Estimating Peer Effects: A Structural Econometric Model Using a Field Experiment of a Health Promotion Program in Rural China*

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Abstract

When myopic students make decisions about whether to own and/or use glasses, peer effects might play a role in their decision-making. In this paper, we take advantage of a large-scale field experiment that provides free eyeglasses and training to 3,177 myopic students in rural China, and from which we collected three rounds of glasses ownership and usage data. We estimate peer effects using both reduced-form models and structural models of both the ownership decision and the usage decision; as well as a structural model of the multi-stage timing game in which the first stage is the decision to own glasses and, conditional on deciding to own, the second stage is the decision to use glasses. In the multi-stage model, our preferred model, we find that the fraction of all peers who own glasses has a significant positive effect on the payoff to a myopic student from using glasses. The peer effect is roughly half as important as partially relieving the liquidity constraint combined with providing a training program; completely relieving the liquidity constraint; or completely relieving the liquidity constraint combined with providing a training program.

Keywords: peer effects, myopia, eyeglasses, China, structural model
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1. Introduction

Understanding and measuring peer effects are often viewed as a Holy Grail of social science and the key to understanding many social problems and opportunities (Sacerdote, 2014). In the economics literature, studies of peer effects have been done in the fields in education (see review by Epple and Romano, 2011); technology adoption (Oster and Thornton, 2012); juvenile behaviors like criminal and health behaviors (Gaviria and Raphael, 2001; Kling, Liebman and Lawrence, 2007); and financial decisions (Bursztyn et al., 2014).

In his seminal work, Manski (1993) defines three types of peer effects: *endogenous effects*, which arise from the influence of peers' outcomes; *exogenous effects*, which arise from the influence of peers' exogenous characteristics; and *correlated effects*, which arise when individuals in the same group tend to behave similarly because they face similar individual characteristics or environments which are unobserved to econometricians. There are two therefore identification problems that arise when analyzing peer effects (Bramoullé et al., 2009). First, it is difficult to separate the real endogenous and exogenous peer effects from the unobservable correlated effects. Second, even assuming away the correlated effects, it is hard to distinguish between endogenous peer effects and the exogenous peer effects, a problem termed the reflection problem.

A recent growing strand of policy evaluation studies employs field experiments or quasi-natural experiments to identify peer effects. They do so by adding exogenous peer compositions or changing the fraction of peers treated. These studies include those that add cohort-to-cohort variations in the gender mix of schools (Hoxby, 2000), randomly assign college roommates (Carrell, Fullerton and West, 2009; Shue, 2013), or take advantage of the migration of hurricane refugees into new schools (Damm and Dustman, 2012; Imberman, Kugler and Sacerdote, 2012).

However clever their identification strategies to separate peer effects from correlated effects, the studies make no attempt to separate the exogenous and endogenous peer effects. Another type of study proposes the assumption that the friends of one's friends only affect oneself via one's friends' outcomes and assume away the presence of exogenous peer effects. Therefore, researchers can instrument for peer outcomes (endogenous effects) using the exogenous peers' characteristics (De Giorgi, Pellizzari and Redaelli, 2010).

In this paper, we take advantage of a large-scale field experiment in China that provides free eyeglasses and training to 3,177 myopic students among 485 classes in 252 primary schools. This field experiment provides an ideal context to test for peer effects in the decisions to own and/or use eyeglasses. In rural China, since students are enrolled into the primary schools located in town seats in which their villages are subdistricts, and since people's residences are linked to the location of their farm land, it is not possible for parents to choose places to live in order to enroll their children in better schools. Even if there is some potential unobserved self-selection in the formation of classes, there is little evidence that self-selection would be based on children's myopia and their attitudes about wearing eyeglasses. Therefore, our field experiment and the institutional details of schools in rural China remove the concern of correlated effects and allows us to focus on the identification of effects from peers' background (exogenous effects) and peers' outcome (endogenous effects).

We collect three rounds of individual level data of eyeglasses ownership and usage and use three types of econometric models to identify peer effects. The first model is a reduced-form model in which we apply an instrumental variables method. We instrument for contemporaneous peer outcomes (ownership or usage) using the exogenous peers' characteristics collected in the baseline. We also estimate a lagged model to capture the dynamic nature of our data generating process, and similarly instrument for peer outcomes (endogenous effects) using the exogenous peers' characteristics collected in the baseline.

The second model we estimate is a structural model of a dynamic game. The structural estimation allows us to explicitly model the dynamic decision to own and/or use glasses, including the continuation value to waiting. Our structural model also allows us to estimate the effect of each state variable on the expected payoff from owning and/or using glasses. In addition, it enables us to better estimate the strategic (social) interaction between classmates.

In our third model, we expand our dynamic structural model to a multi-stage game. In the first stage, a student decides whether or not to own eyeglasses. In the second stage, conditional on owning eyeglasses, a student decides whether or not to use them. This model enables us to explicitly model each of the stages in the dynamic decision-making problem faced by myopic students. As a consequence, the analysis of strategic interactions in this multi-stage model is more complete than that of the previous models because it incorporates the second stage of usage decision along with the first ownership decision, not only by allowing for strategic interactions in both stages but also by linking the decisions made in each stage together in one integrated, multi-stage model that recognizes that the decisions made in the first decision depend on the value of advancing to the second stage (Lin, 2013).

We make several contributions to the existing literature on peer effects. First, the structural model enables us to separate the two types of endogenous and exogenous peer effects in peer effects literature. Second, our multi-stage model adds a sequential decision-making component to the existing structural modeling literature. Third, the structural parameters can be interpreted to enable comparison between the effects of peers and the effects of information and subsidies, which are two common important interventions in the health literature.

Our structural models also contribute to the burgeoning literature using structural models in development economics. While most of the dynamic structural econometric models in development economics model single-agent dynamic decision-making (see e.g., Todd and Wolpin, 2010; Duflo, Hanna and Ryan, 2012; Mahajan and Tarozzi, 2011), our structural models model a dynamic game between decision-makers, and thus allow for both dynamic and strategic decision-making. Our structural econometric models of the dynamic game between school children in rural China enables us to estimate peer effects.

According to the results of our multi-stage model, our preferred model, the fraction of all peers who own glasses has a significant positive effect on the payoff to a myopic student from using glasses. The peer effect is roughly half as important as partially relieving the liquidity constraint combined with providing a training program; completely relieving the liquidity constraint; or completely relieving the liquidity constraint combined with providing a training program.

The rest of paper proceeds as following. Section 2 describes the research setting and data. Section 3 describes methods of three models. Section 4 presents the results. Section 5 concludes.

2. Research Setting and Data

Half of all disabilities among children in the developing world are due to poor vision (Condon et al., 2008). The leading and most readily treated cause of children's vision problem is myopia, affecting 12.8 million 5- to 15-year-old children world-wide, half of whom live in China (Resnikoff et al., 2008). Wearing eyeglasses have been proven to be the most cost-effective solution to correct myopia (Ma et al., 2014). In the context of primary schools in China, several studies have documented that teaching materials are primarily presented on the blackboard and children with uncorrected myopia have lower scores in a variety of tests (Yi et al., 2014; Ma et al., 2014). A few empirical studies show that wearing eyeglasses can improve students' academic performance (Ma et al., 2014; Glewwe, Park and Zhao, 2014). However, only as few as one in six myopic children needing eyeglasses have them in the developing world (Yi et al., 2014; He et al., 2004, 2007). Meanwhile, the prevalence of myopia has been increasing among Chinese children, afflicting about one in four children in primary schools (Yi et al., 2014; He et al., 2004, 2007). The potential welfare loss due to uncorrected myopia can be large in developing world.

In this paper, we use data from a randomized controlled trial which we designed to promote eyeglasses among myopic students in primary schools (see Ma et al., 2014 for a detailed description of the experimental design and data collection).

Sampling

Our experiment took place in two adjoining provinces of western China: Shaanxi and Gansu.[1] In each of the provinces, one prefecture was included in the study. A map of these regions is provided in Figure 1. From each prefecture, a list of all rural primary schools was obtained. To minimize the possibility of inter-school contamination, we first randomly selected townships and then randomly selected one school per township for inclusion in the experiment. Within the schools, our data collection efforts (discussed below) focused on 4th and 5th grade students. From each grade, one class was randomly selected and surveys and visual acuity examinations were given to all students in these classes.

[1] Shaanxi's GDP per capita of USD6108 was ranked 14th among China's 31 provincial administrative regions in 2012, and was very similar to that for the country as a whole (USD 6091) in the same year, while Gansu was the second-poorest province in the country (per capita GDP USD3100) (China National Statistics Bureau, 2012).

Experimental Design

Following the baseline survey and vision tests, schools were randomly assigned to one of the six cells in the 3 by 2 experimental design shown in Figure 2. Schools were first randomized into one of three *provision* groups (free distribution, ordeal, and control). Half of the schools assigned to each provision group were then assigned to receive a training program. To improve power, we stratified the randomization by county and by the number of children in the school found to need eyeglasses. In total, this yielded a total of 42 strata. Our analysis takes this randomization procedure into account (Bruhn and McKenzie, 2009).

The three experimental provision groups are as follows:

Free distribution: In this group each student diagnosed with myopia[2] was given a free pair of eyeglasses as well as a letter to their parents informing them of their child's prescription. The child was permitted to select a pair of frames, which were then fit to the proper prescription and delivered to the hands of students at schools by a team of one optometrist and two enumerators.

Ordeal: In this group, each student diagnosed with myopia was given a voucher as well as a letter to their parents informing them of their child's prescription. Their prescription was also printed in the voucher. This voucher was redeemable for one pair of free glasses at an optical store that was in the county seat. To a large extent, the ordeal of voucher redemption is simply the cost (in transportation fare, in needed, and time) associated with travel to this optical shop. The distance from each student's home and the county seat varied a great deal within our sample, ranging from 1 kilometer to 105 kilometers with the mean distance of 33 kilometers. The vouchers were non-transferable. The student's information, including name, school and county,

[2] More than 95% of poor vision is due to myopia. The rest is due to hyperopia and astigmatism. For simplicity, we will use myopia to refer to vision problems more generally.

was printed on each voucher, and students were required to present their identification in person to redeem the voucher.

Control: Students in the control group were given only a letter addressed to their parents informing them of their child's myopia status and prescription.

In each of these three provision groups, half of the schools were assigned to receive a training program:

Training program: The training program included three components. First, a short documentary-type film was shown to students in classes. Second, students were given a set of cartoon-based pamphlets in classes. Finally, parents and teachers were invited to a lecture in which they were shown the film and additional handouts were distributed. Each component of the training addresses the importance of wearing glasses and provides information meant to correct common misconceptions that lead to inflated perceptions of use costs and contribute to low adoption rates. For example, the training program specifically addressed the common misperceptions that wearing glasses deteriorates vision and that eye exercises can cure myopia.

Data Collection

Three rounds of data were collected by our enumeration team (denoted as t = 0, 1, 2 hereafter. See Figure 3 for the project timeline). A baseline survey was conducted in September 2012. The baseline survey (denoted as t = 0) collected detailed information on students' eyeglasses ownership and usage as well as their individual and household characteristics. As shown in Table 1, the baseline characteristics are well-balanced across the treatment groups. At the same time as the school survey, a two-step eye examination[3] was administered to all students

[3] First, a team of two trained staff administered visual acuity screenings using Early Treatment Diabetic Retinopathy Study (ETDRS) eye charts (ETDRS charts are accepted as the worldwide standard for accurate visual acuity

in all sample classes of project schools. In total, 19,934 students in 252 schools were surveyed and given eye examinations at baseline, 3,177 (16%) among 485 classes[4] were found myopic and benefit from correction. We include only these myopic students in the analysis sample.

Free and vouchers for free eyeglasses and training interventions were implemented and completed one month after the baseline survey (October 2012). The first follow-up was conducted immediately after the interventions were completed (denoted as t = 1). A second follow-up was conducted by the end of the school year in May 2013 (denoted as t = 2). The overall attrition rate was less than four percent between period t = 0 and period t = 2. The attrition rate does vary significantly across treatment groups.

Ownership and Usage of Eyeglasses

Our analysis focuses on two key variables: eyeglass ownership and usage. Ownership is defined by ownership, i.e., a binary variable taking value of one if a student owns one pair of eyeglasses. Ownership is 100% in the free distribution group. Usage is defined by whether a student wears his or her glasses. Both variables are self-reported during the three rounds of data collection.

measurement (Camparini et al., 2001)). Students who failed the visual acuity screening test (cutoff is defined by VA of either eye less than or equal to 6/12, or 20/40) were enrolled in a second vision test that was carried out at each school 1-2 days after the first test. This second vision test was conducted by a team of one optometrist, one nurse and one assistant staff and involved cycloplegic automated refraction with subjective refinement (a cycloplegic refraction is a procedure used to determine a person's degree of myopia-refractive error-in a more strictly terminology by temporarily paralyzing the muscles that aid in focusing the eye. It is often used for testing children's vision who sometimes subconsciously accommodate their eyes during the eye examination, making the results invalid) to determine prescriptions for children needing glasses.

[4] There are 19 classes (504 minus 485) with zero myopic students diagnosed.

3. Methods

In this paper we study the effect of peers on the decisions of myopic children in rural primary schools of China of whether to own eyeglasses and whether to use eyeglasses. We estimate peer effects using both reduced-form models and structural models of both the ownership decision and the usage decision; as well as a structural model of the multi-stage timing game in which the first stage is the decision to own glasses and, conditional on deciding to own, the second stage is the decision to use glasses. The peers are defined as the classmates in the same classroom.

Reduced-Form Model

We first estimate reduced-form models of a student's decision to own glasses, and also of his or her decision to wear[5] glasses. For our ownership regression, our dependent variable y_{it}^{own} is a dummy variable for the decision to own, which is equal to 1 for student i at time t if the student decides to own glasses at time t. For our usage regression, our dependent variable y_{it}^{use} is a dummy variable for the decision to use glasses, which is equal to 1 for student i at time t if the student decides to use glasses at time t.

To analyze peer effects in the ownership decision, we regress the student's decision y_{it}^{own} to own glasses on the fraction $\overline{y}_{-it}^{own}$ of his or her peers[6] who own eyeglasses and on the fraction $\overline{y}_{-it}^{use}$ of his or her peers who use eyeglasses. Similarly, to analyze peer effects in the usage

[5] In this paper, we use the terms *use* and *wear* interchangeably.
[6] In this paper, we use the terms *peers* and *classmates* interchangeably.

decision, we regress the student's decision y_{it}^{use} to own or use glasses on the fraction $\overline{y}_{-it}^{own}$ of his or her peers who own eyeglasses and on the fraction $\overline{y}_{-it}^{use}$ of his or her peers who use eyeglasses.

We estimate the following econometric models:

$$y_{it}^{own} = \alpha^{own} + \beta_{own}^{own}\overline{y}_{-it}^{own} + \beta_{use}^{own}\overline{y}_{-it}^{use} + \delta^{own}y_{i0}^{own} + x_{i0}'\gamma^{own} + \varepsilon_{it}^{own} \quad (1)$$

$$y_{it}^{use} = \alpha^{use} + \beta_{own}^{use}\overline{y}_{-it}^{own} + \beta_{use}^{use}\overline{y}_{-it}^{use} + \delta^{use}y_{i0}^{use} + x_{i0}'\gamma^{use} + \varepsilon_{it}^{use} \quad , \quad (2)$$

where y_{i0}^{own} is a dummy variable for the baseline ownership decision, y_{i0}^{use} is a dummy variable for the baseline usage decision, and x_{i0} is a vector of other baseline characteristics of student i which are time-invariant. These baseline characteristics include gender, grade level, test scores,[7] awareness of refractive status, belief that wearing glasses harms vision (a common misinformation in China, as discussed previously), severity of myopia, whether a family member wears eyeglasses, whether the student boards at the school, parental migration status, parental education, and household assets. The coefficients of interest are β_{own}^{own}, β_{use}^{own}, β_{own}^{use}, and β_{use}^{use}.

Measuring peer effects is difficult owing to two sources of endogeneity. One source is the simultaneity of the peer effect: if student *i* is affected by his or her classmate *j*, then student *j* is affected by his or her classmate *i*. The other arises from spatially correlated unobservable variables (Manski, 1993; Manski, 1995; Brock and Durlauf, 2001; Conley and Topa, 2002; Glaeser, Sacerdote and Scheinkman, 1996; Moffitt, 2001; Lin, 2009; Robalino and Pfaff, 2012;

[7] Standardized mathematics tests appropriate for children in the fourth and fifth grades were administered on printed-paper. Local educators assisted with the selection of questions from items developed for the Trends in International Mathematics and Science Study. The examination was timed (25 minutes) and proctored by two study enumerators at each school. Mathematics was chosen for testing to reduce the effect of home learning on performance and to better focus on classroom learning. For analysis, we normalize scores using control group baseline distribution in each program and discretize scores in three bins (low, median, high).

Pfeiffer and Lin, 2012). It is therefore important to address these endogeneity problems in order to identify the peer effects.

To address the endogeneity of classmates' ownership decisions $\bar{y}_{-it}^{own}$ and usage decisions $\bar{y}_{-it}^{use}$, we use the classmates' baseline characteristics as instruments for the fraction $\bar{y}_{-it}^{own}$ of classmates who own eyeglasses and for the fraction $\bar{y}_{-it}^{use}$ of classmates who use eyeglasses. The classmates' baseline characteristics are correlated with the classmates' ownership and usage decisions but uncorrelated with a student's own ownership and usage decisions except through their effect on the classmates' decisions. In particular, we use the following instruments: fraction of classmates aware of their myopia status, class average of household wealth, and fraction of classmates who own glasses in the baseline.

We also estimate the peer effects in an alternative lagged reduced-form model in which we regress the own or use decision for student *i* at time *t* on the peers' ownership and usage decisions at *t-1* as in the following model specifications:

$$y_{it}^{own} = \alpha^{own} + \beta_{own}^{own}\bar{y}_{-it-1}^{own} + \beta_{use}^{own}\bar{y}_{-it-1}^{use} + \delta^{own}y_{i0}^{own} + x_{i0}'\gamma^{own} + \varepsilon_{it}^{own} \quad (3)$$

$$y_{it}^{use} = \alpha^{use} + \beta_{own}^{use}\bar{y}_{-it-1}^{own} + \beta_{use}^{use}\bar{y}_{-it-1}^{use} + \delta^{use}y_{i0}^{use} + x_{i0}'\gamma^{use} + \varepsilon_{it}^{use}. \quad (4)$$

We estimate our models in (3) and (4) using both OLS and IV regressions. The IV regression uses the fraction of classmates aware of their myopia status and the class average of household wealth as instruments for the peers' lagged ownership and usage decisions.[8]

[8] Because the endogenous variables include the fraction of classmates who own glasses in the baseline in the case of short term decision, we do not use fraction of classmates who own glasses in the baseline as one of our instruments as we did in the regressions of equations (1) and (2).

The primary advantages of the reduced-form models are that we can use continuous variables without having to discretize them and, because state-space constraints are less of a concern, we can include many covariates. However, the reduced-form models only estimate the per-period probability of owning and using glasses, and therefore do not have a clear structural interpretation. As we explain below, because the payoff from owning and/or using glasses may depend on whether other classmates are owning and/or using glasses, and because whether other classmates are owning and/or using glasses may be uncertain and evolve stochastically over time, a student who hopes to make a dynamically optimal decision would need to account for the option value to waiting before making these decisions (Dixit & Pindyck, 1994). The parameters in the reduced-form models are therefore confounded by continuation values. We now develop a dynamic structural econometric model which better and more explicitly captures the dynamic and interdependent nature of a student's ownership and usage decisions.

Structural Models

We follow up the reduced-form models of the decisions to own and use glasses with a structural model for several reasons. First, the structural model explicitly models the dynamic investment decision, including the continuation value to waiting. Because the payoff from owning and/or using glasses may depend on whether other classmates are owning and/or using glasses, and because whether other classmates are owning and/or using glasses may be uncertain and evolve stochastically over time, a student who hopes to make a dynamically optimal decision would need to account for the option value to waiting before making these decisions (Dixit & Pindyck, 1994). In contrast, the reduced-form model only estimates the per-period probabilities of owning and using.

A second advantage of the structural model is that with the structural model we are able to estimate the effect of each state variable on the expected payoff from owning and/or using glasses. In the reduced-form model, we estimated the effect of these variables on the per-period probability of owning and using. A student will decide to own a pair of glasses if the payoff from owning exceeds the continuation value from waiting. A student will decide to start using a pair of glasses if the payoff from using exceeds the continuation value from waiting. The parameters in the reduced-form model represent parameters in the relative difference between the payoff from owning or using and the continuation value from waiting, and therefore are not the structural parameters of interest, since there is a structural relationship between the continuation value from waiting and the payoff from owning or using. In particular, the continuation value from waiting is the expected value of the value function next period, where the value function is the maximum of the payoff from owning or using and continuation value from waiting. In contrast, with the structural model we are able to estimate parameters in the payoffs from owning and in the payoffs from using, since we are able to structurally model how the continuation value from waiting relates to the payoffs from owning and the payoffs from using, respectively.

A third advantage of the structural model is that with the structural model we are able to better estimate the strategic (social) interaction between classmates. In the reduced-form model, we are unable to explicitly measure the effect of other potential owners and users of glasses on a student's payoffs to owning and/or using glasses. In contrast, with the structural econometric model, students base their decisions in part on expectations of the future, including their expectations of what fraction of their classmates will own by next year and their expectations of what fraction of their classmates will use by the next year.

We estimate three structural models: a dynamic ownership game, a dynamic usage game, and a multi-stage game.

Dynamic Ownership Game

In our structural econometric model of the dynamic ownership game, the action variable for each student *i* in class *k* is I^o_{ikt}. For the ownership decision, I^o_{ikt} is equal to 1 for student *i* in class *k* at time *t* if the student owns glasses for the first time at time *t*, and 0 if the student does not yet own glasses at time *t*. I^o_{ikt} is coded as missing for student *i* in class *k* at time *t* if the student already owned glasses in the previous period *t*-1, since then he or she no longer has an ownership decision to make.

For each class *k*, the state of the class at time *t* is given by a vector $\Omega^o_{kt} = (N^o_{kt}, X^o_{kt})$ of discrete and finite-valued state variables that are observed by all the students in the class *k* as well as by the econometrician. The decision of student *i* in class *k* of whether to own glasses in year *t* depends on the publicly observable state of the class $\Omega^o_{kt} = (N^o_{kt}, X^o_{kt})$. The state variables N^o_{kt} and X^o_{kt} evolve according to a first-order Markov process and summarize the direct effect of the past on the current environment.

The state variables N^o_{kt} capture the strategic components of the ownership decision. In this model, N^o_{kt} includes the fraction of classmates in class *k* who own glasses by time *t* and the fraction of myopic classmates in class *k* who own glasses by time *t*. The state variables in X^o_{kt} are a subset of the variables used in the reduced-form estimation. X^o_{kt} includes the six treatment dummies which indicate student *i*'s school type of random treatment assignment (pure control;

training only; ordeal only; ordeal and training; free only; or free and training); baseline class size; class average of baseline awareness of myopia status; class average of baseline misinformation; and class average of baseline myopia severity. Due to the computational nature of the problem it is not possible to include all the variables in one specification, so we include those that are important based on the reduced-form results.

We discretize the two endogenous state variables into 10 bins each (1=lowest to 10=highest). In particular, we discretize the fraction of myopic peers who own eyeglasses by time *t* into 10 equally spaced bins from 0.0 (lowest bin) to 1.0 (highest bin), with an increment of 0.1 between each bin. We discretize the fraction of all peers who own eyeglasses by time *t* into 10 equally spaced bins from 0.0 (lowest bin) to 0.50 (highest bin), with an increment of 0.05 between each bin.

We discretize the baseline class size; class average of baseline awareness of myopia status; class average of baseline misinformation; and class average of baseline myopia severity variables into 2 bins each (1=low or 2=high) with the cutoff defined as the median of each variable.

In addition to the observable state variables $\Omega^{o}_{kt} = (N^{o}_{kt}, X^{o}_{kt})$, the decision of a student *i* in class *k* of whether to own glasses in year *t* also depends on a shock ε^{o}_{ikt}, which is private information to the student and unobserved by either other classmates or by the econometrician. One source of the shock is utility or disutility of the aesthetic feeling of owning one pair of eyeglasses at time *t*. This shock, which is observed only by the student owning eyeglasses, represents his or her aesthetic feeling of the looking of eyeglasses before wearing it. The shock may also include any private shocks to a student's cost or benefits of owning glasses. We assume the error term is independently and identically distributed exponentially with parameter σ^o, which is among the parameters to be estimated.

The payoff $\pi(N^o_{kt}, X^o_{kt}, \varepsilon^o_{ikt}; \theta)$ from owning glasses in class *k* in time *t* can be separated into a deterministic component and a stochastic component as follows:

$$\pi(N^o_{kt}, X^o_{kt}, \varepsilon^o_{ikt}; \theta) = \pi_0(N^o_{kt}, X^o_{kt}; \theta) + \varepsilon^o_{ikt},$$

where the deterministic component $\pi_0(\cdot)$ is linear in the state variables:

$$\pi_0(N^o_{kt}, X^o_{kt}; \theta) = N^o_{kt}{}'\gamma_N + X^o_{kt}{}'\gamma_X,$$

and where $\theta = \left(\gamma_N, \gamma_X, \sigma^o\right)$ denotes the parameters to be estimated. The coefficients γ_N and γ_X measure the effects of the state variables N^o_{kt} and X^o_{kt}, respectively, on the payoff to owning glasses.

The coefficients γ_N on the fraction of classmates in class *k* who own glasses by time *t* and the fraction of myopic classmates in class *k* who own glasses by time *t* measures the net peer effect.

A positive coefficient γ_N would indicate that a student is more likely to own glasses if his or her peers do. There are several possible reasons for a positive peer effect. One source of a positive peer effect is that students may imitate the behaviors of their peers, perhaps to "keep up with the Joneses" (Luttmer, 2005; Fliessbach et al., 2007; Card et al., 2010), in the sense that myopic students may just mimic their peers' ownership decisions without really understand the benefit and cost of owning a pair of eyeglasses. The second source of a positive peer effect is a positive learning effect in the sense that myopic students choose to own eyeglasses due to the fact that they learn from their peers that owning eyeglasses yields net benefits. These benefits that students can learn from their peers include not only better vision and better classroom performance, but also perhaps the potential aesthetic benefits of wearing glasses, if they think the glasses look good on their peers.[9]

A negative value for γ_N would indicate that a student is less likely to own glasses if his or her peers do. This could be due to a negative learning effect in the sense that myopic students learn from their peers that owning eyeglasses yields net costs.

The value function for a student *i* in class *k* who does not yet own glasses by period *t* can be written as:

$$V(N^o_{kt}, X^o_{kt}, \varepsilon^o_{ikt}; \theta) = \max\{\pi(N^o_{kt}, X^o_{kt}, \varepsilon^o_{ikt}; \theta), \beta V^c(N^o_{kt}, X^o_{kt}; \theta)\}.$$

The student will invest in owning glasses if and only if the payoff from investing exceeds β times the continuation value $V^c(\cdot)$ to waiting. The continuation value $V^c(\cdot)$ is the expected value of the next period's value function, conditional on not owning glasses in the current period, and is given by:

$$V^c(N^o_{kt}, X^o_{kt}; \theta) = E[V(N^o_{k,t+1}, X^o_{k,t+1}, \varepsilon^o_{ik,t+1}; \theta) \mid N^o_{kt}, X^o_{kt}, I^o_{ikt} = 0].$$

Let $g(N^o_{kt}, X^o_{kt}; \theta)$ denote the probability of investing in owning glasses at time *t*, conditional on the publicly available information $\Omega^o_{kt} = (N^o_{kt}, X^o_{kt})$ at time *t*, but not on the private information ε^o_{ikt} . The investment probability $g(N^o_{kt}, X^o_{kt}; \theta)$ function represents a student's perceptions of the probability that a classmate who has not yet invested will decide to invest at time *t*.

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[9] See reviews of different channels of peers effects in education Epple and Romono (2011) and in financial investment (Bursztyn et al., 2014).

Using the exponential distribution for ε^o_{ikt} the continuation value $V^c(\cdot)$ reduces to:

$$V^c(N^o_{kt}, X^o_{kt}; \theta) = E[\beta V(N^o_{k,t+1}, X^o_{k,t+1}, \varepsilon^o_{ik,t+1}; \theta) + \sigma g(N^o_{k,t+1}, X^o_{k,t+1}; \theta) \mid N^o_{kt}, X^o_{kt}, I^o_{ikt} = 0],$$

and the investment probability $g(\cdot)$ reduces to:

$$g(N^o_{kt}, X^o_{kt}; \theta) = \exp\left(-\frac{\beta V^c(N^o_{kt}, X^o_{kt}; \theta) - \pi_0(N^o_{kt}, X^o_{kt}; \theta)}{\sigma^o}\right),$$

as shown by Lin (2013).

The parameters to be estimated are $\theta = (\gamma_N, \gamma_X, \sigma^o)$, which includes the parameter σ^o in the exponential distribution of the private shock ε^o_{ikt}, and the coefficients γ_N and γ_X on the state variables N^o_{kt} and X^o_{kt}, respectively, in the investment payoff function $\pi(\cdot)$.

The econometric estimation technique we use employ a two-step semi-parametric estimation procedure following Pakes, Ostrovsky and Berry (2007) and Lin (2013). In the first step, the continuation value is estimated non-parametrically and this estimate is used to compute the predicted probabilities of investment. In the second step, the parameters $\theta = (\gamma_N, \gamma_X, \sigma^o)$ are estimated by matching the predicted probabilities with the actual probabilities in the data using generalized method of moments (GMM).

For the first step in the estimation, we first estimate the transition matrix M, which describes the evolution of the state variables N^o_{kt} and X^o_{kt} over time conditional on not investing. In particular, the transition matrix M gives, for each combination of state variables this period, the probability of transitioning to each combination of state variables the next period conditional on not investing this period. The element in each row *r* and each column *c* of the transition matrix M is $M_{rc} = \Pr(\Omega^o_{k,t+1} = c \mid \Omega^o_{kt} = r, I^o_{ikt} = 0)$. We estimate M non-parametrically using empirical averages. We therefore assume rational expectations on the part of potential eyeglass owners, namely that their expectations about the evolution of state variables over the time period of our data set were consistent with the actual evolution realized.

Let $\overline{g}$ be the vectorized investment policy function, which is a vector whose length is the number of combination of state variables and whose value at each component is the investment policy function $g(\cdot)$ evaluated at a particular combination of state variables. $\overline{g}$ gives the probability of investment in owning glasses for every tuple of state variables. We estimate $\overline{g}$ using empirical averages:

$$\overline{g}(N^o_{kt}, X^o_{kt}) = \Pr(I^o_{ikt} = 1 \mid N^o_{kt}, X^o_{kt}).$$

From equation (3), the vectorized continuation value $\overline{V}^c$, which is a vector whose length is the number of combination of state variables and whose value at each component is the continuation value $V^c(\cdot)$ evaluated at a particular combination of state variables, can be specified in vector form as:

$$\overline{V}^c = M(\beta \overline{V}^c + \sigma^o \overline{g}),$$

where M is the empirical transition matrix, β is the discount rate, and $\overline{g}$ is the vector of empirical investment probabilities. Since this is an infinite horizon problem, we estimate the continuation value by solving for the fixed point $\hat{V}^c$, which, from Blackwell's Theorem, is unique. We then use this estimate $\hat{V}^c$ to form the predicted probability of investment in owning glasses, which from equation (4) can be specified in vector form as:.

$$\hat{g}(N^o_{kt}, X^o_{kt}; \theta) = -\frac{\beta \hat{V}^c - N^o_{kt}{}'\gamma_N - X^o_{kt}{}'\gamma_X}{\sigma}.$$

In the second step of the estimation procedure, we estimate the parameters $\theta = \left(\gamma_N, \gamma_X, \sigma^o\right)$ by finding the parameters that best match the investment probability predicted by our model with the respective empirical investment probabilities in the data using GMM. We use the following moment function:

$$\psi = \left(\hat{g}(N^o_{kt}, X^o_{kt}; \theta) - \bar{g}(N^o_{kt}, X^o_{kt})\right) n(N^o_{kt}, X^o_{kt} \mid I^o_{ik,t-1} = 0),$$

where $n(N^o_{kt}, X^o_{kt} \mid I^o_{ik,t-1} = 0)$ counts the number of times each state $\Omega^o_{kt} = (N^o_{kt}, X^o_{kt})$ occurs where there is a student who has not yet invested by time t. Thus, ψ is a vector where each row represents difference in the predicted and empirical probabilities of investment in owning glasses for each of the possible states of the world Ω^o_{kt}, and is weighted by the number of times that state occurs in the data. The population moment condition is that in expectation, ψ equals zero. Additional moments are constructed by interacting the above moments ψ with the state variables Ω^o_{kt}.

The GMM estimator $\hat{\theta}$ is the solution to the problem:

$$\min_\theta \left(\frac{1}{n\_obs} \Sigma \psi\right) W_n^{-1} \left(\frac{1}{n\_obs} \Sigma \psi\right),$$

where n_obs is the number of student-time observations. Since the system is exactly identified, an identity matrix is used as the weight matrix W_n.

Standard errors are formed by a nonparametric bootstrap. Classes are randomly drawn from the data set with replacement to generate 100 independent panels of size equal to the actual sample size. The structural econometric model is run on each of the new panels. The standard error is then formed by taking the standard deviation of the estimates from each of the random samples.[10]

The problem of spatially correlated unobservables can be addressed by interpreting the investment payoff in the model as expected payoff conditional on observables, where the expectation is taken over the correlated unobservables. In this case, the coefficients on the strategic variables measure the expected effect of the strategic variables, where the expectation is taken over the correlated unobservables. Thus, the model is still able to separately identify the (expected) strategic interaction from the correlated unobservable. As shown by results reported in the online Appendix of Lin's (2013) Monte Carlo experiments analyzing the effect of a state variable that is observed by the decision-makers (in this case, students) when they make their decisions but unobservable to the econometrician (i.e., a common shock), the bias introduced by spatially correlated unobservables is small. This is consistent with Pakes, Ostrovsky and Berry (2007), who find that the bias from serially correlated common shocks is small.

Dynamic Usage Game

For our model of the dynamic usage game, the action variable I^u_{ikt} is equal to 1 for student *i* in class *k* at time *t* if the student uses glasses for the first time at time *t*, and 0 if the student does not yet use glasses at time *t*. I^u_{ikt} is coded as missing for student *i* in class *k* at time *t* if the student already used glasses in the previous period *t*-1, since then he or she no longer has a usage decision to make.

[10] One challenge is determining whether the model has converged at a global or local minimum. We experimented with several combinations of starting values to initialize the parameters to be estimated. We found the model is robust to the starting value.

Similar to the decision of ownership, we define two observable endogenous state variables and 11 exogenous state variables in $\Omega_{kt}^{u} = (N_{kt}^{u}, X_{kt}^{u})$. In this model, N_{kt}^{u} includes the fraction of classmates in class k who use glasses by time t and the fraction of myopic classmates in class k who use glasses by time t. The exogenous state variables in X_{kt}^{u} include the 10 exogenous state variables used in the dynamic ownership model and one additional variable: the fraction of classmates own eyeglasses in the baseline.

We discretize the two endogenous state variables into 10 bins each (1=lowest to 10=highest). In particular, we discretize fraction of myopic peers who use eyeglasses by time t into 10 equally spaced bins from 0.0 (lowest bin) to 1.0 (highest bin), with an increment of 0.1 between each bin. We discretize the fraction of all peers who use eyeglasses by time t into 10 equally spaced bins from 0.0 (lowest bin) to 0.50 (highest bin), with an increment of 0.05 between each bin.

We discretize the baseline class size; class average of baseline awareness of myopia status; class average of baseline misinformation; and class average of baseline myopia severity variables into 2 bins each (1=low or 2=high) as before. We also discretize the fraction of classmates own eyeglasses in the baseline into 2 bins (1=low or 2=high) with the cutoff defined as the median as well.

In addition to the observable state variables $\Omega_{kt}^{u} = (N_{kt}^{u}, X_{kt}^{u})$, the decision of a student i in class k of whether to use glasses in year t also depends on a shock ε_{ikt}^{u}, which is private information to the student and unobserved by either other classmates or by the econometrician. One source of the shock is utility or disutility of wearing one pair of eyeglasses at time t. This shock, which is observed only by the student owning eyeglasses, represents his or her physical feeling of wearing eyeglasses. For example, some students might feel dizzy or uncomfortable of wearing first time they wear eyeglasses. The shock may also include any private shocks to a student's cost or benefits of using glasses. We assume the error term is independently and identically distributed exponentially with parameter σ^u, which is among the parameters to be estimated.

The method of estimation is the same as that in the case of ownership described above.

Multi-Stage Game

In the third structural model, we expand our dynamic structural model to a multi-stage game. In the first stage, a student decides whether or not to own eyeglasses. In the second stage, conditional on owning eyeglasses, a student decides whether or not to use them. This model is our preferred model as it enables us to explicitly model each of the stages in the dynamic decision-making problem faced by myopic students. As a consequence, the analysis of strategic interactions in this multi-stage model is more complete than that of the previous models because it incorporates the second stage of usage decision along with the first ownership decision, not only by allowing for strategic interactions in both stages but also by linking the decisions made in each stage together in one integrated, multi-stage model that recognizes that the decisions made in the first decision depend on the value of advancing to the second stage (Lin, 2013).

Similar to our previous two structural models, we define the observable state variables as $\Omega_{kt} = (N_{kt}, X_{kt})$ which can be decomposed as four endogenous state variables and 11 exogenous state variables. The four endogenous state variables denoted as N_{kt} includes the fraction of classmates in class *k* who own glasses by time *t* and the fraction of myopic classmates in class *k* who own glasses by time *t*, as well as the fraction of classmates in class *k* who use glasses by time *t* and the fraction of myopic classmates in class *k* who use glasses by time *t* conditional on owning eyeglasses by the time of *t*. The 11 exogenous state variables in X_{kt} are the same 11 exogenous state variables used in the dynamic usage model. As before, we discretize the four endogenous state variables into 10 bins each and the 11 exogenous state variables into 2 bins each (low or high), using the same bins as in both the dynamic ownership model and the dynamic usage model.

In addition to the publicly observable state variables $\Omega_{kt} = (N_{kt}, X_{kt})$, the time-*t* decision of each myopic student *i* in class *k* also depends on two types of shocks that are private information to the students and unobserved by either other students or by the econometrician. The first source of private information is a shock to the utility of owning one pair of eyeglasses at time *t*, ε^{o}_{ikt}. This shock, which is observed only by the student owning eyeglasses, can represent his or her aesthetic feeling of the looking of eyeglasses before wearing it, as well as any private shocks to a student's cost or benefits of owning glasses. We assume the error term is independently and identically distributed exponentially with parameter σ^{o}, which is among the parameters to be estimated.

The second source of private information is a shock to the utility of wearing one pair of eyeglasses at time *t*, ε^{u}_{ikt}. This shock, which is observed only by the student owning eyeglasses, can represent a student's physical feeling of wearing eyeglasses, as well as any private shocks to a student's cost or benefits of using glasses. For example, some students might feel dizzy or uncomfortable of wearing first time they wear eyeglasses. We assume the error term is independently and identically distributed exponentially with parameter σ^u, which is among the parameters to be estimated.

The sequential decision making problem of each myopic student i in class k is a two-stage optimization problem and can be solved backward using dynamic programming (Dixit and Pindyck, 1994; Lin, 2013). In the second, or usage, stage a myopic student who owns a pair of eyeglasses but has not yet used it must decide whether and when to use it. Assume that the payoff $\pi^u(N_{kt}, X_{kt}, \varepsilon_{it}; \theta)$ from using eyeglasses in class k in time t can be separated into a deterministic component and a stochastic component as follows:

$$\pi^u(N_{kt}, X_{kt}, \varepsilon_{it}; \theta) = \pi_0^u(N_{kt}, X_{kt}; \theta) + \varepsilon_{ikt}^u,$$

where the deterministic component $\pi_0^u(\cdot)$ is linear in the state variables:

$$\pi_0^u(N_{kt}, X_{kt}; \theta) = N_{kt}'\gamma_N + X_{kt}'\gamma_X,$$

and where $\theta = (\gamma_N, \gamma_X, \sigma)$ denotes the parameters to be estimated.

The coefficients γ_N and γ_X measure the effects of the state variables N_{kt} and X_{kt}, respectively, on the payoff to use glasses. A positive coefficient γ_N would indicate that a student is more likely to use glasses if his or her peers do. One source of a positive peer effect is that students may imitate the behaviors of their peers, perhaps to "keep up with the Joneses" (Luttmer, 2005, Fliessbach et al., 2007, Card et al., 2010), in the sense that myopic students may just mimic their peers' usage decisions without really understand the benefit and cost of using a pair of eyeglasses. The second source of a positive peer effect is a positive learning effect in the sense that myopic students choose to use eyeglasses due to the fact that they learn from their peers that use eyeglasses yields net benefits. These benefits that students can learn from their peers include not only better vision and better classroom performance, but also perhaps the potential aesthetic benefits of wearing glasses, if they think the glasses look good on their peers. A negative value for γ_N would indicate that a student is less likely to use glasses if his or her peers do. This could be due to a negative learning effect in the sense that myopic students learn from their peers that using eyeglasses yields net costs.

The value function for a myopic student *i* in class *k* at time *t* who owns but has not used eyeglasses is given by:

$$V^o(N_{kt}, X_{kt}, \varepsilon^u_{ikt}; \theta) = \max\{\pi^u(N_{kt}, X_{kt}, \varepsilon^u_{ikt}; \theta), \beta V^{co}(N_{kt}, X_{kt}; \theta)\}.$$

The student who already own eyeglasses will choose to use eyeglasses if and only if the payoff $\pi^u(N_{kt}, X_{kt}, \varepsilon^u_{ikt}; \theta)$ from using glasses exceeds β times the continuation value $V^{co}(\cdot)$ to waiting. The continuation value $V^{co}(\cdot)$ is the expected value of the next period's value function, conditional on not using glasses in the current period, and is given by:

$$V^{co}(N_{kt}, X_{kt}; \theta) = E[V^o(N_{k,t+1}, X_{k,t+1}, \varepsilon^u_{ik,t+1}; \theta) \mid N_{kt}, X_{kt}, I^u_{ikt} = 0].$$

Let $g^u(N_{kt}, X_{kt}; \theta)$ denote the probability that a myopic student *i* in class *k* at time *t* who owns eyeglasses but has not used them at time *t* chooses to use glasses, conditional on the publicly available information $\Omega_{kt} = (N_{kt}, X_{kt})$ at time *t*, but not on the private information ε^u_{ikt}. The investment probability function $g^u(N_{kt}, X_{kt}; \theta)$ represents a student's perceptions of the probability that a classmate who own eyeglasses but has not yet used it will decide to use at time *t*.

Using the exponential distribution for ε^u_{ikt} the continuation value $V^{co}(\cdot)$ reduces to:

$$V^{co}(N_{kt}, X_{kt}; \theta) = E[\beta V^{co}(N_{k,t+1}, X_{k,t+1}, \varepsilon_{ik,t+1}; \theta) + \sigma^u g(N_{k,t+1}, X_{k,t+1}; \theta) \mid N_{kt}, X_{kt}, I^u_{ikt} = 0],$$

and the use probability $g^u(\cdot)$ reduces to:

$$g^u(N_{kt}, X_{kt}; \theta) = \exp\left(-\frac{\beta V^{co}(N_{kt}, X_{kt}; \theta) - \pi_0^u(N_{kt}, X_{kt}; \theta)}{\sigma^u} \right) ,$$

as shown by Lin (2013).

In the first, or ownership, stage a myopic student i in class k without eyeglasses must decide whether and when to own one pair of eyeglasses. Owning to the sequential nature of the decisions, the publicly observed deterministic component of the payoff to owning eyeglasses in the first place is equal to the expected value of using glasses in the second stage, net the cost of owning glasses:

$$\pi^o{}_0(N_{kt}, X_{kt}; \theta) = E_{\varepsilon^u}[V^o(N_{kt}, X_{kt}; \theta) \mid N_{kt}, X_{kt}] - c^o(X_{kt}; \theta) ,$$

where the cost $c^o(X_{kt}; \theta)$ of owning glasses is giving by the following linear function of the treatment dummies, since the treatment group the student is in determines his or her costs to owning glasses:

$$c^o(X_{kt}; \theta) = -X_{kt}{}'\alpha .$$

Assume that the actual payoff to own eyeglasses at time t also includes a privately observed stochastic component as well:

$$\pi_0^o(N_{kt}, X_{kt}; \theta) = E_{\varepsilon^u}\left[V^o(N_{kt}, X_{kt}; \theta) \mid N_{kt}, X_{kt} \right],$$

where the stochastic component ε_{ikt}^o represents student i's aesthetic feeling of the looking of eyeglasses before wearing it, as well as any private shocks to a student's cost or benefits of owning glasses, at time t.

The payoff of a myopic student i in class k at time t who does not yet own eyeglasses is given by:

$$V^{n}(N_{kt},X_{kt},\varepsilon^{o}_{ikt};\theta)=\max\{\pi^{o}(N_{kt},X_{kt},\varepsilon^{o}_{ikt};\theta),\beta V^{co}(N_{kt},X_{kt};\theta)\},$$

where $V^{cn}(\cdot)$ is the continuation value to waiting instead of owning eyeglasses at time *t*. The continuation value to waiting is the expectation over the state variables and shocks of the next period's value function, conditional on not owning this period:

$$V^{cn}(N_{kt},X_{kt};\theta)=E[V^{n}(N_{k,t+1},X_{k,t+1},\varepsilon^{o}_{ik,t+1};\theta)\mid N_{kt},X_{kt},I^{o}_{ikt}=0],$$

where I^{o}_{ikt} is an indicator for whether ownership began at time *t*.

Let $g^{o}(N_{kt},X_{kt};\theta)$ denote the probability that a myopic student *i* in class *k* without owning eyeglasses at time *t* chooses to own eyeglasses, conditional on publicly observable information $\Omega_{kt}=(N_{kt},X_{kt})$, but not on the private information ε^{o}_{ikt}. As with the use probability, the current value of the ownership represents a myopic student's perceptions of the probability that a peer without eyeglasses would decide to own one at time *t*, given the state variables of $\Omega_{kt}=(N_{kt},X_{kt})$ at time *t*; its expected value at time *t*+1 represents a myopic student's expectation of his or her own probability of owning eyeglasses in the next period.

Using exponential distribution for ε^{o}_{ikt}, the continuation value $V^{cn}(\cdot)$ to waiting instead of owning can be reduced to:

$$V^{cn}(N_{kt},X_{kt};\theta)=E[\beta V^{cn}(N_{k,t+1},X_{k,t+1},\varepsilon_{ik,t+1};\theta)+\sigma^{o}g(N_{k,t+1},X_{k,t+1};\theta)\mid N_{kt},X_{kt},I^{o}_{ikt}=0],$$

and the own probability $g^{o}(\cdot)$ can be reduced to the following function of the continuation values, state variables and parameters:

$$g^{o}(N_{kt},X_{kt};\theta)=\exp\left(-\frac{\beta V^{cn}(N_{kt},X_{kt};\theta)-\left(\beta V^{co}(N_{kt},X_{kt};\theta)+\sigma^{u}g^{u}(N_{kt},X_{kt};\theta)\right)}{\sigma^{o}}\right).$$

Owning to the sequential nature of the two-stage decision makings, the continuation value $V^{co}(\cdot)$ and the use probability $g^{u}(\cdot)$ in the second stage appear in the expression for the own probability $g^{o}(\cdot)$ in the first stage.

The ex ante expected payoff of a myopic student *i* in class *k* without owning eyeglasses at time *t*=0, where expectations are taken over the private information is utility or disutility of aesthetic feeling of owning one pair of eyeglasses, is given by:

$$E_{\varepsilon^o}[V^n(N_{k0},X_{k0},\varepsilon^o_{ik0};\theta)\,|\,N_{k0},X_{k0}]=\beta V^{cn}(N_{k0},X_{k0},\varepsilon^o_{ik0};\theta)+\sigma^o g^o(N_{k0},X_{k0},\varepsilon^o_{ik0};\theta).$$

The econometric estimation technique we use is similar to that of the structural model of ownership and usage decision above. In particular, the econometric estimation technique we use employ a two-step semi-parametric estimation procedure following Pakes, Ostrovsky and Berry (2007) and Lin (2013). In the first step, the continuation values for both stages are estimated non-parametrically and these estimates are used to compute the predicted probabilities of ownership and usage. In the second step, the parameters $\theta=(\gamma_N,\gamma_X,\sigma^u,\sigma^o)$ are estimated by matching the predicted probabilities with the actual probabilities in the data using generalized method of moments (GMM).

4. Results

Results of Reduced-Form Model

The first-stage and second-stage results of our IV regressions of the reduced-form ownership and usage equations (1) and (2) are presented in Appendix Tables 1 and 2, respectively. We tried several different combinations of our three instruments: fraction of classmates aware of their myopia status, class average of household wealth, and fraction of classmates who own glasses in the baseline (three sets of two out of the three and the last set of all three variables). However, we do not find any statistically significant peer effects in either the ownership decision or the usage decision. Because these reduced-form models do not explicitly model the dynamic decision-making and may not fully address the endogeneity issue (few of them pass all weak instruments and under-identification tests), we believe these reduced-form results are less realistic than the results of the structural models that follow and thus may be misleading indicators of the actual peer effects that take place (Lin, 2013).

Table 2 presents the results of OLS regression of reduced-form models using lagged values of both the fraction of peers who own eyeglasses and the fraction of peers who wear eyeglasses. We find statistically significant effects of peers' decisions at the short term on a student's decisions at the medium term (specifications 2 and 4). Specifically, a 10% increase of the fraction of classmates owning glasses in the short term increases the likelihood of a myopic student owning glasses by 5 percentage points in the following medium term (p-value = 0.004). However, the fraction of classmates who use eyeglasses at the short term does not have a significant effect on myopic student's use decision in the next period. In the case of use, a 10% increase of the fraction of classmates owning glasses in the short term decreases the likelihood of myopic student using glasses by 31 percentage points in the following medium term (p-value = 0.000). In contrast, a 10% increase of the fraction of classmates using glasses in the short term increases the likelihood of myopic student owning glasses by 43 percentage points in the following medium term (p-value = 0.000).

Although peers' decisions in the short term affect a myopic student's ownership and usage decisions in the medium term, peers' baseline ownership and usage do not have a significant effect on a myopic student's ownership and usage decisions in the short term.

We also ran the lagged model using two instruments for the peers' ownership and usage decisions: the fraction of classmates aware of their myopia status, and the class average of household wealth.[11] However, we do not find any statistically significant lagged peer effects in either the ownership decision or the usage decision (results shown in the Appendix Table 3 and 4). Like the results in Appendix Table 1 and 2, because these reduced-form models do not explicitly model the dynamic decision-making and may not fully address the endogeneity issue (few of them pass all weak instruments and under-identification tests), we believe these reduced results results are less realistic than the results of the structural models that follow and thus may be misleading indicators of the actual peer effects that take place (Lin, 2013).

Results of Structural Models

Dynamic Ownership Game

Table 3 presents the results of the dynamic ownership model. We tried many different sets of initial guesses for the parameters, and report the results that minimize the weighted sum of squared moments.

We find that the coefficients in the ownership payoff function on the discretized fraction of myopic peers who own glasses and on the discretized fraction of all peers who own glasses are both significant and negative, which indicates that an increase in the fraction of peers who own eyeglasses reduces a myopic student's payoff to a myopic student from owning eyeglasses.

[11] Because the endogenous variables include the fraction of classmates who own glasses in the baseline in the case of short term decision, we do not use fraction of classmates who own glasses in the baseline as one of our instruments as we do in the regressions of equations (1) and (2).

We also find the cost of obtaining eyeglasses or liquidity constraint plays an important role of the ownership decisions. Specifically, being in control schools without any subsidized eyeglasses significantly reduces the payoff from owning eyeglasses, and being in schools in which students are expected to spend some non-monetary ordeal to redeem the voucher for a free pairs of eyeglasses significantly reduces their payoff from owning eyeglasses, while being in schools where free eyeglasses were delivered in schools significantly increases their payoff from owning eyeglasses. Conditional on the cost of obtaining eyeglasses, we also find providing information increases the payoffs from owning eyeglasses.

In addition, we find class average of baseline awareness of myopia status and class average of baseline myopia severity are positively associated with the payoff from owning glasses, which is intuitive. However, we find the larger the class size the lower the payoff to a myopic student of owning eyeglasses. And we find that having more classmates with misinformation is actually positively associated with the payoff to a myopic student from owning glasses.

All our parameters are statistically significant at a 1% level (except for the coefficient on class average of baseline misinformation, which is significant at a 5% level).

Dynamic Usage Game

Table 4 presents the results of the dynamic usage model. We tried many different sets of initial guesses for the parameters, and report the results that minimize the weighted sum of squared moments.

We find that the fraction of myopic peers who use glasses decreases the payoff to a myopic student from using glasses, while the fraction of all peers who use glasses increases the payoff to a myopic student from using glasses.

In addition, we find even the relief of liquidity constraint does not necessarily guarantee myopic students wearing eyeglasses, since having the glasses offered for free (the free only group) has a negative effect on the payoff from using glasses. Providing information helps increase the payoff from using eyeglasses only in the case of free eyeglasses (as the coefficient of free and training is positive).

What is more, we find the baseline class size, class average of baseline awareness of myopia status, class average of baseline misinformation and class average of baseline myopia severity are positively associated with the payoff to a myopic student from wearing eyeglasses, which is expected. Surprisingly, however, we find that the fraction of classmates own eyeglasses in the baseline is negatively associated with the payoff to a myopic student from wearing eyeglasses.

All parameters are statistically significant at a 1% level (except for the coefficient on class average of baseline misinformation, for which we fail to reject the null at a 10% level).

Multi-Stage Game

Table 5 presents the results of multi-stage model. We tried many different sets of initial guesses for the parameters, and report the results that minimize the weighted sum of squared moments.

We start by interpreting the coefficients in the usage payoff function. We find that the fraction of all peers who own glasses significantly increases the payoff to a myopic student from using glasses at a 5 percent level. Neither the fraction of myopic peers who use glasses nor the fraction of all peers who use glasses has a significant effect on the payoff to a myopic student from using glasses.

Compared to being in the control group, being in any of the treatment groups providing glasses either for free or with an ordeal, and with or without a training program has a less negative effect on the payoff from wearing glasses that being in the control group without any of the treatments. Being in the control group has the most negative effect on the usage payoff, followed by being provided the training program only and then by being provided the ordeal only. In contrast, being in the ordeal and training group; the free only group; or the free and training group has no significant negative effect on the usage payoff.

Among the other parameters in the usage payoff function, we find the class average of baseline awareness of myopia status is positively and significantly associated with the payoff to a myopic student from wearing eyeglasses and class average of baseline misinformation is negatively and significantly associated with the payoff to a myopic student from wearing eyeglasses. Thus, the more aware and better informed the class on average, the higher the payoff to a student from wearing glasses. In addition, we find that baseline fraction of peers who own glasses is positively and significantly associated with the payoff to a myopic student from wearing eyeglasses which implies that the pre-existing experience of ownership matters.

We then interpret the coefficients in the ownership payoff function. We find that each of the treatment dummies has a significant positive effect on the payoff from owning glasses, and that the magnitudes of the treatment dummies are roughly equal to each other. Thus, each treatment group has a roughly equal positive effect on the payoff from ownership.

As for the values of the parameters governing the distribution of private information, both the mean σ^u shock to the payoff from usage and the mean σ^o shock to the payoff from ownership are statistically significant, with the former greater in magnitude than the latter.

In terms of economic significance, one way to interpret both the mean σ^u shock to the payoff from usage and the mean σ^o shock to the payoff from ownership is to compare them with the magnitudes of the dummies for treatment, such as free only or training only, in corresponding payoff function (following Lin, 2013). For example, the ratio of sigma to the magnitude of the corresponding treatment dummy measures the importance of private information relative to the complete relief of the liquidity constraint and to the provision of the training program, respectively, in the decision making of glasses ownership and usage. In both cases, a high value of the ratio indicates a high relative importance of private information.

In the usage payoff function, the mean of the private information shock is roughly equal in magnitude to the control dummy. Thus, private information has roughly the same magnitude an effect on the payoff from using glasses as does not being provided either free glasses, an ordeal mechanism, or a training program.

In addition, we can also compare the magnitude of the parameters of peer effects and treatment dummies (relief of liquidity constraint completely by free glasses or partially by ordeal mechanism; and/or the provision of a training program) and interpret it as the relative importance of peer effects in payoff functions. The only statistically significant peer effect parameter is the effect of the fraction of all peers who own glasses on the usage payoff function. Its magnitude is about 23 times lower than the control dummy, which means that not being provided any treatment has a detrimental effect on the payoff from wearing glasses 2.3 times larger than an increase in the fraction of all peers who own glasses from 0.0 to 0.50 (corresponding to an increase in the discretized fraction of all peers from the lowest of the 10 bins to the highest). Since the coefficients on the ordeal and training dummy, the free only dummy, and the free and training dummy are all insignificant, this means that, when compared with the control group, providing the ordeal with a training program; providing glasses for free; or providing free glasses and a training program has a positive effect on the payoff from using glasses that is roughly 2.3 times more important that increasing the fraction of all peers who own glasses from 0.0 to 0.50 (corresponding to an increase in the discretized fraction of all peers from the lowest of the 10 bins to the highest). In other words, the peer effect is roughly half as important as partially relieving the liquidity constraint combined with providing a training program; completely relieving the liquidity constraint; or completely relieving the liquidity constraint combined with providing a training program.

5. Conclusion

When myopic students make decisions about whether to own and/or use glasses, peer effects might play a role in their decision-making. In this paper, we take advantage of a large-scale field experiment in rural China that provides free eyeglasses and training to 3,177 myopic students among 485 classes in 252 primary schools. We collected three rounds of glasses ownership and usage data, We estimate peer effects using both reduced-form models and structural models of both the ownership decision and the usage decision; as well as a structural model of the multi-stage timing game in which the first stage is the decision to own glasses and, conditional on deciding to own, the second stage is the decision to use glasses.

We do not find any statistically significant peer effects in either the ownership decision or the usage decision in the reduced-form models. Because these reduced-form models do not explicitly model the dynamic decision-making and may not fully address the endogeneity issue (few of them pass all weak instruments and under-identification tests), we believe these reduced-form results are less realistic than the results of our structural models and thus may be misleading indicators of the actual peer effects that take place (Lin, 2013).

When we use a structural model and estimate peer effects in the decision of ownership as a dynamic ownership game, we find that the fraction of peers who own eyeglasses has a significant negative effect on the payoff to a myopic student from owning eyeglasses. We also find the cost of obtaining eyeglasses or liquidity constraint plays an important role of the ownership decisions.

According to the results of our structural model of the dynamic usage game, the fraction of myopic peers who use glasses has a significant negative effect on the payoff to a myopic student from using glasses, while the fraction of all peers who use glasses has a significant positive effect on the payoff to a myopic student from using glasses. In addition, we find even the relief of liquidity constraint does not necessarily guarantee myopic students wearing eyeglasses.

In our structural model of the multi-stage game, we define the first stage as the decision to own glasses and, conditional on deciding to own, the second stage is the decision to use glasses. This model is our preferred model as it enables us to explicitly model each of the stages in the dynamic decision-making problem faced by myopic students. As a consequence, the analysis of strategic interactions in this multi-stage model is more complete than that of the previous models because it incorporates the second stage of usage decision along with the first ownership decision, not only by allowing for strategic interactions in both stages but also by linking the decisions made in each stage together in one integrated, multi-stage model that recognizes that the decisions made in the first decision depend on the value of advancing to the second stage (Lin, 2013).

According to the results of our structural model of the multi-stage game, the fraction of all peers who own glasses has a significant positive effect on the payoff to a myopic student from using glasses. The peer effect is roughly half as important as partially relieving the liquidity constraint combined with providing a training program; completely relieving the liquidity constraint; or completely relieving the liquidity constraint combined with providing a training program.

The research presented in this paper is important for both peer effects and dynamic structural modeling studies in the field of development economics. While most of the dynamic structural econometric models in development economics model single-agent dynamic decision-making (see e.g., Todd and Wolpin, 2010; Duflo, Hanna and Ryan, 2012; Mahajan and Tarozzi, 2011), our structural models model a dynamic game between decision-makers, and thus allow for both dynamic and strategic decision-making. Our structural econometric models of the dynamic game between school children in rural China enables us to estimate peer effects.

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Figure 1. Study Region

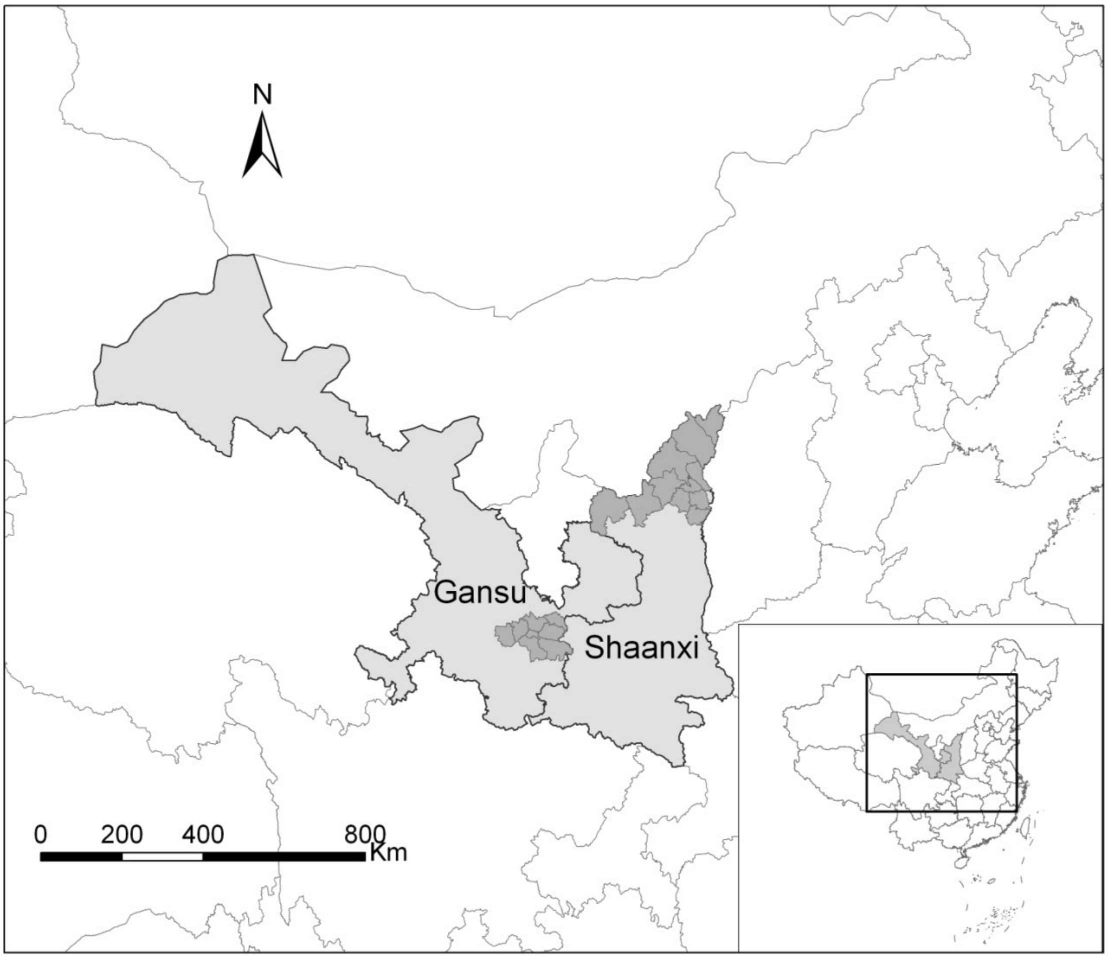

Figure 2: Experimental Design

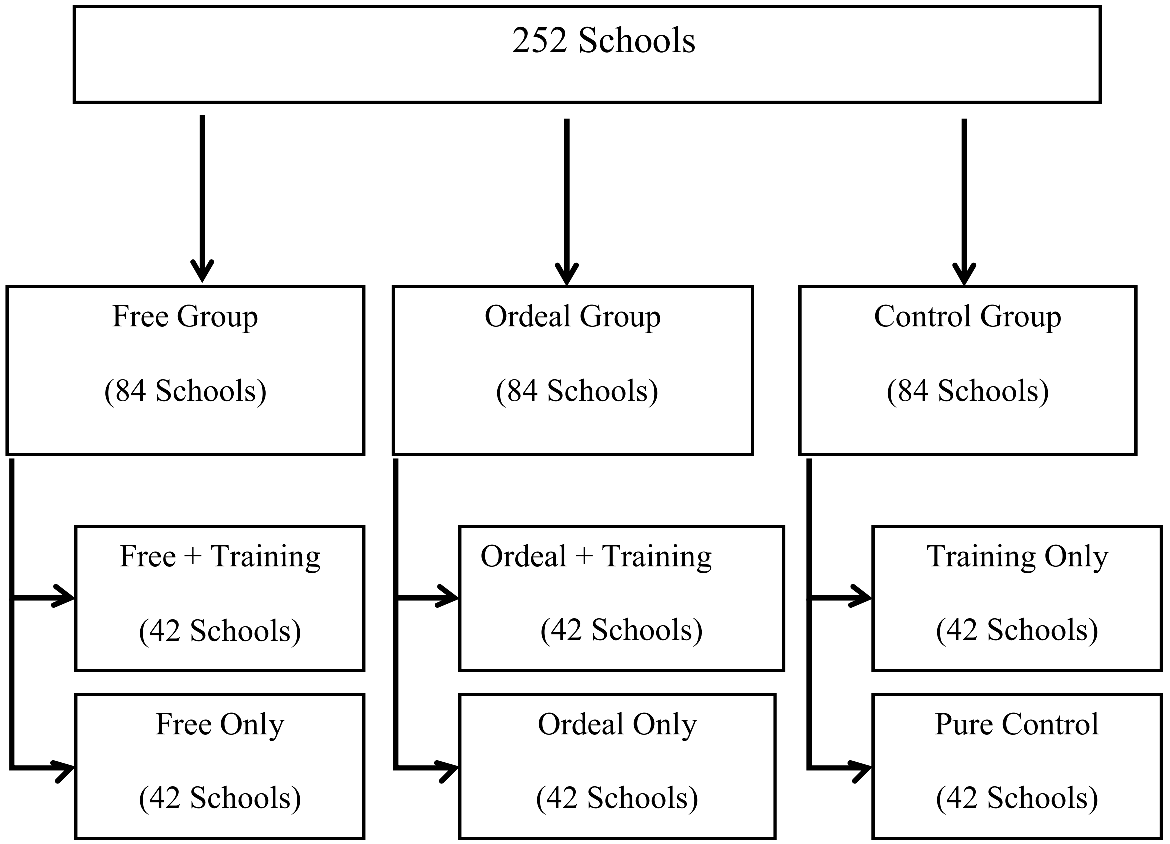

Figure 3: Data Collection and Intervention Timeline

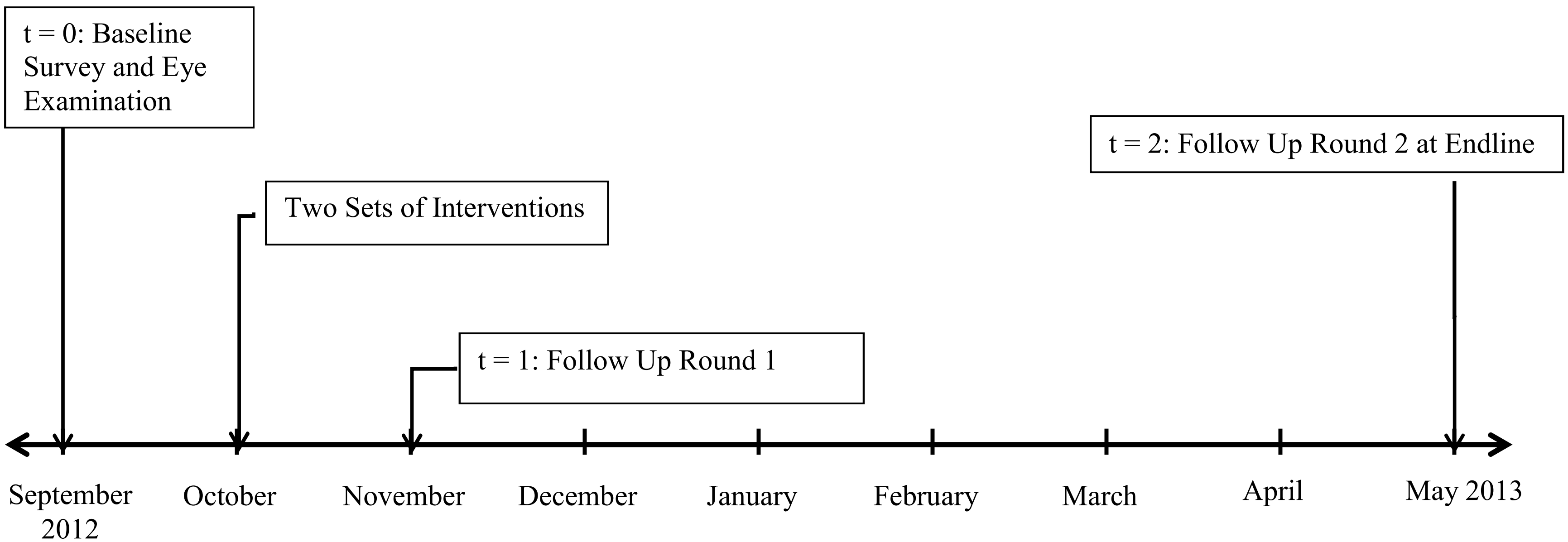

Table 1. Baseline Descriptive Statistics and Balance Check

	Mean (SD)	Coefficients (Standard error) on:					N	P-value: Equality of All Groups
	Control, No Training	Control, Training	Ordeal, No Training	Free, No Training	Ordeal, Training	Free, Training		
Already owned glasses in the baseline (dummy)	0.208	-0.037*	0.004	-0.042*	-0.021	-0.007	3177	0.049
	(0.406)	(0.022)	(0.025)	(0.024)	(0.024)	(0.025)		
Already used glasses in the baseline (dummy)	0.167	-0.044**	-0.017	-0.039*	-0.012	-0.008	3177	0.048
	(0.373)	(0.022)	(0.024)	(0.022)	(0.025)	(0.024)		
Male (dummy)	0.527	-0.049	-0.039	-0.052*	-0.050	-0.045	3177	0.020
	(0.500)	(0.031)	(0.029)	(0.027)	(0.031)	(0.029)		
Grade5 (dummy)	0.608	-0.031	0.002	0.000	0.005	-0.009	3177	0.020
	(0.489)	(0.030)	(0.031)	(0.028)	(0.032)	(0.028)		
Test score (1 = low 2 = median, 3= high)	2.198	0.037	-0.111	0.016	-0.054	0.073	3176	0.059
	(0.821)	(0.066)	(0.067)	(0.066)	(0.063)	(0.063)		
Believe he/she is myopic (dummy)	0.468	-0.026	0.013	-0.012	-0.000	-0.015	3157	0.044
	(0.499)	(0.035)	(0.035)	(0.035)	(0.034)	(0.033)		
Believe wearing glasses harms vision (dummy)	0.400	0.025	-0.050	-0.020	0.001	0.052*	3177	0.045
	(0.490)	(0.034)	(0.036)	(0.034)	(0.033)	(0.031)		
Severity of myopia ((1 = low 2 = median, 3= high)	2.314	-0.022	-0.000	-0.060	-0.050	-0.022	3175	0.050
	(0.623)	(0.033)	(0.034)	(0.038)	(0.040)	(0.033)		
Student boards at school (dummy)	0.330	0.036	0.003	-0.009	0.009	0.031	3170	0.026
	(0.471)	(0.027)	(0.031)	(0.027)	(0.031)	(0.027)		
At least one family member wears glasses (dummy)	0.248	-0.052	-0.087*	-0.034	-0.014	0.042	3174	0.231
	(0.432)	(0.054)	(0.049)	(0.056)	(0.062)	(0.053)		
Both parents migrant elsewhere for work (dummy)	0.101	0.007	0.013	-0.011	-0.009	-0.006	3147	0.038
	(0.302)	(0.018)	(0.017)	(0.017)	(0.017)	(0.016)		
Father education (1 = illiterate; 2= 9 years; 3=12 years or higher)	2.112	-0.024	-0.064*	-0.022	-0.009	-0.009	3163	0.031
	(0.467)	(0.031)	(0.037)	(0.031)	(0.031)	(0.030)		
Mother education (1 = illiterate; 2= 9 years; 3=12 years or higher)	1.832	0.107***	0.024	0.050	0.092***	0.088**	3154	0.052
	(0.564)	(0.039)	(0.036)	(0.042)	(0.035)	(0.037)		
Household assets (1 = poor tertile; 2 = medium tertile; 3 = rich tertile)	2.194	-0.031	-0.055	-0.047	0.011	0.009	3032	0.151

	(0.782)	(0.051)	(0.057)	(0.056)	(0.048)	(0.052)

Notes: Table uses full baseline sample which included 3,177 myopic students among 485 classes in 252 primary schools. First column shows the mean and standard deviation of the baseline characteristic in the comparison (control, no training) cell. Columns 2 through 6 show coefficients and standard errors (in parentheses) from a regression of the characteristic on other five treatment dummies. Standard errors are clustered at the school level. The final column shows the p-value from a Wald test that coefficients are jointly zero. Significance codes: * 10% level, ** 5% level, and *** 1% level.

Table 2. Results of OLS Regression of Lagged Reduced-Form Model

	Dependent variable is probability of:			
	owning glasses in the short term (t=1)	*owning glasses in the medium term (t=2)*	*using glasses in the short term (t=1)*	*using glasses in the medium term (t=2)*
	(1)	(2)	(3)	(4)
fraction of classmates who own glasses at baseline (t=0)	-0.401		0.701	
	(0.134)		(0.109)	
fraction of classmates who use glasses at baseline (t=0)	0.192		-0.316	
	(0.531)		(0.515)	
fraction of classmates who own glasses at the short term (t=1)		0.490***		-3.064***
		(0.166)		(0.298)
fraction of classmates who use glasses at the short term (t=1)		-0.257*		4.308***
		(0.146)		(0.282)
already owned glasses in baseline (t=0) (dummy)	0.279***	0.179***		
	(0.033)	(0.025)		
already used glasses in baseline (t=0) (dummy)			0.337***	0.318***
			(0.033)	(0.032)
male (dummy)	-0.011	-0.001	0.008	0.002
	(0.011)	(0.013)	(0.016)	(0.014)
grade 5 (dummy)	0.015	-0.006	-0.005	-0.031**
	(0.011)	(0.013)	(0.020)	(0.013)
test score (1 = low 2 = median, 3= high)	0.007	0.004	0.011	0.012
	(0.007)	(0.007)	(0.009)	(0.009)
believed at baseline (t=0) that he/she was myopic (dummy)	0.037***	0.033**	0.056***	0.064***
	(0.013)	(0.014)	(0.020)	(0.018)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.006	0.002	0.013	0.008
	(0.011)	(0.012)	(0.015)	(0.013)
myopia (1=low, 2=medium, 3=high)	0.013	0.043***	0.052***	0.035***
	(0.010)	(0.011)	(0.013)	(0.013)
at least one family member wears glasses (dummy)	-0.003	0.010	0.000	-0.009
	(0.012)	(0.013)	(0.015)	(0.015)
student boards at school (dummy)	0.001	0.003	0.046*	0.033

	(0.019)	(0.023)	(0.025)	(0.021)
both parents migrate for work (dummy)	0.004	0.006	-0.004	-0.014
	(0.017)	(0.020)	(0.023)	(0.022)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.000	-0.004	0.009	0.006
	(0.012)	(0.014)	(0.017)	(0.016)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.017	0.026**	0.026*	0.023*
	(0.010)	(0.012)	(0.014)	(0.014)
household wealth tertile	0.002	0.005	-0.002	-0.004
	(0.008)	(0.008)	(0.010)	(0.009)
pure control (dummy)	0.031	0.051	0.049	0.028
	(0.030)	(0.039)	(0.030)	(0.024)
ordeal only (dummy)	0.593***	0.413***	0.441***	0.423***
	(0.029)	(0.035)	(0.031)	(0.028)
ordeal and training (dummy)	0.659***	0.468***	0.525***	0.470***
	(0.030)	(0.038)	(0.037)	(0.036)
free only (dummy)	0.747***	0.510***	0.506***	0.500***
	(0.023)	(0.033)	(0.035)	(0.033)
free and training (dummy)	0.748***	0.514***	0.591***	0.491***
	(0.021)	(0.032)	(0.031)	(0.030)
constant	0.047	0.224***	-0.125	-0.072
	(0.056)	(0.062)	(0.085)	(0.060)
# Observations	2918	2856	2918	2918

Notes: Standard errors clustered at school level are reported in parentheses. Significance codes: * 10% level, ** 5% level, and *** 1% level.

Table 3. Results of Dynamic Ownership Model

	Dynamic ownership model
	(1)
sigma in distribution of shock to payoff from ownership	32.06***
	(0.07)
Coefficients in the ownership payoff function on:	
fraction of myopic peers who own glasses by time *t* (discretized)	-4.55***
	(0.59)
fraction of all peers who own glasses by time *t* (discretized)	-1.02***
	(0.17)
pure control (dummy)	-31.36***
	(0.14)
training only (dummy)	-24.53***
	(0.18)
ordeal only (dummy)	-0.69***
	(0.05)
ordeal and training (dummy)	7.71***
	(0.05)
free only (dummy)	25.45***
	(0.03)
free and training (dummy)	36.21***
	(0.01)
class size (discretized)	-5.45***
	(0.51)
baseline class average awareness of being myopic (discretized)	2.93***
	(0.45)
baseline class average of believing wearing glasses harms vision (discretized)	1.24**
	(0.49)
baseline class average of myopia severity level (discretized)	11.02***
	(0.48)

Notes: Standard errors calculated by bootstrap are reported in parentheses. Class averages are averaged over all classmates (including both myopic and non-myopic classmates). There are 970 observations spanning 485 classrooms. Significance codes: * 10% level, ** 5% level, and *** 1% level.

Table 4. Results of Dynamic Usage Model

	Dynamic usage model (1)
sigma in distribution of shock to payoff from usage	25.01***
	(0.12)
Coefficients in the usage payoff function on:	
fraction of myopic peers who use glasses by time *t* (discretized)	-3.33***
	(0.41)
fraction of all peers who use glasses by time *t* (discretized)	2.29***
	(0.55)
pure control (dummy)	-34.00***
	(0.16)
training only (dummy)	-29.59***
	(0.14)
ordeal only (dummy)	-6.42***
	(0.16)
ordeal and training (dummy)	-0.92***
	(0.15)
free only (dummy)	-3.54***
	(0.27)
free and training (dummy)	4.89***
	(0.33)
class size (discretized)	2.65***
	(0.32)
baseline class average awareness of being myopic (discretized)	8.66***
	(0.32)
baseline class average of believing wearing glasses harms vision (discretized)	0.30***
	(0.27)
baseline class average of myopia severity level (discretized)	12.11***
	(0.45)
baseline fraction of all peers who own glasses (discretized)	-22.10***
	(0.18)

Notes: Standard errors calculated by bootstrap are reported in parentheses. Class averages are averaged over all classmates (including both myopic and non-myopic classmates). There are 970 observations spanning 485 classrooms. Significance codes: * 10% level, ** 5% level, and *** 1% level.

Table 5. Results of Multi-Stage Model

	Multi-Stage Model (1)
sigma in distribution of shock to payoff from usage	2.6479***
	(0.4747)
sigma in distribution of shock to payoff from ownership	1.0000***
	(0.0000)
Coefficients in the usage payoff function on:	
fraction of myopic peers who own glasses by time *t* (discretized)	-0.3417
	(0.2588)
fraction of all peers who own glasses by time *t* (discretized)	0.109**
	(0.0541)
fraction of myopic peers who use glasses by time *t* (discretized)	0.0897
	(0.2013)
fraction of all peers who use glasses by time *t* (discretized)	0.0192
	(0.0413)
pure control (dummy)	-2.4706**
	(1.0492)
training only (dummy)	-1.2857***
	(0.3274)
ordeal only (dummy)	-0.9104***
	(0.2239)
ordeal and training (dummy)	-0.4728*
	(0.2629)
free only (dummy)	-0.5505*
	(0.3011)
free and training (dummy)	-0.2284
	(0.4942)
class size (discretized)	-0.846
	(0.5821)
baseline class average awareness of being myopic (discretized)	0.6049**
	(0.2789)
baseline class average of believing wearing glasses harms vision (discretized)	-0.2465***
	(0.09)
baseline class average of myopia severity level (discretized)	-0.0167
	(0.1297)
baseline fraction of peers who own glasses (discretized)	0.6176*
	(0.3344)
Coefficients in the ownership payoff function on:	
pure control (dummy)	0.2000***
	(0.0000)
training only (dummy)	0.2000***
	(0.0000)
ordeal only (dummy)	0.2000***
	(0.0000)
ordeal and training (dummy)	0.2000***

	(0.0000)
free only (dummy)	0.2000***
	(0.0000)
free and training (dummy)	0.2000***
	(0.0000)

Notes: Standard errors calculated by bootstrap are reported in parentheses. Class averages are averaged over all classmates (including both myopic and non-myopic classmates). There are 970 observations spanning 485 classrooms. Significance codes: * 10% level, ** 5% level, and *** 1% level.

Appendix

Appendix Table 1. Results of First-Stage Regressions of Reduced-Form Model

Panel A. Short Term Ownership

	Dependent variable is fraction of classmates who:							
	own glasses in the short term (t=1)	*use glasses in the short term (t=1)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Instrumental Variables								
fraction of classmates aware of their myopia status	0.407***	0.369***			0.289***	0.240***	0.286***	0.237***
	(0.041)	(0.048)			(0.043)	(0.049)	(0.042)	(0.048)
class average of household wealth	0.040*	0.039*	0.035	0.032			0.029	0.027
	(0.018)	(0.020)	(0.019)	(0.020)			(0.018)	(0.019)
fraction of classmates who own glasses in the baseline			0.905***	0.902***	0.589***	0.642***	0.572***	0.626***
			(0.089)	(0.104)	(0.083)	(0.094)	(0.084)	(0.096)
Individual Baseline Characteristics								
already owned glasses in baseline (t=0) (dummy)	0.008**	0.013***	-0.011***	-0.007**	-0.004*	-0.001	-0.004	-0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
male (dummy)	0.000	0.002	-0.002	-0.001	-0.001	-0.000	-0.001	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
grade 5 (dummy)	0.031***	0.027***	0.027***	0.022**	0.023***	0.018**	0.023***	0.018**
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
test score (1 = low 2 = median, 3= high)	0.000	0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
believed at baseline (t=0) that he/she was myopic (dummy)	-0.010***	-0.012***	0.005*	0.001	-0.007***	-0.009***	-0.007***	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.003	0.003	0.000	0.001	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)

myopia (1=low, 2=medium, 3=high)	0.005**	0.007***	0.002	0.005**	0.003*	0.006***	0.003*	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
at least one family member wears glasses (dummy)	-0.002	0.000	-0.001	0.002	-0.001	0.002	-0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
student boards at school (dummy)	-0.007	-0.002	-0.005	0.000	-0.005	0.000	-0.005	0.001
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
both parents migrate for work (dummy)	0.003	0.004	0.002	0.003	0.002	0.004	0.002	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.003	-0.002	-0.002	-0.001	-0.003	-0.001	-0.003	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
household wealth tertile	0.002	0.001	0.002	0.001	0.004*	0.003	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
pure control (dummy)	0.017	0.017	0.019	0.019*	0.016	0.016	0.017	0.017
	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
ordeal only (dummy)	0.120***	0.089***	0.124***	0.092***	0.115***	0.084***	0.117***	0.086***
	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)
ordeal and training (dummy)	0.139***	0.111***	0.144***	0.117***	0.138***	0.111***	0.141***	0.114***
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)
free only (dummy)	0.158***	0.112***	0.165***	0.118***	0.158***	0.112***	0.158***	0.113***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)	(0.012)
free and training (dummy)	0.179***	0.150***	0.178***	0.148***	0.174***	0.145***	0.174***	0.145***
	(0.013)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)
constant	-0.159***	-0.160**	-0.108*	-0.109*	-0.061**	-0.063*	-0.128**	-0.125**
	(0.046)	(0.049)	(0.046)	(0.047)	(0.019)	(0.026)	(0.044)	(0.047)
Angrist-Pischke F-statistic	55.17	31.86	61.08	45.98	102.48	59.80	69.20	41.30
Anderson underidentification test p-value	0.7922		0.7923		0.1790		0.4053	
weak-instrument-robust inference test p-value	0.4999		0.1197		0.1706		0.1764	
Sargan-Hansen test	exactly identified		exactly identified		exactly identified		0.3020	

# Observations	2918	2918	2918	2918	2918	2918	2918	2918

Panel B. Medium Term Ownership

	Dependent variable is fraction of classmates who:							
	own glasses in the medium term (t=2)	*use glasses in the medium term (t=2)*	*own glasses in the medium term (t=2)*	*use glasses in the medium term (t=2)*	*own glasses in the medium term (t=2)*	*use glasses in the medium term (t=2)*	*own glasses in the medium term (t=2)*	*use glasses in the medium term (t=2)*
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Instrumental Variables								
fraction of classmates aware of their myopia status	0.415***	0.429***			0.298***	0.272***	0.295***	0.271***
	(0.040)	(0.041)			(0.042)	(0.046)	(0.042)	(0.045)
class average of household wealth	0.034	0.026	0.029	0.017			0.023	0.011
	(0.019)	(0.019)	(0.020)	(0.018)			(0.018)	(0.017)
fraction of classmates who own glasses in the baseline			0.911***	1.060***	0.581***	0.752***	0.567***	0.745***
			(0.092)	(0.105)	(0.088)	(0.105)	(0.089)	(0.106)
Individual Baseline Characteristics								
already owned glasses in baseline (t=0) (dummy)	0.005	0.010***	-0.015***	-0.012***	-0.007***	-0.006**	-0.007**	-0.005**
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
male (dummy)	0.001	0.001	-0.001	-0.002	-0.001	-0.001	-0.000	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
grade 5 (dummy)	0.037***	0.027***	0.033***	0.020**	0.029***	0.016*	0.029***	0.016*
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
test score (1 = low 2 = median, 3= high)	0.001	0.000	-0.000	-0.001	-0.000	-0.001	-0.000	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
believed at baseline (t=0) that he/she was myopic (dummy)	-0.010***	-0.010***	0.005	0.005	-0.007***	-0.007***	-0.007***	-0.007***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.004	0.004	0.002	0.001	0.003	0.002	0.003	0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
myopia (1=low, 2=medium, 3=high)	0.006**	0.007***	0.003	0.005*	0.005**	0.006**	0.005**	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
at least one family member wears glasses (dummy)	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001

	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
student boards at school (dummy)	-0.008	-0.003	-0.006	0.000	-0.006	0.000	-0.006	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)
both parents migrate for work (dummy)	0.002	-0.002	0.002	-0.002	0.001	-0.003	0.001	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.003	0.003	-0.001	0.004	-0.003	0.003	-0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.003	0.004	0.004	0.005*	0.004	0.005*	0.003	0.005*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
household wealth tertile	0.002*	0.002	0.001	0.001	0.004*	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
pure control (dummy)	0.027**	0.022*	0.029**	0.024*	0.026*	0.022*	0.027**	0.022*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)
ordeal only (dummy)	0.086***	0.056***	0.091***	0.059***	0.082***	0.052***	0.084***	0.052***
	(0.011)	(0.011)	(0.012)	(0.010)	(0.011)	(0.009)	(0.011)	(0.009)
ordeal and training (dummy)	0.105***	0.070***	0.111***	0.076***	0.105***	0.072***	0.106***	0.072***
	(0.012)	(0.011)	(0.013)	(0.010)	(0.012)	(0.010)	(0.012)	(0.010)
free only (dummy)	0.117***	0.065***	0.123***	0.070***	0.116***	0.064***	0.117***	0.065***
	(0.011)	(0.010)	(0.012)	(0.010)	(0.011)	(0.009)	(0.011)	(0.009)
free and training (dummy)	0.137***	0.094***	0.136***	0.091***	0.132***	0.087***	0.132***	0.088***
	(0.013)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)	(0.011)	(0.010)
constant	-0.107*	-0.113*	-0.055	-0.052	-0.022	-0.044**	-0.075	-0.070
	(0.048)	(0.048)	(0.048)	(0.043)	(0.017)	(0.014)	(0.046)	(0.043)
Angrist-Pischke F-statistic	58.97	55.35	55.09	56.70	98.15	102.36	65.22	68.96
Anderson underidentification test p-value	0.5596		0.2984		0.1568		0.2266	
weak-instrument-robust inference test p-value	0.5808		0.3911		0.3109		0.3293	
Sargan-Hansen test	exactly identified		exactly identified		exactly identified		0.044	
# Observations	2856	2856	2856	2856	2856	2856	2856	2856

Panel C. Short Term Usage

	Dependent variable is fraction of classmates who:							
	own glasses in the short term (t=1)	*use glasses in the short term (t=1)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Instrumental Variables								
fraction of classmates aware of their myopia status	0.407***	0.370***			0.289***	0.240***	0.285***	0.236***
	(0.041)	(0.048)			(0.043)	(0.048)	(0.042)	(0.048)
class average of household wealth	0.040*	0.039*	0.036	0.032			0.029	0.027
	(0.018)	(0.020)	(0.019)	(0.020)			(0.018)	(0.019)
fraction of classmates who own glasses in the baseline			0.900***	0.900***	0.588***	0.642***	0.572***	0.627***
			(0.089)	(0.103)	(0.083)	(0.094)	(0.083)	(0.096)
Individual Baseline Characteristics								
already used glasses in baseline (t=0) (dummy)	0.005	0.010**	-0.013***	-0.008*	-0.005*	-0.002	-0.005	-0.001
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
male (dummy)	0.000	0.002	-0.002	-0.001	-0.001	-0.000	-0.001	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
grade 5 (dummy)	0.031***	0.027***	0.027***	0.022**	0.023***	0.018**	0.023***	0.018**
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
test score (1 = low 2 = median, 3= high)	0.000	0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
believed at baseline (t=0) that he/she was myopic (dummy)	-0.009***	-0.011***	0.005	0.001	-0.007***	-0.009***	-0.007***	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.003	0.003	0.000	0.001	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
myopia (1=low, 2=medium, 3=high)	0.005**	0.008***	0.002	0.005**	0.003*	0.006***	0.003*	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
at least one family member wears glasses (dummy)	-0.002	0.001	-0.001	0.002	-0.001	0.002	-0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
student boards at school (dummy)	-0.007	-0.002	-0.005	0.000	-0.005	0.000	-0.005	0.001
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)

both parents migrate for work (dummy)	0.003	0.005	0.002	0.003	0.002	0.004	0.002	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.003	-0.001	-0.002	-0.001	-0.003	-0.001	-0.003	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.001	0.001	0.002	0.002	0.001	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
household wealth tertile	0.002	0.002	0.002	0.001	0.004*	0.003	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
pure control (dummy)	0.017	0.017	0.018	0.018*	0.015	0.016	0.017	0.017
	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
ordeal only (dummy)	0.120***	0.089***	0.124***	0.092***	0.115***	0.084***	0.117***	0.086***
	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)
ordeal and training (dummy)	0.138***	0.111***	0.144***	0.117***	0.138***	0.111***	0.141***	0.114***
	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)
free only (dummy)	0.158***	0.112***	0.165***	0.118***	0.158***	0.112***	0.158***	0.113***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)	(0.012)
free and training (dummy)	0.179***	0.150***	0.178***	0.148***	0.174***	0.145***	0.174***	0.145***
	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)
constant	-0.160***	-0.161**	-0.108*	-0.109*	-0.061**	-0.063*	-0.128**	-0.125**
	(0.046)	(0.049)	(0.046)	(0.047)	(0.019)	(0.026)	(0.044)	(0.047)
Angrist-Pischke F-statistic	54.83	31.69	61.10	45.85	103.29	59.84	69.71	41.32
Anderson underidentification test p-value	0.8059		0.7759		0.1778		0.4033	
weak-instrument-robust inference test p-value	0.3176		0.1208		0.2021		0.2278	
Sargan-Hansen test	exactly identified		exactly identified		exactly identified		0.6208	
# Observations	2918	2918	2918	2918	2918	2918	2918	2918

Panel D. Medium Term Usage

Dependent variable is fraction of classmates who:

	own glasses in the medium term (t=2)	*use glasses in the medium term (t=2)*	*own glasses in the medium term (t=2)*	*use glasses in the medium term (t=2)*	*own glasses in the medium term (t=2)*	*use glasses in the medium term (t=2)*	*own glasses in the medium term (t=2)*	*use glasses in the medium term (t=2)*
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Instrumental Variables								
fraction of classmates aware of their myopia status	0.415***	0.429***			0.298***	0.272***	0.295***	0.271***
	(0.040)	(0.041)			(0.042)	(0.046)	(0.042)	(0.045)
class average of household wealth	0.034	0.026	0.030	0.018			0.023	0.012
	(0.019)	(0.019)	(0.020)	(0.018)			(0.018)	(0.017)
fraction of classmates who own glasses in the baseline			0.904***	1.053***	0.578***	0.748***	0.564***	0.742***
			(0.092)	(0.105)	(0.088)	(0.104)	(0.088)	(0.105)
Individual Baseline Characteristics								
already used glasses in baseline (t=0) (dummy)	0.002	0.007*	-0.017***	-0.013***	-0.008**	-0.006*	-0.008**	-0.006*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
male (dummy)	0.001	0.001	-0.001	-0.002	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
grade 5 (dummy)	0.037***	0.027***	0.033***	0.020**	0.029***	0.016*	0.029***	0.016*
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
test score (1 = low 2 = median, 3= high)	0.001	0.000	-0.000	-0.001	-0.000	-0.001	-0.000	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
believed at baseline (t=0) that he/she was myopic (dummy)	-0.009***	-0.009***	0.005	0.004	-0.007***	-0.007***	-0.007***	-0.007***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.004	0.004	0.002	0.001	0.003	0.002	0.003	0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
myopia (1=low, 2=medium, 3=high)	0.006***	0.008***	0.003	0.004*	0.005**	0.006**	0.005**	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
at least one family member wears glasses (dummy)	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
student boards at school (dummy)	-0.008	-0.003	-0.006	0.000	-0.006	0.000	-0.006	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)

both parents migrate for work (dummy)	0.002	-0.002	0.002	-0.002	0.001	-0.003	0.001	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.003	0.003	-0.002	0.004	-0.003	0.003	-0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.003	0.004	0.004	0.005*	0.004	0.005*	0.003	0.005*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
household wealth tertile	0.002*	0.002	0.001	0.001	0.004*	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
pure control (dummy)	0.026*	0.022*	0.028**	0.024*	0.025*	0.022*	0.026**	0.022*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)
ordeal only (dummy)	0.086***	0.056***	0.091***	0.059***	0.082***	0.052***	0.083***	0.052***
	(0.011)	(0.011)	(0.012)	(0.010)	(0.011)	(0.009)	(0.011)	(0.009)
ordeal and training (dummy)	0.105***	0.070***	0.111***	0.076***	0.105***	0.072***	0.106***	0.072***
	(0.012)	(0.011)	(0.013)	(0.010)	(0.012)	(0.010)	(0.012)	(0.010)
free only (dummy)	0.117***	0.065***	0.123***	0.070***	0.116***	0.064***	0.117***	0.065***
	(0.011)	(0.010)	(0.012)	(0.010)	(0.011)	(0.009)	(0.011)	(0.009)
free and training (dummy)	0.137***	0.094***	0.136***	0.091***	0.132***	0.087***	0.132***	0.088***
	(0.013)	(0.012)	(0.012)	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)
constant	-0.108*	-0.114*	-0.056	-0.052	-0.021	-0.043**	-0.075	-0.070
	(0.048)	(0.048)	(0.049)	(0.043)	(0.017)	(0.014)	(0.046)	(0.043)
Angrist-Pischke F-statistic	58.77	55.05	54.71	56.59	98.29	102.46	65.32	69.05
Anderson underidentification test p-value	0.5495		0.2923		0.1586		0.2277	
weak-instrument-robust inference test p-value	0.0619		0.1050		0.0363		0.0727	
Sargan-Hansen test	exactly identified		exactly identified		exactly identified		0.9226	
# Observations	2856	2856	2856	2856	2856	2856	2856	2856

Notes: Standard errors clustered at school level are reported in parentheses. *, **, and *** indicate significance at 10%, 5% and 1%.

Appendix Table 2. Results of Second-Stage Regressions of Reduced-Form Model

Panel A.

Dependent variable is the probability of owning glasses in the short term (t=1)

	(1)	(2)	(3)	(4)
fraction of classmates who own glasses in the short term (t=1)	-14.258	21.409	3.026	3.126
	(55.982)	(82.682)	(2.899)	(2.952)
fraction of classmates who use glasses in the short term (t=1)	15.664	-21.819	-3.339	-3.415
	(61.075)	(83.788)	(3.055)	(3.110)
already owned glasses in baseline (t=0) (dummy)	0.196	0.370	0.290***	0.291***
	(0.301)	(0.368)	(0.035)	(0.035)
male (dummy)	-0.034	0.019	-0.007	-0.007
	(0.092)	(0.118)	(0.013)	(0.013)
grade 5 (dummy)	0.029	-0.092	0.006	0.004
	(0.115)	(0.423)	(0.019)	(0.019)
test score (1 = low 2 = median, 3= high)	0.008	0.002	0.006	0.006
	(0.016)	(0.028)	(0.007)	(0.007)
believed at baseline (t=0) that he/she was myopic (dummy)	0.086	-0.051	0.025	0.024
	(0.191)	(0.347)	(0.016)	(0.016)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	-0.008	0.024	0.009	0.009
	(0.055)	(0.076)	(0.012)	(0.012)
myopia (1=low, 2=medium, 3=high)	-0.037	0.078	0.024	0.024
	(0.198)	(0.249)	(0.014)	(0.014)
at least one family member wears glasses (dummy)	-0.037	0.047	0.005	0.005
	(0.137)	(0.196)	(0.014)	(0.014)
student boards at school (dummy)	-0.070	0.121	0.018	0.018
	(0.297)	(0.449)	(0.025)	(0.025)
both parents migrate for work (dummy)	-0.023	0.032	0.009	0.009
	(0.101)	(0.115)	(0.017)	(0.017)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.015	0.022	0.003	0.003
	(0.061)	(0.090)	(0.013)	(0.013)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.013	0.021	0.018	0.018
	(0.028)	(0.030)	(0.011)	(0.011)
household wealth tertile	0.007	-0.013	0.001	0.000
	(0.032)	(0.053)	(0.008)	(0.008)
constant	0.177	-0.141	0.012	0.012

	(0.572)	(0.700)	(0.077)	(0.078)
Instruments:				
fraction of classmates aware of their myopia status	Y		Y	Y
class average of household wealth	Y	Y		Y
fraction of classmates who own glasses in the baseline		Y	Y	Y
# Observations	2918	2918	2918	2918

Panel B.

Dependent variable is the probability of owning glasses in the medium term (t=2)

	(1)	(2)	(3)	(4)
fraction of classmates owning glasses in the short term (t=2)	3.746	3.169	2.313	2.523
	(7.485)	(3.954)	(2.092)	(1.919)
fraction of classmates using glasses in the short term (t=2)	-3.543	-2.892	-2.148	-2.339
	(7.332)	(3.469)	(1.953)	(1.800)
already owned glasses in baseline (t=0) (dummy)	0.198***	0.194***	0.190***	0.191***
	(0.048)	(0.030)	(0.025)	(0.025)
male (dummy)	-0.003	-0.003	-0.002	-0.002
	(0.014)	(0.013)	(0.013)	(0.013)
grade 5 (dummy)	-0.039	-0.036	-0.023	-0.026
	(0.082)	(0.063)	(0.034)	(0.032)
test score (1 = low 2 = median, 3= high)	0.002	0.003	0.003	0.003
	(0.009)	(0.008)	(0.008)	(0.008)
believed at baseline (t=0) that he/she was myopic (dummy)	0.036*	0.035*	0.036*	0.036*
	(0.016)	(0.016)	(0.015)	(0.015)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	-0.001	-0.000	0.000	0.000
	(0.015)	(0.013)	(0.012)	(0.012)
myopia (1=low, 2=medium, 3=high)	0.048**	0.046***	0.046***	0.046***
	(0.016)	(0.012)	(0.012)	(0.012)
at least one family member wears glasses (dummy)	0.009	0.009	0.009	0.009
	(0.015)	(0.014)	(0.014)	(0.014)
student boards at school (dummy)	0.021	0.018	0.013	0.014
	(0.043)	(0.030)	(0.026)	(0.025)

both parents migrate for work (dummy)	-0.007	-0.005	-0.002	-0.003
	(0.036)	(0.026)	(0.022)	(0.022)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.016	0.013	0.008	0.010
	(0.045)	(0.026)	(0.019)	(0.018)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.030*	0.029*	0.028*	0.028*
	(0.015)	(0.013)	(0.012)	(0.012)
household wealth tertile	0.002	0.002	0.003	0.003
	(0.010)	(0.009)	(0.009)	(0.009)
constant	0.140	0.152	0.172*	0.167*
	(0.190)	(0.123)	(0.079)	(0.080)
Instruments:				
fraction of classmates aware of their myopia status	Y		Y	Y
class average of household wealth	Y	Y		Y
fraction of classmates who own glasses in the baseline		Y	Y	Y
# Observations	2856	2856	2856	2856

Panel C.

Dependent variable is the probability of using glasses in the short term (t=1)

	(1)	(2)	(3)	(4)
fraction of classmates owning glasses in the short term (t=1)	-9.269	5.848	-1.385	-1.332
	(26.584)	(35.587)	(2.109)	(2.124)
fraction of classmates using glasses in the short term (t=1)	10.582	-5.329	1.927	1.884
	(28.991)	(35.974)	(2.201)	(2.217)
already used glasses in baseline (t=0) (dummy)	0.287	0.367*	0.331***	0.331***
	(0.147)	(0.182)	(0.034)	(0.034)
male (dummy)	-0.007	0.016	0.006	0.006
	(0.044)	(0.052)	(0.015)	(0.015)
grade 5 (dummy)	0.001	-0.051	-0.011	-0.012
	(0.053)	(0.188)	(0.018)	(0.018)
test score (1 = low 2 = median, 3= high)	0.013	0.011	0.012	0.012
	(0.010)	(0.014)	(0.008)	(0.009)
believed at baseline (t=0) that he/she was myopic (dummy)	0.088	0.034	0.063**	0.062**
	(0.085)	(0.145)	(0.019)	(0.019)

	(1)	(2)	(3)	(4)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.003	0.017	0.011	0.011
	(0.030)	(0.037)	(0.014)	(0.014)
myopia (1=low, 2=medium, 3=high)	0.017	0.066	0.045**	0.045**
	(0.094)	(0.106)	(0.015)	(0.015)
at least one family member wears glasses (dummy)	-0.024	0.013	-0.004	-0.004
	(0.068)	(0.085)	(0.015)	(0.015)
student boards at school (dummy)	-0.002	0.080	0.039	0.039
	(0.146)	(0.199)	(0.024)	(0.024)
both parents migrate for work (dummy)	-0.022	0.002	-0.008	-0.007
	(0.053)	(0.053)	(0.022)	(0.022)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.000	0.016	0.008	0.008
	(0.036)	(0.045)	(0.016)	(0.016)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.022	0.026	0.025	0.025
	(0.018)	(0.019)	(0.014)	(0.014)
household wealth tertile	0.000	-0.008	-0.002	-0.002
	(0.016)	(0.025)	(0.009)	(0.009)
constant	-0.018	-0.160	-0.097	-0.098
	(0.285)	(0.316)	(0.070)	(0.070)
Instruments:				
fraction of classmates aware of their myopia status	Y		Y	Y
class average of household wealth	Y	Y		Y
fraction of classmates who own glasses in the baseline		Y	Y	Y
# Observations	2918	2918	2918	2918

Panel D.

Dependent variable is the probability of using glasses in the medium term (t=2)

	(1)	(2)	(3)	(4)
fraction of classmates owning glasses in the short term (t=2)	1.516	1.221	0.769	0.881
	(7.704)	(4.415)	(2.515)	(2.302)
fraction of classmates using glasses in the short term (t=2)	-0.878	-0.543	-0.151	-0.253
	(7.540)	(3.878)	(2.315)	(2.131)
already used glasses in baseline (t=0) (dummy)	0.282***	0.280***	0.278***	0.278***
	(0.050)	(0.034)	(0.027)	(0.027)

male (dummy)	-0.002	-0.002	-0.002	-0.002
	(0.017)	(0.017)	(0.017)	(0.017)
grade 5 (dummy)	-0.053	-0.052	-0.044	-0.046
	(0.087)	(0.072)	(0.044)	(0.041)
test score (1 = low 2 = median, 3= high)	0.022*	0.022*	0.022*	0.022*
	(0.011)	(0.010)	(0.010)	(0.010)
believed at baseline (t=0) that he/she was myopic (dummy)	0.077***	0.076***	0.077***	0.077***
	(0.021)	(0.021)	(0.020)	(0.020)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.001	0.001	0.002	0.002
	(0.018)	(0.017)	(0.016)	(0.016)
myopia (1=low, 2=medium, 3=high)	0.103***	0.102***	0.102***	0.102***
	(0.017)	(0.014)	(0.014)	(0.014)
at least one family member wears glasses (dummy)	0.016	0.016	0.017	0.017
	(0.017)	(0.017)	(0.017)	(0.017)
student boards at school (dummy)	0.023	0.022	0.019	0.020
	(0.047)	(0.034)	(0.027)	(0.026)
both parents migrate for work (dummy)	-0.025	-0.024	-0.022	-0.022
	(0.040)	(0.032)	(0.027)	(0.027)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.025	0.023	0.020	0.021
	(0.050)	(0.032)	(0.024)	(0.024)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.031	0.030	0.030	0.030
	(0.019)	(0.017)	(0.017)	(0.017)
household wealth tertile	-0.005	-0.005	-0.005	-0.005
	(0.012)	(0.012)	(0.011)	(0.011)
constant	-0.159	-0.153	-0.142	-0.145
	(0.194)	(0.128)	(0.083)	(0.083)
Instruments:				
fraction of classmates aware of their myopia status	Y		Y	Y
class average of household wealth	Y	Y		Y
fraction of classmates who own glasses in the baseline		Y	Y	Y
# Observations	2856	2856	2856	2856

Notes: Standard errors clustered at school level are reported in parentheses. The coefficients on the treatment dummies are not reported to save space. Significance codes: * 10% level, ** 5% level, and *** 1% level.

Appendix Table 3. Results of First-Stage Regressions of Lagged Reduced-Form Model

	Dependent variable is fraction of classmates who:							
	own glasses at baseline (t=0)	*use glasses at baseline (t=0)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*	*own glasses at baseline (t=0)*	*use glasses at baseline (t=0)*	*own glasses in the short term (t=1)*	*use glasses in the short term (t=1)*
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Instrumental Variables								
fraction of classmates aware of their myopia status	0.212***	0.104***	0.408***	0.373***	0.214***	0.107***	0.408***	0.374***
	(0.022)	(0.023)	(0.040)	(0.048)	(0.022)	(0.022)	(0.040)	(0.048)
class average of household wealth	0.020**	0.019**	0.037**	0.036*	0.019**	0.018**	0.037*	0.035*
	(0.009)	(0.009)	(0.019)	(0.020)	(0.009)	(0.009)	(0.019)	(0.020)
Individual Baseline Characteristics								
already owned glasses in baseline (t=0) (dummy)	0.021***	0.016***	0.007***	0.012***				
	(0.002)	(0.002)	(0.003)	(0.003)				
already useed glasses in baseline (t=0) (dummy)					0.018***	0.024***	0.004	0.009***
					(0.002)	(0.002)	(0.003)	(0.003)
male (dummy)	0.003**	0.003**	0.000	0.002	0.003**	0.003***	0.000	0.002
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
grade 5 (dummy)	0.014***	0.016***	0.032***	0.028***	0.014***	0.016***	0.032***	0.028***
	(0.004)	(0.004)	(0.006)	(0.007)	(0.004)	(0.003)	(0.006)	(0.007)
test score (1 = low 2 = median, 3= high)	0.002*	0.001	0.000	-0.000	0.002*	0.001	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
believed at baseline (t=0) that he/she was myopic (dummy)	-0.005***	-0.003**	-0.010***	-0.012***	-0.003**	-0.004***	-0.009***	-0.011***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	0.002	0.002**	0.003	0.003	0.002	0.002**	0.003	0.003
	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
myopia (1=low, 2=medium, 3=high)	0.002**	0.001	0.005**	0.007***	0.003***	0.001	0.005***	0.007***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
at least one family member wears glasses (dummy)	-0.002	0.000	-0.002	0.000	-0.001	0.000	-0.002	0.000
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
student boards at school (dummy)	-0.004	-0.005**	-0.006	-0.002	-0.004	-0.005*	-0.006	-0.001

	(0.003)	(0.003)	(0.006)	(0.006)	(0.003)	(0.003)	(0.006)	(0.006)
noth parents migrate for work (dummy)	0.002	0.001	0.002	0.003	0.002	0.001	0.002	0.003
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
father’s education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.001	-0.001	-0.002	-0.001	-0.000	-0.000	-0.002	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
mother’s education (1 = illiterate; 2= 9 years; 3=12 years or higher)	-0.001	-0.001	0.000	0.001	-0.001	-0.001	0.000	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
household wealth tertile	-0.000	-0.001	0.003**	0.002*	0.000	-0.000	0.003**	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
pure control (dummy)	-0.000	-0.002	0.016	0.017*	-0.000	-0.002	0.016	0.017*
	(0.006)	(0.006)	(0.010)	(0.009)	(0.006)	(0.005)	(0.010)	(0.009)
ordeal only (dummy)	0.004	-0.002	0.119***	0.087***	0.005	-0.001	0.119***	0.088***
	(0.005)	(0.006)	(0.011)	(0.011)	(0.006)	(0.006)	(0.011)	(0.011)
ordeal and training (dummy)	-0.003	-0.004	0.139***	0.111***	-0.004	-0.004	0.139***	0.111***
	(0.005)	(0.006)	(0.012)	(0.012)	(0.006)	(0.005)	(0.012)	(0.012)
free only (dummy)	-0.001	0.002	0.160***	0.113***	-0.001	0.002	0.159***	0.113***
	(0.006)	(0.006)	(0.011)	(0.012)	(0.006)	(0.006)	(0.011)	(0.012)
free and training (dummy)	0.008	0.006	0.178***	0.149***	0.008	0.006	0.178***	0.149***
	(0.006)	(0.006)	(0.014)	(0.014)	(0.006)	(0.006)	(0.014)	(0.014)
constant	-0.055**	-0.039*	-0.155***	-0.153***	-0.057**	-0.038*	-0.157***	-0.154***
	(0.023)	(0.023)	(0.047)	(0.050)	(0.024)	(0.022)	(0.047)	(0.050)
Angrist-Pischke F-statistic	53.07	13.78	56.07	32.29	51.87	15.33	55.78	32.11
Anderson underidentification test p-value	0.1571		0.8795		0.1618		0.8968	
weak-instrument-robust inference test p-value	0.4999		0.5808		0.3176		0.0619	
Sargan-Hansen test	exactly identified		exactly identified		exactly identified		exactly identified	
# Observations	2918	2918	2918	2918	2918	2918	2918	2918

Notes: Standard errors clustered at school level are reported in parentheses. *, **, and *** indicate significance at 10%, 5% and 1%.

Appendix Table 4. Results of Second-Stage Regressions of Lagged Reduced-Form Model

	Dependent variable is the probability of:			
	owning glasses in the short term (t=1)	*using glasses in the medium term (t=0)*	*owning glasses in the short term (t=1)*	*using glasses in the short term (t=1)*
	(1)	(2)	(3)	(4)
fraction of classmates who own glasses at baseline (t=0)	-2.449		-1.005	
	(2.984)		(4.101)	
fraction of classmates who use glasses at baseline (t=0)	4.846		3.355	
	(5.548)		(7.530)	
fraction of classmates who own glasses in the short term (t=1)		-16.918		-2.946
		(116.299)		(37.633)
fraction of classmates who use glasses in the short term (t=1)		18.613		3.895
		(126.596)		(41.029)
already owned glasses in baseline (t=0) (dummy)	0.246***	0.074		
	(0.045)	(0.705)		
already used glasses in baseline (t=0) (dummy)			0.281**	0.254
			(0.110)	(0.228)
male (dummy)	-0.019	-0.037	0.001	-0.009
	(0.013)	(0.241)	(0.021)	(0.079)
grade 5 (dummy)	-0.035	0.030	-0.041	-0.034
	(0.051)	(0.229)	(0.065)	(0.076)
test score (1 = low 2 = median, 3= high)	0.004	0.013	0.010	0.024
	(0.008)	(0.055)	(0.010)	(0.019)
believed at baseline (t=0) that he/she was myopic (dummy)	0.039***	0.096	0.063**	0.088
	(0.014)	(0.404)	(0.025)	(0.122)
believed at baseline (t=0) that wearing glasses harms vision (dummy)	-0.001	-0.007	0.007	0.001
	(0.014)	(0.064)	(0.018)	(0.027)
myopia (1=low, 2=medium, 3=high)	0.012	-0.009	0.053***	0.091
	(0.010)	(0.357)	(0.014)	(0.120)

at least one family member wears glasses (dummy)	-0.009	-0.026	-0.002	0.010
	(0.014)	(0.250)	(0.017)	(0.084)
student boards at school (dummy)	0.019	-0.072	0.059*	0.001
	(0.025)	(0.513)	(0.032)	(0.170)
both parents migrate for work (dummy)	0.002	-0.015	-0.005	-0.026
	(0.017)	(0.146)	(0.023)	(0.056)
father's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.001	-0.015	0.010	0.016
	(0.012)	(0.083)	(0.017)	(0.033)
mother's education (1 = illiterate; 2= 9 years; 3=12 years or higher)	0.019*	0.012	0.028*	0.029
	(0.011)	(0.098)	(0.015)	(0.039)
household wealth tertile	0.001	0.008	-0.002	-0.004
	(0.008)	(0.029)	(0.010)	(0.012)
constant	-0.002	0.353	-0.167	-0.084
	(0.073)	(0.931)	(0.105)	(0.318)
Instruments:				
fraction of classmates aware of their myopia status	Y	Y	Y	Y
class average of household wealth	Y	Y	Y	Y
# Observations	2918	2856	2918	2856

Notes: Standard errors clustered at school level are reported in parentheses. The coefficients of treatment dummies are not reported to save space. Significance codes: * 10% level, ** 5% level, and *** 1% level.