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Redefining Clinical Science Training: Purpose and Products of the Delaware Project

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Abstract

The Delaware Project, initiated in a conference at the University of Delaware, aims to redefine psychological clinical science training in ways that emphasize continuity across a spectrum of intervention development activities ranging from basic research to implementation and dissemination. The project generated specific recommendations for elevating dissemination and implementation, both at different stages of clinical science training and in different training settings, and highlighted several experiential training innovations to foster this goal. The project also helped sharpen competing priorities of two broad approaches to intervention science: one emphasizing translation, or moving from basic research to systematic applications in practice, and the other privileging dissemination–implementation per se, where a priority is understanding and maximizing the accessibility, acceptability, adaptability, and sustainability of interventions in the contexts where practitioners deliver them. The training of future clinical scientists will be crucial to reconciling these perspectives on how best to address significant public health problems.

Keywords

training, intervention science, translation, implementation

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The Delaware Project aims to redefine psychological clinical science training in ways that emphasize continuity across a spectrum of research activities concerned with (a) basic mechanisms of psychopathology and behavior change, (b) intervention generation and refinement, (c) intervention efficacy and effectiveness, and especially (d) implementation and dissemination. An initial meeting at the University of Delaware brought together clinical scientists representing different sectors of this spectrum in hopes of creating productive (even visionary) dialogue leading to the articulation of new, improved models for training. In addition to accomplishing this, the conference helped to sharpen the sometimes competing priorities of two broad approaches to intervention science—one emphasizing *translation*, or moving from basic research on clinical problems and mechanisms of change to systematic applications in clinical practice, and the other privileging *dissemination and implementation* per se, where a priority is to understand and maximize the accessibility, acceptability, adaptability, and sustainability of interventions in the settings and social contexts where practitioners deliver them.

In this overview article we first summarize the background and purpose of the project, then describe what emerged from the Delaware discussions, including central themes and recommendations, two experiential training innovations, and a project Web site (www.delawareproject.org) where some of the products are available for closer

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examination. An intermediate section contrasts two perspectives on intervention science that appeared to inform participants' deliberations, and a final section offers our own reflections on the crucial role clinical science training will play in shaping the future of the field.

Background

Despite drastic changes in the nature of clinical practice and clinical science research over the past half century, the "scientist–practitioner" Boulder model promulgated in 1949 remains the dominant paradigm for mainstream clinical psychology training programs (Belar & Perry, 1992). Unfortunately, despite impressive advances in developing empirically supported interventions for specific problems and mental disorders, these treatments too often do not reach the patients in community settings who need them most. Increasingly, faculty in clinical science programs recognize that our students—the next generation of clinical scientists—do not receive optimal training for the leadership roles many of them will assume in developing and implementing new treatment and prevention interventions, testing interventions in real-world settings, or managing supervisory and training activities in an ever-evolving health care system.

In contrast to the aims of the Boulder conference, the Delaware Project's aims are aspirational and inspirational rather than regulatory and prescriptive. The goal is not to define a singular model of clinical science training nor in any way restrict (e.g., via checklists, mandatory competencies, etc.) how programs should approach their training goals. Instead, we envision the project generating state-of-the-art (and state-of-the-science) training resources and recommendations relevant to knowledge generation across all stages of intervention development. This does not obviate the need for accrediting clinical training in the context of strong clinical science programs, as instantiated by the new, outcome-oriented Psychological Clinical Science Accreditation System (PCSAS; Baker, McFall, & Shoham, 2008), which allows programs to free up curriculum hours and training resources in the service of better training in intervention science.

The project began in a 2-day meeting at the University of Delaware in October 2011 with major sponsorship from the National Institute of Mental Health (NIH), and it continues as a vehicle for training dissemination under the auspices of the Academy of Psychological Clinical Science (APCS).[1] A central goal was to elevate the place of dissemination and implementation (hereafter D&I) in mainstream psychological clinical science training. Rather than marginalizing dissemination science by splitting it off from other arenas of intervention development, we aimed to locate and integrate implementation within the broader stage model that several NIH institutes use to guide the funding of research (Onken, Carroll, Shoham, Cuthbert, & Riddle, 2014; Rounsaville, Carroll, & Onken, 2001).

Almost 50 clinical scientists, including representatives of clinical science doctoral and internship programs, participated in the Delaware discussions, which alternated between plenary (full group) and breakout (work group) formats.[2] On the first day, five work groups focused primarily (but not exclusively) on particular stages of the intervention development stage model. Within the framework of its designated stage, each work group addressed two broad questions: (a) What should psychological clinical scientists of the future know and be able to do across the spectrum of intervention development? (b) How, when, and where can we best help them accomplish this? A set of more specific stimulus questions, distributed to participants before the meeting and reproduced here in the appendix, aimed to sharpen this focus with respect to particular stages and their interrelationships, as well as for clinical science training in general. The stimulus questions also distinguished training content (knowledge, skills, attitudes) from pedagogy (how to help trainees learn) and pushed to locate both in the context of training stages (preinternship, internship, postdoc) and settings (e.g., university clinics, VA centers, community- and school-based programs).

From discussion of these issues emerged a revised agenda for Day 2: Five reconstituted work groups attempted to address questions and generate products more immediately relevant to training in D&I—namely (a) examples of project- or problem-based learning, (b) cross-stage and cross-institution training opportunities, (c) didactic and experiential resources for exposure to implementation and dissemination issues, (d) proposals for specific training experiences that could be reduced or eliminated, and (e) opportunities for exposing students to D&I phenomena outside the ivory tower.[3]

The Delaware Project now has an interactive Web site (www.delawareproject.org), which provides summaries of work group discussions, recommendations, and presentations from the October 2011 meeting, as well as presentations from meetings that followed (e.g., the 2012 APCS-SSCP Clinical Science Forum) and links to relevant publications, including those in this special series. The most distinctive feature of the Web site is its aim to incorporate and build on contributions from clinical science training programs and clinical scientists in the field at large. The site provides a shell for materials in categories such as Training Resources (e.g., course syllabi, didactic and experiential DI training innovations, case formulation exercises), Scientific Resources (e.g., treatment fidelity measures, measurement feedback systems, cutting-edge data analytic strategies, technology applications), and

Announcements (e.g., workshops and other training events, opportunities for interinstitutional collaboration or shared training activities) and relevant readings pertaining to all these categories. New categories will hopefully emerge as submissions from the field accumulate (e.g., uses of technology in training). Accordingly, the Web site seeks contributions via a Request for Submission portal (http://www.delawareproject.org/wordpress/request-for-contribution/).[4]

The Translation-Implementation Divide

In planning the October 2011 conference, we encountered priorities and methodologies in the relatively new arena of dissemination-implementation science that diverged somewhat from those emphasized in most university-based clinical science programs. To highlight these differences and stimulate discussion about their implications for training, the opening conference plenary included two contrasting talks. The first featured Foa et al.'s programmatic work on prolonged exposure for anxiety disorders, which illustrates a translational path from basic research on mechanisms of change through efficacy and effectiveness studies to D&I (Cahill, Foa, Hembree, Marshall, & Nacash, 2006; Craske et al., 2009; Foa & Kozak, 1986; Karlin et al., 2010). The second stimulus talk, by Chorpita, outlined a rather different approach to intervention development based on using already available research to identify common elements of effective interventions for different problems, adapting interventions based on this knowledge to the social/organizational contexts in which clinicians operate, and monitoring patient response with measurement feedback systems (Chorpita & Weisz, 2009; Lambert et al., 2002; Weisz & Chorpita, 2011). We attempt to summarize some of the competing priorities and methodological considerations that distinguish these generalized translational and dissemination-implementation perspectives on intervention development.

Translational science follows a clear pathway, using knowledge gained from basic research on mechanisms of clinical problems and clinical change to generate, implement, and evaluate an intervention. This intervention focus typically requires developing methods to evaluate the *fidelity* with which clinicians implement clinical procedures (based on a manual of principles and procedures) before testing the intervention in a randomized efficacy trial and moving on to effectiveness research in real-world settings. This then extends to studying how best to implement and disseminate the intervention, while preserving its integrity (fidelity) in the field. The NIH stage model embodies good translational science while highlighting its nonlinear, recursive aspects, where findings or experiences at a later stage (e.g., an effectiveness trial) feed back to inform research questions at an earlier stage (e.g., treatment refinement), and where intervention development work is not complete until the intervention achieves its maximal level of implementability (Onken et al., 2014).

Translational intervention development research also places heavy emphasis on *how* interventions work and *for whom* they work best. Careful study of mediators and mechanisms of change can suggest how to increase efficiency (and economy) by paring an intervention down to its essential ingredients (e.g., by eliminating unnecessary procedures or reducing the number of sessions), whereas research on moderators of treatment effects (what works for whom) has obvious implications for personalized treatment. Very much in this tradition is the growing translational emphasis on *experimental therapeutics*, where investigation focuses on whether manipulated interventions engage their hypothesized targets (or mediators) and whether such target engagement leads to, or at least correlates with, subsequent clinical benefit (Insel, 2012).

A contrasting view is that the academic establishment is not asking enough dissemination-relevant research questions, and that adoption of effective treatment technologies is not likely to happen on its own, regardless of how promising an intervention may prove to be in efficacy trials (Chorpita & Regan, 2009; Fixsen, Naoom, Blase, Friedman, & Wallace, 2005; Rogers, 2003). Accordingly, this dissemination-implementation perspective often attaches more importance to studying the social/organizational context of the intervention than the clinical procedures themselves. For example, according to Rogers's (2003) influential model of innovation adoption, the potential for sustained adoption of an intervention (and ultimate patient benefit) should be greatest when the intervention is simple rather than complex, is compatible with existing agency practices, and adds benefit to what clinicians are already doing. An interesting and controversial corollary is that treatment fidelity may be less crucial to successful outcome than translational scientists assume: In Rogers's view, adoption and patient benefit depend instead on locally relevant adaptations, through which clinicians to some extent "reinvent" evidence-based interventions rather than strive for rigorous fidelity to a treatment manual (cf. Chorpita & Regan, 2009, p. 991).

Another central idea in the D&I perspective, related to what Weisz, Ng, and Bearman (2014) call the "too many ESTs" problem, involves identifying common elements of evidence-based treatments by managing knowledge from the existing clinical trials literature. Using such

a "distillation and matching" approach, Chorpita, Weisz, and colleagues attempted to map evidence-based treatments for children and adolescents (Chorpita, Daleiden, & Weisz, 2005) and on this basis developed an integrative "modular" model of treatment for youth internalizing and conduct problems that compared favorably to both usual care and standard evidence-based treatments in a randomized clinical trial (Weisz et al., 2012; cf. Weisz, Jensen-Doss, & Hawley, 2006).

Yet another D&I priority is using measurement feedback systems to monitor client progress, guide and adjust clinician behavior, and ultimately improve clinical outcomes (Bickman, Kelley, & Athay, 2013; Garland, Howley, Brookman-Frazee, & Hurlburt, 2008; Lambert et al., 2002). Applications of such feedback can be intervention specific, exemplified by the clinician dashboard that guides modular therapy for youth problems, or simply generic, with clinicians in an agency or clinic receiving feedback on patient progress regardless of what intervention or interventions they use.

It also seems fair to say that an overriding theme of urgency propels some sectors of the dissemination-implementation movement. For example, Kessler and Glasgow (2011) recently proposed a 10-year moratorium on randomized efficacy trials, citing the need to "speed the translation of healthcare research into practice" (cf. Riley, Glasgow, Etheredge, & Abernethy's, 2013, call for "rapid, responsive, relevant [R3] research"). Rather than attempting to isolate, simplify, and decontextualize variables of interest (as one would in earlier stages of the translational pathway), "contextualist" (rather than reductionist) research strategies aim to address pressing real-world problems in all their complexity. This would entail more qualitative and mixed-methods research, including innovations such as simulation studies, pragmatic trials (Thorpe et al., 2009), and "rapid learning healthcare evidence" (Etheredge, 2007, p. 107) more directly relevant to public health and policy. In this vision, issues of applicability, feasibility, cost-effectiveness, and external validity have priority—and impacts of interest range beyond patient participants to settings, intervention staff, and delivery conditions (Kessler & Glasgow, 2011).

On balance, dissemination scientists attach more importance than translational scientists to studying the social processes that influence successful implementation of effective treatments in community settings. These processes include the behavior and attitudes of the clinicians who implement the treatments—hence the call for "practice-based evidence" to balance the "evidence-based practice" mantra of mainstream clinical science.

Finally, a caveat about our use of the term *translation*: This term has multiple meanings (Zerhouni, 2005), and in the framework of the NIH stage model, it can apply at any stage of the intervention development spectrum. For example, one might reasonably describe aspects of D&I work as translating accumulated knowledge from clinical trials into a treatment package, or as translating research into policy. Our usage here refers to following the pathway template (including mechanisms, fidelity, efficacy, etc.) in developing and studying a specific intervention as it moves from basic science to implementation. For expository purposes we contrast this with a different (D&I) view of intervention development, which gives greater priority to later stages than earlier ones, sometimes attaching as much or more importance to the social contexts and processes relevant to both initial and sustained adoption than to the intervention itself. We do not mean to reify these camps by suggesting that those in the field embrace one view or the other—in fact, many implementation scientists on the ground adopt elements of both perspectives.

Emergent Themes and Recommendations

Although conference discussion ranged widely, most of it bore directly or indirectly on the core stimulus questions (appendix) concerned with training content, training pedagogy, exemplary training innovations, training evaluation, or training barriers. Below we attempt to summarize the main themes and recommendations that emerged from these discussions. The project Web site (www.delawareproject.org) has more detailed reports composed in Delaware by the work groups themselves.

Regarding training content and pedagogy, the discussions yielded several points of broad consensus:

- Clinical science programs do not sufficiently emphasize or prepare students for dissemination-implementation work in community-based training settings. At the very least, students should receive in-depth exposure to theory, research, and practice in this arena, and they should be literate in dissemination–implementation discourse.
- Regardless of whether training focuses on translation, implementation, or both, the most important pedagogical methods are experiential: Students learn by doing. The discussion touched on a number of innovative clinical science training methods, many experiential. Two of these—a translation-oriented approach advocates called *problem-centered learning* and a dissemination-oriented approach modeled on the metaphor of automobile production—received special attention. Levenson's article in this issue describes how the University of California, Berkeley's Clinical Science Program uses problem-centered learning in the context of a practicum seminar, and in the next section we outline both approaches in somewhat greater detail.

Other notable themes and recommendations include the following:

- The content of clinical science training requires consideration of training goals and potential outcomes (e.g., master scientists, master practitioners, master clinical scientists, master mental health administrators, master trainers). These goals vary both across programs and for students within the same program, though some (e.g., training master clinicians) are less appropriate for clinical science programs than are others. Curricular considerations, core competencies, and so on vary accordingly, and flexibility is key: One size cannot fit all programs, and APA-style accreditation checklists do not apply (Berenbaum & Shoham, 2011).
- Because the knowledge base of clinical science will continue to evolve and change, learning to learn is an essential springboard for student development. In the translational framework, for example, skills necessary to formulate research questions at the most sophisticated levels include, first, synthesizing the relevant research literature; second, identifying the gaps in knowledge that are represented there; third, asking questions in a way that leads to a productive search for answers; fourth, developing high levels of skills in causal inference; and fifth, learning to approach the question of efficacy/effectiveness with an eye toward the conditions that may maximize effect (moderators) or the mechanisms through which effect is established (mediators).
- Because methodology is so crucial to clinical science, students need sound training in statistical and other approaches appropriate to different stages of (and perspectives on) the intervention development process. The world of data analysis has become increasingly complex, so training in multilevel modeling and the myriad of other relatively new data analytic techniques is a priority. Also important, however, is exposure to qualitative, single-case, and other methodologies that may be better suited to treatment generation and refinement. A particular concern is that students understand when it is appropriate to use sophisticated statistical techniques and when the research question and/or limitations of a data set might indicate simpler alternatives.
- Students also need exposure to other areas largely missing from clinical science programs but important for dissemination-implementation science. These range from organizational behavior, systems change, and qualitative research to marketing, health economics, social media, and use of electronic health records.
- Clinical science students especially need training experiences outside the ivory tower. This includes providing students with opportunities to act as clinical scientists in community settings, exposing them to multiple disciplines (e.g., social work, medicine, public health, marketing), and coaching them on how to communicate with service providers, policymakers, public stakeholders, and even insurers, especially about formulating research questions and product dissemination.
- "Collaborative fluency" is an increasingly important skill in the era of team science. This includes understanding not only the languages of disciplines relevant to dissemination-implementation, but also those of hard sciences such as genetics, biochemistry, and neuroscience.
- Sound clinical training—including clinical experience in general and with specific populations to be studied—is essential to training intervention scientists at all stages of the intervention development spectrum.
- Because training, supervising, and guiding others is a central component of intervention research, it is important for students to acquire mentoring skills as well.
- A formidable barrier to incorporating dissemination-implementation in predoctoral clinical science programs is the relative lack of faculty with relevant expertise who could serve as role models. One partial solution is to share resources across institutions, with training collaboration and exchange programs for students and faculty alike. For example, with creative use of technology, it may be possible to create long-distance (or virtual) exposure to role models from other programs. Another is for the Delaware Project Web site to include a resource map where students and graduates can learn about effectiveness and D&I research opportunities (e.g., for postdoctoral training).
- A vexing question is how best to evaluate clinical science training, given the inherent diversity of training goals, methodologies, and potential outcomes. Again, one size cannot fit all. At the individual student level, one suggestion was to have trainees generate faculty-approved target benchmarks for themselves annually, so that progress toward these goals can provide a basis for subsequent evaluation. At the program level, virtually all conference participants endorsed the outcome-oriented accreditation system embodied in PCSAS.
- Above all, what distinguishes clinical science programs from other areas of applied psychology is a shift of emphasis that goes beyond mastery to generativity and discovery. This requires individualized,

flexible, experiential training that even small programs can afford.

- Another distinguishing emphasis is critical thinking and cultivation of scientific skepticism. This may be especially important at the dissemination-implementation end of the intervention development spectrum, where implementation urgency, mental health advocacy, and even marketing priorities may compete with skeptical inquiry and cautious interpretation of research results. For example, some conference participants expressed concern that dissemination-implementation skill training could subordinate scientific priorities to promulgating a "product line" (cf. Weisz et al., 2014).
- For clinical science programs wishing to implement Delaware Project recommendations, a crucial final consideration is deciding what to cut from already-overloaded program curricula. Participants generally agreed that outcome-based accreditation allowing programs to design individual goal-oriented training experiences will help reduce most, but not all, barriers to implementing the project's recommendations. Remaining barriers include licensing laws (e.g., requiring course checklists and "clinical hours" only a licensed psychologist can supervise) and the prevailing expectation that students complete a yearlong internship largely discontinuous from other predoctoral training experiences. Strauman et al. (2014) offer suggestions for how clinical science programs can address at least the second barrier, while at the same time bolstering opportunities for training in dissemination-implementation science.

Training Innovations: Translation- and Dissemination-Centered Learning Exercises

As noted above, one of the most tangible recommendations for clinical science training was more emphasis on experiential learning relevant for intervention development. Several examples of innovative experiential training methods emerged from the discussion: One, a problem-centered practicum seminar approach, follows the translational model, proceeding from basic science toward implementation and dissemination (Levenson, 2014; Levenson, Cowan, & Cowan, 2010). Another, more in keeping with the D&I perspective, begins on the practice side, emphasizing knowledge management, measurement feedback, and adaptation to the social-organizational context of service delivery (Chorpita, 2012; Chorpita, Bernstein, & Daleiden, 2008).

A Problem-Centered, Translational Approach

Clinical science programs in psychology, psychiatry, and related disciplines currently train students how to administer existing treatments, but not how to develop and evaluate new ones. Despite impressive advances in developing behavioral interventions for a variety of mental health problems, there is much room for improvement. For example, most available evidence-based treatments address specific *Diagnostic and Statistical Manual of Mental Disorders* categories of limited validity (Cuthbert & Insel, 2010). Yet many patients have complex clinical problems for which off-the-shelf treatment manuals do not exist, whereas others either do not respond to treatments that do exist or do not receive them. One factor in this shortfall is scientific: Despite having identified specific aspects of dysfunction that interventions should target, we have done very little so far to verify that behavioral interventions indeed engage these targets, and that such target engagement leads to improvement in the patient's symptoms (Kazdin, 2007). Thus, the wave of innovation that could yield more precise and implementable psychological treatments has yet to materialize. A step toward solution will involve exposing a new generation of clinical scientists to methods that could foster innovation in treatment development.

Problem-centered learning (similar to "project-based" or "inquiry-based" learning; Amador, Miles, & Peters, 2007) is a guided discovery process through which faculty and students integrate applied work and scholarship in the service of addressing some practical mental health problem of concern to a broader (and local) community. After identification of a target problem suitable for the exercise, a faculty-led project team conducts a thorough review of relevant scientific, theoretical, and clinical literature and begins to formulate a novel intervention approach applicable in an available clinical setting (e.g., a training clinic). Subsequent steps could include pilot testing the intervention's acceptability and feasibility, designing methods to study the intervention and its effects (e.g., via quasi-experimental or single-case designs focusing on hypothesized change mechanisms and short-term patient outcomes), and, finally, preparing a presentation about the intervention for local stakeholders or practitioners to emphasize user-friendly possibilities for future implementation. This template has been the basis for multiple iterations of a yearlong practicum seminar at the University of California, Berkeley (Levenson et al., 2010).

Regardless of how innovative the interventions emerging from such exercises prove to be, the aim of this training approach is more to develop creative clinical scientists than to develop new interventions: Indeed, the new

intervention products may not be ready for prime time, and the exercises will stop short of giving trainees much experience with actual dissemination. On the other hand, the problem-centered learning process should drive home a crucial point about behavioral intervention development: Clinical scientists must keep applicability and implementability in mind while they engage in the creative process of scientific discovery.

A Practice-Centered, Dissemination-Implementation Approach

Although problem-centered learning about intervention development begins with translating basic science into specific targets for intervention, conference discussion also highlighted an alternative, implementation-centered approach through which students synthesize existing knowledge about evidence-based practices into modular components relevant to the problem at hand and tailor these to the implementation context through direct collaboration with practitioners in real time (Chorpita, 2012; Chorpita et al., 2008).

As a first step, students learn to apply an evidence-based treatment (EBT) to gain experience working with a treatment manual. Faculty next expose students to elements of EBTs (aggregated in a database across hundreds of randomized trials), and teach them a technology for coordinating these elements by mapping treatments to people and problems (Chorpita & Daleiden, 2009). Psychology graduate students and psychiatry fellows also learn how to monitor both client progress and clinical practice using dashboard measurement feedback systems, and they take these skills into community placements where they collaborate with practitioners to design and evaluate treatments, using the evidence base as a guide. In this way, Chorpita's team at the University of California, Los Angeles uses an expanding network of Los Angeles–area agencies and collaborators at other universities to teach intervention design and refinement as part of clinical science (Chorpita, 2012).

Reflections and Directions

In our view, the Delaware Conference made good preliminary progress toward accomplishing its goal of elevating the place of D&I research in university-based clinical science training. Participants overwhelmingly endorsed the importance of exposing students to D&I science, and even the most hardcore basic scientists were eager to learn more about how to do this. Accordingly, the meeting produced a broad array of recommendations and highlighted several innovative intervention-development training approaches applicable at the predoctoral level. At the very least, students who do not have opportunities to do actual D&I work during graduate school should become literate in the language of this arena, as D&I often features prominently in the increasingly diverse career paths of clinical science graduates.

Conference participants also identified and attempted to resolve some formidable obstacles—for example, clinical science programs not having faculty with D&I expertise, program curricula overloaded with other requirements, and clinical internships (which in theory could provide ideal settings for studying D&I) too often discontinuous from predoctoral scientific training. Two potential (but admittedly partial) solutions include (a) curricular overhauls that replace course models with focused learning experiences and (b) explicitly sequenced intervention development training, wherein students gain expertise in early stages of treatment development (e.g., Stages I, II, and III from Onken et al., 2014) during their graduate training, and in effectiveness and D&I research (Stages IV and V) during internship and postdoctoral training.

For the internship problem, Atkins, Strauman, Cyranowski, and Kolden (2014, this issue) recommend several ways to increase continuity between scientific and applied aspects of training—for example, by interspersing them. Another approach, managing internships "in house," might also help alleviate the tail-wags-dog problem of students spending inordinate amounts of time preparing application materials and documenting clinical hours of dubious relevance to clinical science training.

Finally, to compensate for university programs lacking D&I-savvy faculty, conference participants recommended wider sharing of resources between institutions—for example, webinars, faculty/student exchanges, shared research or training activities, and other opportunities announced on the project Web site. The workability or practicality of such sharing remains an open question, however.

Despite widespread enthusiasm for better integration of D&I into mainstream clinical science training, several questions and concerns about this endeavor were implicit in the conference dialogue. In one way or another, most reflect the long-standing divide between science and practice, including the idea that operating in the realm of practice may in some way invite less rigorous thinking and research. A prototype for this concern is McFall's (1991) "Manifesto for a Science of Clinical Psychology," which argues that "all competent clinical psychologists must be scientists first and foremost" (p. 77) and that

> for clinical psychology to have integrity, scientific training must be integrated across settings and tasks. Currently, many graduate students are taught to think rigorously in the laboratory and classroom,

> while being encouraged—implicitly or explicitly—to check their critical skills at the door when entering the practicum or internship setting. (p. 87)

Faculty should therefore "focus on training all students to think and function as scientists in every aspect and setting of their professional lives" (p. 85). A quarter century later most faculty in clinical science programs embrace McFall's recommendations (even if the broader practice field does not), but what it means to think and function rigorously as an *implementation* scientist inspires some debate.

Indeed, the Delaware Project presentations and discussions highlighted shifting, sometimes competing priorities for research and training as one moves along the continuum from intervention generation to implementation. Especially at the dissemination-implementation end of this continuum, respectable scientists have differing perspectives on what research questions and methodologies to pursue, as illustrated by the translation-implementation divide we described earlier (cf. Weisz et al., 2014). This in turn raises questions about what programs should train psychological clinical scientists of the future to *do*: Study interventions, including their mechanisms of change, or study the social contexts in which interventions occur? Install evidence-based technologies in community settings or allow "reinvention" of these interventions to improve usual care? Conduct more randomized trials or manage knowledge from existing trials? And so on. The facile answer—we should do "both/and," not "either/or"—neglects questions of conceptual consistency and empirical outcome equivalence, not to mention the difficulty of doing justice to competing priorities and perspectives in a single clinical science program. On the other hand, one cannot argue with the recommendation that clinical science students receive exposure to the entire spectrum of intervention development, from treatment generation through efficacy and effectiveness testing and D&I. This should increase their capacity to adapt and collaborate across various ranges of this spectrum as their careers unfold.

Because D&I is the new kid on the intervention science block, it is not surprising to behold competing ideas about how it should proceed, or for that matter about growing splits between D&I science and D&I practice (what Weisz et al., 2014, call DIS and DIP) that parallel science-practice gaps in the broader field of psychosocial interventions. In addition to important scientific questions (e.g., D&I outcomes, sustainability, cost-effectiveness, etc.), a burgeoning market for "evidence-based" D&I products has added difficult ethical questions to the mix. Crisscrossing the public service sector, we have now a proliferation of specific brand-name interventions (e.g., ACT, BSFT, DBT, FFT, MATCH, MST, PPP, to name but a few), each with its own quality control, research/evaluation, and marketing operations, and most recently an emerging generation of knowledge management tools such as MAP (Chorpita & Daleiden, 2009) and SPEP (Lipsey, Howell, Kelly, Chapman, & Carver, 2011) offering algorithms to help organizations approximate evidence-based practice based on already available scientific research.[5] Each of these brand names represents a potentially profitable business venture justified to varying degrees by psychological clinical science—and with this comes enormous potential for conflict of interest. Weisz et al. (2014) discuss D&I conflict-of-interest problems in their cautionary essay about putting the DIP cart before the DIS horse.

Apart from such commercial and ethical considerations, juxtaposing the translational and D&I perspectives on intervention development raises important scientific questions—and in our view, the *training* of future clinical scientists offers a vital path to addressing these, at least to the extent that it emphasizes critical thinking and rigorous tests of experimental hypotheses. For example, one crucial question concerns the relative advantages of "installing" evidence-based interventions in community settings, complete with centralized supervision and careful fidelity monitoring (what Simon & Ludman [2013], R. M. McFall [personal communication, February 4, 2013], and others call a "factory farmed" or "franchise" strategy), versus adapting interventions to usual care a la Rogers's (2003) innovation-adoption model, complete with clinicians reinventing evidence-based aspects of what they do. To date, we know of very few direct attempts to compare these strategies, though one (Fortney et al., 2013) appears to favor the centrally controlled franchise approach. Centralized, technology-based, and other economized approaches to intervention delivery—including those recommended by Kazdin and Blase (2011) for "rebooting psychotherapy research"—need outstanding clinical scientists at the helm, ranging from the off-site specialists, supervisors, and fidelity monitors to program developers and evaluators. Where better than clinical science doctoral, internship, and post-doctoral programs to produce them?

Related to installing versus adapting implementation strategies is an empirical question concerning the value of accommodating to clinician preferences. Although the jury is still out on this, we would recall Simon and Ludman's (2009) comment about the success of a computerized, Internet-based, telephonic intervention—that traditional therapists

> might be horrified by the prospect of an overseas cognitive-behavioural call centre or live-chat centre, available whenever patients choose. . . . The expectations of health-care providers are not the

> same as evidence. And the evidence that matters concerns clinical benefits and economic value to patients, rather than appeal or value to providers (p. 595; see also Simon, Ludman, & Rutter, 2009)

Intervention scientists of the future have much to do in this area—and their training will shape how they proceed.

The D&I arena also offers many opportunities for clinical science graduates to exercise critical thinking skills. In the translation paradigm, for example, what factors could account for the alarming falloff in effect sizes from efficacy to effectiveness studies (Curtis, Ronan, & Borduin, 2004; Henggeler, 2004; Miller, 2005) or in testing EBTs against usual clinical care (Weisz et al., 2006; Weisz, Kuppens, et al., 2013)? Regarding knowledge management and modular approaches, how can we know whether *common* elements of EBTs are also the *effective* elements (Weisz, Ugueto, Herren, Afienko, & Rutt, 2011), or if dashboard feedback to clinicians in and of itself might be sufficient to promote client behavior change? These and other questions can engage students' critical thinking skills and stimulate questions for empirical research.

Clinical scientists of the future can also help to reconcile competing priorities of the translational and D&I perspectives. For example, a synthesis of the translation-implementation dialectic might involve translational scientists identifying essential elements or change mechanisms that set boundary conditions for adapting an intervention to various implementation contexts, whereas contributions from the D&I side could encourage attention to implementability earlier in the translational process. A *deployment-focused model* of intervention development outlined by Weisz and colleagues (e.g., Weisz, 2004; Weisz & Gray, 2008) approximates this by developing and sequentially testing intervention components as soon as feasible, with the kinds of clients, therapists, and real-world settings for which the interventions are ultimately intended. With this approach, efficacy testing is only a brief initial phase in intervention development, used to establish the potential for benefit, whereas effectiveness testing under clinically representative conditions is the dominant empirical activity. The goal is to create interventions that are implementable and effective within the "mental health care ecosystem" (Weisz, Ugueto, Cheron, & Herren, 2013) *and* a body of evidence on how the interventions operate (e.g., moderator and mediator effects, mechanisms of change) in actual practice.

Embedded here, as well as in the Onken et al. article to follow, is encouragement for clinical science programs to attend to shifting priorities in some NIH institutes. For one, the National Institute of Mental Health is shifting emphasis from large-scale clinical trials to an *experimental therapeutics* approach that focuses on mechanisms of action and specific target engagement in developing both treatments and strategies for implementing them (Insel, 2012). Regardless of whether an intervention is biological or behavioral, it is not enough to know the treatment's overall effect on broad diagnostic categories of patients. To produce more precise treatments we need to show not only that an intervention engages specific, theory-derived targets, but also that this target engagement leads to, or at least correlates with, subsequent clinical benefits. Extending the experimental therapeutics idea to D&I science involves essentially parallel questions about how an implementation strategy works and for whom it works best. It also encourages an experimental approach to D&I questions, and the literature includes several recent examples of what this might look like (Schoenwald, 2010). Experimental D&I research is a tall order, but one worth pursuing—and we therefore encourage clinical science students to ask questions about moderators, mediators, and mechanisms of implementation strategies as well specific interventions. On the other hand, one could see this as encouraging more of the same retrograde methodology (Kessler & Glasgow, 2011; Riley et al., 2013) rather than bringing rigor to D&I science. Again, it will remain for clinical scientists of the future to resolve this debate—and their training will help shape the outcome.

Regardless of such scientific considerations, clinical science graduates are already forging new career paths, often in the arena of D&I, and their career trajectories may be useful for training programs and organizations like APCS to study and understand. Not long after the meeting in Delaware, APCS President H. Berenbaum (personal communication, March 28, 2013) conducted an informal survey of member programs seeking descriptive information about graduates' successful, albeit nontraditional (i.e., not strictly academic), clinical science career paths. Although only 13 programs participated, their responses revealed a diverse portfolio of relevant roles: There were policymakers (e.g., a Senate staffer), policy analysts, NIH program officers, health science administrators, agency chief psychologists, a science writer, and more—and their work settings ranged from community-based health care organizations and major urban hospitals to military and the Veteran Affairs health care systems. When programs asked graduates to reflect on training themes that helped their careers, the dominant responses included learning to think critically, ask good questions, and stay on top of the science. Although inspiring, such anecdotal success stories offer little guidance for designing good clinical science training. More helpful (building on the preliminary Berenbaum results) would be systematic qualitative data on what productive clinical science graduates actually do in real-world settings. To this end,

we encourage the PCSAS to mine its ever-expanding database to (a) categorize successful career paths and (b) hypothesize about effective training ingredients that might help to reverse engineer these paths.

With an outcome-oriented psychological clinical science accreditation system in place, and visions of new content and pedagogical directions emerging from the Delaware Project, we are confident the clinical science training train has left the station. It is a local train that stops at many crossroads, adds new passengers, drops some others, and even explores occasional sidetracks. We look forward to the journey.

This Special Series

The articles that follow in this special series of *Clinical Psychological Science* elaborate on central activities, issues, or themes the Delaware Project helped bring into focus. In the next article, Onken et al. describe a vision of translational clinical science grounded in a recursive, iterative stage model of intervention development. The Delaware Project used this NIH stage model as an organizing heuristic for constituting work groups and for accentuating continuity and tensions between translation-centered and implementation-centered approaches to intervention science training. The third article, by Levenson, describes an innovative specialty clinic training model based on problem-centered learning, where participants identify a target problem, review relevant literature, then design, evaluate, and begin to implement a brief intervention. In the fourth article, Atkins, Strauman, Cyranowski, and Kolden review the history of clinical internships as a prelude to suggesting ways to increase continuity between scientific and applied aspects of clinical science training by better coordinating predoctoral and internship programs. The final article, by Weisz, Ng, and Bearman, addresses the growing divide between dissemination-implementation science (DIS) and dissemination-implementation practice (DIP), calling for the former to guide the latter more than is currently the case. Each of these articles makes important contributions to the Delaware Project's overarching aim of redefining clinical science training.

Appendix

Stimulus Questions

A. Core questions *(relevant to all stage-model stages):*

1. What *skills, knowledge, and attitudes* are essential to becoming a successful clinical scientist at this stage of the intervention science model as well as across stages? [What conceptual and behavioral skills do clinical science students need to acquire before they can do meaningful research and before many of them can train others to implement or study clinical interventions?] What knowledge and skills associated with other stages are helpful to clinical scientists concentrating at this stage?
2. What *specific research and clinical training experiences* (e.g., courses, practica, mentorship, community-based experiences) best prepare students to become successful clinical scientists at this stage as well as across stages? In what *settings* and at what *phase(s) of training* (doctoral, internship, postdoctoral) are particular training experiences most feasible and impactful?
3. What are some *noteworthy exemplars* of training methods in this arena?
4. How can we reliably *evaluate* short and longer-term outcomes of specific clinical science training activities?
5. What are the main *impediments* to implementing key clinical science training activities? What are some potential resolutions?

B. Supplemental stage-specific questions *(optional for group discussion; many relevant to some stages more than others)*

1. *How much breadth*, both within and beyond psychology, is appropriate for clinical scientists concentrating at a particular bandwidth of the stage-model spectrum? How does this vary by stage?
2. What is the place of *clinical experience* in preparing students to conduct research at this stage? What kind(s) of, and how much, clinical experience is necessary (e.g., exposure to particular target disorders or EBT, training in supervising others)?
3. What is an appropriate *balance of didactic and experiential training* in this stage? How does this vary by training phase?
4. What is the place of *theory* (regarding both problems and change) at this stage of the intervention science model? What should students learn about how theory guides not only the constructs we assess, but also the methods used to assess them and the interpretation of findings?
5. What *methodological and statistical approaches* are most relevant to research at this stage? How can we help students master the logic of research design (e.g., appropriate controls, threats to internal or external validity, measurement validity,

adaptive and SMART designs) along with the increasingly sophisticated quantitative methods they encounter?
6. What is the place of *idiographic (single case) and qualitative methods* at this stage of the intervention science model? What should students know about these methods and their relationship to traditional quantitative methods?
7. What should students know about studying *mechanisms, mediators, and moderators* of psychological interventions? Is this more or less important at some stages than others? How relevant is the distinction between *common and model-specific change processes* at this stage?
8. What should students learn about *intervention fidelity* at this stage of the intervention science model? Is this more or less important at some stages than others?
9. What should students know about *cultural and ethical considerations* in research at this stage?

C. Supplemental questions that transcend stages *(optional for group discussion)*

1. In the current era of team science, what is the place and importance of *"collaborative fluency"* (conversance with the discourse of non-psychological disciplines, ranging from genetics and molecular chemistry to organizational science and public health)? How can trainees acquire such fluency?
2. What experiences best prepare trainees to *think critically* about what they and others do in the realms of theory, research, and practice (assuming this is the sine qua non of good clinical science).
3. What should students know about the distal and recent *history of psychosocial and pharmacological treatments*?
4. What is the place of *DSM diagnosis and traditional psychological assessment* (e.g., testing) in intervention science training? How can we better connect assessment and intervention?
5. What is the *role of biology* in behavioral intervention development? How can biologically oriented research inform behavioral intervention—and conversely, how can behavioral research inform biomedical intervention? What examples best illustrate the relevance of biological or psychophysiological measurement to guiding intervention selection or documenting clinical change?
6. What considerations should guide the *balance between basic (e.g., psychopathology) and applied (e.g., intervention or prevention) research* in a model clinical science curriculum? Is it conceivable that a good program could emphasize one to the near exclusion of the other?
7. Does current clinical science training give sufficient attention to *implementation and dissemination* of evidence-based interventions to community settings? What priority should we give to studying the social contexts and processes relevant to both initial and sustained adoption of these interventions? Should dissemination efforts aim to install evidence-based technologies in community settings or adapt these to improve usual care?
8. What is the place of *technology* in intervention science training? How can we use technology to help students acquire relevant conceptual and behavioral skills? How can they learn to assess and optimize the role of technology in their own research programs?
9. What should constitute a quality *"clinical hour"* in clinical science doctoral and internship programs? Can or should we expand the definition beyond face-to-face client contact to include other applied clinical science activities (e.g., supervision and training of master's-level practitioners)?

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Notes

1. Instigated by faculty from the University of Delaware, initial discussions of a possible meeting about dissemination and implementation science occurred in the Academy of Psychological Clinical Science (APCS), an organization of science-oriented doctoral programs, and the APCS member program at Delaware agreed to host such a meeting were it to occur. As this Delaware Project gained traction, with sponsorship first from the National Institute of Mental Health (NIMH) and then from the National Institute on Drug Abuse (NIDA) and the Office of Behavioral and Social Science Research (OBSSR), its scope expanded beyond APCS programs and beyond dissemination to include the entire spectrum of intervention

development. In alphabetical order, planning committee members were Marc Atkins, Ryan Beveridge, Kathleen Carroll, Bruce Chorpita, Bruce Cuthbert (co-chair), Timothy Fowles, Stacy Frazier, Lisa Onken, Varda Shoham (chair), Timothy Strauman, and Teresa Treat. Fowles and Beveridge now chair the Delaware Project Web site committee, which also includes Treat, Adele Hayes, and Robert Simons.

2. Primary participants (N = 54) included 30 representatives from APCS doctoral and internship programs; 16 leading treatment researchers from non-APCS settings; and 8 representatives from NIMH, NIDA, OBSSR, the National Heart, Lung, and Blood Institute, the National Institute of Dental and Craniofacial Research, and the National Center for Complementary and Alternative Medicine. The meeting also included observers from the American Psychological Association and the Association for Psychological Science, as well as more than a dozen student and faculty observers from the University of Delaware.

3. The work group (stage) topics were basic research, intervention generation and refinement, efficacy in research and community settings, effectiveness research, and dissemination and implementation. One reason for organizing the conference according to the National Institute of Mental Health (NIH) stage model was to increase correspondence between graduate training and the structure of NIH funding. Another was to accentuate the competing priorities and inevitable tensions the stage model presents, at least as these inform training. As it turned out, the conference served this latter purpose very well.

4. Although unplanned, this departure from the conference design had the energizing effect of focusing discussion on tangible resources and training practices relevant to implementation science—a direction welcomed not only by disseminationists, but also by translation-oriented faculty who wished to elevate dissemination and implementation in their training programs. At the conference process level, this development appeared to reflect a sense of urgency for moving the field forward, perhaps paralleling the kind of "disruptive innovation" some implementation scientists call for in the field at large (Rotheram-Borus, Swendeman, & Chorpita, 2012; Simon & Ludman, 2009).

5. The acronym definitions are as follows: ACT is acceptance commitment therapy (Hayes, Luoma, Bond, Masuda, & Lillis, 2006); BSFT is brief strategic family therapy (Szapocznik, Hervis, & Schwartz, 2003); DBT is dialectic behavior therapy (Linehan, 1993); FFT is functional family therapy (Sexton & Alexander, 2005); MATCH is the modular approach to therapy for children (Chorpita & Weisz, 2009); MET is motivational enhancement therapy (Miller, 1994); MST is multisystemic therapy (Henggeler, Melton, Brondino, Scherer, & Hanley, 1997); PPP is the Positive Parenting Program (Sanders, 2012); MAP is mapping and adapting practice (Chorpita & Daleiden, 2009); SPEP is the standardized program evaluation protocol (Lipsey, Howell, Kelly, Chapman, & Carver, 2011).

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