

Can Computer-based Training Enhance Adolescents' Resilience? Results of a Randomized Controlled Trial

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ABSTRACT

It seems counter-intuitive that adolescents could gain resiliency through a computer program. A longitudinal, repeated measures, randomized controlled trial of a computerized, social-emotional learning intervention tested whether under real-world school conditions, self-regulated use of the intervention would result in higher scores for four key resiliency assets, and positively impact school outcomes. One hundred and fifty-four sixth graders from diverse backgrounds participated. Treatment group students completed 42 multimedia tutorials (about 12 contact hours), over seven weeks. Control group students received live instruction-as-usual. Resiliency assets were measured at pre, post, and five-month follow-up, using scales from the previously validated California Healthy Kids Survey. Attrition was low to moderate and dosage was uniformly high. The treatment group showed significantly higher mean scores from pre- to post- on two of four resiliency assets: empathy and problem-solving. The control group had significantly higher mean scores on connectedness. No effect was detected on autonomy. Treatment students had significantly more excused absences from pre- to follow-up. There were no other significant changes in mean scores for either group from post-testing to five-month follow-up. There were not significant differences in grades or discipline referrals. Principals reported the whole cohort had improved behavior. Social contagion may have been a factor in several outcomes.

KEY WORDS: social-emotional learning; resilience; empathy; adolescents; computer-aided instruction

BACKGROUND AND PURPOSE

The intervention under investigation is a comprehensive, computer-based training program to promote social-emotional competency and address risk factors in adolescents. Solid evidence has established that a core set of social and emotional competencies is highly predictive of success in school and life. These competencies are correlated with better grades, healthier behavior, fewer discipline problems and better health outcomes (Benard, 1991, 2004; Durlak & Weissberg, 2007; Masten & Coatsworth, 1998; Snyder & Lopez, 2002; Werner & Smith,

2001; Zins, Weissberg, Wang & Walberg, 2004). Often called "internal assets," these competencies together comprise resilience, the ability to weather adversity and even thrive as a result of it (Werner & Smith, 1992). Resilience assets can be further grouped into four categories of human strengths: social competence, autonomy, problem solving, and sense of purpose (Benard, 1991, 2004).

Foremost among social competence strengths is that of empathy, sometimes called the "hallmark of resilience" (Werner, 1989; Werner & Smith, 1992). According to Daniel Goleman, author of *Emotional Intelligence* (1995), empathy is the fundamental people skill

and takes the form of identifying with others, perspective taking, and responding and listening to others. Among children, lack of empathy is correlated with bullying, teasing and bias activity, all of which threaten school safety and take precious time away from instruction. School shootings by students in communities believed to be safe have consistently been correlated with prior emotional bullying of the shooters. In addition, the perpetrators have tended to both display and receive a lack of empathy in their social world.

Another key social competence strength is connectedness – the ability to connect to and communicate with others – which is operationalized by joining groups, participating in conversations, appreciating diversity, helping others, making friends, showing respect to others, taking responsibility, and getting help. Through use of this strength, young people are able to form caring relationships and connections to others, the most powerful of environmental protective factors.

The second category of human strengths, autonomy skills, includes self-awareness, having an understanding of one's own strengths, risk and protective factors, learning style, feelings, and sensations. According to Daniel Goleman, self-awareness is the most critical source of emotional intelligence (1995). Other autonomy skills include self-management skills such as impulse control, ability to stop emotional reactions, feeling management, and self-talk. Autonomy also includes having a sense of self-efficacy, a belief in one's power to accomplish what one wants to accomplish. Self-efficacy research has clearly established that "confidence, effort, and persistence are more potent than innate ability" (Maddux, 2002, p. 285) in success in success.

The category of problem-solving skills includes decision-making, conflict resolution (for students this especially means negotiating conflict with a teacher), brainstorming, predicting consequences, and dealing with bullying and sexual harassment. Werner and Smith found that "Among the high risk individuals who succeeded against the odds, there was a significant association between...a

nonverbal measure of problem-solving skills at age 10 and successful adaptation in adulthood" (1992, p. 176).

Having a sense of purpose includes intrinsic motivation, a sense of future, having goals and a success orientation, exerting effort, and having an optimistic attitude. A positive and strong future focus has consistently been identified with academic success, a positive self-identity, and fewer health-risk behaviors (Masten & Coatsworth, 1998; Snyder et al., 2002).

These abilities exist in the social-emotional realm, but have implications for the academic realm as well. A meta-analysis of social-emotional learning (SEL) programs by University of Illinois researchers demonstrated that promotion of social-emotional competency is correlated with success in school on three levels: attitudes, behavior, and academic achievement (Durlak & Weissberg, 2007).

Research in the last two decades has firmly established that at least some of these innate resilience factors and social emotional assets can be promoted and strengthened strategically (Benard, 2004; Elias, Zins, Weissberg, Greenberg, Haynes & Kessler, 1997; Zins et al., 2004). A growing body of research validates specific strategies as effective methods for strengthening and learning resilience, with cognitive, behavioral, and social skill training techniques generating the highest effects in promoting many of these abilities (Lipsey, Wilson, & Noser, 2007; Wilson & Lipsey, 2007).

For all of these reasons, schools have become interested in interventions that promote the development of social-emotional competencies. Many have been shown to work, but implementing, scaling and sustaining them have proven difficult. Implementation fidelity rates in real world situations are as low as 19% for a variety of programs that have been successfully implemented in academic research environments (Ennet, et al., 2003; Fixsen et al., 2005; Gottfredson & Gottfredson, 2001; Hallfors & Godette, 2002).

Advances in computer-based technology may offer some help in meeting this challenge.

Database structure makes it easier to ensure a standardized intervention, extract a subset from a comprehensive program, and adapt a program to diverse cultural contexts and site-specific constraints. Rich media – sound, video, interactive games – can more easily accommodate learning differences, including short attention span, and low reading ability. Use of images, narrative (stories), and modeling from diverse peers can increase identification with training across populations. Further, data management systems provide an objective way to monitor implementation, track dosage, and measure effects to inform decision-making.

One software-based, social-emotional learning (SEL) intervention, Ripple Effects, purports to have overcome key challenges to successful implementation: fidelity to evidence-based practices, capacity for easy adaptation with fidelity, accommodation of learning differences, and accurate documentation of implementation levels and dosage. The Ripple Effects intervention standardizes delivery of science-based content, provides multiple modes for learning evidence-based strategies, and automatically tracks usage.

Even with these advantages, it is counter-intuitive that a computer program can effectively build intangible abilities that are components of resilience, such as empathy, when computer-based training has had mixed results in impacting academic outcomes (Dynarski, et al., 2007; Kulik, 2003; Schacter, & Fagnano, 1999). Computers are unfeeling, not self-aware, often lack nuance, miss non-verbal cues, and in most case, do not provide an environment for physical rehearsal of new skills. All are factors in implementer effectiveness with SEL programs (Devaney, et al., 2006).

Nonetheless, there is a growing body of evidence that technology-based training can be effective for some psychosocial interventions. The best evidence is for internet-delivered cognitive behavioral therapy for adults, for anxiety disorders (Carlbring et al.; 2005; Farvolden, et al. 2005) and substance abuse treatment (Carroll, Ball, Martino, et al., 2008; Brendryen & Kraft, 2008), as well as internet-

delivered cognitive behavior therapy and psycho-education for depression (Clark et al. 2005; Christensen et al., 2004). Other studies show promising positive outcomes for disorders such as uncontrollable anxiety, and eating disorders (Andersson, et al., 2005; Pull, 2006; Ybarra et al., 2005; Zabinski et al., 2003). These studies examined standardized, group-level protocols among adults.

There is a smaller but growing number of scientific studies of effectiveness of self-directed, computer-delivered programs for secondary prevention for children. One early study showed that a school-based health promotion/behavior change CD-ROM-based program (*BARN*) resulted in reductions in risk-taking behavior in adolescents (Bosworth, et al., 1994). An evaluation of a kiosk based HIV/AIDS prevention program using a game format, showed increased understanding of safety issues, and modest pre to post gains in self-efficacy scores, but the study lacked a comparison group to substantiate findings (Thomas et al., 1997).

More recent research has shown that computerized delivery of science-based health information to children and adolescents can be effective in transferring accurate understanding related to substance abuse (Marsch, Bickel & Badger, 2006; Schinke, Schwinn & Ozanian, 2005). Computerized delivery of social skill training has been shown to be effective in promoting self-reported assertiveness and decision-making skills, the former at a level equal to or higher than, a widely validated, instructor-delivered program (Marsch et al., 2006). Several studies of computer-based training for children with autism have shown positive impacts on social-cognitive deficits related to autism (Bernard-Opitz et al., 2001; Whalen et al., 2006). Other research has demonstrated that adolescents and adults are both more comfortable seeking help from a computer than a live interviewer, and are more honest in answering questions on the computer, especially about matters that may carry perceived social stigma (Karabenick & Knapp, 1988; Turner et al., 1998; Weisband et al., 1996). There is no published research that

shows the impact of computerized social-emotional learning as a primary intervention to promote resilience.

We believe the Ripple Effects system merits further study because:

- It is theory-driven and provides specific training in evidence-based practices for each of the components of resilience described above.
- It was created by the initial developer of, and has the same conceptual underpinnings as, *Second Step*, a clinically validated “model” program that promotes empathy, impulse control, anger management and problem solving.
- It holds unique possibilities for scale-up and is economically more feasible than most face-to-face options; and
- It is supported by well-designed research (described below) that suggests effectiveness in areas for which resilience is widely considered a mediator.

Evidence of Effectiveness to Date

Six randomized control trials (RCT) of the Ripple Effects teen program have separately shown it to have one or more of the following significant positive effects with sixth to eleventh graders: improved grades ($p < .01$), higher attendance ($p < .05$), fewer suspensions ($p < .05$), and fewer tardies ($p < .05$), (Perry, Bass, Ray & Berg, 2008); and, fewer anti-social behaviors related to conflict and unkindness ($p < .05$) and more respectful behavior ($p < .01$) (Stern & Repa, 2000).

Very little study has been done about the program’s effect on core social-emotional capabilities (resilience components). A single, short term RCT measured the impact from pre-to-post of a one-hour intervention involving five Ripple Effects tutorials on assertiveness (from the hundreds available). It showed that the computer-based training reduced aggressiveness, ($p = .014$), and increased assertiveness ($p = .015$), among an ethnically diverse group of ninth graders, as measured by the Children’s Assertiveness Behavioral Scale.

However, the sample was small, the duration was short, and there was no follow up (Ray, 1999).

Six of the studies cited above measured “self-determination,” including components of autonomy (along with the academic and behavioral outcomes noted above), but the studies yielded contradictory and inconclusive findings on the autonomy-related measures, suggesting the need for further study (Perry et al., 2008). To date, the potential for self-directed, computer-based training to directly impact an affective characteristic – the ability to identify with the felt experience of others – had never been demonstrated. This study, funded by a grant from the Lucille Packard Foundation for Children’s Health, attempts to fill that gap.

Purpose

Based on the promising body of previous research into the effectiveness of Ripple Effects, its unique characteristics as a CBT program, and its status as a model SEL program, WestEd designed a study to examine the proximal effects of Ripple Effects computer-based training software on four categories of resilience assets: social competence (including empathy and connectedness) problem-solving; autonomy; and sense of purpose. Distal impacts of the program on attendance, discipline, and academic achievement among sixth-grade students, were assessed both immediately after the intervention and at five-month follow-up.

Significance

If the Ripple Effects intervention proved effective, this study would have immediate relevance to a large body of educators and policy makers. A wider number of people might successfully facilitate cost-effective, social emotional learning with middle school students, requiring far less training than had previously been necessitated and resulting in high implementation fidelity. The Ripple Effects system has already been commercialized and is being used at some level in more than 500 school districts in the United States.

METHODS

Research Design

The study employed a randomized controlled trial, experimental design with multiple, repeated measures (pre-test/post-test and 5-month follow-up). Success was measured by the extent to which exposure to Ripple Effects was related to increases in sixth-graders' emotional and behavioral outcomes as measured by positive changes in resilience, school-connectedness, and academic performance.

Participants

Recruitment. Schools were recruited via email and/or telephone contact with individual teachers and principals, and thorough district offices in several San Francisco bay area counties. All middle schools that included sixth-grade classes were invited to participate, contingent on meeting several criteria, including minimal technology requirements and the willingness to accept a phased-in RCT design. Presentations about Ripple Effects and the evaluation study were made to interested school principals, teachers, and staff. Once schools agreed to participate in the study, a parent information meeting was held at the district offices during which the Ripple Effects intervention and the evaluation study were described. At this meeting, parents were given a chance to ask questions and give feedback.

Setting. In the end, two middle schools (both grades six through eight) from one San Francisco bay area school district participated during the 2005-2006 school year. One of these was a year-round school; the other followed a more traditional academic calendar. The county in which the two schools are located is known for its affluence and educated workforce, but is also characterized by pockets of entrenched poverty, many new immigrants, and growing homelessness. About one third of students at each school were eligible for free or reduced meal plans. Educators in the county, particularly those who work with typically underserved students, expressed an urgent need to support the development of students' social-

emotional assets and raise academic achievement.

Earlier that year, the district adopted a new Student Social Responsibility Strategic Plan whose mission was to support social and emotional learning competencies and promote socially responsible citizens. To that end, there were plans to establish regular social skills classes at the schools where students would participate in SEL programs and curricula. At the time of the study, however, district-wide SEL materials had not yet been selected or adopted. Because of this district-wide support, at one of the schools, two periods per week had been set aside for social skills classes. That school was able to implement the Ripple Effects program during those periods. The other school implemented the Ripple Effects intervention during their technology lab period, usually on two days per week. At both schools, Ripple Effects was the only SEL program in use during the study tenure. En lieu of Ripple Effects, control students at each school participated in extra technology lab time or carried on "business as usual" in their core courses.

Consent procedure. We ultimately used a multi-level approval process; procuring district approval, principal approval, teacher consent, and active parent and student consent for participation in the study. As described previously, a parent Q&A session was also held at the district offices prior to beginning the study in order to present the Ripple Effects program to parents, explain the study goals and procedures, and provide a venue for asking questions about Ripple Effects and the evaluation study.

Study sample. In order to determine the appropriate sample sizes required for the study, we calculated *minimum detectible effect sizes* (MDES) based on the unit of randomization and the availability of baseline explanatory variables using the procedures described by Cohen (1986). MDES estimates represent the smallest true program impacts in standard deviation units that can be detected with high probability (Bloom, 1995). Calculations were based on the following assumptions: (1) statistical power levels of 0.80, (2) Type-1 error

rates of 0.05, (two-sided), and (3) covariates included in the statistical model explain 30 percent of the variance in the outcome variable. These calculations revealed that 300 students were needed to detect an effect size between 0.25 and 0.30, which is a typical effect size for this type of intervention. However, recruitment difficulties resulted in a final sample size of 154 students – a large enough reduction to allow detection of only moderate-to-large effect sizes. This challenge will be discussed in more detail in the discussion section of this article.

The final study sample included 154 sixth-graders, with 71 students in the treatment group and 83 students in the control group. Females and males were fairly evenly distributed in both the treatment (35 females/36 males) and control (40 females/43 males) groups. Other demographic variables included: Race/Ethnicity (African American 4%, Asian American/Pacific Islander 19%, Caucasian 52%, and Hispanic/Latino 26%); English language proficiency (17% of students were English language learners, and 41% came from homes where the first language was not English); and socio-economic standing as indicated by free or reduced meal eligibility (31.9% at one school and 29.3% at the other). There were no statistically significant baseline differences between the treatment and control conditions for gender, ethnicity, English language learner (ELL) status, or home language, either within or between the two schools. In addition, no significant baseline differences were revealed between control or treatment conditions for resiliency assets, academic performance, attendance and suspension, or disciplinary referrals.

Assignment to condition. Randomization and assignment to condition occurred at the student level, meaning that students who consented to participate in the study were randomly assigned to treatment and control groups according to a computer algorithm using Stata 9.0 (StataCorp 2005). To improve precision of impact estimates and to guard against chance non-equivalence, students were stratified into eight groups based on their home language prior to random assignment. Within

each home language group, students were randomly assigned to treatment and control conditions. Teachers at each school were also randomly assigned to be either trained in and facilitate Ripple Effects during the study (treatment condition) or delay training and implementation of Ripple Effects in their classrooms until after the study was completed (control condition).

Intervention

Generally, the learning in the Ripple Effects program is self-paced and self-directed, such that students are encouraged to choose whichever tutorials they feel will be of most help or interest to them. However, in order to maintain experimental controls for the purposes of the study, the interactive exercises in each assigned tutorial were defined as core components of the intervention and were required. The treatment condition consisted of self-directed training on 42 (from a total more than 390) Ripple Effects tutorials over a seven-week intervention period. Thirty-six of those tutorials, chosen in concert with participating school staff, were selected because they targeted some key strategies and resilience assets the schools felt were most needed by their sixth grade students. The remaining six tutorials could be self-selected by each student, based on his or her personal needs and interest. These self-selected tutorials could be accessed only after the 36 prescribed tutorials were completed.

In addition, each school developed a sequence for the tutorials that students were mandated to follow during the intervention. The two schools selected the same tutorial content to implement, but chose to sequence them slightly differently. Each tutorial included at least two interactive elements - one content-mastery assessment, and one journal-writing exercise. Some tutorials also included interactive self-profiles, including tutorials on resilience, empathy and problem-solving. There were 121 interactive exercises available, in total.

As described previously, at one school, students used the intervention in the computer

lab located in the library. At the other school, it was used during a social skills class, in place of their regular curriculum. No adults (not school personnel, not instructors, not program developers) were involved in any part of presenting the program content. Table 1 shows

the tutorials implemented at the two schools, plus an example of the kinds of self-selected tutorials chosen by students. Ripple Effects' organizational scheme for resiliency can also be seen.

Table 1. *Scope and Sequence of Ripple Effects Tutorials Selected by Participating Middle Schools.*

Sense of self (Autonomy)	Sense of others (Social Competence)	Sample of Self-Selected Tutorials (topics varied)
<p>Self-awareness</p> <ol style="list-style-type: none"> 1. strengths 2. risk and protection 3. learning style 4. feelings-names for 5. physical sensations <p>Self-management</p> <ol style="list-style-type: none"> 6. controlling impulses 7. stopping reactions 8. internal triggers (self-talk) 9. outside triggers 10. relaxing <p>Self-efficacy</p> <ol style="list-style-type: none"> 11. control-taking 12. assertiveness <p>Sense of purpose</p> <ol style="list-style-type: none"> 13. motivation 14. future (not there) 15. setting goals 16. success-phobia 17. luck 18. effort 19. resilience 	<p>Empathy</p> <ol style="list-style-type: none"> 20. empathy 21. perspective taking 22. showing care 23. paraphrasing <p>Connectedness</p> <ol style="list-style-type: none"> 24. joining a group 25. conversations 26. appreciating diversity 27. helping others 28. friends-choice of 29. respect - showing 30. responsibility 31. getting help <p>Problem-Solving</p> <ol style="list-style-type: none"> 32. problem-solving 33. resolving conflict 34. brainstorming 35. cause and effect 36. teacher 	<ol style="list-style-type: none"> 37. testing 38. bullied 39. sexually harassed 40. solidarity-showing (bystander) 41. change-normal 42. resisting pressure

Completion of the interactive parts of the program was logged on each student computer and became the basis for defining dosage. Students who were absent for a particular session were allowed to make it up at another time. Adult implementers were mandated to check data records to ensure compliance, but not to otherwise mediate any part of the program.

The *Whole Spectrum Learning System* (WSLS) powers the Ripple Effects intervention as both an information and navigation system. The WSLS offers at least nine modes of learning in every tutorial, including cognitive, behavioral, affective, attention, and social skill-building strategies that have been shown to work in live instruction. Student confidentiality is assured through password-protected entrance, encryption of written entries, and a

privacy screen that can shield users from unwanted intrusion.

Training. Staff assigned to the treatment condition at the two schools consisted of five teachers and two counselors. They received a single, three-hour training to orient them to the software, identify the scope and sequence of the assigned tutorials that best fit their site-based constraints, prepare them to introduce the software to students (but not mediate any content), and enable them to use the built-in data management system to monitor compliance and track student progress.

Instruments and Data Sources

Resiliency assets. The strength of students' resilience assets was measured at baseline, upon completion of the Ripple Effects program, and five months following the end of the program. Resilience assets were measured using scales from the Resilience and Youth Development Module (RYDM) of the previously validated California Healthy Kids Survey (CHKS) (WestEd, 2004), that were adapted for delivery via a reading-independent, computer-based interactive survey engine developed by Ripple Effects and used widely as an assessment tool with the program. Autonomy was measured by averaging mean scores from three RYDM scales - self-management, self-efficacy, and sense of purpose. Social competence was assessed by averaging mean scores of two RYDM scales (empathy and connectedness), with additional items to measure behavioral aspects of empathy, as well as cognitive ones. Problem-solving was measured by averaging means of eight individual RYDM items. Means of resilience assets are reported. Table 3 presents the items that comprise each of these scales and their reliability coefficients. Items q6, q17-q19, q23, q25, q31, q40, and q41 were

reverse-coded. Students accessed the resiliency survey on the Ripple Effects survey engine. Data from the survey were exported from the Ripple Effects program for analysis.

It is important to note the low reliability (.33) of the empathy scale. This is most likely due to the fact that the empathy-related items on the CHKS measure three separate abilities and, as such, do not constitute a true scale. Together, these items measure apprehension of feelings, (an affective ability), perspective taking (a cognitive ability) and showing care (a behavioral response). Students might well score differently on each of these constructs, meaning that the responses to these questions would not have the same reliability rating as would questions from a single scale. The .33 reliability rating would be consistent with this distinction. This issue will be addressed in more detail in the discussion section of this article.

School connectedness – absenteeism and student behavior. In addition to specific survey items related to school connectedness, school administrators provided school-based archival data on student attendance, suspensions, and discipline referrals. These three outcomes were assessed by examining incidents per one hundred school days – the approximate number of days from pre-test to post-test for each cohort – calculated using the formula (number of incidents)/(number of school days)*100.

Academic performance. Student grade point averages (GPA) were used to determine academic performance. GPAs were obtained from school administrations, and reflected the grading periods just prior to, and at the end of, the implementation of Ripple Effects at each of the schools. As the schools followed different academic calendars, implementation was carried out in three cohorts.

Table 2. *Constructs, Items, and Scale Reliability Coefficients of Resilience Assets*

Scale	Item	Coefficient
Autonomy		0.79
<i>Self-Management</i>		0.56
	Q3. I notice clues in my body that tell me what I'm feeling.	
	Q6. Whatever my first impulse is, I go with it, without thinking of the consequences	
	Q7. I have the skills to stop my reactions whenever I want.	
	Q8. If I get angry, sad or afraid I know how to change my thoughts to feel better.	

	Q9. I know what things outside me get me upset and I try to avoid them. Q10. I can relax my muscles whenever I want, even when I'm upset. Q41. When things change from what I'm used to, I freak out.	
<i>Self-Efficacy</i>	Q1. I can describe the easiest way for me to learn. Q4. I know what things I can control, and what things I can't control, to make my life easier Q5. I can name lots of things that I'm good at. Q11. I'm in control of a lot of what happens in my life. Q12. I know how to get respect without frightening or hurting others. Q13. Somehow I get through hard times and bounce back. Q19. Putting effort into something is usually not worth it. Q29. I have the skills to make the kind of friends I really want. Q38. If I'm being bullied, I know what steps to take to make it stop. Q40. Sexual harassment happens, I'm helpless to stop it.	0.55
<i>Sense of Purpose</i>	Q14. I really want to do well in school. Q15. I picture myself growing up, getting old and being happy. Q16. I've set some goals and I'm serious about reaching them. Q17. It's bad to be more successful than my friends. Q18. Most of what happens in my life is just a matter of luck. Q20. Even when hard things happen, good things often come out of it.	0.52
Social Competence		0.65
<i>Empathy</i>	Q21. I notice it and feel bad when someone gets their feelings hurt. Q22. I try to look at things from other people's point of view. Q23. There's no point in repeating back what somebody just said. Q28. In the last week, I've offered to help someone else. Q39. If someone else is being bullied, I'll do something to make it stop.	0.33
<i>Connectedness</i>	Q24. I belong to a group, team or club that does something that I'm interested in. Q25. With friends, I mostly ask questions that need a simple "yes" or "no" answer. Q26. If I've spoken, I'll wait for someone else to talk before I speak again. Q27. I like the fact that people are really different. Q28. In the last week, I've offered to help someone else. Q29. I have the skills to make the kind of friends I really want. Q30. I always try to show respect to other people. Q31. If I do something wrong, I try to get out of taking responsibility for it. Q32. If I need help with a problem, I ask for help.	0.58
Problem-Solving	Q33. When problems come up, I have a system for solving them. Q34. It helps to come up with lots of ideas, to get to a good solution. Q35. I usually try to predict the consequences before I do something. Q36. When there's a conflict, I look for a way to meet everyone's needs. Q37. When I have a conflict w/a teacher I know how to figure out what's causing it Q38. If I'm being bullied, I know what steps to take to make it stop. Q39. If someone else is being bullied, I'll do something to make it stop. Q42. I know some ways to make taking tests easier.	0.74

Dosage data. As students progressed through the intervention, the tutorials and exercises they completed were recorded automatically and exported directly from the software program. Dosage was determined by adding the number of available, interactive exercises a student completed. At one school, 119 exercises were available; 121 were

available at the second school. Dosage data were examined by categorizing treatment students into "high implementer," "middle implementer," and "low implementer" groups. High implementers were defined as students completing at least 75% of the total interactive assessments. Middle implementers were students completing from 26% - 74% of the

total interactive assessments, and low implementers completed 0% - 25% of the assessments.

Teacher interviews. Participating staff were administered a telephone interview during which they were asked about their and their students' experiences with Ripple Effects, including implementation and delivery of the program, their opinions about its efficacy and quality as an SEL 'curriculum', their perceptions of its social and academic value to students, and its impact on the school climate. All five teachers and two counselors participated in the interviews.

Data Analysis

Statistical method. Data analysis was conducted using statistical program STATA/SE 9.2. Descriptive statistics including mean scores on the measures at baseline, post-, and follow-up tests are reported. Baseline comparisons of scores within/between groups for treatment vs. control were conducted using t-test. We examined changes between pre-post, post-follow-up, and pre-follow-up using Analysis of Covariance controlling for baseline or posttest scores, gender, and ethnicity. Dosage was included in the models to examine whether treatment students receiving high program exposure did better than treatment students receiving low program exposure.

RESULTS

Implementation Rates and Attrition

Survey data. Of the 148 students who participated in the pretest, four (2.7%) did not take the posttest, and 16 (10.8%) did not take the follow-up test.

Archival data. Of the 154 students for whom there were archival data, we were unable to collect data for 1 student (0.6%) for post-testing. At the time of the follow-up, 13 (8.4%) students had moved out of the two schools.

Implementation Rates

In this study, implementation rates were uniformly high. Eighty percent of students in one school and 100% of students in the second school completed 75% or more of the assigned interactive exercises (defined as high implementation). The fact that compliance rates were so high is noteworthy and will be discussed in the final section of this article. However, because of this finding, dosage-correlated effects could not be studied further.

Key Findings

Resilience assets. Table 3 gives mean scores for pre-, post-, and follow-up student resilience surveys, and shows the results of statistical analyses of change differences between treatment and control students. As there were no significant cross-school differences in pre-, post- or follow-up survey scores within the control and treatment groups, those data were aggregated across the schools. As Table 3 demonstrates, the treatment group showed significantly higher mean scores than the control group from pre- to post-test on two resiliency assets: empathy ($\eta^2=.146$, $p=.02$) and problem-solving ($\eta^2=.149$, $p=.03$). Although there were no other positive significant findings for the treatment group, a positive trend did emerge in how treatment vs. control students responded to the survey items. From pre-test to post-test, treatment students showed gains in mean scores on 67% of the items, as opposed to control students who showed gains on only 33% of the items. Likewise, control students had lower mean post-test scores on two-thirds (67%) of the items, whereas treatment students showed lower mean post-test scores on only one-third (33%).

The control group had significantly higher mean scores than the treatment group on one resiliency asset – connectedness ($\eta^2=.101$, $p=.04$). There were no significant gains or losses in mean scores for resiliency assets from pre-test or post-test to follow-up.

Table 3. *Changes in Resilience Assets Between Pre-, Post- and Follow-Up (FU) Testing*

	Pre	Post	FU	Difference in Changes between Groups ^a									
				Pre to Post		Post to FU		Pre to FU					
				M	M	M	M	β	p -value	β	p -value	β	p -value
Autonomy													
Treatment	2.66	2.66	2.63										
Control	2.67	2.65	2.62										
Self-Management													
Treatment	2.46	2.48	2.49	.031	0.48	.002	0.97	-.005	0.93				
Control	2.48	2.47	2.49										
Self-Efficacy													
Treatment	2.70	2.75	2.74	.051	0.31	.019	0.66	.047	0.30				
Control	2.74	2.72	2.70										
Sense of Purpose													
Treatment	2.83	2.76	2.66	-.017	0.72	-.006	0.91	-.032	0.55				
Control	2.80	2.75	2.69										
Social Competence													
Treatment	2.85	2.85	2.81	.023	0.60	.010	0.85	.039	0.46				
Control	2.89	2.85	2.78										
Empathy													
Treatment	2.83	2.92	2.83	.146*	0.02	-.016	0.83	.099	0.17				
Control	2.90	2.80	2.76										
Connectedness													
Treatment	2.88	2.79	2.79	-.101*	0.04	.045	0.45	-.024	0.67				
Control	2.87	2.89	2.79										
Problem-Solving													
Treatment	3.01	3.20	3.11	.149*	0.03	-.024	0.77	.078	0.35				
Control	3.06	3.09	3.00										

Notes: Sample consists of 70 students in treatment group and 80 students in control group at two middle schools.

^a Estimates were produced using Analysis of Covariance controlling for baseline scores, school differences, gender and ethnicity.

Statistically significant differences in changes between treatment and control groups – * $.01 \leq p < .05$; ** $p < .01$.

Academic achievement and student behavior. Table 4 provides results of the analyses of academic performance, attendance, tardies and suspensions, and disciplinary referrals for treatment and control students across all three measurement periods. Data are aggregated across schools.

Academic performance. Grade point averages were collected at the beginning and

end of the semesters or terms during which the study was implemented. Table 4 demonstrates that, although mean grade point averages increased for treatment students and remained virtually the same for control students, the differences were not statistically significant. There were no significant gains or losses in mean scores for academic performance from either pre-test or post-test to follow-up. Once

again, control and treatment condition data are aggregated across the two schools.

Student behavior - attendance, tardiness, suspension, and discipline referrals. Table 4 also shows that, like academic performance, the analysis of data on student behavior (absences, tardiness, suspensions, and referrals) revealed no significant differences between treatment and control groups (data are combined across schools). There were no significant gains or losses from either pre- or post- to follow-up measures for disciplinary referrals. However, treatment students showed a significant increase in excused absences from pre-test measures to follow-up ($\eta^2=1.318, p<.01$).

Teacher interviews. The five teachers and two counselors reported during interviews that the behavior and attitudes of students in the treatment group seemed to be improving, and that students were generally responding very positively to the program. Interview findings are summarized below:

- (1) All participating staff claimed that they were 'very' to 'extremely' pleased with the Ripple Effects program, and that they would use it again and recommend it to other teachers.
- (2) All participating staff reported that they felt that the program had a positive impact on their students, with two teachers noting that the usual, end-of-the-year discipline issues they normally face with sixth-graders were much improved in their treatment students. In an informal conversation, the principle of the other middle school offered the same insight about her school climate. Prior year's administrative data, which could have confirmed or corrected

teachers' and principal perceptions, were not available.

(3) All participating staff reported that the vast majority of their students enjoyed using Ripple Effects, liked the look and general tone of the program, and could identify with the characters and youth portrayed in the program. Further, most of the students used the software on their own, after completing the required topics, "just to explore what was there and get information about personal issues."

(4) Some difficulties setting up and accessing the program were reported, and a few of the staff said that the system did not always properly track what assessments their students had completed. Those technology-related issues that were reported to Ripple Effects during implementation were addressed and solved by Ripple Effects IT staff.

(5) Four of the five teachers and one counselor said they felt that the program was not as well-suited for ELL students, claiming that the vocabulary was too sophisticated and the reading level too high for English learners (as well as some native English speakers who fell below the fifth grade reading level targeted by the program). The four teachers all suggested embedding a rollover Spanish/English glossary that students could easily access to get help with vocabulary and language. All seven interviewees suggested that the text narration be slowed down considerably, or programmed so that students could adjust the rate of speech themselves.

Table 4. Pre-, Post-, and Follow-Up (FU) Data and Differences in Changes in Academic Performance, Attendance, Suspension, and Disciplinary Referrals^a

	Pre	Post	FU	Difference in Changes between Groups					
				Pre to Post		Post to FU		Pre to FU	
				M	M	M	M	M	M
Academic Performance									
GPA									
Treatment	2.88	3.01	3.04	.086	0.19	-.064	0.35	.013	0.87
Control	3.05	3.06	3.21						

	Pre	Post	FU	Difference in Changes between Groups					
				Pre to Post		Post to FU		Pre to FU	
				β	p-value	β	p-value	β	p-value
Attendance and Suspension									
Excused absences				.686	0.33	.949	0.06	1.318**	<0.01
Treatment	1.90	3.99	2.77						
Control	2.03	3.41	1.45						
Unexcused absences				.057	0.81	-.002	1.00	-.072	0.84
Treatment	0.44	0.35	0.52						
Control	0.26	0.23	0.51						
Tardy				-.137	0.87	-.290	0.59	-.453	0.50
Treatment	1.26	2.44	1.60						
Control	0.64	2.07	1.60						
Suspension				.117	0.23	—	—	—	—
Treatment	0.04	0.13	—						
Control	0.03	0.00	—						
Disciplinary Referrals									
Physical Contact (with intent to harm)				-.004	0.92	-.021	0.38	-.021	0.37
Treatment	0.00	0.03	0.00						
Control	0.05	0.03	0.02						
Rudeness/Disrespect				.008	0.93	.036	0.50	.027	0.60
Treatment	0.19	0.16	0.09						
Control	0.08	0.11	0.06						
Rule-Breaking (conventional – no harm)				-.049	0.52	-.027	0.58	-.030	0.53
Treatment	0.10	0.10	0.05						
Control	0.04	0.11	0.08						
Rule-Breaking (potential or real Harm to other)				.094	0.17	.063	0.19	.064	0.15
Treatment	0.02	0.10	0.07						
Control	0.03	0.00	0.00						
Non-Attendance (in class or detention)				.117	0.17	-.014	0.72	.037	0.50
Treatment	0.00	0.16	0.09						
Control	0.01	0.03	0.04						

Notes: Sample consists of 71 students in treatment group and 83 students in control group with data on GPA, attendance, suspension and disciplinary referrals

·Absence and suspension were assessed by examining incidents per a hundred school days. Incidents per a hundred school days were calculated using formula “(number of incidents)/(number of school days)*100”.

·Estimates were produced using Analysis of Covariance controlling for baseline scores, school differences, gender and ethnicity.

Statistically significant differences in changes between treatment and control groups – * .01 ≤ p < .05; ** p < .01.

Summary

The results from the study showed that Ripple Effects had a significant, positive impact on resiliency assets in the areas of empathy and problem-solving after 10 - 12 contact hours. In addition, students who used the program showed higher (but not statistically significant)

gains than control students in self-management, self-efficacy, and sense of purpose. No persistent effects of the program on students were revealed from either pre-test to follow-up or post-test to follow-up. Although some of the school facilitators felt the program may have limitations for use with ELL students, they were very positive about the impact Ripple Effects

had on students in general and about its ease of implementation. Control group students who were not exposed to the program, but were exposed to the students who received it, showed significant, positive gains in connectedness. Further research would be necessary to clarify the neutral findings for autonomy, academic performance, and student behavior. These findings will be discussed in the following section.

DISCUSSION

The **key finding** that Ripple Effects computer-based training program helped students build two critical social-emotional skills - empathy, and problem-solving - with 12 or fewer contact hours *and no teacher intervention* suggests that there may indeed be a practical way to scale training that has formerly required substantial, specialized expertise from implementers. This has important implications for schools, where children's resilience can mean the difference between success and failure, but where resources like time, money and expertise are limited. It may be especially useful in addressing common, widespread problems, like bullying, which are correlated with lack of empathy and problem-solving skills.

The **unexpected finding** that control students had significantly higher mean scores than treatment students on connectedness was initially surprising. It is possible that this can be explained as the result of the treatment groups' increase in empathy, which could improve relationships with control students, resulting in their feeling more connected. However, further study would be necessary to fully understand this interesting finding. To-date, many efforts have focused on "fixing" at-risk students, which reinforces the message that they are the problem. These new findings suggest that a program might be able to target *any* students with empathy training, not just those identified as having behavioral difficulties, with the result that whomever the 'treated' students come in contact with, will feel more connected. This has

special relevance to issues like bullying and bias activity.

Another unexpected finding was that students in the treatment group had higher rates of excused absences from pre-test to follow-up, compared with control group students. This contrasts to findings from a prior experimental study, where Ripple Effects students had significantly lower rates of absenteeism (Perry, Bass, Ray & Berg, 2008), and four other experimental studies of Ripple Effects that demonstrated trends towards lower absenteeism (Bass et al., 2008). It is possible that control group students' higher rates of reported connectedness resulted in higher attendance rates. Further study is needed, to clarify both the effects of the intervention on attendance, and the causal mechanisms involved.

Further research would also be necessary to clarify the **neutral findings** for academic performance and student behavior; especially, since prior studies of Ripple Effects software showed statistically significant gains in these areas. Since the principal and staff at both schools perceived improvement in the behavior of the entire sixth grade student body, it is possible that an overall positive trend is the function of a spillover effect. The same possibility could explain the lack of significant differences between treatment conditions from either pre-test to follow-up, or post-test to follow-up.

A large number of discipline referrals are related to social conflict between students (it really does take two to fight), and it stands to reason that, if a randomly chosen group of half of the students in any grade develop greater empathy and improved problem-solving skills, relationships between these students and their classmates (including treatment, control, and non-participating students) would all improve. Discipline rates would be impacted in a positive way for the students as a whole, not just for the treatment group. It is unfortunate that prior years' discipline data were not available in a useable format to test this hypothesis.

Impact of cross-contamination. This challenge is intrinsic to studies in which the intervention being tested involves social interaction among peers, and where analysis is at the level of the individual in a closed, social space such as a classroom. This is true for even RCT studies like this one, where careful randomization is employed for assignment to condition at both the student and instructor level, but the overall study sample is drawn from within the same school. Because this study followed that model, we could not escape some of the impacts of cross-contamination on our data. Although random assignment to treatment condition at the level of demographically-matched schools would have made more theoretical sense, the numbers of schools required to detect significant meaningful effects was prohibitive within our recruitment and budget constraints. Unfortunately, this issue is all too common in educational research as a whole, and all too often cannot be resolved in small- and medium-scaled studies.

Implementation level. It is rare to get the high implementation rates found in this real world study. As referenced in the first section of this report, implementation rates for a variety of successful SEL programs are typically very low - in some cases, averaging only about 19% (Ennet, et al., 2003; Gottfredson & Gottfredson, 2001; Hallfors & Godette, 2002). The 80% rate achieved in this study is notable, and is in line with the 70% average implementation rate across seven other randomized controlled trials studies conducted on the intervention in the past five years.

This result brings up at least two key research questions; "Why were implementation rates (a measure of fidelity) so much higher than the norm?" and, "What does this tell us about how technology can support SEL programming?" Four possible hypotheses that address these questions present themselves:

1. As implementation levels are continuously monitored through the Ripple Effects program data management system, feedback on how much and which parts of the program have been completed may

prompt greater compliance on the part of instructors and students alike.

2. All the program content, expertise, and audiovisuals are contained within the software. This greatly reduces the load on heavily burdened instructors who might otherwise 'back-burner' using the program because they lack the time and/or expertise to implement and deliver the curriculum by themselves.
3. Because of the brief time required to complete a tutorial (about 15 minutes), easy access to computers in the two schools, and the independence with which students use the program (i.e., it doesn't require instructional time from the teacher), students are able to fairly easily make up missed lessons, and the effect of absenteeism (both students' and teachers') is reduced.
4. Students who need (or want) more repetition or alternative modes of learning can get it privately, without impacting the group or requiring additional time from the teacher. This may increase the likelihood that students will seek and receive much-needed 'extra help' on issues they face.

A large-scale study of the implementation process for this kind of application could go far toward informing the field of social-emotional learning about the unique value of computer-based training to enhance and deliver high-fidelity, effective, youth development programs.

Study Limitations

Small sample size. As described previously, in order to determine the appropriate sample sizes required for the study, *minimum detectible effect sizes* (MDES) were calculated, and the study was powered to detect an effect size between 0.25 and 0.30, which is a typical effect size for this type of intervention. An effect size of this magnitude would have required us to recruit 300 students (150 treatment and 150 control), and would have provided confidence that reasonably-sized intervention impacts, if present, could have surfaced.

Just prior to beginning the study, we had secured passive consent for more than 300

sixth-grade students, divided equally into treatment and control conditions.

Unfortunately, the final analytic sample was cut almost in half due to a late decision by the District Superintendent to require active, rather than passive consent, even in the face of an IRB exemption.¹ With such a reduced number of students (between 70 and 80 students per condition), the study was, in the end, powered to detect an effect size of 0.39 standard deviations – a moderate-to-large effect size for this type of intervention. This change greatly reduced the chances of uncovering the small effect sizes commonly associated with classroom research. It is unknown whether the positive trends we saw in treatment group resilience asset gains would have been maintained with a larger sample size or shown to be statistically significant.

Lack of full one-year follow-up. It would have been worthwhile to conduct another follow-up data collection after a full academic year had passed since the implementation of the intervention in the schools. However, funding constraints and the schools' desires to begin using the program with all their students prevented us from collecting a second round of follow-up data.

Conclusion

The application of emerging technologies to social-emotional learning is still in its early stages. Results from this study are very promising, yet much still needs to be learned about what works best, with which groups of students, and under which conditions. The findings that students who participated in Ripple Effects for only 10 -12 hours showed significant gains in two key resilience assets – empathy and problem-solving, are a strong indication that computer-

based SEL training is a viable, effective means for teaching and strengthening resilience. High praise from school staff who implemented the program about its ease of implementation, its positive impact on their students (and the sixth grade classes in general), and their students' enthusiasm about the program are further evidence of the strength of technology-mediated SEL training and of Ripple Effects in particular. Finally, the extremely high compliance rates and the findings that significant results were achieved with virtually no additional instruction or teacher intervention are exciting. They underscore the ability of software to mediate the persistent challenges of implementation fidelity that often hamper SEL program delivery and evaluation.

¹ This change was prompted by concerns raised by a parent/school board member who felt that any study involving students should use an active consent process.

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