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The Good Behavior Game: A Best Practice Candidate as a Universal Behavioral Vaccine

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A "behavioral vaccine" provides an inoculation against morbidity or mortality, impacting physical, mental, or behavior disorders. An historical example of a behavioral vaccine is antiseptic hand washing to reduce childbed fever. In current society, issues with high levels of morbidity, such as substance abuse, delinquency, youth violence, and other behavioral disorders (multiproblems), cry out for a low-cost, widespread strategy as simple as antiseptic hand washing. Congruent research findings from longitudinal studies, twin studies, and other investigations suggest that a possibility might exist for a behavioral vaccine for multiproblem behavior. A simple behavioral strategy called the Good Behavior Game (GBG), which reinforces inhibition in a group context of elementary school, has substantial previous research to consider its use as a behavioral vaccine. The GBG is not a curriculum but rather a simple behavioral procedure from applied behavior analysis. Approximately 20 independent replications of the GBG across different grade levels, different types of students, different settings, and some with long-term follow-up show strong, consistent impact on impulsive, disruptive behaviors of children and teens as well as reductions in substance use or serious antisocial behaviors. The GBG, named as a "best practice" for the prevention of substance abuse or violent behavior by a number of federal agencies, is unique because it is the only practice implemented by individual teachers that is documented to have long-term effects. Presently, the GBG is only used in a small number of settings. However, near universal use of the GBG, in major political jurisdictions during the elementary years, could substantially reduce the incidence of substance use, antisocial behavior, and other adverse developmental or social consequences at a very modest cost, with very positive cost-effectiveness ratios.

KEY WORDS: substance abuse prevention; violence prevention; public policy; best practice.

INTRODUCTION

A behavioral vaccine is a simple, scientifically proven routine or practice put into widespread daily use that reduces morbidity and mortality. A powerful example comes from an epidemic that occurred 150 years ago.

During the nineteenth century, women died in childbirth at alarming rates in Europe and the United States. Up to 25% of women who delivered their babies in hospitals died from childbed fever (puerperal sepsis), discovered later to be caused by *Streptococcus pyogenes* bacteria.

In the late 1840s, Dr Ignaz Semmelweis worked in the maternity wards of a Vienna hospital. By meticulous observation, he discovered that the mortality rate in a delivery room staffed by medical students was up to three times higher than in a second delivery room staffed by midwives. Semmelweis postulated that the students might be carrying the infection from their dissections to mothers giving birth. He tested the hypothesis by having doctors and medical students wash their hands with a chlorinated solution before examining women in labor. The mortality rate in his maternity wards eventually dropped to less than 1%. Washing of hands with antiseptic solution—a behavioral vaccine—now saves millions of lives every year. Today, the Centers of Disease Control and Prevention (CDC) web site states, "[Antiseptic] hand washing is

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the single most important means of preventing the spread of infection."

Other behavioral vaccines have been promoted on the premise of reduced mortality or morbidity. In the 1960s and 1970s, seat-belt use for adults and car seats for children were examples from the injury control literature.

In contemporary society, an epidemic affecting young people has waxed and waned since the 1960s. Substance abuse; delinquency; school failure; psychiatric disorders such as ADHD, oppositional defiance, and depression; teen suicide; teen pregnancy; and youth violence have adversely affected the lives of America's adolescents (see the various Surgeon General's reports on these topics). These problems often co-occur in what Biglan (2001) describes as multiproblem youth. Could there be a behavioral vaccine, nearly as simple as antiseptic hand washing, which might significantly reduce the mortality and morbidity of multiproblem behavior? Yes, there could be. This paper details what one might be and how it might become as common as a doctor or nurse washing hands with antiseptic solution.

Behavioral Vaccine Defined

A behavioral vaccine is a simple procedure that can dramatically change an adverse outcome. Unlike prevention programs, which are typically described as a collection of procedures delivered over a set time such as 8–12 weeks, a behavioral vaccine is given only once or used as a simple *routine* of daily life. Traffic safety research offers some useful examples. A drivers' education program is a prevention program. Both optional air bags and seat belts are behavioral vaccines. In the case of optional air bags when they were introduced, a person only needed to make a decision to buy a new car *with air bags* to enjoy the benefit of increased safety. In the case of seat belts, one must buckle up each time to maximize safety from harm. Both types of behaviors are relatively easy, unlike the complexity of a drivers' training course on accident avoidance. A hallmark of a behavioral vaccine is that a simple action yields large results. Per se, behavioral vaccines do not preclude other strategies, and may even work synergistically with or be combined with more strategies to leverage effects. Behavioral vaccines are typically very inexpensive, and work for a broad population, with few adverse effects.

The Logic Model of Behavioral Vaccines

Like any public-health measure, behavioral vaccines must be able to be used across the whole population to achieve the full societal as well as individual prevention effect. The need for universality can be modeled mathematically and logically (e.g., Embry & Flannery, 1999). Mathematically, prevalence rates of multiproblem behaviors (e.g., substance abuse, misuse, juvenile crime) typically range from 1 to 15% for the purposes of illustration here. Prediction of who will develop these problems over life span is quite clearly *not* 100%, and ranges vary dramatically depending upon the complexity, comprehensiveness, and sensitivity of the prediction tools. Issues of false negative and false positive identification loom large, however (Embry & Flannery, 1999). If one presumes that certain problem behaviors happen in around 5% of the population, then 500 out of 10,000 people ought to be afflicted. An 85% accurate prediction model (which would be the envy of most behavioral epidemiologists) could correctly classify 425 people, missing 75. How many might be false positives though? In a rough way, that can be calculated by subtracting the 425 correct positive predictions from 10,000. Then, multiply that number by the prediction error term (15%). The result is that public-health practitioners, school, law-enforcement, and/or parents might have erroneously identified 1,436 people as at-risk when they are not. In times of scarce resources, implementing selected or targeted interventions for those 1,436 people makes little economic, logical, political, social, or health sense—especially when the delivery of targeted or selected prevention strategies may run thousands of dollars per person, be very difficult to deploy, or both.

The logic of a behavioral vaccine improves the power, prediction, and cost-effectiveness of targeted and selected prevention strategies. This can be illustrated by problems posed by bioterrorism prevention and early detection. Chills, fevers, vomiting, and other such symptoms are common early signals of some agents suitable for bioterrorism, such as anthrax—necessitating an elaborate screening and detection (U.S. Surgeon General, 2002). These signals are also the early symptoms of the flu and colds, which are perversely common, resulting in false negatives or positives. Thus, an epidemic of flu-like symptoms could precipitate a dramatic overresponse from authorities (false positive)—which uses up valuable social, economic and political capital making, paradoxically making the society more vulnerable.

Or, the authorities might underrespond, dismissing the events as simply colds or flu (false negative). In the case of multiproblem behavior such as substance abuse and juvenile crime, behaviors such as early impulsivity, inattention, and disruptiveness among children—nearly as common as flu-like symptoms metaphorically—predict serious problems a decade or so later (e.g., Tremblay, Masse, Perron, and Leblanc, 1992); even though, a good half or so of the children will desist a decade later in these behaviors (e.g., Walker, Colvin, & Ramsey, 1995). If every young child who exhibits these behaviors receives medication, behavioral interventions at home, and behavioral interventions at school, the personnel and economic cost would be substantial. And, substantial numbers of children or families would be subjected to medication or services simply not needed and possibly iatrogenic. Now, imagine that a universal precaution can cut the incidence rate of the key manifestations of a behavioral or a public-health problem from 20 to 50%. Such prevention effects dramatically improve the sensitivity, power, and and cost-effectiveness of selected or targeted interventions—which can be modeled mathematically. This efficiency effect can be exemplified by the harried school counselor or psychologist who now has 20–50% *fewer* referrals for evaluation for conduct or attention problems, and who now has more time for more accurate screening and treatment.

The logic of a behavioral vaccine has even more potency if there are suspected contagion effects. Contagion can be real or via social learning in multiproblem behaviors. For example, placing a child with risk factors among other children who manifest those same symptoms for an intervention or prevention can dramatically escalate the expression of the rate and severity of symptoms, causing more harm to the individuals, peers, and society (e.g., Dishion, McCord, & Poulin, 1999). Even the simple random assignment of impulsive or disruptive 1st graders to classrooms with high, medium, or low levels of peer aggression can dramatically escalate or mitigate serious behavioral problems a decade later (e.g., Kellam, Ling, Merisca, Brown, & Ialongo, 1998). These adverse contagion effects could be the result of imitation, peer reinforcement of antisocial behavior, or escape conditioning from aversive behaviors by adults, or some combination. One might usefully think about contagion effects as "tipping points," which could be altered by classroom management, school climate, or community-wide behavioral vaccines.

A final set of issues exists in the logical model of behavioral vaccines: ability to scale to nearly universal coverage, low adverse reactions, and robustness to be used in combinations with other strategies.

Logically, a behavioral vaccine must be easily scaled to cover large areas of social geography and its attendant population to achieve protective effects. Logically, the behavioral vaccine would have to work with very diverse ages and work across different ethnic or cultural groups. Mathematically, it is virtually impossible to affect community-level outcomes (e.g., crime rates, drug use) without near universal coverage of a primary prevention strategy. A behavioral vaccine must also have low negative side effects, if used at scale. Why so? Lipsey (1992) reports that approximately 29% of the interventions to prevent delinquency actually make young people worse, and this may be a significant underestimate because efforts with adverse results are less likely to be published for many reasons. Thus, a behavioral vaccine with significant adverse effects for a subset could actually make community-level results worse, instead of better. An extension of the logic of reducing adverse reactions would extend to how the vaccine interacted with other prevention or intervention efforts, as a behavioral vaccine could be like certain drug interactions. To the dismay of most program developers, users of prevention protocols often do not implement them with fidelity or may mix them with home grown strategies. A potential behavioral vaccine could have robust internal validity in carefully randomized control-group studies, yet fail miserably in the field. Thus, a behavioral vaccine would need to have evidence of impact and utility in sloppy, naturalistic conditions.

The logic model for a behavioral vaccine shares some elements of the risk and protective factor literature currently driving much of the prevention policy in the United States (e.g., Catalano, 2001), yet is quite different in other ways more akin to large public-health campaigns. Both models rely on empirical data. In the risk and protective factor model (Catalano, 2001), small units of government (e.g., schools, school districts, or communities) attempt to create a plan presumptively based on their *unique* data. The behavioral vaccine model holds that certain risks or protective factors must be considered at a population or near universal level. The nature of the data construct (normative based) of the risk and protective factor model makes it very difficult to detect general population factors adversely affecting child development vis-a-vis small unit prediction. Further, the risk and protective factor model does not take into account the time sequence of prediction, only the current prediction in a cross-sectional mode. The behavioral vaccine model presumes a developmental sequence or vector, which if interrupted, has long-lasting effects.

If the logic model is true for behavioral vaccines, then great benefits could accrue for individuals, families, schools, and communities from a powerful prevention strategy that could be used in large-scale public health models. The question begs: does prevention science suggest any strategies as potentially appropriate as a behavioral vaccine for multiproblem behavior?

A Candidate Behavioral Vaccine

A bit over 30 years ago, two graduate students, Harriet Barrish and Muriel Saunders, and one of the founders of behavior analysis, Montrose Wolf, published a study on the effects of something called the Good Behavior Game (hereinafter, the Game; Barrish, Saunders, & Wolf, 1969). It worked pretty well, and became a behavior-modification "trick" most graduate students in behavior analysis or special education learned during the heyday of behavioral psychology. Neither Barrish, Saunders, or Wolf, nor the graduate students who learned to use the Game as a classroom strategy, had the slightest idea then how powerful the strategy might be for changing the future of children destined for lifetime multiproblems of substance abuse, violence, and school failure (Kellam & Anthony, 1998; Reid, Eddy, Fetrow, & Stoolmiller, 1999; White, Loeber, Stouthamer-Loeber, & Farrington, 1999).

Even with the spread of "best practice" guides, very few policymakers, government agencies, educators, prevention specialists, mental-health providers, or even research scientists know about the Good Behavior Game. Very few people know about the potential for the Game to prevent multiproblem behavior that gobbles up special education, juvenile delinquency, and treatment dollars.

The Game is the simplest of behavioral strategies, which has been described in detail in a manual (Embry & Straatemeier, 2001). First, the adult inducts children's definitions of the rules of the setting, specifically what would make the classroom or nonacademic setting a good place to learn, more enjoyable, pleasant, etc., all labeled as the "good things we all want." Second, the adult inducts children's descriptions of behaviors that would interfere with desirable outcomes and labels these generically as "fouls." Third, examples of both are presented physically and in words for the children to form a generalized concept. Fourth, the adult explains that the Game is played at intervals, like innings, but never for the whole day. Fifth, the adult divides the group into teams and explains that a team may win the Game by having the fewest fouls (or below a criterion in later research, enabling multiple winners), because that means more good has happened. Every team can win some brief activity prize if they have less than a predetermined number of fouls during an interval. Sixth, the adult makes sure a daily scoreboard is highly visible, just like the scoreboard of baseball or football, with fouls much smaller than wins. The Game has procedures for how to play in certain circumstances, how to keep it exciting, how to improve generalization, and how to solve problems for players who cheat or flout the conventions.

In this paper, I outline why and how the widespread application of the Game might be one of the most cost-beneficial prevention strategies available for schools and other settings. The paper will also map out the scientific and practical ways that the Game might become a universal public-health measure or vaccine for the prevention of multiproblem behavior. The rationale for the idea of a universal behavioral vaccine can be advanced on the basis of epidemiological research, findings from the neurochemistry of behavior, evolutionary psychology, replicated behavioral studies, and simple mathematics. This paper also discusses research and practical issues related to a "behavioral vaccine" for prevention.

EPIDEMIOLOGY OF MULTIPROBLEM BEHAVIOR AS FOUNDATION FOR A BEHAVIORAL VACCINE

The foundation for a behavioral vaccine would, of necessity, make sense only if there were evidence of a behavioral trajectory that predicted adverse outcomes. That evidence would be even stronger for the vaccine if the behavioral trajectory were measurable, meaningful, and malleable. Such a foundation is becoming much stronger because of the quality and quantity of scientific research on multiproblem behavior of substance abuse, delinquency, violence, school failure, and related mental-health disorders.

Just a few years ago, practitioners and scientists built program and scientific castles about the causes, prevention, and treatment of substance abuse, delinquency, violence, various mental-disorders, and school failure. Champions argued that each problem was caused by very unique factors, necessitating a tobacco prevention program, a marijuana prevention program, a violence prevention program, etc. These prevention castles have been defended to the death, even when they are expensive and show weak or no effects. Typically, the prevention models emerged largely as a result of simple cross-sectional studies or incomplete epidemiological information. It was and is a classic case of inadequate experimental design on *developmental* issues, leading to erroneous conclusions—just as Schaie and Baltes (1975) warned.

Over time, well-controlled multiple longitudinal and twin-studies stormed and demolished the castles, though defenders of the rubble still continue. Consider some examples of the castle sieges.

In 1990, Shedler and Block published landmark results on substance abuse from a long-standing longitudinal study. They reported that substance abuse (vs. substance experimentation) at age 18 could be predicted by simple measures of coercive parent–child interactions at age 8. Shedler and Block's findings mirrored the more fine-grained longitudinal studies on the role of parent–child coercive interactions in the cause of antisocial behavior by Patterson and Stouthamer-Loeber (1984), by Patterson, De Baryshe, and Ramsey (1989), and more recently by Ary et al. (1999). Other longitudinal studies, such as by Walker, Stieber, Ramsey, and O'Neill (1993), followed, showing the links between early aggression in boys and lifetime problem behavior. Tremblay et al. (1992) observed these connections in boys in Montreal. Consistent reports emerged from researchers in other locations. Raine, Venables, and Mednick (1997) found similar relationships in a long-term study in Mauritius. In the long-standing Child Development Study in New Zealand, Moffitt (1990, 1993) provided strong evidence for life-course continuity of early problem behaviors and adverse adolescent outcomes. Swedish studies showed long-term relationships between aggression, alcohol use, and criminals behaviors (Andersson, Mahoney, Wennberg, Kuehlhorn, & Magnusson, 1999). In the United Kingdom, Champion, Goodall, and Rutter (1995) have shown the connections between various adverse developmental outcomes in a decade-long study. Recently, more complex longitudinal studies have revealed similar data (Loeber, Stouthammer-Loeber, & White, 1999), yet expand on how depression and internalizing symptoms affect the outcomes along with early aggression. What do all these longitudinal data tell us? In general, the data suggest that many serious behavioral problems of adolescence and young adulthood emerge from similar behavioral pathways. These studies clearly suggest that the behavioral trajectory is measurable and meaningful. Are the trajectories malleable?

Some of the longitudinal studies, by happy circumstance, indicate that environmental or social events alter the apparent trajectory of multiproblem behavior. Consider just a few examples from the longitudinal literature. Patterson and colleagues have had the opportunity to study behavioral interactions (interval-by-interval coding) in the context of longitudinal study of antisocial children. What did they find? Patterson, Dishion, and Yoerger (2000) reported that more than 50% of the outcome of substance use, health-risking sexual behavior, and police arrests can be predicted by how much reinforcement of deviant behavior children receive. In a 1998 study, Patterson, Forgatch, Yoerger, and Stoolmiller argued that the prediction of lifetime deviancy had stable behavioral roots at least as early as the 4th grade, based on their data. One of Patterson's key colleagues has further documented that deviance reinforcement and delinquent behavior follow the matching law (Dishion, Spracklen, Andrews, & Patterson, 1996). The pattern of reinforcement delivered by parents and the reciprocal interactions between parent and child have been well documented to be malleable in high-quality, thorough behavior analysis or in other studies (e.g., Kosterman, Hawkins, Spoth, Haggerty, et al., 1997; Tremblay, Pagani-Kurtz, Masse, Vitaro, et al., 1995; Webster-Stratton & Hammond, 1997).

Most of the above work focuses on the family context, and other researchers have examined school or community contexts in terms of behavioral trajectory. Rutter, Maughan, Mortimore, Ouston, and Smith (1979) and Rutter (1985) show powerful effects of school organization on delinquency, behavior problems, and other outcomes. Rutter proposes that the structure and organization of school may differentially reinforce resilient behavior versus antisocial behavior. One of the original descriptive studies of the Baltimore Prevention Project (Kellam, Mayer, Rebok, & Hawkins, 1998) showed that classroom context had a 6-year impact on developmental outcomes for children with elevated developmental risk. Specifically, Kellam, Ling, et al. (1998) report that high-risk children who were randomly assigned to classrooms with naturally occurring low or high levels of aggression by other children had very adverse impact on the randomly assigned longitudinally studied boys but not girls. Collectively, Kellam's work suggests that the boys in his research settings might have been reinforced for aggressive behavior by peers (both negatively and positively), in much the same way as Patterson's cycle of coercion was observed in a family context. School context, at least, offers evidence of a behavioral trajectory that is measurable and meaningful.

Some evidence suggests that the behaviors might not be easily malleable, perhaps reducing the likelihood of a behavioral vaccine. It appears, from several types of inquiry, that some children have an innate vulnerability to the cycle of family or peer coercion, and possibly, the reinforcement of aggressive behavior. Some of the longitudinal studies strongly suggest a genetic modulation of outcome, as well as leverage points for intervention or prevention. In a report from their Montreal study, Tremblay, Pihl, Vitaro, and Dobkin (1994) obtained teacher ratings on 1,161 kindergarten boys from 53 schools with the lowest socioeconomic status, on the dimensions proposed by Cloninger, Sigvardson, and Bohman (1988). Tremblay et al. (1992) correlated the teacher survey results with the presence of self-reported delinquent behavior at age 13. Scores for *high impulsivity* and *hyperactivity* were the strongest predictors of delinquency ($p <$ .0001), whereas scores for low anxiety ($p < .016$) and low reward dependence ($p < .029$) provided a lower level of prediction (see Fig. 1). The results confirmed the prediction of Cloninger's neurotransmitter model that high impulsivity and novelty seeking predict high risk for antisocial behaviors, which are behaviors modulated by serotonin, dopamine, and norepinephrine (e.g., Cloninger, 1994).

If the longitudinal studies are correct, then the need for a strong behavioral vaccine might be even greater for individuals who have a genetic risk for multiproblem behaviors. The question is whether such genetic vulnerability exists. The answer is yes. Studies of twins amplify and refine the general longitudinal studies on multiproblem behavior, suggesting strong genetic linkages. Slutske et al. (1997) utilized the Australian Twin Registry for the largest twin study of conduct disorder ever reported. They examined 2,682 adult twins, and concluded that genetic factors contributed to at least 71% of the disorder. A related publication from the Australian Twin Registry

Fig. 1. Longitudinal prediction from Montreal Study.

(Slutske et al., 1995) showed that girls with conduct disorder had a 10-fold greater risk of having problems with alcoholism than girls without conduct disorder. The Minnesota Twin Study shows a strong association for alcoholism, ADHD, and other behavioral problems among 1,200 twins (Disney, Elkins, McGue, & Iacono, 1999). Most of the twin studies suggest a strong linkage between problems of attention, hyperactivity, and aggression as key underlying factors predicting multiproblem behavior in boys. Reduction in rate, intensity, and duration of these behaviors might be the logical target of a behavioral vaccine—unless such behaviors were so profoundly genetically driven as to be immutable. The research on genetic mechanisms of these findings has considerable implications for prevention.

Genetic studies of multiproblem behavior have advanced significantly in the last decade, and these advances suggest that genetic vulnerability is not static but sensitive to social events—potentially making the need for behavioral vaccine higher, which might prevent the disturbing problems from unfolding. Few social scientists realize the significance of advances in genetics research, which regulate some of the neurotransmitter candidates identified by Cloninger (e.g., Cloninger, Adolfsson, & Svrakic, 1996) as implicated in multiproblem behavior (e.g., Comings, 1995; Comings et al. 2000; Comings, Gade, Muhleman, & MacMurray, 1996; Comings, Gade, Wu, et al., 1996). Importantly, candidate polygenic alleles for multiproblem behaviors have strong evidence for being turned on by exposure to perceived human stress (e.g., Madrid, Anderson, Lee, MacMurray, & Comings, 2001), and the neurotransmitters implicated in multiproblem behavior are clearly related to social interactions (e.g., Quist & Kennedy, 2001). Because the evolutionary psychologists and other scientists have convincingly documented that individuals who likely carry these genes (and behaviors) do not randomly mate (e.g., Buss, 1984; Krueger, Moffitt, Caspi, Bleske, & Silva, 1998), a behavioral vaccine for multiproblem behavior in children might have to operate in schools or community. The advances in genetics research help resolve the tension between nature versus nurture debate (see Embry, 2002, for a complete discussion), and a behavioral vaccine might mitigate against the interactions between genetic vulnerability and common social risk factors articulated by numerous investigators found in schools, communities, peers, and even homes.

What are the implications of all of these diverse epidemiological findings? First, reductions in early inattention, disruptiveness, and related behaviors ought to decrease long-term adverse socially undesirable outcomes—nothing particularly new but worth restating. Second, the *biological* processes of multiproblem behaviors are clearly affected by social events, and scientific advances now make it possible to understand how the social environment might affect the expression of genes related to the biology of multiproblem behavior. Third, the epidemiological data suggest that effective behavioral procedures, universally promoted and used, might well be powerfully effective environmental or behavioral "vaccines" to prevent the occurrence of multiproblem behavior.

A BEHAVIORAL VACCINE

Presently, society has two current operative definitions or venues of the vaccine concept. In medicine, a vaccine is a preparation containing weakened or dead microbes of the kind that cause a particular disease administered to stimulate the immune system, protecting the individual from future exposure. In computer science, it is a software program that protects a computer from a virus or worm infection. Both of these concepts can be extended to the behavioral realm.

With a behavioral vaccine, a person might be exposed to a weakened behavioral risk, which could stimulate a protective response to a more full-blown exposure to the social, emotional, or psychological risk. Or, a person might learn a protective program of behavior that attacks, dislodges, or protects against any exposure to a dangerous behavioral assault in the future.

Vaccines are most effective when everyone who has a risk receives a critical dose. Under such circumstances, the virus has no host population to infect. Childhood immunizations are classic cases of vaccines for a vulnerable population, with few children in developed countries now dying from scourges of the past.

A vaccine is not like treatment, the latter of which is typically given after the onset of the disease or disorder. Vaccines are typically given universally before onset.

Could certain simple-to-apply, universal behavioral interventions confer some sort of "immunity" against multiproblem behaviors such as substance abuse, juvenile delinquency, and other problems? The answer appears to be "yes." The Good Behavior Game is a good candidate to consider as a potential behavioral vaccine, and the next sections of this paper present the evidence and logic for the possibility.

The Good Behavior Game: General Theory and History

Some 100 years of solid psychological research shows that behavior varies as a function of its consequences (e.g., Catania, 1992; Malott, Whaley, & Malott, 1997). Thorndike first labeled this as the "Law of Effect" back in the early 1900s. Since that time, the observations have been codified into the most robust replicated general principles of the science of behavior such as the "Matching Law" (e.g. Herrnstein, 1970). There is a profound reason that scientists refer to this principle as a "law." It is universal, highly replicated, easily demonstrated, and parsimonious. Against this backdrop, graduate students like Harriet Barrish and Muriel Saunders and scientists like Montrose Wolf thought disruptive, disagreeable behaviors by students might happen because peers and others somehow reinforced them in school settings. Perhaps, the smiles, giggles, laughs, and even pointed taunting from other students were *reinforcing* the high rate of the behaviors that teachers found so difficult to handle or harmful to the learning process. In this context and time, the graduate students and senior scientists reasoned that some kind of group-based reward for *inhibiting* negative behavior might be a boon for classrooms. Already, there were powerful precedents for such an idea. The idea for the Good Behavior Game was born.

Behavior Analysis Studies of Good Behavior Game Demonstrate Efficacy

Applied behavior analysis (Baer, Wolf, & Risley, 1968) posits careful testing of strategies to change human behavior in context, most frequently using time-series methodologies such as reversal or multiple-baseline evaluations, which have powerful advantages in applied research (e.g., Barlow & Hersen, 1973). The initial efficacy evaluations of the Game occur in this context.

First Test of Efficacy

In 1969, Barrish et al. published the first study on the Good Behavior Game using a multiple-baseline design in a very difficult classroom. It was this class that became the first to try the Game in a controlled study. The 4th-grade children were observed during maths and reading. Trained observers coded student behavior every minute for an hour, 3 days a week for several weeks. The children were out-of-seat or talking-out for about 80–96% of each class period, making instruction nearly impossible. Bedlam would have described the class.

The Game was played everyday during maths, with the class divided down the middle row into two teams. One or both teams could win privileges (e.g. wear victory tags, be first in lunch line, get a star on a winners' chart, earn free time) by having the lowest number of marks tallied on the board for disruptive behaviors. Teams with under 20 marks for the week earned special privileges at the end of the week.

The rate of disruptions fell immediately from about 90% to 10% of the intervals during the math hour, a great improvement. Meanwhile, the disruptions during reading time stayed pretty much the same.

After a few weeks, the teacher stopped playing the Game during maths but started playing it in reading. The results immediately showed the efficacy of the Game. Behavior during maths looked pretty bad again, just like the "baseline." Behavior during reading was greatly improved. After a week, the teacher played the Game during both times, and the rate of problem behavior fell quite low.

Efficacy Test of Game Components

The Good Behavior Game actually has several potentially "active ingredients" that might account for its efficacy. In 1972, Medland and Stachnik tested the good-behavior Game in a 5th-grade reading class consisting of two groups of 14 students each in a reversal design, using the class as its own control. They tested the whole game and different components to see how they worked. Game components included rules, red or green lights (response feedback using nonemotional cueing), and group consequences of extra recess and extra free time. Two observers counted talking-out, disruptive, and out-of-seat behaviors. The graphs from the study show that the total Game package reduced all the disruptive behaviors from their baseline rate by almost 99% for one group and 97% for the other. The component analysis revealed that after association in the Game, the nonemotional cueing stimuli of rules and lights were moderately effective in reducing the problem behaviors; the whole Game package was, however, most efficacious. What was particularly noteworthy was the fact that the students and teacher were able to cover 25% more academic material during the Game. This study revealed that the use of the signal light decreased bad behavior, underscoring the importance of a consistent, unemotional response or cue about bad behavior. The study also revealed that enunciation of the rules by the teacher each day had a small effect, which could explain the often reported comment by teachers that the children "need to be nagged" about the rules. Figure 2 summarizes Medland and Stachnik results.

Efficacy Test With Higher Risk Population

Children who ultimately develop multiproblem outcomes often have a special-education history (e.g.,

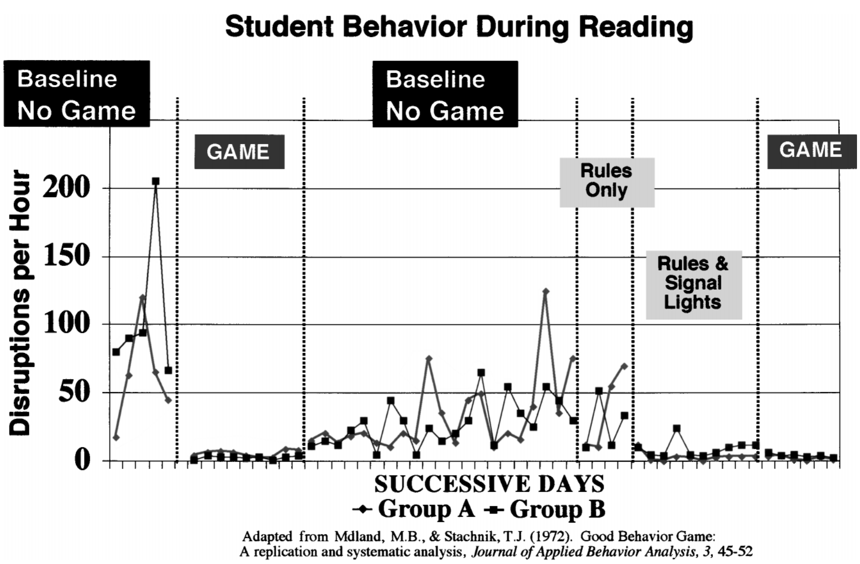

Fig. 2. Medland and Stachnik (1972) results.

Walker et al., 1995), and it would be important to demonstrate that a potential behavioral vaccine could be efficacious with such higher risk populations. Grandy, Madsen, and De Mersseman tried the Game with elementary-age special-education students in 1973 in a behavior analysis design. Again, the disruptive behaviors went way down. This study showed that the Game could generalize to a higher risk population.

Refinement of the Efficacious Components

Medland and Stachnik (1972) did not test all the salient components of the Game package, which might be crucial in understanding the active ingredients of this potential behavioral vaccine. Harris and Sherman tested the Game components in 1973, and they too found that disruptive talking and out-of-seat behavior fell dramatically in 5th- and 6th-grade students. By testing the Game in multicomponent reversal design, they allowed for a better understanding of key, effective components of the Game. Key ingredients turned out to be the division of the class into teams, positive consequences for a team winning the Game, and a low number of marks set as criteria for winning the Game. Harris and Sherman did find that reductions in negative behavior only slightly affected academic achievement, which flags the need for other research to determine whether the Game could be combined with explicit academic improvement strategies without adverse effects as teachers and schools would be likely to pursue additional components.

Efficacy Test With Young Primary School Children

In the chronology of efficacy studies, all had been focused on intermediate-level students in elementary schools. No evidence existed that it could be efficacious with younger students, which would naturally boost its potential as behavioral vaccine. Bostow and Geiger evaluated the Game's effects using a behavior analysis design on 2nd graders in 1976. Here again, it was effective, expanding the generalizability to younger ages.

Comparative Efficacy Trials for Rival Strategies

The Game is not the only school-based strategy that could be used to decrease the impulsive, disruptive, and inattentive behaviors that predict multiproblem behavior. A good candidate for a behavioral vaccine is likely to have a family of related interventions, and finding the most efficacious alternative would be logical. One of the most obvious alternative strategies is teacher attention, that is, training a teacher to pay more attention to a child's good behavior. In 1977, Warner, Miller, and Cohen compared the effects of the Game against simple teacher attention for being good among 4th and 5th graders. The Game was much more effective and simpler to use, which was important for building a case for it as a potential behavioral vaccine. Warner and colleagues also provided a key finding for social validity of the Game as a potential behavioral vaccine. As teachers often complain that they cannot praise for a variety of reasons, the differential effects of the Game met a key objection to a common recommendation of increasing praise.

The Role of Peer Pressure as Key Component

Deviant peers are clearly a risk factor in the epidemiology of multiproblem behavior (e.g., Dishion et al., 1999), and the Game historically made explicit use of peer-related variables: peer pressure, peer competition, and peer recognition via teams. Was this an important element for the Game achieving its therapeutic effects, which is important to understand for the use of the Game as a behavioral vaccine. Hegerle, Kesecker, and Couch directly replicated the Game again in 1979, but examined the efficacy of these peer-related components. They found that peer pressure, competition, and social recognition were all important components. This added to the understanding of why the Game might work. These components fit well into the notion of the matching law with peers and school systems (e.g., Dishion et al., 1996; Embry & Flannery, 1999). The matching law (Herrnstein, 1970) can be expressed as

$$B = kr/(r + re)$$

B is the behavior in question. k is a asymptotic constant and r is the rate of reinforcement of the B; this is divided by the same r plus re (the rate of reinforcement of all other behaviors. Peer pressure and competition reduce the re term, thereby making the r (social recognition) more potent for positive actions in the classroom. This author believes this matching law effect helps explain why just putting check marks up by individual children's names is far less effective than the strategy of a mark for a child's team. The competition diminishes the re (e.g., peer attention to negative behavior), making the rewards controlled by the teacher for wining the game (e.g., the *r*) more potent.

Efficacy of the Game After Initial Training

How long might the effects of the Game last after being played briefly with no coaching from anyone outside the classroom? Johnson, Turner, and Konarski answered that question in 1978. The answer helps shape how an effective behavioral vaccine might be delivered. Among highly disruptive intermediate classrooms, they found that the effects of the Game did last but started to decay after 2 months when the "coach" stopped coming to the classroom to encourage the use of the Game. This particular study suggests, not surprisingly, that a diffusion model of the Game as behavioral vaccine might require some attention to produce longer term effects.

Efficacy of the Game Across Cultures

If the Game worked across different cultures then it might mean that the processes were very strong, profound, and universal. Such a finding would boost confidence that the Game could be a viable candidate as a behavioral vaccine. Huber reported positive results in Germany in 1979 in a behavior analysis efficacy study. Saigh and Umar (1983) found strong effects for Sudanese 2nd graders whose parents could not read or write, in a reversal design. Saigh and Umar were among the first investigators to report that the Game reduced aggression. It is interesting to note that younger children vis-a-vis older children seem to show reversal effects rather quickly, suggesting that young children will require more consistent, lengthy use of the Game. These published studies suggest that the Game can be effective in culturally diverse contexts.

Generalized Efficacy of the Game to Non-classroom Settings

Previously, all published studies had focused on the efficacy of the Game in classrooms. From a behavioral vaccine perspective, the odds for success would be strengthened if the "vaccine" could be administered in other settings where the epidemiologically relevant behaviors are manifest. In 1981, Fishbein and Wasik showed that the Game could be played in the school library and bridge to the classroom at the same time. Their study also illuminated a variable that could improve the social validity of the Game, its widespread use: A delightful twist involved having the students help set and define the rules, with no loss of effects. As almost any classroom teacher could articulate, students are more likely to "buy in" and not resist the Game, if they can help set the rules. Although the efficacy of the Game in the library is nice, bad behavior in the library is not a huge known predictor of substance abuse, violence, and other ills. In 1998, Patrick, Ward, and Crouch found that the Game could be powerfully adapted to physical education or play-type activities outside. This suggested that the Game could also be used to solve playground or recess problems—which is an epidemiologically relevant risk predictor (e.g., Walker et al., 1995).

Efficacy of the Game for Special Education Students in Regular Classrooms

A behavioral vaccine would have limited value if it could not buffer or protect a vulnerable child in a high-risk setting. Children with special education designation in regular classrooms are an example of such a risk. Did the Game work for really serious behavior-problem children who were "mainstreamed" in a regular classroom when the whole class played the Game? Yes, discovered Darveaux in 1984. She had the Game played in a classroom while observing two targeted children on each team. The two target behavior-problem children did improve when the whole class played the Game. This suggested that classroom teachers would be able to use the Game as an effective behavior management strategy for children at-risk for placement in special services.

Impact of Different Kinds of Rewards on Efficacy

Teachers typically select and apply rewards for behavior quite idiosyncratically, which could seriously impair the efficacy of the Game if significant fidelity of implementation were required for rewards for the behavioral vaccine to work. What kind of rewards work for the Game? Kosiec, Czernicki, and McLaughlin found in 1986, that students did equally well when they played the Game for activity rewards versus candy. The children did like the candy as a reward, but it was useful to discover that activity rewards were powerful. The fact that activity rewards appear to be as powerful as material or edible rewards helps with the acceptability of the Game by teachers and school administrators, who often express dislike for material rewards.

Efficacy of the Game With Adolescents

Previous prevention research has suggested that boosters, rather like vaccine boosters, improve long-term results. Thus, it is reasonable to ask if the Game might work with adolescents. In 1986, Phillips and Christie found the Game worked quite well for intellectually impaired students whose ages ranged from 12 to 23 years. In 1989, Salend, Reynolds, and Coyle proved that the Game worked for emotionally disturbed adolescents. The older students liked the Game and stopped doing inappropriate verbalizations, inappropriate touching, negative comments, cursing, and drumming. These findings suggest that the Game could be played, possibly as a booster, with older youth.

Efficacy With Very Young Children

People often apply medications for other uses or for different age groups. It is natural to wonder if the Game might be used with very young children, which would broaden the basis for the Game as a behavioral vaccine. A special puppet helped the preschoolers learn the Game in the study by Swiezy, Matson, and Box in 1992. Some other adaptations were required, however. Special colored badges were needed by the teacher to track the preschoolers as they moved from place to place in the room.

Summary of Efficacy Studies

The early phases of science are best served by repeated measure studies such as those used in applied behavior analysis. Such studies provide a powerful, simple way of determining if the procedure has any probability of effect and helps identify how it varies based on different conditions, something not easy to do in randomized control group studies or is very very expensive. The early studies on the Good Behavior Game show it to be a very promising, robust procedure.

Social Validity Studies

A potential behavioral vaccine might be efficacious, but highly disliked by its putative users. Consumer liking of a product can obviously affect word-of-mouth, fidelity of use, and other factors that would be relevant to long-term prevention. Social validity is an important concept in large-scale behavior change, which measures (1) the social significance or importance of the goals, (2) the social appropriateness of the procedures, and (3) the social importance of the effects (Sulzer-Azaroff & Mayer, 1991). These questions are pivotal in the diffusion of any science-based practice. How does the Game measure in the field of consumer satisfaction? In 1994, Tingstrom found out that over 200 teachers did like the Game and would use it. An important signal came from that study in that teachers who did not "believe in positive reinforcement" were not as likely to adopt it, however.

Randomized Control Studies for Effectiveness of a Potential Behavioral Vaccine

The efficacy studies discussed certainly point to the utility of the Good Behavior Game in changing modifiable, meaningful, and measurable risk factors of multiproblem behavior. However, the "Gold Standard" of science is the use of random assignment to condition, especially large numbers of participants. By the late 1980s, it was apparent that the Game had strong effects and could be something to try in a large randomized trial, which happened with the Baltimore Prevention Project.

A total of 864 1st-grade students from 19 Baltimore public schools participated in the study during the 1985–86 academic year. Short-term results relied on assessments of all students in the fall and spring of 1st grade using three tools:

- The Teacher Observation of Classroom Adaptation Revised (TOCA-R)—measuring a variety of childhood developmental psychopathologies,
- The Peer Assessment Inventory (PAI)—measuring peer social networks, and
- Direct observations of student behavior by classroom observers.

The study had both control classrooms within (internal controls) and across schools (external controls), making for a more powerful but complicated study.

In Baltimore, as in the earliest versions of the Game, classes were divided into teams, which were rewarded when members behaved appropriately and participated in classroom activities rather than broke rules and fought. Three teams were created per class, with equal distributions of aggressive and shy children per team. During the first weeks of the intervention, the Good Behavior Game was played three times each week, for a period of 10 min. Over successive weeks, duration per Game period was increased by 10 min, up to a maximum of 3 hr.

What were the early results? Dolan and the other Johns Hopkins scientists made an initial report in 1993. First, both teachers and peers rated boys as more aggressive. Second, boys were seen as more shy by teachers, but not by peers. Third, the Good Behavior Game had a significant short-term impact on teacher ratings of aggressive and shy behavior for both males and females. There were some useful subfindings:

- The intervention had greater impact in reducing aggressive behavior in students who began the year with high aggressive ratings compared with students who began with low aggressive ratings—an important finding if the Game were to be viable as a potential behavioral vaccine.
- Peer nominations of aggressive behavior among boys by their classmates were also significantly reduced. Only one of the three peer nominations of shy behavior showed significant impact ("has few friends") and that was only in the case of females.
- Finally, the Good Behavior Game increased students' on task performance in the classroom as assessed through direct observations.

What were the longer term results? These are exceptionally important from a developmental perspective, because the real problems, related to early predictors such as aggression, do not show up until the adolescent years. In Baltimore, the longitudinal results were collected 6 years later. Kellam, Mayer, et al. (1998) reported that although the positive effects reported by teachers during intervention years in 1st and 2nd grades waned somewhat in the 3rd and 4th years, they reappeared in 5th grade and strengthened in 6th grade. More aggressive 1st-grade males benefited the most from the Game, with the aggression rating of over 30% significantly dropping by 6th grade. It appears, then, that the Game might function as a behavioral vaccine in a long-term study.

There were other long-term effects, not wholly predicted when the study started, strengthening the potential of the Game as a behavior vaccine for multiproblem behavior. For example, males were significantly less likely to initiate smoking (a 50% reduction in initiation rate) in the early teens (Kellam & Anthony, 1998). Teacher ratings and self-reported age at first use of tobacco showed that (1) boys who had received the Good Behavior Game intervention were rated as better-behaved than their counterparts in the other study conditions ($p < .05$), and (2) the risk of starting to smoke tobacco by age 13–14 years was substantially greater for boys in the "standard setting" control classrooms as compared to those who had spent 1st and 2nd grades in the Good Behavior Game classrooms ($p < .05$). Kellam and Anthony (1998) concluded from the long-term follow-up that targeting early risk of aggressive behavior is an important smoking prevention strategy, something that longitudinal tracking studies with no intervention had suggested but not proved. To this author's knowledge, the result published by Kellam and Anthony is the first inkling that a single classroom teaching strategy by an individual teacher might substantially reduce substance abuse, misuse, or initiation (see Fig. 3).

A whole array of publications exist on the Baltimore project, noting its theory, design, and results (e.g., Ialongo et al.,1999; Kellam et al., 2000; Kellam, Ling, et al., 1998; Kellam, Mayer, et al., 1998; Kellam & Rebok, 1992; Kellam, Rebok, Ialongo, & Mayer, 1994). Kellam and associates are continuing longitudinal follow-ups of the original cohorts, which will likely reveal more information about the life-course effect of the Game on such issues as arrest, educational attainment, and other milestones. When new

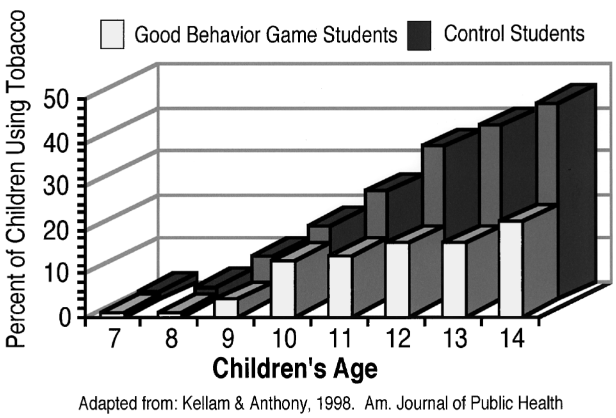

Fig. 3. Good Behavior Game impact on tobacco initiation.

medicines are introduced and approved by the Federal Drug Administration, it is rare for the approvals to cite ongoing inquiries with a decade or more long-term follow-up. Game is similarly rare in the prevention science literature, and the long-term follow-up strengthens the case for the use of the Game as a potential behavioral vaccine.

Not all reviewers concur about the value of the Game for prevention. Greenberg, Domitrovich, and Bumbarger (1999) offer a critique of Kellam's studies, observing that the intervention did not include family or the larger school ecology (which this author views as a strength, in terms of the utility of the Game as a behavior vaccine). The 1999 critique did not have the benefit of the Ialongo, Poduska, Werthamer, and Kellam (2001) study comparing the impact of combined classroom intervention (both the Game and Mastery Learning) against a Family Program, which showed that the combined classroom approach was superior to the family-only program. Greenberg and colleagues also argue that two of the primary sources of data (teachers and peers) were aware of the treatment condition and in some ways had a stake in the outcome, which may have affected internal validity. Again, the fact that these two sources of data did show change is a source of strength, considering that both peer nominations and teacher ratings are extremely resistant to *any* intervention, yet are highly predictive of serious antisocial behavior many years later (e.g., Embry & Flannery, 1999; Embry, Flannery, Vazsonyi, Powell, & Atha, 1996; Walker et al., 1995). To provide a comparison in top-rated prevention programs, Second Step (a violence prevention curriculum for elementary students) shows no impact on teacher ratings or parent ratings after a considerably more intensive classroom intervention in a randomized control group study (e.g., Grossman et al., 1997). Greenberg and colleagues review (Greenberg et al., 1999) of the Good Behavior Game erroneously reported that there had been no independent replications of the intervention, failing to cite the extensive, prior, peer reviewed studies mentioned herein while also observing that the Linking the Interests of Families and Teachers (LIFT) project incorporated the Game as part of its overall strategy.

Linking the Interests of Families and Teachers (LIFT), a prevention program designed for delivery to children and parents within the elementary school setting (e.g., Eddy, Reid, & Fetrow, 2000), worked in 12 public elementary schools with about 700 students in higher risk neighborhoods. The LIFT targets child oppositional, defiant, and socially inept behavior and parent discipline and monitoring—many of the variables targeted by Kellam and colleagues. The LIFT is (a) classroom-based child social and problem skills training, (b) playground-based behavior modification using an adaptation of the Good Behavior Game, and (c) group-delivered parent training. The results of a randomized controlled evaluation of the LIFT are reviewed. To date, during the 3 years following the program, the LIFT delayed the time that participants first became involved with antisocial peers during middle school, as well as the time to first patterned alcohol use, to first marijuana use, and to first police arrest. Reid et al. (1999) report reductions in playground aggression, with the largest effect size among the most aggressive children, as well as improvements in family problem-solving actions. At 30-month posttest, children from the treatment group were also significantly less likely to have been arrested. Microcoding of real-time playground aggression showed that intervention benefited the most aggressive children at recess with substantially high effect sizes (Stoolmiller, Eddy, & Reid, 2000).

The LIFT effort by Reid and his colleagues is noteworthy, because it is a systematic rather than direct replication of the Game, which was imbedded in a larger effort. This means that the Game can be incorporated with family and social skills interventions with no apparent adverse effects. From the perspective of a behavioral vaccine, it is vital that a strategy be able to work in combination with other strategies and still show benefit.

Awards and Recognition for the Good Behavior Game

The positive effects of the Game have been recognized by a number of sources. The Game is one of the few "universal," simple strategies identified by the Colorado Violence Prevention Blueprints Project, funded by the U.S. Centers for Disease Control, as meeting the scientific standards for a truly promising violence prevention practice. The Substance Abuse and Mental Health Administration has also identified the Game as a research-based promising practice. The Surgeon General's Report on Youth Violence (U.S. Surgeon General, 2001) lists the Good Behavior Game as a desirable practice.

These awards and recognition are all the more remarkable, because the Game is the only such intervention in the public domain, and something that an individual teacher or staff member can implement versus a comprehensive school-wide program. The breadth of replications of the Game by so many different investigators across time only strengthens the accolades.

Support From Current Field Trials and Other Studies for Potential Behavioral Vaccine

As established in the early parts of this paper, a behavioral vaccine envisions widespread use of a procedure. The Game needs to have some evidence of real-world diffusability.

Presently, my colleagues and I are engaged in a number of trials of the Game in a larger context. These community trials are described below.

Approximately 15 schools in the Greater Cleveland area are involved in an open field trial of the Game to determine if the game can be simply packaged and trained in the course of 4–6 h. The Game is referred to here as the PAX Game to denote the inclusion of some ancillary components documented to improve compliance and classroom management such as "beat the timer," nonverbal cues for stop (see Medland & Stachnik, 1972) and transition cues for walking in hallways. Early data show that schools can implement the game, and have impact on such variables as student referrals and suspensions.

Several years ago, my colleagues and I helped Cook County Health Department in Cook County, Illinois, design a protocol to have paraprofessionals visit classrooms and teach the Game to the students and their teachers. To date, Cook County Health Department has taught numerous classrooms the Game and collected simple observational data on those classrooms. The iteration of the Game designed by the author and colleagues incorporates the identified active ingredients from the efficacy and effectiveness studies, and it has been put together in such a way to encourage the use of other research-based protocols that might round out the effectiveness of the Game.

Besides the components of teams, peer pressure, competition, activity rewards, nonemotional cues, enunciation of the rules, and group-based rewards, the iteration includes some simple procedures to help improve the social acceptability, participant buy-in, facilitate generalization, and assist the tracking of the game. Here are a few examples. The students induct the rules and vision of the class using some special lessons. They pursue productivity, peace, health, and happiness by creating PAXIS™. Things that get in the way of PAXIS, a made-up word, are called spleems™, also a made-up word. The word for the goal helps foster positive debriefs (e.g., "What did you do to create PAXIS today?"), which has been shown to assist in the generalization of self-management and is a substitute behavior for teachers to avoid negative attention. Spleems are a word designed to reduce the verbally inflected emotionality attached to noticing a rule-breaking event, a key ingredient. Conversationally, it is much less explosive to say "that was a spleem" than "you broke the rule." The PAXIS version includes many small but useful stratagems needed to package a research-based practice for diffusion—a critical factor in a bringing a potential behavioral vaccine to scale.

The new words like PAXIS and spleems help track the behavioral contagion effects of the Game, as the words are completely novel. The words are what some cultural anthropologists define as "memes"—a sort of potentially self-replicating cultural concept, again to a gene. Lynch (2001) describes a meme (pronounced "meem") as a self-spreading thought, idea, attitude, belief, or other brain-stored item of learned culture. The idea of memes are frequently used in marketing as a way to track name recognition and build up brand recognition.

The use of words for the Game such as PAXIS and spleems create a "meme" in a school setting, providing a way to assess the frequency of the use of the Game. For example, children who have played the Game in the last week are able to explain in great detail if their team received any "spleems" that week. Children who do not know what the Game is, will look quite blankly at a visitor if you ask what "spleems" their team committed yesterday. Thus, prevention specialists such as the ones in Cook County Health Department can quickly assess whether staff are really following through with the daily repetitions—a necessary element of a putative behavior vaccine. It is rather like the question, "did you floss your teeth this morning" versus "do you practice good dental hygiene?"

The teaching of the Game by Cook County paraprofessionals is the first attempt to move the Game to a behavioral vaccine model, capable of being taught outside the context of graduate students and research personnel. A sample of data from one school and classrooms in Cook County appears in Fig. 4, showing observed "spleems" over time before and after the teaching of the Game, which are very encouraging. Not all schools and classrooms have the same results.

The current effort in Cleveland and the past effort in Cook County suggest that the Game can be

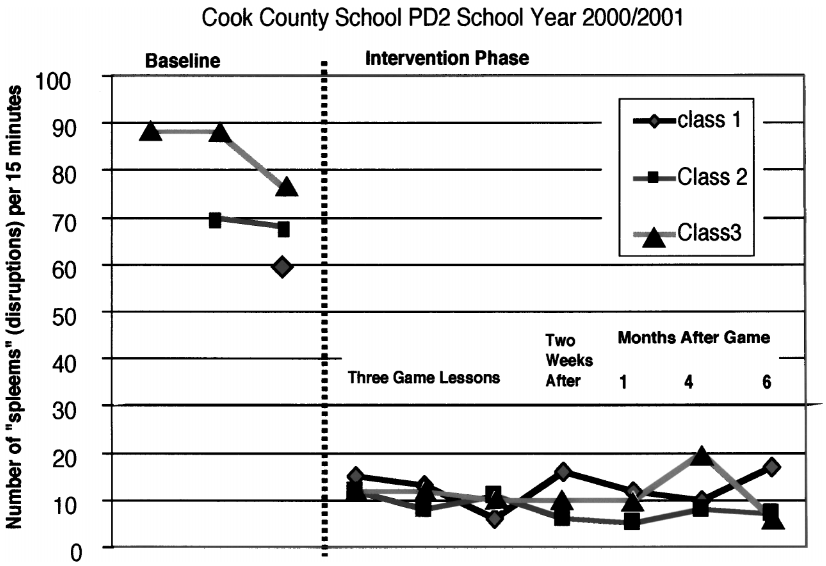

Fig. 4. Impact of Game taught by paraprofessionals.

practically disseminated in a real-world context. In the case of greater Cleveland, the Game was trained on a school site or across school sites in a brief training for teachers. In the case of the effort by Cook County, paraprofessionals learned how to implement and teach the game to many different schools in the actual classrooms. Other field trials are in place by the first author in Wyoming (a rural area with extremely high rates of substance abuse), in Tucson, AZ, with very high rates of Hispanic and Native American populations, in the multicultural context of some schools undergoing comprehensive school reform, and even in Singapore and Malaysia to assess the acceptability in very different systems and cultures.

MEDICAL RESEARCH ON INHIBITION RELATED TO A BEHAVIORAL VACCINE

Various studies implicate the problems of inhibition in the etiology of multiproblem behavior (e.g., Frick, Kuper, Silverhorn, & Cotter, 1995). For some time, it has been evident that medications, such as methylphenidate, increase inhibition and improve the kinds of behaviors studied in all of the studies on the Good Behavior Game (see Gadow, Nolan, Sverd, Sprafkin, & Paolicelli, 1990). In the United States, the daily use of such stimulant medication is extremely widespread—representing a rival treatment for the risk factors that might be addressed by a behavioral vaccine.

It is documented that an effective behavior management protocol will reduce the dose need of medication (i.e., Carlson, Pelham, Milich, & Dixon, 1992). Recent reviews suggest that behavioral protocols ought to be the first line of defense for the treatment of such conditions as ADHD (e.g., Pelham & Fabiano, 2000), for a variety of legal, ethical, and practical considerations. The issue here is not whether behavioral interventions or medical interventions are better.

The fact that both medication and a powerful strategy like the Game result in inhibition of negative behavior suggests that the two techniques probably operate in similar ways in the brain. In science, this is called the Law of Parsimony or Occam's Razor. It typically means that if two things have similar effects they most likely have common causal mechanisms. In the beginning of this paper, I have hypothesized that the common factor is the inhibition circuitry of the brain, which may have been altered as a result of genetic expression, gene–environment interaction, exposure to traumatic events, coercive parenting practices, deviant peer reinforcement, or even exposure to environmental toxins such as lead. The potential mechanisms for this are becoming more apparent with various scanning technologies and reaction-time studies (e.g., Lazzaro, Gordon, Whitmont, Meares, & Clark, 2001). Reaction times can be measured in two ways: go reaction and stop reaction.

Hyperactive children and children with oppositional defiant disorder compared to "normal" children have similar "go" reaction times, but have longer stop times (e.g., Oosterlaan, Logan, & Sergeant, 1998). Methylphenidate improves children's stop times (Tannock, Schachar, Car, Chajczyk, & Logan, 1989). A study by Tannock, Schachar, and Logan shows various dose effects for stimulant medication. Pharmacologically, methylphenidate stimulates the inhibition circuitry of the brain via dopaminergic and serotonergic mechanisms. The Game creates social, activity, and primary reward for inhibition as well as a sense of belonging for inhibition—which appear to be dopamninergic and serotonergic respectively. The Game clearly and rapidly increases "stop" behavior, by rewarding it. The Game is not like most behavior programs (e.g., Kolko, Bukstein, & Barron, 1999) that reward positive behavior (e.g., social skills or attention to task); the Game rewards *not* doing things such as blurting, interrupting, getting out of seat, etc. All behavior modification is not the same in effectiveness on children with these attention or behavior problems, even with or without the use of medication (e.g., Baldwin, 1999; Northup et al., 1999). The Game is different from most behavioral protocols in that it is group based, decreases peer reinforcement for antisocial behaviors, and provides yoked individual and group rewards. The use of rewards for attention or positive behavior for individual behavior does not seem to have the same power compared with medication (e.g., Solanto, Wender, & Bartell, 1997). The fact that this simple Game can have profound long-term effects on the "stop circuitry" is very promising from a putative medical explanation of it as a potential behavioral vaccine.

MAKING THE GAME INTO A UNIVERSAL BEHAVIORAL VACCINE

Good research and best practices do not necessarily translate into public benefit. An effective behavioral vaccine must overcome a number of barriers. First, policymakers must be sold on the idea. Second, the vaccine must be appropriately packaged for delivery. Third, the vaccine must have appropriate infrastructure to support diffusion and practice. Fourth, regulations, policies, and even laws may need to change to support the distribution of a behavioral vaccine. Fifth, current practitioners may need enticement to change. It is wise to note that it took some 80 years to make the practice of antiseptic hand washing common practice. Figure 5 summarizes what is required to create a system for a universal behavioral vaccine.

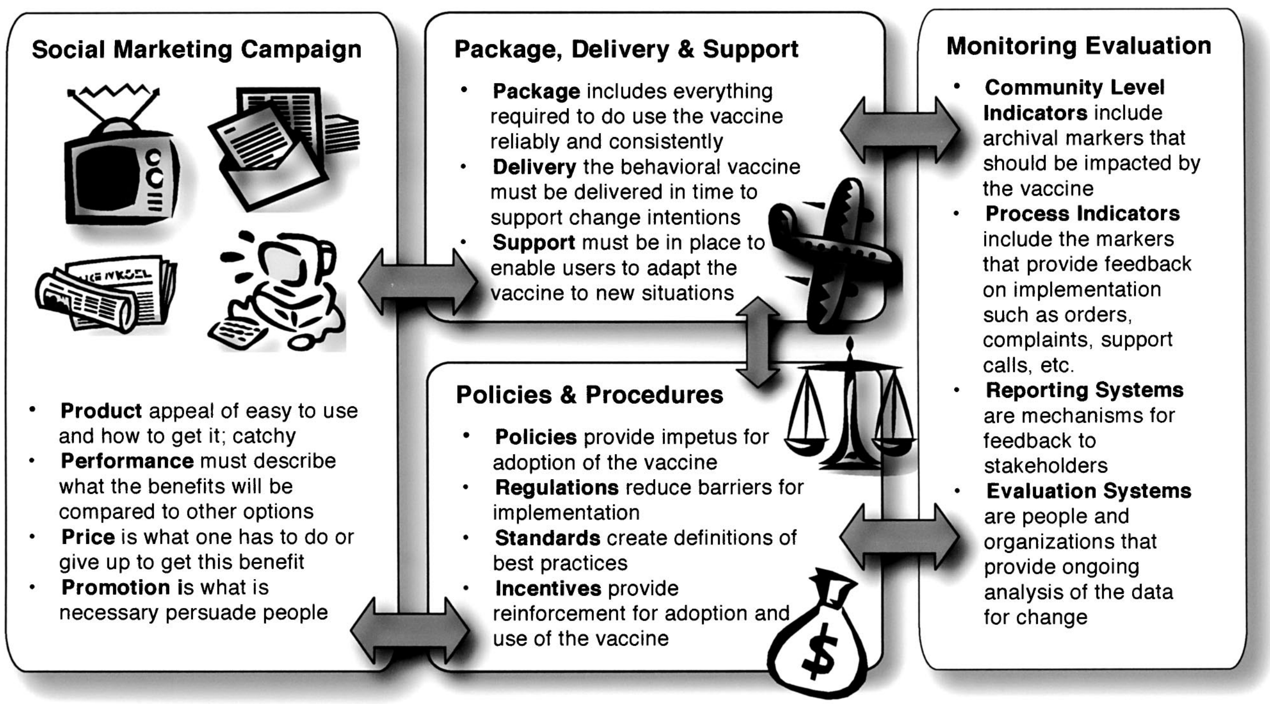

Fig. 5. System diagram for behavioral vaccine.

$$\frac{\text{Resource Cost (e.g., people, time and/or money)}}{\left(\text{Likely Prevention Effect} = \text{Power of Prevention Tools (effect size)} \times \text{Percentage of population reached} \times \text{Effects across time, people \& places} - \text{Negative Side Effects}\right)}$$

Fig. 6. Cost-effectiveness formula.

"Selling" the Game to Policymakers

Proven practices can take decades to become common practice, with many lives in forfeit as a consequence. A public-health model of prevention envisions that most effective practices must be universal for positive effect. This can be seen in a formula shown in Fig. 6. For a behavioral vaccine to work, the formula requires that the resource cost per participant be low, the effects potent, and the reach of the strategy be wide and long-lasting with few adverse side effects.

The Game works potentially well in this formula. The costs of implementation are low compared to other alternatives. The comparison between several alternatives illustrates the point. These types of data are crucial for selling state policymakers on the benefits of a behavioral vaccine.

Medication costs about $70 per child per month, plus medical supervision. Just 10 children in a school will cost at least $7,000 per year. Long-term positive results of medication are not well documented by comparison. Trademarked interventions such as Second Step, which are highly rated or extolled, have little or no impact on aggression in the classroom (e.g., Grossman et al., 1997), yet may cost at least $10,000 per school to use. (Note: this is not an exhaustive analysis of all the rival strategies).

Measures of lifetime prevention benefits are microscopic from a mathematical perspective at the time of this writing. Favorite strategies such as character education, peer mediation, conflict mediation, or police officers on campus have little or no effect size impact at this writing, though future studies or publications might change that. The fact that the Game might only cost a few hundred dollars per classroom to implement and reduce placement in special services represents an immediate cost savings; its long-term cost-effectiveness becomes even more impressive. For example, the long-term effects on reduced special education and correctional expenditures from the use of the Game are calculable and mind-boggling. Here are a just a few of the implications of the Game, if used widely in primary grades, on projections of public expenditures in a decade, for Wyoming—a state with the smallest population of all the 50 states yet with very high rates of multiproblem behavior that merit prevention. Why the example of Wyoming? Having just completed an extremely detailed blueprint for prevention of substance abuse in Wyoming (Embry & McDaniel, 2001), the author has easy access to state budget numbers.

- A 5% reduction in special education placement, not improbable based on the results from the Baltimore Prevention Project, could potentially save $2–4 million dollars per year—which has grown from $50 million to $83 million per budget period.
- A 2% reduction in involvement with corrections, not excessive based on the Baltimore Prevention Project, might yield at least $3–10 million per year in projected savings based on an analysis of growth in arrests of juveniles for serious drug arrests by the Wyoming Statistical Analysis Center at the University of Wyoming.
- A 4% reduction in lifetime prevalence of tobacco use, again not improbable from the Baltimore Prevention Project, could save the state millions of dollars per year in deferred medical costs associated with tobacco-related diseases based on cost data calculated by the U.S. Centers for Disease Control and Prevention for the state of Wyoming.

These savings from a prevention-effect sum to something like $15–20 million per year over time in Wyoming. What might be the cost of the prevention effort? There are about 5,000 1st and 2nd graders in Wyoming total. If the Game cost $200 per child per year to implement in those grades, the annual cost of implementation would run about $1,000,000 per year and thereafter. Breakeven would occur in about 3–5 years against special-education expenses, and the lifetime savings of the prevention effort would provide even stronger cost-savings.

Packaging of a Behavioral Vaccine

Public health models versus disease or disorder models envision universal coverage. To achieve the large-scale prevention or vaccine effect from something like the Game, it will be necessary to solve a number of problems for widespread social marketing:

1. *Make the research-based prevention strategies easy to use in the real world*. The public-domain protocols for the Game are not easy to use or understand. During the past 2 years, the author and colleagues have been conducting open trials on exactly this concern. For example, we have found it necessary to build in simple behavioral cueing strategies to improve effectiveness (e.g., Posavac, Sheridan, & Posavac, 1999), because many new teachers do not know these strategies.
2. *Increase social acceptability of the science-based intervention.* Unless large numbers of people adopt or participate in the strategy, the prevention effect will be small. It has been over 30 years since the Game was first invented, and very few classrooms use it nationally. Although the underlying principles are rock solid scientifically, they do require some social marketing elements. The emphatic behavioral language of the original research manual used by Kellam is potentially off-putting to many who typically have little exposure to such language, witnessed by the fact that strong behavioral concepts can impair adoption (e.g., Tingstrom, 1994).
3. *Integrate interventions for more difficult children in the front end*. Although the Game has powerful effects for aggressive children, staff typically voice worry about the children who are seen as the "worst kid ever." Having some front-end strategies for staff to use with such children when introducing the Game or "customizing it" could provide a greater confidence for the adoption of the Game as a sound practice. Explicit links need to be built in for more intensive clinical interventions for children who require higher doses of intervention such as in classroom behavioral coaching (e.g., Kotkin, 1998). Providing explicit components for higher risk young people would also minimize the chance that local innovations might combine to produce adverse effects.
4. *Strengthen linkages to other science-based strategies*. The Game has excellent results in reducing aggression and disruptive behaviors. This is good but not good enough. For example, the reduction in problem behavior only modestly translates into improvements in academic performance, unless there are other strategies introduced. The decline in problem behavior sets the stage for potent academic interventions such as class-wide peer tutoring (e.g., Greenwood, Terry, Utley, & Montagna, 1993), peer-assisted learning (e.g., Mathes, Howard, Allen, & Fuchs, 1998), or cooperative learning (e.g., Slavin, 1992). Presently, the author and colleagues have been conducting pilot efforts on such integration, combining several strategies. Although Kellam and colleagues originally tested both the Game and Mastery Learning singly and in combination, we found Mastery Learning simply not possible to implement in the current conditions of U.S. schools. Adoption and use of the Game as a daily practice would seem to be hypothetically better (and testable) if linked explicitly with some compatible empirically driven strategies that also improved academics.
5. *Address common barriers for adoption*. A well-proven science-based strategy can elicit many practical, emotional, or logistical barriers. The private sector typically responds to such issues by figuring out how to remove barriers to purchase or adoption, which is not always the case in the public sector. Current field trials have identified some significant barriers to adoption of the Game as a behavioral vaccine. Each barrier has testable potential solutions. Barriers and potential solutions follow:
   - *Restricted staff development time*. Some states or local districts now only have a few days available for any staff development. Mass media, Internet, and other approaches might help resolve this barrier. Mini demonstrations might be another mechanism.
   - *Competing demands for staff development time*. Major federal, state, or local initiatives with funding contingencies or political consequences attached tend to compete for staff

development time. Part of the promotional elements need to test whether putative linkages to these other demands improves adoption and diffusion.

- *Existing activities or procedures that might be threatened by the Game*. The doctors of Vienna did not welcome the innovation by Semmelweiss, despite its scientific logic. Classically, innovations like the Game appeal to the "innovators" or "early adopters" in diffusion models (e.g., Rodgers, 1995)—but not if framed as bureaucratic mandate and especially if the innovators or early adopters have developed something from their own time investment, while the developers of science-based protocols diminish the potential for the practices developed by the innovators. Again, marketing appeals to different types of people on the wave of adoption postulated by Rodgers needs to be tested.
- Perceived as overwhelming by staff who may be experiencing depression or burnout. Different models of delivery need to be tested to determine how the Game or any school-based behavioral vaccine might be diffused in school settings where depression or burnout are common. (This problem cannot be underestimated. I have been shown tightly held data from various districts, suggesting that antidepressant medication use is one of the highest cost centers in their health plans—which needs to be verified in a national study.)
- Beliefs about causation that reinforce inaction (e.g., "we can't do anything until the families change"). In general, marketing research suggests that testimonial-based promotions would be effective in overcoming this barrier, yet this is not the way that science-based practices are typically promoted.
- A belief that children should not be reinforced for behavior, because of such popular books as *Punished by Rewards* (Kohn, 1993). The belief is surprisingly widespread based on the number of objections and comments I get in seminars, and already identified as a significant barrier to adoption in prior research (Tingstrom, 1994). Changing this belief and related behaviors needs to be experimental tested.

Infrastructure for a Behavioral Vaccine

All materials have to be manualized and standardized in ways compatible with current issues and concerns of potential stakeholders. The original research manuals and publications are typically not standardized. After that, a considerable amount of infrastructure must be created to support the rapid dissemination of a behavioral vaccine.

1. Training strategies must be developed that can be sustained in diverse settings and organizations. If trainers with advanced degrees, certain professional qualifications, or job titles can only successfully diffuse a strategy, then the diffusion will be inherently limited. The training capacity depends on extensive documentation, support materials, "error proof" instructions, and extensive flexibility to deal with diverse objections and problems likely to happen in the field. The materials from research projects do not typically meet these criteria.
2. Implementation strategies must include ways to reduce backfires, increase fidelity of implementation, and facilitate generalization across time, people, and places. These issues are not typically addressed in research studies. At the same time, the implementation strategies must encourage principle-driven innovation and adaptation, as this author has found an inverted U-shaped curve in past large-scale studies of the diffusion of behavioral explicit prevention strategies in school settings (e.g., Embry & Malfetti, 1982). That is, poor fidelity produced the worst results, modest levels of fidelity produced the best results, and high levels of fidelity also produced poor results. What seems to happen with medium level of fidelity, based on my observation, is that people are more focused on behavior change, adjusting their actions to produce result. Very high fidelity seems to be driven by adherence to process ("by the book"), which may not respond to poor behavioral outcomes. How to structure this kind of principle-driven implementation and adaptation in the context of fidelity of implementation is also a question that needs experimental testing in the field of behavioral science to further the diffusion of any behavioral vaccine.

3. Strategies and incentives will be required to help organizations and individuals adopt the Game as an innovation. A good idea is not enough. Local service providers for example may be wedded to their particular program or approach, which may or may not have scientific or empirical validity. Interestingly, research on other behavior approaches shows the power of incentives or other organizational strategies for increasing adoption, which is evident from long-term research initiated by Denise Gottfredson (e.g., 1988) on delinquency prevention or from the experimental analysis studies on the use of seat belts or car seats.
4. The entire package or approach must be able to ramp up to very large scale, which requires distribution, marketing, and technical support. The package or program must be sustainable in different cultural contexts. These issues have not been previously addressed as fully as they need to be but can be in the context of large-scale diffusion.
5. An entire marketing campaign must be created to encourage adoption and use, and such a campaign must have sufficient reach and exposure for effectiveness. Such campaigns are rare except by commercial products with high profitability, like prescription drugs. Marketing campaigns might test such variables as inquiries to obtain a kit, recruitment success for workshop participation, early use after training, and word-of-mouth marketing effects as a result of such campaigns.

Policies to Support a Behavioral Vaccine

Many policy issues need attention to make something like the Good Behavior Game a universal behavioral vaccine. I list a few, which have emerged in the past 2 years of field trials and state policy development work:

1. State Departments of Health need to be directed by the Governor, the Legislature, or both to implement behavioral vaccines. This might be achieved through the vehicle of the various federally mandated Governor's Advisory Boards for Title IV Safe and Drug Free Communities, the Juvenile Justice Board, etc.
2. Federal block grant funds such as Title IV to schools, juvenile justice, maternal health, and other such funds need to be consolidated by executive order to support statewide behavioral vaccines instead of Balkanized efforts so that a universal approach is justified and leveraged.
3. State Departments of Health, and Departments of Education or Public Instruction, Family or Child Services need to issue combined standards of prevention and early intervention that support a public-health approach to behavioral vaccines.
4. Legislatures may need to pass special legislation that allows governmental departments or "quangos" (quasi-governmental agencies) to mix public money and marketing funds from the private sector (sponsors) to support behavioral vaccines, so that incentives and other considerations may be undertaken.
5. State Medicaid provisions often need to be clarified so that qualifying practitioners might write a prescription for the behavioral vaccine and be appropriately reimbursed. Such provisions would allow, for example, a general practitioner to write a behavior prescription for something like the Good Behavior Game for a child's classroom, have the "prescription" paid for by Medicaid, and be reimbursed for the consult or follow-up. Presently, incentives only work for a general practitioner to write prescriptions for such things as medication for behavioral disorders, never to prescribe something like a behavioral intervention that must be purchased.
6. State Departments of Education or Public Instruction need to issue policies or procedures naming research procedures like the Game as desirable procedures for inclusion or mainstreaming of children with individual education plans (IEP's) or Section 504 Rehabilitation Plans.
7. The State Departments of Education or Public Instruction in conjunction with the State Attorney Generals may need to clarify that the public posting of team points for the Game does not violate the Family Educational Rights and Privacy Act (FERPA) regulations.

Monitoring and Evaluating the Impact of a Behavioral Vaccine

Most behavioral scientists conduct controlled experiments, typically seeking an effort with high internal validity. A behavioral vaccine, by nature, seeks to have broad community level impact—to decrease the population level indices. Public accountability as well as marketing of the vaccine also gains from high-quality monitoring.

The monitoring and evaluation might proceed with some of the following:

1. Extensive monitoring of the uptake and rates of the behavioral vaccine will be required, such as the number of Game kits requested, reusable supplies ordered (a proxy measure for fidelity), school entries in community competitions using the game, or other such markers.
2. Monitoring of archival records such as per capita rates of Schedule II medications used for treatment of disorders typically targeted by the Game collected from the state pharmacy board, Medicaid, or the local health care providers; nurses' office visits for medicine checks; etc.
3. The State Department of Health might use a standardized tool such as Strengths and Difficulties Questionnaire (Goodman, 1997), which is a brief, clinically normed instrument that compares well to the Child Behavior Checklist (e.g., Goodman & Scott, 1999) to monitor prevalence rates of key *DSM-IV* diagnoses at school enrollment, public health visits, etc.
4. A consortium of federal, state, or private groups should undertake a longitudinal sample to follow for exposure to the Game, examining the impact of the Game interacting with known polygenic cofactors predicting multiproblem behavior such as various alleles of the dopamine receptors and transporters, using such tools as buccal smears and SNP analyses (e.g., Comings et al., 2000). Such a longitudinal study might be augmented by other physiological measures that are known to be correlated with outcomes, such as heart rate and brain activity (e.g., Raine et al., 1997). Such a study would help answer some of the hypothesized interactions of behavioral outcomes between environment and polygenic mechanisms from an experimental way instead of just a correlational perspective.
5. The synergy of different types of behavior vaccines needs to be tested, because multiproblem behavior has multiple vectors (e.g., parenting) that might be ameliorated by research-based protocols for parenting that can be delivered in multiple contexts or levels with prospects of success (e.g., Sanders, 1999). It is quite conceivable that certain combinations of behavioral vaccines might confer considerable "resistance to" adverse developmental outcomes such as substance abuse, delinquency, and school failure.

The practicalities of a public-health level implementation make it difficult to have classic randomized-control group study. Several possibilities do exist to provide some element of control such as a multiple baseline across communities or age groups. Over time, epidemiological monitoring such as the commonly used Youth Risk Behavior Survey (Centers for Disease Control and Prevention, 2000) might be used to measure the longer-term impact of exposure to the Game in elementary school, by matching grade school and classroom exposure to the Game or other interventions, and the avoidance of multiproblem outcomes in a dose–response-type quasi-experimental paradigm.

The idea of behavioral vaccines—simple actions that can be repeated by nearly everyone on a daily basis with positive health effects—has face validity from the public health model. Antiseptic hand washing is a powerful example, and there have been other examples in very recent history such as seat-belt and car-seat use. The concept of a universal behavioral vaccine has intuitive appeal based on epidemiological and intervention studies of multiproblem behavior such as substance abuse, delinquency, violence, and other ills. Epidemiological studies of mutliproblem behavior suggest that there are apparent behaviors (e.g., early disruptiveness) that could be modified and reduce the future occurrence of the adverse outcomes. A behavioral vaccine for multiproblem behavior would have to be low cost, easy to use, have powerful effects, and be capable of wide distribution across the target population. A potential candidate for a behavioral vaccine against multiproblem behavior would have to have a strong history of efficacy and effectiveness studies, and be adaptable to many different circumstances. The Good Behavior Game, first reported by Barrish et al. (1969) represents a strong candidate for a behavioral vaccine, because of the simplicity and multiple replications of positive results in efficacy studies with strong long-term results in effectiveness trials. Early field replications suggest that the Game can be used in very diverse circumstances. Large-scale testing of the Game as a behavioral vaccine could provide a rich source of theory building for the diffusion of science-based prevention practices, because the Game is rare in having measurable effects based on a single classroom instead of schoolwide adoption. Against the common practice of encouraging communities to engage in an elaborate processes of prevention logic models or the abnegation of powerful behavioral vaccines used across the country or states could substantially improve developmental outcomes, benefit many diverse stakeholders, and save substantial sums of government expenditures at scale.

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