater detail below, efficient transportability through manualization or other means is likely pivotal to the adoption, at a global scale, of technologies based on derived stimulus relations.

Simplicity: A Barrier to Solving Complex Social Problems

One further way to characterize the applied research on derived stimulus relations that Rehfeldt (2011) reviewed is that the repertoires crafted, and the procedures used to create them, were fairly simple. In virtually every study to date the outcomes have been the same: Training is engineered to promote the emergence of three or four-member stimulus classes. These studies demonstrate something important but, tracing back to Sidman's (e.g., 1971) first experiments involving reading-related skills, the demonstration is now roughly 50 years old. Many interesting aspects of human behavior – including behavior related to the world's great problems – involve far more complex repertoires (think of terrorism, musical improvisation, corporate greed, poetic composition, brinksmanship in international relations, and so forth). Indeed, every member of society interacts with thousands of stimulus relations every day. Current research in derived stimulus relations is a long way from examining the nuanced, novel repertoires that this kind of rich behavioral history can produce.

[8] A possible objection is that, whatever advances may have been made in behavior science, the means do not exist to distribute behavioral technology on a wide scale. We regard that objection as justification for a lack of ambition, or at least ingenuity, and point to promising examples of how behavioral technology might be adapted to mechanisms that support broad implementation. For instance, Root, Rehfeldt, and Castro (under review) described an online equivalence-based training system, in which instruction was presented online using a university learner management system, and generated better learning outcomes than traditional teaching practices. Rehfeldt, Jung, Aguirre, Nichols, and Root (2016) took the approach a step further by creating the first Massive Open Online Course (an electronically-delivered course available to anyone, anywhere) in which the instruction was designed with derived stimulus relations in mind. To date, unfortunately, few have attempted such in-the-trenches applications targeting large numbers of potential beneficiaries.

Applied behavior analysis has heavily emphasized problems related to developmental disabilities and other learning challenges, and this has also been a major focus in research employing derived stimulus relations. Some successes have been reported. For example investigators have employed emergent unimodal and cross-modal relations (Hayes, Tilley, & Hayes, 1988; Rehfledt & Dixon, 2005) to team academic topics such as simple mathematics (Lynch & Cuvo, 1995), geography (LeBlanc, Miguel, Cummings, Goldsmith, & Carr, 2003). derived manding (Murphy, Barnes-Holmes, & Barnes-Holmes, 2005), identification of coin values (Keintz, Miguel, Kao, & Finn, 2011), and derived textual control of activity schedules (Miguel, Yang, Finn, & Ahearn, 2009). Yet in many cases the relevant stimulus relations reflect mostly beginner-level skills and are much less complex than what has been demonstrated in the basic research laboratory. More importantly, as far as we have ascertained, the emergent abilities of interest remain linked to the procedures of a specific intervention. Almost never targeted is the capacity of persons with learning challenges to entail relations, as a higher order operant, in novel ways under a variety of everyday circumstances. To date, only a single investigation has demonstrated a technology for improving the generalized relational abilities of individuals with disabilities (Dixon, Belisle, Belvins, & Hayes, under review).

Research on college instruction provides hints that it is possible to develop complex intellectual repertoires. For example, Walker and Rehfeldt (2012) used an equivalence paradigm to teach single-subject design, and Fienup and Critchfield (2011) taught concepts related to inferential statistics. These studies suggest that it is possible to teach complex material to sophisticated learners with instruction based on derived stimulus relations. However, one need only consult Bloom's taxonomy of educational objectives (https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/) to see that what has been accomplished to date pales by comparison to the skills that college students are expected to display upon completing a degree program. Most relevant studies still tend to employ equivalence protocols modeled closely after those used by Sidman (1971) in pioneering work with developmentally disabled individuals (e.g., involving match-to-sample procedures in which the critical performances involve pointing at, reading, or speaking simple words or phrases). It is difficult to describe the emergent performances in these studies as representing anything other than the lowest level on Bloom's taxonomy. In the real world, advanced students are also expected to create, evaluate, and analyze; to produce new and original work; to argue and defend conceptual positions; and to investigate complex problems (Anderson et al., 2001). In the process they presumably employ repertoires that involve non-equivalence relations and more complex behaviors than typically are examined in behavioral research. For this reason, existing research on instruction with advanced learners provides little inspiration for the development of a technology focusing on truly important college student learning outcomes, much less outcomes that are directly relevant to "saving the world."

This is unfortunate because, where "saving the world" is concerned, college-level instruction should be of special interest. Effective college instruction has the potential to shape the repertoires of college students, who by virtue of being college students in

the first place may be well positioned to someday occupy positions of societal influence. But flexible, cognitively complex repertoires of independent and collaborative problem solving are needed to address the most challenging global problems. Identifying parts of a graph (Walker & Rehfeldt, 2012) and responding appropriately to a *p* value (Fienup & Critchfield, 2011) are probably important fundamentals for people with scientific and technical aspirations, but what comes next? We are aware of no widely discussed strategic vision for moving instruction based on derived stimulus relations beyond simple demonstrations and toward comprehensive technologies that can shape world-changing repertoires.

Looking Ahead

Failure and Success in Translational Research in Stimulus Relations

If insights based on derived stimulus relations research have any potential for addressing large-scale human problems, this potential can only be realized through an energetic program of translational and applied research. To illustrate both hurdles and opportunities, we provide brief descriptions of one failure, and one success, in achieving societal impact by harnessing derived stimulus relations.

An Example of Failure: Combating Terrorism Previously we described our own efforts to make sense of terrorism and of prejudice toward Middle Easterners that resulted in the wake of the 2001 terror attacks. We acknowledge that these efforts failed to "save the world," and it is easy to understand why. Our work consisted entirely of demonstration-of-concept exercises. A theoretical paper, for instance, can suggest plausible applications but does not design them, implement them, or test their effectiveness. Our empirical studies were no more impactful because they were conducted in convenient laboratory environments using easy-to-recruit university students as participants. We did not work with people in war torn countries, and we did not devise persuasive ways to explain our work to people unfamiliar with behavior science. We did not develop scaled-up technologies that could be implemented at scale and evaluated for social impact.

Ultimately, evidence of our failure to "save the world" is abundant. Approximately one decade after we began that line of research, the war-related death toll of a war in Iraq, purportedly begun to reduce terrorism, had reached 461,000 (Hagopian et al., 2013). Controversial policies to ban immigration of Muslims were being pursued in the United States (Gomez, 2017, January 28). While we could argue that considerable strife might have been avoided if only people had listened to our theory, the reality is that our "technology" never progressed beyond the incipient stage and therefore had virtually no prospect of reducing real-world suffering.

An Example of Success: Acceptance and Commitment Therapy A more positive example can be found in Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999), which is a treatment approach based on RFT principles (e.g., McEnteggart, in press) and treatment aspects translated from Eastern philosophy.

ACT focuses on several processes (see Hayes et. al (1999) for a review) that are elements of *psychological flexibility,* which loosely describes a person's ability to behave adaptively in a dynamic and evolving context. Large-scale effectiveness of ACT for clinical problems such as depression, anxiety, and addiction has been demonstrated in rigorous randomized control trial evaluations (Hayes, 2004; Powers, Vörding, & Emmelkamp, 2009). ACT is considered the catalyst for the so-called "third-wave" behavioral therapies (Hayes, 2004) that are employed routinely by professionals in numerous helping profession (e.g., psychology, social work, and counseling).

For present purposes, three features of ACT will be emphasized. First, it is a technology designed specifically for use with verbally sophisticated humans. It focuses on how verbal behavior can create, and remediate, maladaptive outcomes,[9] and some of its procedures represent what is sometimes called "talk therapy." Second, manualized treatment protocols have been developed to aid in the dissemination and implementation of ACT. Third, although ACT is complex, it incorporates a non-technical language that the general population can understand (Barnes-Holmes, Hussy, McEnteggart, Barnes-Holmes, & Foody, 2016; Vilardaga, Hayes, Levin, & Muto, 2009) and that, arguably, has helped to fuel its societal acceptance. Exemplifying this acceptance, ACT was featured in a 2006 *Time* magazine cover story, and concepts integral to ACT, such as mindfulness have become familiar to everyday people outside of therapeutic situations (e.g., Boyce, 2011). An ACT popular press book, *Get out of your mind and into your life* (Hayes & Smith, 2005) was a top-25 Amazon best-seller.

Strangely, despite these successes, many behavior analysts have been slow to embrace ACT and its component concepts. The *Behavior Analyst Certification Board* (BACB, 2016) does not require that Board Certified Behavior Analysts® (BCBA) be competent in ACT. The Association for Behavior Analysis International Accreditation Board does not require coverage of ACT or RFT in accredited graduate programs. Perhaps as a result, many popular applied behavior analysis textbooks (e.g., Cooper, Heron, & Heward, 2007; Mayer, Sulzer-Azaroff, & Wallace, 2013) make no mention of ACT or RFT. This is not entirely surprising given that such books tend to emphasize interventions for individuals with limited communicative abilities. For instance, by our own count more than 90% of the interventions described in Cooper et al. (2007) do not demand the use of language (e.g., differential reinforcement procedures), whereas ACT is, like the majority of human beings, explicitly language intensive. Behavior science is unlikely to get very far with the world's big problems, we maintain, if it ignores the primary features that make humans human.

A Better Next 30 Years

It would be unproductive for us to lament the failure of research on derived stimulus relations to "save the world" without considering that it is us – scientists most acquainted with derived stimulus relations – who are most responsible for so little

[9] For example, ACT addresses the role of unproductive rule-governance in human problems. RFT provides insights about how stimulus relations contribute to rule development and rule following.

having been achieved to date. We acknowledge that, for more than 40 years, people like us have shown too little vision and initiative in taking on the world's big problems, and this must change. At the same time, we do not wish to under-sell the complexity and difficulty of those problems. Even with vision and initiative aplenty, those problems are not going to be solved overnight. It is, therefore, not our goal to suggest specific solutions to any given problem but rather to propose some changes that might move our field toward a meaningful exploration of possible solutions.

Below we outline three goals that we feel, if achieved, could aid in translating theoretical advancements and basic experimental findings on derived stimulus relations to impactful social-level interventions to solve the world's greatest issues.

More Behavior Analysts must Become Fluent in Stimulus Relations Research and Technologies

Before principles of derived stimulus relations can contribute to "saving the world," they must be widely known. Stimulus equivalence was developed over 40 years ago, and basic research in RFT followed shortly thereafter. Yet only recently was stimulus equivalence added to the BACB task list that guides the requisite information and experiences that all practicing BCBAs must possess (BACB, 2016). Neither ACT nor RFT is on the task list, so there is no guarantee that any given BCBA would even know that things can be related on dimensions other than sameness, nor how this skill develops operantly. We find this a disturbing reality given that relational operant development may be the most important higher order operant to target in children with disabilities, and a necessity to consider relational events in treating other non-disabled populations. Cooper et al.'s (2007) *Applied Behavior Analysis,* perhaps the most commonly used text in behavior analysis training programs, devotes a total of 6 pages to rule-governed behavior and equivalence. The description of rule-governed behavior is strictly Skinnerian and does not reflect conceptual advances made since 1969. The description of stimulus equivalence is inaccurate in its treatment of transitivity and equivalence relations.[10] Neither ACT nor its conceptual underpinnings in RFT research are mentioned. Overall, there appears to be no ready means for applied behavior analysis students to learn the relevant concepts, and contingency requiring applied behavior analysis faculty to teach them. In an effort to assist interested readers with addressing this problem, in Table 1 we provide a brief annotated bibliography of resources that explain equivalence, RFT, and ACT.

We acknowledge that "becoming familiar" is no simple matter. Any reader who inspects published resources on derived stimulus relations will quickly encounter a host of thorny technical terms and various forms of symbolic notation that many people find hard to follow. If too few people know about derived stimulus relations, this is in part due to the fact that considerable effort must be invested to master the literature. About this we offer two observations. First, the literature on *any* specialized topic is difficult for a non-expert to master. But if, as we believe is true for derived stimulus relations, a

[10] Cooper et al. (2007, p. 398) describe equivalence as the demonstration of reflexivity, symmetry, and transitivity, noting only that following A = B and B=C in a linear arrangement, that the transitive A = C is needed for equivalence; however, as noted by Sidman and Tailby (1982), both A = C and the bidirectional C = A are required.

Table 1 Annotated bibliography of resources needed to establish a foundational understanding of stimulus equivalence, Relational Frame Theory, and Acceptance and Commitment Therapy

Stimulus Equivalence	
Sidman and Tailby (1982) **Conditional discrimination vs. matching to sample: An expansion of the testing paradigm**	Sidman had initially tested his stimulus equivalence theory in a paper published in 1971, where an equivalence-based conditional discrimination procedure was used to teach a boy with an intellectual disability to read. Sidman and Tailby (1982) provides a more detailed overview of the key components of stimulus equivalence. The paper additionally provides insight into experiments that could be developed to test the assumptions of Sidman's stimulus equivalence theory.
Sidman (1994) **Equivalence relations and behavior: A research story**	Sidman (1994) is a comprehensive book describing the history of stimulus equivalence theory and research up to that point. The author goes beyond simply describing research that was done, and provides some background narrative into *why* the experiments were conducted in the first place. Another extension of this book is that the potentially far-reaching implications of Sidman's stimulus equivalence theory are described in terms of complex, cognitive events such as planning and remembering.
Relational Frame Theory	
Hayes, Barnes-Holmes, and Roche (2001) **Relational frame theory: A post-Skinnerian account of human language and cognition**	Hayes, Barnes-Holmes, and Roche (2001) wrote this comprehensive book following just over a decade of research on derived relational responding and Relational Frame Theory. All key aspects of the theory are described in formulaic detail. In addition, implications of the theory in explaining complex language and cognitive events are described, such as thinking and emotion. As well, clinical implications are described in term of complex clinical issues not typically treated by behavior analysts.
Törneke (2010) **Learning RFT: An introduction to relational frame theory and its clinical application**	Törneke (2010) extends the work previously completed by Hayes and colleagues by considerably simplifying the description of Relational Frame Theory in a way that is accessible to all readers with a background in behavior analysis. Formulaic descriptions have been replaced with more general descriptions, and several situational examples are used to explain the concepts. Again, the implications for the theory are discussed.
Acceptance and Commitment Therapy	
Hayes, Strosahl, and Wilson (1999) **Acceptance and commitment therapy: An experiential approach to behavior change**	Hayes, Strosahl, and Wilson (1999) provide an in-depth analysis of the basic tenants of ACT and its potential implications in this edited book. Direct links between findings in RFT research and the therapeutic concepts of experiential avoidance and cognitive fusion are described in detail. As well, a formulaic overview of each component of the ACT hexaflex is provided along with a detailed description of what is meant by "psychological flexibility."
Walser, Luoma, and Hayes (2007) **Learning ACT: An acceptance & commitment therapy skills-training manual for therapists**	Luoma, Hayes, & Walser (2007) extend upon the work previously completed by Hayes and colleagues by creating a user-friendly description of ACT. The book uses considerably more middle level terms than Hayes, Strosahl, and Wilson, and is designed to provide meaningful information to both behavior analysts as well as individuals without behavior analytic training. Clinical examples are provided of ACT in practice.

Note: Full references for these materials are provided in the references section

topic is an integral part of a well-rounded professional repertoire, there is little excuse for not doing the needed work. Second, however, if those who are already well-informed about derived stimulus relations expect others to join the party, they will have to do more to make the relevant concepts accessible.

There is evidence that non-experts find technical terms to be not only hard to understand but also aversive (Critchfield, Becirevic, & Reed, 2016; Critchfield et al., 2017), in which case user-friendly language would appear to be a prerequisite for recruiting converts to any specialized area. Here we remind the reader of ACT's model for translational success, which is built in part on describing very technical ideas in less technical language (e.g., see the resources in Table 1). For example, in ACT "motivative augmental rules" are described as "values" to make contact with the existing repertoires of end users who are not behavior scientists. In essence, what has been accomplished in ACT is to build equivalence classes in which technical terms are equated with easier-to-grasp alternatives. For the benefit of novices just entering the world of derived stimulus relations, more of this translating is needed.

More Stimulus Relations Research Programs Are Needed

Many accomplished fields of study seek to evaluate the progression of knowledge from basic theories to societally-impactful outcomes (Hörig, Marincola, & Marincola, 2005; Tashiro & Mortenson, 2006). In medicine, this is called the bench-to-bedside model (Friedman, 2003; Drolet & Lorenzi, 2011; for a related biomedical framework, see Kyonka & Subramaniam, in press). Figure 1 shows this general model as it could be applied to behavioral research (in particular research on derived stimulus relations), which we have termed the *Theory-to-Impact* model. A theory sets the conditions for

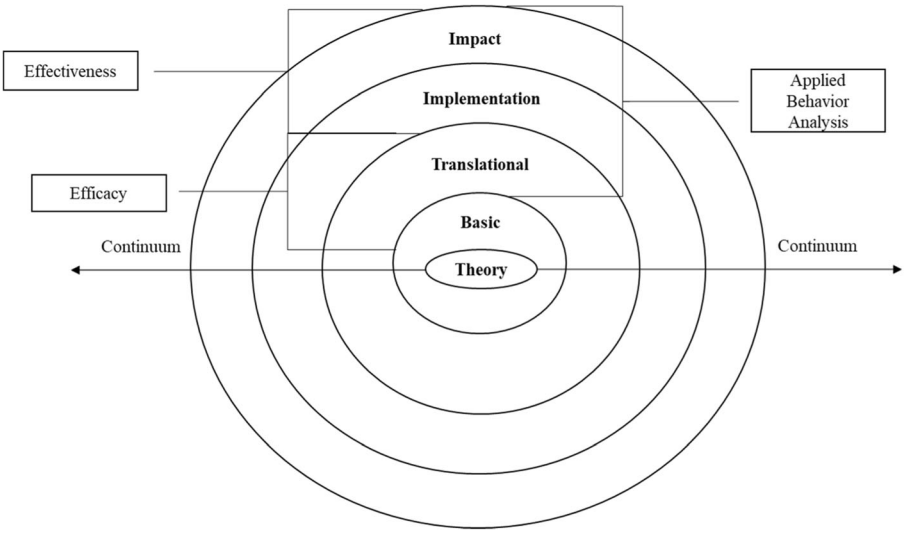

Fig. 1 Diagram of a theory to impact continuum of behavior scientific research. Concentric circles show each level of research beginning with basic theoretical assumptions to large scale social impact. Arrows indicate that the stages are continuous and not categorical. The range of research covered in the subfield of Applied Behavior Analysis is noted, as well as the range of research that describes the efficacy and effectiveness of a behavior analytic approach

evaluating its utility in application. In behavior science, the most notable and widely applied theory is Skinner's operant theory, and the inclusion of stimulus equivalence and RFT further expand the theoretical center of our field. The next stage describes basic research to evaluate the tenets put forward in the theory. Basic research on operant theory has been conducted for decades with animal models (Azrin, 1959; Byrne & Poling, 2017), and as discussed at some length above, several basic experimental studies on equivalence and RFT have supported the viability of these extensions in explaining complex aspects of human behavior. Translational research describes tightly controlled experimental evaluations of the application of theory and basic research findings. Basic research and translational research together comprise what has been described as *efficacy research*. The Society for Prevention Research (Flay et al., 2005) has described efficacy research as tightly controlled experimental research, usually utilizing randomized control trial evaluations that are implemented with strong treatment fidelity. Efficacy research is crucial to translating theory to meaningful technologies to improve the human condition. Most single-case evaluations would also likely function as efficacy research, where intentional and tightly controlled manipulations (e.g., alternating treatments design) in the independent variable are implemented to determine the effect of a treatment on one or several target behaviors.

The next stage describes implementation, where the effect of the treatment is evaluated in real-world settings, conducted by parents, teachers, or staff, and under naturally occurring conditions. Experimental design logic may still be employed; however, trade-offs are made in experimental rigor. For example, Gresham, Gansle, and Noell (1993) discussed the importance of implementation fidelity in ensuring that an independent variable was conducted as intended; however, in naturally occurring conditions, error in implementation is expected. The final stage describes evaluations of treatment impact. These are broader changes in a variable that may have resulted from the larger-scale use of the treatment in society (Khandker, Koolwalk, & Samad, 2010; Marchand, Stice, Rohde, & Becker, 2011; White, 2009). In medicine, for example, the impact of mandatory vaccinations for children is evaluated in terms of global decreases in illnesses targeted by the vaccines. At this stage, there may be minimal or no experimental manipulation, as it is assumed that appropriate steps were taken to determine a causal relationship between the treatment and outcome at earlier research stages.

Implementation and impact research therefore both evaluate the *effectiveness* of treatment. Or, the degree to which the treatment has led to large-scale changes in naturally occurring environments (Flay et al., 2005; Gottfredson et al., 2015). Quasi-experimental designs may replace randomization as an emphasis is placed on the external validity of findings at the expense of internal validity. Confounding factors are not eliminated as in efficacy evaluations, rather confounds are accepted as part of the environment in which the research is conducted. Single-case research designs prevalent in behavioral science may not be generally amenable to effectiveness research, as the time-series manipulations and rigorously described methods are unlikely to be implemented by regular staff in natural settings without the direct oversight of behavior analysts.

Figure 2 provides an example of how research may evolve across these levels in a reticulated fashion. The figure shows that these stages should be viewed as on a continuum rather than as discrete types of research, as noted by previous writers (Critchfield, 2011; Kyonka & Subramaniam, in press; Mace & Critchfield, 2010;

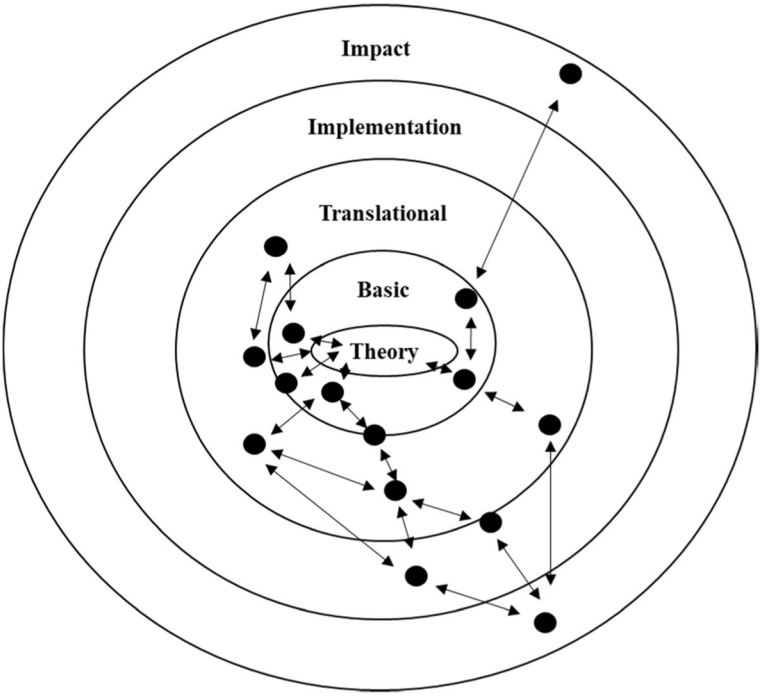

Fig. 2 Exemplar diagram showing how several research studies may interact within the theory to impact continuum of behavior scientific research. Points indicate example studies in a related line of research. Bidirectional arrows show the reticulation of research findings to research in other stages in the model

Vollmer, 2011). The figure also indicates that research at all levels should inform subsequent studies, ultimately building to the development and evaluations of technologies with the potential for large-scale impact. In general, research at all stages of the Theory-to-Impact model is needed. As noted earlier, however, it appears that behavioral research on derived stimulus relations technologies has not progressed far past basic experimental research and theoretical discourse. Only a small amount of efficacy research has been conducted (e.g., Brodsky & Fienup, in press), which is a shame because, in effort to "save the world," this may be the most important type of research.

At least two strategies have been adopted in other fields to aid in translating basic findings to effective treatment technologies. First, the development of manualized protocols allows for procedures to be described in general terms that can be implemented by people in natural settings (Marchand et al., 2011; Gottfredson et al., 2015). The independent variable becomes implementation of the protocol, allowing for larger-scale changes in a socially relevant dependent variable to be evaluated. This approach has been adopted with some success by behavioral scientists in Positive Behavior Intervention and Supports models (PBIS; Horner, Sugai, Todd, & Lewis-Palmer, 2005; Sugai & Horner, 2006). Although the implementation of PBIS likely varies considerably from institution to institution, effectiveness research has firmly established that schools who adopt the protocol produce stronger outcomes for their students (Bradshaw, Koth, Bevans, Bevans, & Leaf, 2008; Childs, Kincaid, George, & Gage, 2016). ACT protocols adopt this same approach, where therapists may vary greatly in implementation, yet effective outcomes are demonstrated none-the-less (Hacker, Stone,

& MacBeth, 2016). Both PBIS and ACT also have in common that commercial techniques are used to gain buy-in from society. "Positive" in PBIS does not refer to exclusive addition of reinforcing stimuli to the environment, rather is used in a colloquial way to refer to the avoidance of aversive techniques, which in some circles have given applied behavior analysis a bad name (Carr et al., 2002). A technical vernacular is important in a science, but what both ACT and PBIS show is that the technical vernacular does not need to be present in the manualized products that are implemented by end users in the everyday world.

Second, multi-tiered levels of support describe an implementation strategy in which loosely controlled general interventions are applied universally, and more tightly controlled interventions are prescribed on an "as-needed" basis (Hoover & Patton, 2008). An argument against the use of manualized protocols may be that such approaches will only work in the least-severe cases. Multi-tiered intervention models elucidate this concern by assessing for severity and individualizing treatment approaches accordingly. Currently, multi-tiered models are adopted in PBIS, response-to-intervention strategies in schools (Barnes & Harlacher, 2008), and as a model in the prevention and systems sciences (Lich, Ginexi, Osgood, & Mabry, 2013). Table 2 provides an example of a multi-tiered model that could make use of derived relational responding technologies to target global warming. The tiers in this model were adapted from PBIS as well as the prevention science model described by Lich et al. (2013). By delineating the level of support, as well as by researching the theory, efficacy, and effectiveness of our models, we may begin to develop technologies that have the potential to influence global behavioral change.

Behavior Analysts must Learn to Effectively Disseminate Technological Approaches to Solving the world's Problems at a Global Level

Dissemination is an active process that requires far more than the initial development of promising interventions (e.g., Fixsen & Blase, 1993). To put it another way, many useful technologies have not been widely adopted even though they were effective. Once behavior analysts begin to develop derived stimulus relations technologies that address the world's big problems, they will have to figure out how to deliver them on a wide scale. Fig. 3 shows a dissemination model adapted from Drolet and Lorenzi's (2011) biomedical research continuum and Gottfredson et al.'s (2015) model for the prevention sciences that could have utility in disseminating derived stimulus relations technologies at large scale once effective technologies have been developed and have obtained empirical support of effectiveness. Evaluating the effectiveness of a technology is the first step in the model. This means implementation and impact stage research, conducted by people in society for whom the technology is intended, and allowing for the likelihood of uncontrolled implementation errors and confounding variables that exist in the real world. Ideally, such effectiveness evaluations have developed as empirical extensions from several controlled evaluations of efficacy. Once effectiveness is established, Gottfredson et al. (2015) suggest scaling-up the technology through manualization, training packages, and other supports so that the technology is publicly accessible. Scaling-up the technology must interact bidirectionally with cost considerations to ensure that the cost associated with entire treatment package is not a barrier to large-scale implementation. Throughout the scaling up

Table 2 A Multi-Tiered model applied to issues of large-scale social importance with global warming as a national crisis as an example and solutions including aspects of Relational Frame Theory

Tier	Description	Example
I. Universal Prevention Efforts	Established to promote improvement in some area for all members of an organization, group, or society. The efforts should be easily implemented and enforceable at a broader scale.	**Problem:** Excessive pollution is depleting the ozone layer. The extinction of some animal species is occurring. There is a potential that the world will no longer be habitable by humans. **Prevention Effort:** Create global warming prevention month activities designed to encourage relations between people's choices, personal values, and their effect on pollution and global warming.
II. Focused At-Risk Prevention Efforts	Established assessment procedures to identify subsections of organizations, groups, or societies that are at-risk developing a problem of large-scale importance. Efforts should evaluate specific situational factors that put the subsection at greater risk and provide additional resources to decrease risk.	**Problem:** The city of Maranne is a top contributor to energy use and pollution levels. **Prevention Effort:** A tax incentive is given to Maranne residents to attend an annual seminar on global warming designed to help promote values clarification and to help residents problem solve how to reduce energy consumption.
III. Focused Intensive Remediation Efforts	Established assessment procedures to identify subsections of organizations, groups, or societies that currently have a problem of large-scale importance. Efforts should evaluate specific problem causes and act to remediate the problems using individualized strategies.	**Problem:** A factory in Maranne contributes over 50% of the pollution generated by the city. Assessment suggests that sustaining human existence on earth is not a value of the factory. **Remediation Effort:** Negotiations with the company are undertaken to reduce emissions by determining the values of the company (e.g., generating revenue) and providing experts to determine how revenues can be maintained or increased while reducing emissions and pollution.

Note: The examples and solutions in this table are designed to provide an exemplar of what an approach may look like. The social groups are fictional and the solutions have not been tested at any stage in the theory to impact model

process, on-going evaluations must continue to ensure that all aspects of the technology are efficacious and effective in promoting the intended social change.

Two technologies developed by behavior analysts provide exemplars for the potential impact of scaling-up and continuously evaluating packaged interventions. PBIS and the Good Behavior Game (Barrish, Saunders, & Wolf, 1969; Embry, 2002; Solomon, Klein, Hintze, Cressey, & Peller, 2012) both incorporate contingency manipulation strategies to reduce challenging behaviors and promote positive social behaviors of children in classrooms. For the Good Behavior Game, impressive longitudinal data also exist, showing that adults who participated in the game as students show reduced rates of smoking initiation (Kellam & Anthony, 1998), drug abuse (Poduska et al., 2008) and

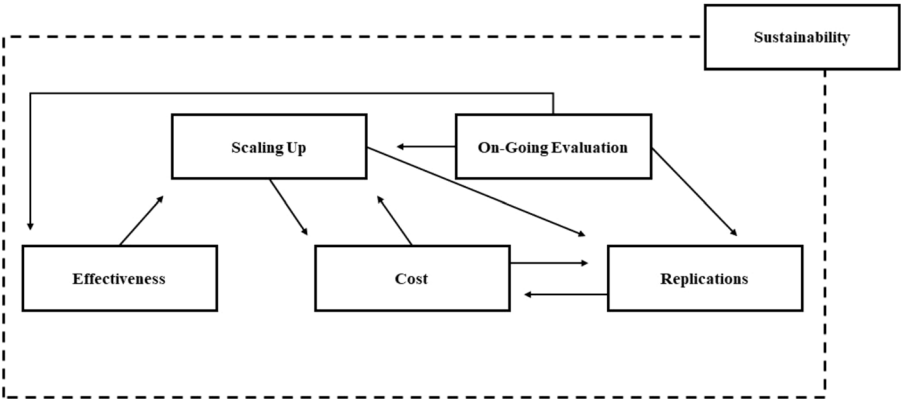

Fig. 3 Dissemination model from progressing from effectiveness research to sustainable replications of scaled-up behavioral applications

risky sexual behaviors (Kellam et al., 2014). These data are interesting because they show the potential utility of behavior science in educational settings if implemented on a larger scale.

Although not as empirically developed as the latter two exemplar systems, the PEAK Relational Training System (Dixon, 2014a, 2014b, 2015, 2016) is one example of a technology grounded in derived stimulus relations that has begun to progress through these stages of technological dissemination. The effectiveness of RFT based procedures was supported in prior research establishing emergent skill repertoires in people with autism. PEAK built on this research by providing a commercially available package in considerable liberties were taken with the technical vocabulary of derived stimulus relations and other operant principles. The goal was for front-line caregivers to be able to implement sophisticated procedures with no outside assistance. In evaluating PEAK empirically, researchers shifted from single-subject research designs to group-based designs that would be familiar to a wider audience. To date the data show that PEAK has good reliability (Dixon, Stanley, Belisle, & Rowsey, 2016), validity (Dixon et al., 2015), and between groups outcome efficacy (McKeel, Dixon, Daar, Rowsey, & Szekely, 2015). One ongoing interest is to evaluate whether the scaled-up treatment package can be effective when conducted by frontline staff in schools and in therapeutic settings (Dixon et al., 2017).

Once effective, scaled-up, and cost-effective models have been developed, replication evaluations should be conducted to ensure that idiosyncratic variables in initial research were not responsible for obtained results (e.g., Fixsen & Blase, in press). Replications are especially necessary in evaluations of effectiveness, which often lack the experimental rigor to control for potential confounding variables in each context. Ongoing evaluation of replications may additionally elucidate changes that need to be made in the package to improve the probability of successful replication. An overarching consideration, especially in the context of global scale interventions as discussed in the current paper, is that all processes in the dissemination model should be implemented with consideration for sustainability. Once efficacious, effective, replicable, and sustainable solutions are available that make use of derived relational responding technologies, we can begin to apply what we know about consumer choice (Foxall, 2016),

synthesizing contingency-based and rule-governed accounts, to innovatively disseminate impactful technologies to affect real-world change. Overall, as should now be evident, the needed program of research and develop is extensive and quite different from what is typically seen in today's literature on applications of derived stimulus relations technology.

A Final Thought

Thirty years have now passed since Skinner's (1987) paper on how behavior scientists should go about saving the world. Unfortunately, where the world's big problems are concerned, our field has really never achieved much wide-scale impact. Perhaps this is because progress in science, especially translational science, is inherently slow. Or perhaps behavior scientists have grown too comfortable with their science as it was depicted in the early days by the field's pioneers (e.g., Critchfield & Reed, 2017). Whatever the reason for the status quo, change is needed. If anything has become clear in the years since Skinner's (1987) essay, it is that the world's problems are not going to solve themselves. We suggest that theoretical and experimental findings emergent from derived stimulus relational accounts can help behavior scientists development and disseminate new technologies, synthesizing approaches rooted in contingency-based and rule-governed accounts of the behavior of verbally sophisticated humans. By their very nature, such technologies will be different from the exclusively contingency-focused approaches that arose from Skinner's (e.g., 1953, 1957) perspective on behavior, and have failed to achieve the global changes sought by behavior scientists of the time. Although it can be uncomfortable to deviate from tradition, if behavior scientists fail to innovate and take up the real challenges that demand solutions, another 30 disappointing years will pass, with real, catastrophic consequences for the world.

To save anything, we need to know why it needs saving in the first place. When all the data and conclusions point to the maladaptive behavior of human beings, and those human beings are verbal, our interventions must be rooted in the best available science regarding human language. Derived stimulus relations as an outcome, relating as a process, and the technologies that bring such behaviors under predictive power, therefore need to be investigated and implemented far more vigorously than what has taken place in the past. Once this happens, we as behavior scientists may well be a little closer to saving the world.

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