Topical Review: Behavioral Economics as a Promising Framework for Promoting Treatment Adherence to Pediatric Regimens

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Objective To summarize previous adult research on behavioral economics (BE) and consider the largely unexplored relevance of BE for promoting adherence to pediatric regimens across a wide variety of illnesses.

Methods Literature review.

Results Default bias, loss aversion, overestimation of rare events, and social norms are four BE concepts that have not been fully incorporated in adherence research for pediatric regimens yet offer promising opportunities for novel intervention development. The possible applications of these four strategies are offered in regards to asthma, cystic fibrosis, migraines, and diabetes, respectively.

Conclusions BE offers pediatric psychology not only low-intensity approaches for promoting adherence but also highly attractive ways of obtaining the attention of health care administrators and policymakers.

Key words behavioral economics; default bias; loss aversion; lotteries; social norms.

Basic Goals and Assumptions of BE
BE is a scientific field featuring insights from psychology, marketing, and economics to improve individual decision-making across diverse topics (Cartwright, 2011). Because health is one of the key target areas for BE, the National Institute of Health (2010), the Robert Wood Johnson Foundation (2013), and the Gates Foundation (2014) have made recent funding announcements that explicitly mentioned BE in their titles and/or descriptions. BE should not be confused with mental health economics, a discipline that investigates the financial ramifications of psychiatric illness and treatment.

BE assumes consumers are often irrational due to limited cognitive capacity and inappropriate rules of thumb, while traditional economics presumes consumers are normally more sophisticated (Cartwright, 2011). In other words, BE assumes that consumers frequently make biased decisions that are ultimately not in their best interests. The title of Predictably Irrational (Ariely, 2008), a leading book on BE, emphasizes this supposition. However, BE assumes that the context of decision-making can be altered through low-intensity interventions to help consumers optimize their choices. Nevertheless, BE strategies preserve freedom of choice—consumers are not banned from certain activities that may detract from their long-term quality.
of life, nor are they forced to engage in behaviors that others think would be beneficial. The title of another BE book, *Nudge: Improving Decisions about Health, Wealth, and Happiness* (Thaler & Sunstein, 2009), underscores that BE strategies neither require Herculean effort from interventionists nor coerce consumers into specific actions.

### The Role of BE in Adult Topics

Four common BE concepts—default bias, loss aversion, overestimation of rare events, and social norms—will each be discussed in turn. From an operant conditioning perspective, these four concepts overlap considerably with antecedent management, response cost, variable ratio reinforcement, and feedback, respectively. Because adult, not pediatric, topics have been the overwhelming focus of BE, this section highlights how each of these BE concepts has been applied in adult health and nonhealth domains. These adult examples should help familiarize readers with BE’s terminology, methodology, and key findings. The successful application of BE in adult studies may stimulate research in other areas, such as promoting adherence to pediatric regimens for chronic illness.

**Default bias** refers to consumers’ tendency to choose the nonmandatory option that has already been preselected for them by an outside entity (Johnson & Goldstein, 2013), even if that default fails to represent the easiest and/or most beneficial pathway to overall well-being. Interventionists can make the most of this bias by changing the default option to the one that will most likely facilitate long-term interests of consumers and/or society. Changing consumer choices from “opt in”—in which they must actively select or do something to engage in a healthy or prosocial behavior—to “opt-out”—in which they must actively take a step against this healthy or prosocial behavior—are among the best known default-bias programs. For example, Abadie and Gay (2006) found that cadaveric organ donation rates for opt-out countries were 25% higher after controlling for various confounds relative to opt-in countries.

**Loss aversion** refers to the phenomenon that gaining a reward often has less emotional valence than losing the same quantity of the identical consequence (Tversky & Kahneman, 1991). Interventionists can make the most of loss aversion by creating incentive systems that feature losing a tangible reinforcer each time a target behavior is not performed. Volpp and colleagues (2008) studied adults with a body mass index of 30–40 who deposited money at the beginning of the month that was matched by the investigative team. These funds were refunded at the end of the month only if weight loss goals were met. They found that adults who participated in this deposit contract program had greater short-term weight loss relative to a control group.

**Overestimation of rare events** refers to people often misinterpreting the likelihood of rare events. Interventionists can make the most of this bias by creating lottery-based incentive systems that feature infrequent large prizes (Loewenstein, John, & Volpp, 2013). For instance, Haisley and colleagues (2012) found that adults who were offered a lottery-based system for completing a Health Risk Assessment (HRA) were more likely to finish the HRA relative to fixed payment and control conditions.

**Social norms** refer to the impact feedback on others’ performance has on one’s own performance. Social norms can be categorized into descriptive norms (obtaining feedback regarding the behavior of an average person) and injunctive norms (obtaining feedback regarding the desirability of one’s current performance from a third party’s perspective). Often aligning these norms produces the greatest change (Cialdini, 2003). Interventionists can take advantage of the influence of social norms by (a) providing low achievers with descriptive norms to encourage them to boost performance and (b) providing high achievers with injunctive norms to encourage them to maintain high performance and not gravitate to the overall group mean. Schultz and colleagues (2007) investigated approaches to reducing household electricity usage, a goal of utility companies that face pressure from governmental regulators to help consumers become more energy efficient (Smith, 2005). Schultz and colleagues reported that adults who were high energy users (low achievers) reduced energy usage when provided with descriptive norms for their neighborhood. In contrast, these researchers found descriptive norms had a detrimental impact on low-energy users (high achievers), leading them to use more energy as they discovered they were more energy conscious than their neighbors were. However, this negative effect was subsequently prevented by providing this subgroup with positive injunctive messages (i.e., happy face icons on their energy bills).

### Possible Applications of BE for Pediatric Illness

The few pediatric studies that have explicitly focused on BE have offered ways to reduce childhood obesity (Epstein, Roemmich, Stein, Paluch, & Kilanowski, 2005; Wansink, Just, Hanks, & Smith, 2013), increase vaccination rates (Opel et al., 2013), promote selection of long-acting
reversible contraception (LARC) for adolescents (Stevens & Berlan, 2014), and maximize adherence rates for infant HIV regimens (Taylor & Buttenheim, 2013). This literature has highlighted the possible benefits of designing default options. Wansink and colleagues (2013) hypothesized that offering a presliced apple as opposed to a whole apple increased fruit sales because the former is easier and cleaner to eat. Opel and colleagues (2013) found that a pediatric provider’s use of an opt-out communication style (e.g., “There are some shots we must do today”), as opposed to an opt-in communication style (e.g., “What would you like to do about shots today?”), was associated with greater parental acceptance of childhood vaccines. Stevens and Berlan (2014) speculated that presenting a one-time procedure for LARC as the preferred birth control option to adolescents who struggle with the ongoing adherence requirements of alternative methods (e.g., taking a daily oral contraceptive pill) might facilitate patient selection of LARC. Winner and colleagues (2012) found that LARC methods that require a single procedure (e.g., intrauterine device placement) are associated with lower pregnancy rates than non-LARC methods, which require adherence on a daily basis (e.g., pills) or a weekly basis (e.g., patches).

The present review highlights how BE strategies might be more broadly applied to promote adherence across a wide range of chronic pediatric illnesses. Table I provides examples of potential BE strategies to promote family adherence across four diverse pediatric regimens—asthma, cystic fibrosis, migraines, and diabetes. Each condition was selected because it is highly prevalent in the pediatric age range and/or is a frequent focus of pediatric psychologists (Wu et al., 2013). However, one could envision how these strategies might be applied to other pediatric illnesses regarding regular medication use, biological monitoring, and/or lifestyle modifications. Table I also highlights traditional adherence approaches that are not based on BE. Further details regarding how the BE and non-BE strategies differ are offered below.

<table>
<thead>
<tr>
<th>BE concept/adherence task</th>
<th>Possible BE intervention(s)</th>
<th>Non-BE intervention(s)</th>
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<tr>
<td><strong>1. Default bias/inhalers for asthma</strong></td>
<td>Health systems provide automated reminders for daily controller inhaler use (e.g., Glowpack™) or help families set daily reminders on their own mobile devices during clinic visits Change the default from families picking up a rescue inhaler at their local pharmacy to distributing an inhaler at clinic visits</td>
<td>Require families to opt-in these reminder systems (e.g., families set their own alarms on their own time outside of clinic visits) Require families to always refill their own rescue inhalers at their local pharmacy</td>
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<td><strong>2. Loss aversion/pancreatic enzymes for cystic fibrosis (CF)</strong></td>
<td>Have the patient/family start at a large baseline reward level and incrementally lose a small portion of that reward for each time the pill bottle is not opened as scheduled according to electronic monitors on pill bottles</td>
<td>Have the patient/family start with no baseline reward and have them incrementally earn a reward for each time the pill bottle is opened as schedule</td>
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<td><strong>3. Overestimation of rare events/exercise for migraine prophylaxis</strong></td>
<td>Offer lottery-based rewards that randomly vary from small amounts given frequently to large amounts given rarely for achieving target exercise level on a particular day according to activity monitors (e.g., Fitbit™)</td>
<td>Offer rewards that feature moderately sized rewards consistently given for desirable exercise levels according to same activity monitors</td>
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<td></td>
<td>Completion of CD-ROM program that teaches self-management skills for headaches (Connelly, Rapoff, Thompson, &amp; Connelly, 2006)</td>
<td>Offer lottery based system in which each adolescent who completes program has a small chance to win a large prize Offer fixed payment system in which each adolescent who completes program earns the same sized reward</td>
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<td><strong>4. Social norms/glucose monitoring for diabetes</strong></td>
<td>Give low-frequency checkers descriptive norms (e.g., how do they compare with other patients in terms of frequency of blood glucose monitoring) along with biological norms Give high-frequency checkers injunctive norms using clear socially laded icons (e.g., happy/sad faces) to protect against gravitation to overall mean</td>
<td>Give these patients just biological norms (i.e., whether their current blood glucose level is medically acceptable) Give these patients just biological norms</td>
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Regarding the first set of BE strategies based on default bias, health systems frequently provide automatic reminders of periodic health-care tasks such as billable appointments or immunizations (Dombkowski et al., 2014; Irigoyen, Findley, Earle, Stambaugh, & Vaughan, 2000), yet typically fail to give automated reminders to help patients complete daily tasks such as medication usage. Of course, medication reminders are not a novel idea for promoting medication adherence for pediatric patients (e.g., Modi et al., 2009). However, traditionally these prompts were based on opt-in approaches—families were required to agree ahead of time to receive these reminders, often by enrolling in a research study (e.g., Johnson, Culpepper, Scott, Gordon, & Harris, 2011; Vasbinder et al., 2013). In contrast, a BE approach would suggest that reminders be used on an opt-out basis in which health systems make daily medication reminders an automatic component of their clinical services but give families the option to decline this assistance. Similarly, from a BE perspective, insurers should consider covering 30-day or 90-day medications or testing kits distributed during outpatient clinic visits because such coverage would reduce families’ need to visit pharmacies and might increase timely access to medical supplies.

Regarding the next set of BE strategies based on loss aversion and overestimation of rare events, respectively, previous reinforcement programs have infrequently incorporated these ideas. Typically, families neither have started with a high level of reward that can be subsequently reduced nor have participated in lottery-based incentives to promote adherence to pediatric regimens. The few exceptions of pediatric psychology interventions that have used lottery-based systems have obtained positive results in regards to keeping health-care appointments, managing Type 1 diabetes, and using car seats (Parrish, Charlop, & Fenton, 1986; Lasecki, Olympia, Clark, Jenson, & Heathfield, 2008; Roberts & Turner, 1986).

Regarding the final set of BE strategies based on social norms, traditional adherence interventions have focused on giving patients/families normative feedback on biological processes (e.g., Is the most recent glucose level within acceptable medical limits?). However, these adherence interventions have not provided social norms (e.g., In regards to consistency of checking glucose levels, how does this adolescent compare with high-achieving adolescents with diabetes who check frequently but do not adhere perfectly to provider standards?). Such social norms may encourage adolescents who check relatively infrequently (low achievers) to view more frequent but imperfect checking as an attainable goal, particularly if they view provider guidelines as largely unrealistic. As technology gets more widely disseminated, it will be easier to capture normative data across large patient subgroups so that such feedback can be readily provided to individual families. It should be noted that providing social norms to healthy groups has been used for discouraging risky behaviors such as college-student alcohol use (Bewick et al., 2010). Similarly, public posting of community norms has been used to encourage safety behaviors such as bicycle helmet use (Van Houten, Van Houten, & Malenfant, 2007) and seat-belt use (Malenfant, Wells, Van Houten, & Williams, 1996). However, offering social norm information has not been featured for promoting adherence to pediatric regimens for chronic physical illnesses.

In summary, these four BE concepts have not been frequently incorporated within existing approaches to promote adherence to pediatric regimens.

**Challenges and Opportunities for BE in Pediatric Psychology**

Several limitations of BE for pediatric psychology deserve mention. To begin with, investigators have not fully tested BE interventions for pediatric use; the efficacy, financial implications, and adverse effects of BE strategies remain largely unknown. In addition, the acceptability of these voluntary BE interventions to families has not been clearly established. Families can decline automated reminder systems, refuse to participate in loss aversion or lottery-based reinforcement, or ignore information on social norms; therefore, the satisfaction and continuation rates of these interventions should be studied. Furthermore, certain BE interventions—particularly lottery-based systems—may be deemed unacceptable to institutional review boards (IRBs) or other regulatory bodies. However, given that previous adult research featuring a lottery has been IRB approved and has led to documented health-related benefits (Haisley, Volpp, Pellathy, & Loewenstein, 2012), there should be feasible ways to construct incentive systems that balance the desire to motivate patients with the need to avoid undue coercion. Finally, the sustainability of BE strategies interventions has not been determined. While the automated nature of technology may enable the provision of reminders and social norms for indefinite periods, the financially oriented BE strategies of loss aversion and lottery-based systems will probably be discontinued. Given that some research has shown that healthy behaviors persist after formal reinforcement programs end (Charness & Gneezy, 2009), the natural consequences of better health are likely necessary for long-term adherence once BE strategies are stopped.
Despite these potential limitations, there are two primary reasons that pediatric psychologists should consider becoming involved with BE. First, BE strategies offer alternatives to time-intensive adherence programs. Multicomponent interventions integrating behavioral and educational strategies have substantial empirical support for promoting treatment adherence according to two recent meta-analyses (Graves et al., 2010; Kahana et al., 2008). The authors of the latter study noted that these adherence interventions for pediatric chronic illnesses averaged nine sessions. Given these considerable time requirements for providers, as well as an insufficient quantity of clinicians trained in these detailed protocols to reach the millions of pediatric patients, brief and simpler interventions deserve attention. The implementation of the possible BE strategies from Table 1 requires minimal provider time and training. Instead, these strategies will typically require that programs be developed and disseminated through smart phones or other Internet-based devices to which the overwhelming majority of low-income families currently have access (Saidinejad, Teach, & Chamberlain, 2012). These BE strategies may also require financial resources (e.g., medical supplies, monetary incentives) that accountable care organizations may be willing to provide lower-income families if cost savings can be realized (Stark, 2013). Furthermore, higher-income caregivers may be willing to cover the costs of financial incentives if their children’s adherence levels and health are improved.

While comprehensive psychosocial models should continue to play a major role in addressing complicated cases of nonadherence, some families may require a simpler approach. For instance, forgetfulness is a major reason for nonadherence according to a review of the literature by Modi, Rausch, and Glauser (2011). For some families, forgetfulness may require a comprehensive approach to address a myriad of educational, attitudinal, psychological, and logistical barriers. But for other families forgetfulness may require a simpler BE intervention such as those listed in Table 1 to overcome.

A second reason to consider BE is its potential advantages over popular existing theories. Skeptics of BE may wonder: Why do we need another conceptual model to inform adherence interventions for pediatric illness? After all, BE’s emphasis on external reminders/incentives is comparable with the “cues to action” component of the Health Belief Model (HBM). Furthermore, as was highlighted in the beginning of the second section of the present review, the four BE strategies sound virtually identical to concepts from Applied Behavioral Analysis (ABA). Similarly, BE strategies presume current antecedents and consequences have profound effects on behavior, an assumption that nearly two decades ago Kazdin (1997) noted as one of the cornerstones of behavioral therapy.

Despite the overlap, BE might overcome some of the limitations of these two models. Patient overoptimism may interfere with the appreciation of significant health risk that precipitates adherence according to the HBM (Rapoff, 2010). But under BE, this irrationality can be a helpful cognitive error—it can make lottery-based incentive programs appealing due to participants overestimating their odds of receiving relatively large rewards for demonstrating adherence. Similarly, BE’s explicit emphasis on freedom of choice may be attractive for those concerned that ABA strategies could be viewed coercive. In addition, while ABA strategies frequently require “use of persons in everyday life as therapeutic agents” (Kazdin, 1997, p. 823), BE may be less time-demanding for parents because technology can be used to deliver a considerable portion of the BE interventions highlighted in the present review.

Even if one rejects the notion that BE offers advantages for intervention development over these two models, BE likely offers an attractive way to market pediatric psychology’s adherence interventions. Kahneman (2013) contended that in the field of public policy, economists are the social scientists whose opinions are valued most because economists are deemed both objective and financially oriented. Perhaps expanding the reach of pediatric psychologists means that we must use the terminology of BE with health care administrators and politicians, particularly those impressed by the term “economic,” which denotes a major concern for addressing rising health care costs. Developing and testing BE strategies rely heavily on expertise in cognitive psychology, social psychology, operant conditioning, and randomized trials; therefore, pediatric psychologists are well-poised to make meaningful contributions above and beyond other social science disciplines (e.g., economics, sociology) whose roots are not as deeply grounded in these topics. If “behavioral economics” is more marketable than “pediatric psychology,” then perhaps some reliance on BE is warranted.

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