



## Review Article

## Behavioral economics and diabetic eye exams

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## ABSTRACT

Diabetic retinopathy is a common microvascular complication of diabetes mellitus and is the leading cause of new blindness among working-age adults in the United States. Timely intervention to prevent vision loss is possible with early detection by regular eye examinations. Unfortunately, adherence to recommended annual diabetic eye exams is poor. Public health interventions have targeted traditional barriers to care, such as cost and transportation, with limited success. Behavioral economics provides an additional framework of concepts and tools to understand low screening rates and to promote regular diabetic eye exams for populations at risk. In particular, behavioral economics outlines biases and heuristics that affect decision-making and underlie pervasive barriers to care, such as not viewing diabetic eye exams as a priority or perceiving oneself as too healthy to need an examination. In this review, we examine the literature on the use of behavioral economics interventions to promote regular diabetic eye exams. From the results of the included studies, we outline how concepts from behavioral economics can improve eye examination rates. In particular, the default bias, present bias, and self-serving bias play a significant role in precluding regular diabetic eye examinations. Potential tools to mitigate these biases include leveraging default options, using reminder messages, providing behavioral coaching, applying commitment contracts, offering financial incentives, and personalizing health messages. When combined with traditional public health campaigns, insights from behavioral economics can improve understanding of pervasive barriers to care and offer additional strategies to promote regular preventive eye care for patients with diabetes.

## 1. Introduction

Diabetic retinopathy is a significant public health burden that affects over a quarter of diabetic patients in the United States, where it is the leading cause of blindness among working age adults (Zhang et al., 2010; Zhang et al., 2013). Blindness from diabetes results in \$500 million in lost income annually (Javitt et al., 1990), and the number of Americans with diabetic retinopathy is expected to triple from 5.5 million people in the year 2005 to 16.0 million people by the year 2050 (Saaddine et al., 2008).

Blinding complications of diabetic retinopathy can be treated or prevented with regular medical and ophthalmic follow-up (The Diabetes Control and Complications Trial Research Group, 1993; UK Prospective Diabetes Study Group, 1998), and the American Academy of Ophthalmology recommends annual screening exams for early detection of signs of disease (American Academy of Ophthalmology Retina/Vitreous Panel, 2016). Unfortunately, many Americans with diabetes are not receiving care that can prevent visual impairment or

blindness. Fewer than half of diabetic patients adhere to annual screening eye exams (Schoenfeld et al., 2001; Paz et al., 2006; MacLennan et al., 2014; Lee et al., 2003), and even patients with a diagnosis of diabetic eye disease have poor rates of annual ophthalmic follow-up (Bressler et al., 2014).

Many factors influence adherence to screening guidelines, including cost, transportation, access to care, limited understanding of disease, and inadequate referral rates (Fathy et al., 2016; Kovarik et al., 2016; Simmons, 2001; Van Eijk et al., 2012). In addition, other pervasive barriers include forgetfulness or not perceiving regular eye exams as a priority. Surveys of urban and rural populations who failed to follow up for ophthalmic evaluation following an abnormal community screening exam have revealed that forgetting the appointment was a common reason for appointment no-show (Quigley et al., 2002; Tsui et al., 2015). Additionally, a qualitative interview study of patients with diabetes found that perceived barriers to having a dilated eye exam included not feeling like going and that it takes too much time (Walker et al., 1997).

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**Table 1**  
Studies directly evaluating behavioral economics interventions for diabetic eye exams.

Behavioral economics intervention (bias addressed)	Study	Study design	Study population		n	Country	Intervention	Outcomes	Implications for promoting diabetic eye exams
			Setting	Country					
Reminder messages (present bias)	Halbert et al. (1999)	RCT	Diabetic patients in an HMO in California with no record of dilated retinal exam	US	19,523	US	9614 patients were mailed a single reminder to obtain a dilated eye exam, compared to 9909 patients who were mailed multiple reminders, at 3, 6, and 9 months	Multiple reminder messages significantly increased annual dilated eye examination rates ( $p = 0.023$ ), with no further effect after a second message	A second reminder message significantly increased rates of annual diabetic eye examinations, with limited additional effects from a third reminder
	Sequist et al. (2005)	RCT	Primary care physicians at 20 clinic sites in the Boston area	US	194 PCPs caring for 4549 diabetic patients	US	Integrated clinical reminder system in the EMR for patients with diabetes to have an annual DFE	Compared to those receiving usual care, physicians under the care of physicians with reminder messages had an increase in diabetes care based on a composite outcome of 5 endpoints (OR 1.30, 95% CI 1.01, 1.67), but there was no increase in DFE rates ( $p = 0.23$ ); rates of documented DFE were low in both groups, with possible deficiency in documentation	Reminder messages in the EMR promote guideline adherence in diabetes care, but this study did not find an increase in rates of documented DFE for diabetic patients of physicians in the reminder condition
Behavioral coaching (present bias)	Weiss et al. (2015)	RCT	African Americans age 65 and older with diabetes who have not had a dilated eye exam in the preceding 12 months, recruited from 2 urban medical centers in Philadelphia	US	206	US	Participants were assigned either to a behavioral activation condition, in which barriers to care are addressed and goal setting were discussed, or to supportive therapy as a control condition	More participants in the behavioral activation for diabetic retinopathy prevention group (87.9%) obtained a DFE compared with those in the supportive therapy group (34.1%) by the 6-month follow-up assessment ( $p < 0.001$ )	Behavioral activation, which involves education, reflection on barriers to care, and goal setting, significantly improved rates of DFE at 6 months
Commitment contracts (present bias)	Aleo et al. (2015)	RCT	Adult patients with diabetes presenting to an urban pharmacy in Philadelphia	US	500	US	Participants were screened with a non-mydratric fundus camera and assigned either to a commitment contract condition, in which they agreed to review results with their PCP and follow up for eye care, or to a non-contract control group	Among the 113 (22.6%) participants with abnormal screening results, there was no significant difference in follow-up adherence between the contract (38.1%) and non-contract group (43.9%) ( $p = 0.59$ )	Commitment contracts for adherence to screening follow up were not found to be effective in this study, which has several limitations
Financial incentives (present bias)	Judah et al. (2016)	Study protocol for an RCT	Patients age 16 or older with diabetes who have been invited for annual DFEs but have not had one in the preceding 24 months	UK	1000 (planned)	UK	Participants will be randomly assigned to receive one of three invitation letters: (1) fixed incentive condition for attending DFE, (2) probabilistic incentive condition with entrance to a lottery for attending DFE, (3) or usual care with invitation only and no financial incentive	Ongoing	This study will explore how fixed and probabilistic financial incentives can promote follow up among diabetic patients who have not had a recent DFE
Personalization effects (self-serving bias)	Anderson et al. (2003)	RCT	African-American patients with diabetes who attended a community-based retinopathy screening clinic in southeastern Michigan	US	132	US	Participants were randomly assigned either to a personalized follow-up intervention, in which those who did not make an appointment after a reminder mailing were called by clinic staff to schedule a DFE, or to usual care with the reminder mailing alone	The return rate for those in the personalized reminder condition was significantly higher than that for those in the usual care condition, at 66% compared to 35% ( $p < 0.001$ )	Personalized reminder phone calls significantly increased follow up for DFE among African Americans with diabetes compared to reminder letter alone
	Walker et al. (2008)	RCT	Adults with diabetes without a DFE in 1 year from 3 healthcare centers in Bronx, NY	US	598	US	A tailored telephone intervention to promote retinopathy screening was compared to a standard print intervention over a 6-month period	There was a 74% increase in retinopathy screening in the telephone (33.8%) versus print group (18.5%) ( $p < 0.0005$ )	Tailored phone interventions have significantly more success at recruiting diabetic patients for DFE compared to print

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