*Editors' Note: Toward the goal of providing an opportunity for initiating and maintaining ongoing discussions of issues relating to lines of research, policy, and practice for students and individuals with a range of developmental disabilities, their parents, and the professionals who work with them, the In FOCUS column has been created. Readers are invited to contact the editors to respond to the ideas presented in the column.*

# Crossing the Bridge: From Best Practices to Software Packages

Jonathan W. Kimball and Karl Smith

A number of empirically validated instructional interventions exist for children with autism and have been characterized by Odom et al. (2003) as ranging from "well-established" (e.g., differential reinforcement; p. 172) to "probably efficacious" (e.g., video modeling, embedded choice; p. 173). Iovannone, Dunlap, Huber, and Kincaid (2003) documented educational practices shown through research to be effective for these children, including individualized supports, systematic instruction, structured environment, and specialized curricula. Unfortunately, as McConnell (2002) observed,

> while empirical support for various intervention components appears strong, the literature still requires practitioners to assume a significant burden in developing a logistically feasible yet sufficiently powerful package for use in their classroom. Researchers in this field may want to develop and evaluate one or more intervention packages that represent compilations of techniques identified in existing research. (p. 368)

McConnell was speaking primarily with respect to social skills, but his point has wider applicability, and computer technology may be particularly well suited to deliver such a package.

Using computers to teach is not a panacea. There are two main problems with much existing computer-mediated instruction. First, although instructional software is commercially available, few programs have been developed for or tested explicitly with children with autism, and many products have significant pedagogical failures. A short list of these problems includes (a) bells and whistles that inadvertently reinforce incorrect responses and/or distract from critical stimuli, (b) limited to no ability to adjust reinforcement schedules, (c) little variety of reinforcers and limited to no ability to vary reinforcers (potentially compromising motivation), and (d) limited instructional exemplars and attention to matters of stimulus control (so the child, for instance, thinks *happy* is the person with the red shirt). Two other shortcomings of particular concern are a limited capacity for prompting and prompt fading, and few instructional steps or levels. These problems can preclude errorless learning and cause frustration or even an aversion to instruction. They may also limit use of a program to only a subset of learners who already possess a number of skills—including many of those the software was designed to teach. Much software is also narrow in scope, focusing primarily on conventional academic or preacademic skills. At best, such programs may provide some practice with skills learned elsewhere, but in many cases they may not teach anything or worse, teach things incorrectly so that precious time must be spent in correction.

Ideally, instructional software should not be merely a reinforcing diversion for a child—least of all one that can be socially isolating or that encourages limited and repetitive patterns of responding—but a resource for teachers and parents. Well-designed software can ensure, with a high degree of treatment integrity, that a child is learning what she or he is supposed to be learning—even doing so independently—while learning a range of skills with the proper amount of instructional support, and can grow with the program with respect to both level of support and content. It should also ensure that skills generalize and are maintained and that performance is reliably measured and recorded. Of course, teachers cannot and should not be replaced by machines, but when it comes to the structured, incremental, and tightly managed instruction known to be beneficial for children with autism, computers may fulfill certain teaching functions quite efficiently and successfully. This is especially important, given the shortage of personnel qualified to teach children with autism (Simpson, 2004). A good software package could help fill gaps in training or gaps in time between visits from professionals who are overseeing a child's programming, and it could help free teachers and parents to address other critical types of instruction, such as daily living and social skills or classroom management. The second author developed a software package—Discrete

Trial Trainer (Accelerations Educational Software)—designed to meet this need. Components of Discrete Trial Trainer are based on principles from the extensive behavior-analytic literature reviewed by Odom et al. (2003) and Iovannone et al. (2003). That said, the software itself, which has generally been well received (see Butter & Mulick, 2001, for a review) and undergoes regular refinement, expansion, and updating, has not been tested by rigorous experiments in the field. This fact underscores the contentions that software tools for educating children with autism require empirical validation and that the single-subject methodology that dominates the field may not be suitable for the nature and process of this research (see Johnston, 2000; Stromer & Kimball, 2004, for discussions of the research and development paradigm).

Although much of the software that is commercially available is ill-suited to teaching children with autism in many respects, the second problem is that much of the computer-mediated instruction that has been documented in the professional literature as promising is not commercially available. Well-researched practices and practical tools are not one and the same (and funding the former will not necessarily lead to the latter). An article that appeared in this journal provides one instructive example. Stromer, Kimball, Kinney, and Taylor (2006) described a number of studies in which children learned to follow activity schedules presented on computers. Their work involved capitalizing on the multimedia capabilities of Microsoft® PowerPoint® to combine several peer-reviewed techniques—including activity schedules (MacDuff, Krantz, & McClannahan, 1993), video modeling (Charlop-Christy, Le, & Freeman, 2000), and matrix training (Goldstein & Mousetis, 1989)—which have each been independently demonstrated to be effective in other forms. Participants in Stromer et al.'s study learned to follow activity schedules and, in doing so, acquired not only academic skills but also (and more noteworthy) new play or social skills. The authors were pleased with these results but hardly satisfied. They encouraged other researchers in the field to try these methods by publishing an article that described how to create activity schedules in PowerPoint (Rehfeldt, Kinney, Root, & Stromer, 2004) and conducting conference workshops (Stromer & Kinney, 2001, 2002). The fact that their platform was PowerPoint—a nearly universally available program—created the potential for their work to be replicated immediately on most computers by researchers and practitioners alike. It may be the case, however, that Stromer and colleagues were not reaching a wide enough audience for the methods to come into generalized use, and PowerPoint itself has limitations when it comes to performing a task for which it was not explicitly designed. In reality, the gap between the potential for use and probability of use can be quite great.

What is involved in moving from promising results like those of Stromer et al. (2006) to widely available, user-friendly teaching tools? This brings us back to the matter of research and development, in which, as Johnston (2000) said,

> There is usually a fairly clear sequence in which research questions need to be addressed so that the resolution of component problems occurs in a coordinated manner. In technology-driven research, each study must fit others like the pieces of a jigsaw puzzle (p. 142)

Clearly, this is a process that requires much collaboration and vision, but it is one in which many readers could participate in some capacity if its components were elucidated and accessible. Toward this end, a three-point plan for assembling the jigsaw puzzle is offered in the hope of stimulating interaction among the community of parents, researchers, and other professionals who are concerned with services for children with autism.

## 1. Autism Technology Grant Fund

According to Johnston (2001, p. 147), "The focused character of R&D … requires someone or some entity to bring related, but still varied, interests and skills of different [multidisciplinary] researchers to bear on a set of problems. This focus is usually coordinated by a funding source." The creation of an Autism Technology Grant Fund would establish a conduit to concentrate monies from different sources to projects explicitly focused on developing tools for teaching. Funded research would involve not only partnerships among different fields (e.g., behavior analysis and engineering, from academia to the private sector) but also different levels of analysis (i.e., from single-subject research to large-scale efficacy studies to consumer surveys), all of which both influence and respond to product development. Potential funding sources for autism technology development include autism and other foundations, corporations, private donors or investors, and government agencies. To date, advocacy to secure such funding has been limited to preliminary conversations with businesses and foundations. Congressional members and staffers were contacted in what proved to be an unsuccessful effort to promote language in the Combating Autism Act that would explicitly support technology research and development. Two promising sources of money for specific projects are the Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs administered by several federal agencies. An objective of these programs is to encourage small businesses to conduct research on innovative technologies that may become both commercially viable and beneficial to the public (National Institutes of Health, Office of Extramural Research, 2007).

## 2. Autism Technology Developers Association

The second author started the Autism Technology Developers Association (ATDA) to share knowledge and resources among developers and researchers and to educate the market with respect to available technologies. This group coordinated several autism technology panel discussions at the last two national conferences of the Autism Society of America. The ATDA is working with the Autism Society to create an autism technology track at the conference.

## 3. Autism Technology Center

The field could benefit from the development of an Autism Technology Center, an entity that would have a director, a research and development coordinator, and a board composed of parents, academics, and technology experts. Among other activities, the Center would

(a) develop a special projects fund intended to, for instance, subsidize product development and thus lower costs for consumers;
(b) facilitate the creation of technology standards and metrics from the various methodology camps;
(c) develop an autism technology research archive;
(d) coordinate research projects;
(e) leverage grant funds, which remain relatively small compared to the money allocated to biomedical research, by supporting products that could bring a reasonable return from the market;
(f) promote communication and cooperation among interested associations, funding sources, and government agencies; and
(g) develop an Autism Technology Incubator that would greatly increase the creation and success of for-profit and not-for-profit entities that are developing affordable autism-related technologies.

Functions of the center, which would require funding for both operating expenses and grant-making, might be variously supported by individual investments or financial or in-kind donations from the business community and by grants from government agencies and private organizations (e.g., Autism Speaks) that raise money for autism research.

In this high-speed information age, these endeavors could significantly accelerate the crossing of the bridge from research to practice and help transform sound experimental findings into effective, affordable, and readily available products so that when it comes to technology, no child with autism is left behind.

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