BEHAVIORAL TRANSMISSION: EVIDENCE FROM A PUBLIC HEALTH CAMPAIGN IN BANGLADESH *

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Abstract

We examine how behavior change transmits across contexts in the setting of hand hygiene in rural Bangladesh. We randomize an edutainment intervention across classrooms to trace school-to-home transmission in handwashing behavior and randomize the proportion of students who receive handwashing resources at home to track home-to-school transmission. We document that, while edutainment generates greater washing at school, it leads to substantially less washing at home, such that total washing is net negative. Likewise, children induced to wash more at home exhibit substantially less washing at school. Our results illustrate that successfully promoting behavior in one environment may crowd out like behavior in another critical context. They highlight an unintended consequence of behavior change interventions, like those often implemented in early childhood education, that assume complementarities in behavior across contexts.

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I. INTRODUCTION

Does behavior change transcend context? Early childhood education relies, to a great extent, upon the assumption of positive behavioral transmission. From norms such as respect for authority and friendly play to practices of daily living such as hygiene and exercise, the lessons imparted in educational institutions are crafted not only for the classroom but to shape how individuals operate at home and in the world at large (Campbell et al. 2002; Hahn et al. 2016; Blackman 2002). Conversely, behaviors cultivated at home are often expected to extend to the school or work, shaping the culture of these contexts in turn.

Yet evidence of behavioral transmission across contexts is scarce. Should this transmission be limited or nonexistent, the objectives of education curricula may require reconsideration. Should they instead be negative, with behavioral improvements in one context *reducing* such behavior in another, then programs deemed successful at the site of evaluation may in fact harm the net welfare of beneficiaries and the communities in which they act.

Our study is motivated by this possibility. We design a field experiment around the health practice of handwashing with soap to causally estimate behavioral transmission between the two settings of the school and the home. Set in rural Bangladesh, we first experimentally induce behavior change in each context. At school, we vary handwashing rates by randomizing the administration of a hygiene edutainment program across classrooms (referred to as 'edutainment treatment' classrooms). At home, we induce improvements in behavior by distributing handsoap dispensers to a randomized subset of children ('dispenser children'), randomly varying the proportion of students per classroom who have a dispenser installed in their home ('high dispenser saturation' classrooms).[1]

We track handwashing rates for five months in each context to estimate both directions of behavioral transmission. We capture school-to-home behavioral transmission by comparing handwashing performance at home between those who were and were not exposed to the edutainment campaign at school, and we capture home-to-school behavioral transmission by comparing handwashing performance at school between those classrooms with more or fewer children in possession of handsoap dispensers at home. Our measures of handwashing performance are objective and high-frequency, as we embed, in both settings, time-stamped sensors within dispensers to track handwashing rates.

We find that the edutainment campaign, despite its low-touch nature of fifteen minutes of content weekly and near-zero marginal cost,[2] meaningfully improves behavior in the classroom: students exposed to the campaign wash their hands in school 37% more often ($p = 0.000$) than their unexposed counterparts. Handwashing levels among treated classrooms are sustained over the course of the five month study, while those in control classrooms steadily decline: by the fifth

1. We are motivated by two papers that document substantial impacts of the handsoap dispenser, when installed in the home, on the health of children who are sociodemographically comparable to those in this study (**hussam21a**; **hussam21b**).

2. We combine edutainment pieces produced by the government of Bangladesh, UNICEF, and other NGOs, resulting in a small cost to curriculum design and near-zero marginal cost to scale

month, students in edutainment-exposed classrooms are washing 107% more ($p = 0.000$) than their control counterparts.

Despite the large positive treatment effect of the edutainment campaign at school, we find that the campaign has a *negative* impact on behavior at home. The magnitude of the negative impact at home is substantial: the edutainment campaign raises daily school handwashing by an average of 0.28 ($p = 0.000$) washes per student, but reduces daily home handwashing by 0.37 ($p = 0.063$) washes per household, implying a net negative effect of the classroom edutainment program on daily handwashing for a treated child and her family. More alarmingly, the poor performance of edutainment-treated students in the home extends into weekends and holidays, during which the households of such children wash 0.48 fewer times ($p = 0.015$) per day than their untreated counterparts. Our results illustrate a public health campaign that is remarkably successful when evaluated at the site of the intervention by the standards of the literature (e.g. Lewis et al. 2018; Bowen et al. 2007; Rosen et al. 2006; Dreibelbis et al. 2014), but in reality reduces total daily handwashing rates for treated students and their families.

This negative behavioral transmission is echoed in the dispenser saturation treatment. Classrooms with a high saturation of students who possess dispensers at home exhibit 9.6% lower ($p = 0.052$) handwashing rates than their low saturation classroom counterparts. In other words, classrooms in which more children are enabled to wash hands at home exhibit lower washing rates at school. This amounts to a lower bound of 0.1 fewer daily handwashing episodes at school per dispenser child if we assume complete peer effects (i.e. if all children in a classroom learn from their dispenser-endowed classmates and reduce their school washing as much as dispenser children do) or an upper bound of 0.47 fewer daily handwashing episodes per dispenser child if we assume no peer effects (i.e. only dispenser children reduce their washing at school). This bounding exercise implies that the negative behavioral transmission that transpires from possessing a dispenser at home is comparable in magnitude to that of receiving an edutainment program at school - a result that is not incumbent given the two distinct interventions, but is a reassuring check on our estimates nonetheless.[3]

This existence of negative behavioral transmission, replicated in the dual directions of the school to the home and the home to the school, suggests that the effects we observe are not unique to a particular environment (school or home) nor a specific intervention (edutainment or dispenser), but rather tied to the nature of the handwashing behavior itself. We explore two broad sets of mechanisms through which negative transmission may transpire. First, a set of behaviors we term 'crowd-out mechanisms': among them, moral licensing and target consumption. In the act of moral

3. By construction, we cannot estimate the direct behavioral impact of handsoap dispensers on handwashing rates at the household, as households without dispensers have no comparable handwashing outcome. Moreover, given the large health impacts of dispensers documented by **hussam21a** and **hussam21b**, we determined it unethical to involve any household in the experiment without providing them a dispenser, precluding a no-dispenser control group from which to collect health outcomes and extrapolate behavior change. Instead, given the comparable context, we use the positive health impacts of dispensers in the household causally identified by the two studies above to assume a positive effect of dispensers on handwashing rates within the household.

licensing, individuals who have already engaged in effortful positive behaviors are more likely to engage in negative ones (or less likely to engage in positive ones) because their good behavior licenses them to become morally lax (Blanken, Ven N., and Zeelenberg 2015; Merritt, Effron, and Monin 2010). Target consumption, as a parallel to target income (Camerer et al. 1997; Luk-Zilberman 2021), proposes that individuals set a time-bound 'quota' of effortful behavior they are willing to engage in, regardless of context. Handwashing more in one setting mechanically reduces the quantity washed elsewhere over a given period of time.

While we cannot tease apart these crowd-out mechanisms, nor are they an exhaustive list of potential behavioral motives behind crowd-out, this body of mechanisms generates a testable temporal prediction: once positive action has been undertaken, subsequent action is less likely. We assess our results against this prediction by exploiting the time-stamped nature of our data to examine what hours in a day the negative transmission effect arises among edutainment-treated children within the home. Indeed, the bulk of the negative impact on hourly home handwashing transpires after children have been exposed to their edutainment-treated classrooms, rather than before they go to school. This is despite the fact that nearly one third of daily handwashing in the household takes place prior to school [among control households], leaving ample opportunity for edutainment-treated students to reduce handwashing within the home during this time should they wish.

Second, we consider the mechanism of cue-based habit formation (Laibson 2001; Wood and Neal 2007; Orbell and Verplanken 2010; Wellsjo 2021), in which repeated behaviors become tied to contextual triggers. A behavior change intervention may amplify the association of a behavior within one context at the expense of others: what before was equally likely in any setting may now be subconsciously triggered at the site of the intervention and no longer in alternative environments. A key prediction of this mechanism, as distinct from that of crowd-out, is that the negative treatment effect for edutainment-treated children at the household should manifest even on days when children do not have school: days in which there is no opportunity for crowding out behavior. Indeed, we find that households of edutainment-treated children exhibit significantly lower rates of handwashing than their non-treated counterparts even on weekends and holidays, when crowding out from school consumption is not possible.

Might cue-based habit formation explain the full story? Not quite: recall that handwashing at home is significantly lower among edutainment treated students only after school; we detect no difference at home in the morning hours prior to school. Rather, the evidence suggests that these two mechanisms act in concert: treated first with the edutainment campaign at school, children wash more at school, crowding out afterschool washing at home. As the school week proceeds, such behavior develops into a cue-based habit, subsequently reducing handwashing at home over the weekend. Consistent with this story, we find that the cue which triggers the handwashing habit (or absence thereof) is specific not only to a place but also to certain hours of the day: even on weekends and holidays, we detect no statistical difference in washing at home during the morning hours. Reductions in handwashing in the households of edutainment-treated children transpire only after this period of the day.

Finally, we consider an alternative interpretation of the results that centers the experimental setting rather than the features of the behavior of handwashing: because the edutainment campaign was administered only in school, perhaps edutainment-treated children [incorrectly] understood handwashing to be a school-specific behavior, consciously increasing washing at school and reducing washing at home relative to those who received no edutainment. We find this unlikely for three reasons: first, the bulk of the edutainment content depicted acts of handwashing at home. Second, we supplemented the edutainment campaign three months into the experiment with an additional video in which we explicitly instructed children to wash both at school and at home. A difference in differences analysis suggests that this video had no impact: edutainment children continued to wash significantly more at school and less at home than their counterparts. Finally and most critically, we document negative behavioral transmission not only from school to home, but also from home to school, using a different intervention that is not vulnerable to this potential artifact: children treated at home were treated with handsoap dispensers, a product they had access to in both contexts and therefore had no reason to interpret as a 'home-specific' technology.

This study makes four primary contributions. Despite serving as the premise for much of early childhood education, literature documenting the transfer of behavior across contexts is scarce and wanting. Hiramatsu et al. (2014) examines how an energy saving school program affects students' families' energy saving behavior at home, but relies on self-reported survey measures and a pre-post analysis. Tidwell et al. (2020) considers the impact of a school handwashing promotion campaign on handwashing behavior at home, but likewise relies on self-reported measures and a non-randomized comparison arm. Both studies document small but positive levels of behavioral transmission from the school to the home. We add to this literature by designing a field experiment that implements two distinct interventions to exogenously alter behavior in each context, allowing us to causally estimate bidirectional transmission in behavior and thereby speak to the nature of the observed *behavior* rather than the features of a particular environment or intervention. We further augment this design with a critical measurement tool: we are able to precisely and objectively track behavior across contexts by employing handsoap dispensers with time-stamped sensors embedded inside, designed in partnership with the MIT Media Lab (**hussam21a**). This measurement technique lies in contrast to self-reports of behavior change or structured observations of hand hygiene, the two measures most frequently employed in existing literature despite their vulnerability to surveyor demand effects (Ram et al. 2010). Our results underscore the importance of this innovation: were we to employ self-reported measures of handwashing, we would, like Hiramatsu et al. (2014) and Tidwell et al. (2020), also document positive behavioral transmission across contexts, and in turn endorse a school-level edutainment campaign for scale that in fact imposes substantial negative consequences on treated children and their families.

Second, we build upon a complementary body of literature examining the phenomenon of behavioral spillovers. This literature finds evidence of negative spillovers across behaviors, whereby increased performance of one behavior reduces performance of a related behavior (irrespective of context). For a recent summary of the empirical work in this space, see Luk-Zilberman (2021), who articulates diversion of attention and depletion of effort or attention as primary mechanisms behind the crowding-out of one behavior vis-à-vis another. This paper, in turn, examines how the *same* behavior may be characterized by negative 'spillovers' over time and across contexts, a phenomenon we term 'behavioral transmission.' We thereby connect the heretofore distinct concepts of crowd-out, as explored in the behavioral spillover literature, to cue-based habit formation, a characterization of repeated behaviors across varying sites or environments of action. This connection yields an especially gloomy prediction: not only might crowd-out neutralize the positive impact of an intervention, but it may be amplified through cue-based habit formation to yield an impact across all sites of action that is negative on net.

Third, our work speaks to literature on hand hygiene behavior change interventions. In the midst of a global pandemic precipitated by the viral transmission of COVID-19, the cultivation of proper hand hygiene has become imperative for the health and survival of exposed populations around the world. Handwashing with soap, however, has long been a necessary tool to reduce infant and child mortality across the developing world, where bacterial and viral contamination end the lives of more than one million individuals per year (WWAP 2019). The COVID-19 pandemic amplifies the need for preventive measures such as handwashing in developing countries, which are characterized by high population densities in urban centers, lack of medical personnel and equipment, scarcity of testing kits, and an absence of proper refrigeration facilities for vaccines. Despite recognition that handwashing with soap is among the most cost-effective prophylactics to bacterial and viral disease (Jamison et al. 2006; World Bank 2005; Barker, Vipond, and Bloomfield 2004; Sanderson and Weissler 1992; World Health Organization 2009), most randomized evaluations of public health interventions document no impact on hygiene practices (ex. WSP 2012; 2013; Galiani et al. 2016), with the few that do relying on structured observations or self-reports to establish behavior change. Building upon the household-level interventions of two recent studies of handwashing that generated substantial improvements in handwashing behavior and health (**hussam21a**; **hussam21b**), this study estimates the impact of a low-cost edutainment intervention at school, a site that may capitalize on economies of scale, on behavior change both at school and at childrens' homes. We find this intervention to be quite successful at improving behavior at school, but document significant unintended consequences in complementary contexts. As efforts to improve handwashing adherence receive increased attention globally, we hope this study may shape how evaluations of such programs are designed and urge caution in the interpretation of existing studies.

Finally, our results stress the need to expand the analytic scope of behavior change interventions to the range of contexts that recipients are expected or likely to operate in. We find that behavioral transmission across contexts does indeed exist, but in the case of handwashing, it does not follow the complementary relationship implicitly assumed when researchers and policymakers restrict analyses to a single setting. Whereas children are often regarded as communicators of norms and behaviors from the outside world to the family (Berniell, Mata, and Valdés 2013; Lundborg and Majlesi 2018) and have even been deemed “change agents” for healthy behaviors (Olayiwole, Ezirim, and Okoro 2003; Bresee et al. 2016), our results paint a different reality: we find that hand hygiene exhibits strong substitutability for a child across contexts. Were substitution via crowd-out the only actor, the worst-case scenario of such negative transmission might be that the positive impacts of an intervention in one site are negated in another, resulting in a net intervention impact of zero. Cue-based habit formation, however, intensifies the potential negative consequences: if ‘bad’ behavior becomes tied to contexts in which more time is spent (such as the home), the net impact of a successful school intervention will be negative, as we find in this study. Notably, the differential presence of spillovers to peers, households, or the community, a margin we do not directly estimate in this study, may further exacerbate - or counteract - these negative consequences, and remains a topic of further study.

While we explore the behavior of hand hygiene, the range of behaviors that may be vulnerable to the patterns we document are vast: the treatment of peers or authority figures, study habits, healthy food consumption, and mask-wearing, among numerous others. So too are the range of contexts in which one might expect negative transmission to transpire: consider for example the workplace, in which character or community-building efforts are increasingly integrated (such as diversity, equity, and inclusion training), or religious institutions, which aim to cultivate behaviors that will be practiced beyond the houses of worship themselves. The implications of ignoring such transmission patterns are therefore potentially substantial.

The remainder of the paper is structured as follows. Section II describes the context and experimental design, Section III describes the data and the empirical strategy, Section IV discusses the results, and Section V concludes.

II. EXPERIMENTAL DESIGN

II.A. *Study sample and context*

We operate in the Gaibandha District of Bangladesh with a sample population of 156 classrooms across 26 public primary schools paired with 775 rural households (each with at least one child in a sample classroom) across 52 villages. Appendix Table 1 presents sample means for a host of classroom, mother, and child characteristics. Primary schools in our sample have six grade levels, from pre-primary to grade five, with an average class size of 36. The average teacher within these classroomos is a female with thirteen years of formal education and fourteen years of teaching experience. The typical female head of household in our sample is a 35 year old mother with four years of education.

We additionally collect measures of hygiene behavior and hygiene knowledge among sample households. Hygiene practice is poor: only 22% of households recognize that a cold can spread between people, and only 17% (24%) report using soap before cooking (eating). This lack of soap use is not due to scarcity of the raw materials required for proper handwashing: 94% of households have soap in the home and 99% have easy access to a shallow tubewell with potable water. We introduce the hygiene edutainment campaign in an effort to increase knowledge of and familiarity with handwashing and the dispenser technology to make the act of handwashing convenient and enjoyable, drawing from the results of two previous evaluations of hand-hygiene interventions (**hussam21a**; **hussam21b**).

II.B. *Dispenser and soap features*

We employ a wall-mounted soap dispenser embedded with a time-stamped sensor, designed in partnership with the MIT Media Lab, to measure handwashing behavior within households and classrooms. The dispenser was installed in the verandah, where families typically eat, or near the shallow tubewell, from which families draw their water, for each household, and was set up by the door inside each classroom. Because each classroom's distance to a water source differed across schools, we supplemented the dispenser with adjacent water stations consisting of large water buckets with spouts.

The sensor in the dispenser was accessible only via a key that was not supplied to schools or households, preventing participants from tampering with the sensor inside. Liquid soap was provided throughout the course of the experiment, refilled directly into the dispenser biweekly for classrooms and monthly for households. The sensor technology addresses a set of challenges pervasive in the public health literature, which typically employ self-reported outcomes or participant observation to measure hand hygiene (Ram et al. 2010, **hussam21a**): demand effects and desirability bias, as behavior is self- or enumerator-reported, lack of statistical power, as behavior is infrequently measured, and lack of time-specificity, precluding observation of time trends in behavior change. A consistent and objective method of measurement is particularly important in our dual-context setting, as different contexts are likely to exhibit different levels of demand effects and error in measurement under participant observation or self-reported outcomes.

II.C. *Treatment groups and randomization*

Figure I provides a map of all treatment arms. The edutainment treatment involved a series of children's edutainment on hand hygiene, the entirety of which took 10 to 15 minutes to air and was done twice per week in treated classrooms for the duration of the experiment. The content was sourced from publicly available material (for example, see links to the following: Meena Cartoon, Bangladesh campaign, and Sesame Street). To maintain interest, we rotated the precise content in six week cycles, varying the edutainment in each session of a cycle. [4]

4. A version of this educational campaign was found to be effective in a similar context at the household level in **hussam21b**: in an RCT which randomized the edutainment campaign across households in rural Bangladesh, the campaign significantly raised household handwashing rates which in turn translated into significant reductions in

The dispenser saturation treatment was administered by selecting a random 25% subsample of students from a randomized set of classrooms (amounting to an average of nine students per treated class) to receive a handsoap dispenser at home. In the remaining comparison classrooms, we randomly selected two students to receive a dispenser at home.[5] To avoid potential confounding effects of greater prestige or popularity that emerge in the classroom due to selection into the home dispenser lottery, children were not notified that their names had been drawn at school; instead, enumerators privately drew names from a classroom roster, secured the household locations of selected students from the teacher, and visited the households independently to recruit and survey the mother and install the dispenser. As such, peers in classrooms could only be affected by a student's household dispenser if the student independently communicated the information to the peer or altered her behavior due to her home environment.

Randomization along the two margins of treatment was implemented as follows: for both the edutainment treatment and the saturation treatment, our sample was stratified by school and treatments were randomized at the classroom level. The six classes in each of the 26 primary schools were randomized into three edutainment treatment classes (T) and three control classes (C). Our final sample includes 150 unique classes of which 76 are edutainment treated and 74 control.[6,7] The saturation treatment was likewise randomized at the classroom level, with 40% of classes randomly allocated to the dispenser saturation treatment and the remainder to the comparison arm.[8] Students in both high and low saturation classes were selected randomly from the class roster conditional on having attended at least 60% of school days in the previous month, a criteria used to ensure that selected students would indeed be engaged in both environments of

incidence of acute respiratory infection and diarrhea symptoms.

5. Two students, rather than a percentage of students, was chosen in comparison classrooms because classroom sizes varied significantly. Two students, rather than one, were selected in order to avoid undue attention being focused on a single student per comparison classrooom.

6. As some schools did not have enough classrooms to accommodate the entire student body at the same time, some classes either worked in two time shifts or arranged the classroom so that two classes would sit in the same classroom simultaneously. For cases where two classes shared the same classrooms in different time periods, we match our time-stamped dispenser presses to the appropriate classes. For cases where two classes' students shared the same classroom simultaneously, it would be impossible to distinguish the presses of students from the two classes; this constraint meant that, if two classes that shared a classroom were initially assigned to different edutainment treatment and control groups for example, we switched the control class to an edutainment treatment class and consider the two classes as a single treated unit. Out of 156 classes, 5 pairs of classes shared the classroom simultaneously and 4 pairs were initially randomly assigned to different treatment groups. In order to maximize our sample size while avoiding problems of imbalance on 'simultaneous shared classroom space,' we do the following: we preserve the one pair of classrooms that were both randomized into the control group, and we randomly preserve one pair from the four mixed classrooms (of which all were functionally treated). We drop the remaining three mixed pairs of classrooms (or six classes) from all analyses. This yields a sample of 150 unique classes of which 76 are edutainment treated and 74 are control. Additionally, because we preserved the treatment status of a classroom as it entered a new school year, an additional pair of classes of mixed treatment status began sharing a classroom simultaneously and are therefore dropped from analysis during the second school year (the last 2.5 months of data). Lastly, we have one pair of classes who are randomized into different saturation treatment statuses and share their classroom simultaneously; we therefore drop only this pair from all saturation-related analyses.

7. Note that the actual number of classes that appear in our data differ by day depending on the number of sensors that were functioning in a given round of data collection.

8. While a balanced randomization would have been optimal for purposes of power, we were constrained by the number of handsoap sensors available to us.

school and home.

II.D. *Identification of effects*

The experimental design is motivated by the dual objectives of identifying cross-contextual transmission of handwashing behavior from (1) school to home and (2) home to school. In order to do either, the design must first generate exogenous variation in handwashing behavior within each context. This is accomplished at the school level by randomizing the administration of the edutainment campaign across classrooms. At the home level, the exogenous variation is generated by randomizing the distribution of soap dispensers. Paired with a saturation design at the school level and tracking of behavior in both contexts, the design delivers the following causally identified treatment effects:

1. **School-level edutainment effect:** The effect of the hygiene edutainment campaign is identified by comparing the handwashing rates of edutainment treatment classes to those of edutainment control classes.

2. **School-to-home transmission effect:** The behavioral transmission from school to home is identified by comparing the handwashing rate of households with children from edutainment treated classes relative to those of children from control classes. Note that handsoap dispensers cannot feasibly be given to a single child in the household. As such, the estimated household level treatment effect represents the sum of a child's altered behavior in the home and any behavioral spillovers to other household members.

3. **Home-to-school transmission effect:** The behavioral transmission from home to school is identified by comparing the handwashing rates of high-saturation classrooms to those of low-saturation classrooms. As with the household level data, dispenser data captured at the classroom level will represent the combined effect of behavior brought to school by students with a dispenser at home as well as any peer effects generated within the classroom by these students. While the experiment cannot disentangle the two, home-to-school transmission is a requisite for peer effects to transpire.

We note that the experiment was not designed to capture the direct effect of the handsoap dispenser on household washing (the analagous househoold-level treatment effect to the direct effect of the edutainment program on school washing). This implies that, if no home-to-school transmission effect manifested (via the saturation treatment at the classroom level), we would not know whether to attribute this to the absence of a direct effect (no impact of dispensers on handwashing rates at the home) or the absence of behavioral transmission from the home into the school. We take this risk intentionally. Two recent studies have documented substantial effects of handsoap dispenser provision at the household level on child handwashing behavior and health. **hussam21a** randomly distributed dispensers identical to those used in this study to comparable rural households in West

Bengal and documented a 48% decline in loose stool incidence, a 29% decline in ARI symptom incidence, and a 0.2 SD increase in child height-for-age. Consistent with these health impacts, mothers in treated households were twice as likely to report that their children had achieved a regular habit of handwashing. **hussam21b** engaged a non-overlapping but geographically and demographically identical population to that of this study (two years prior) and documented 68% lower loose stool incidence and 52% lower ARI symptom incidence among children in households who received a dispenser. Given the preponderance of evidence of the positive benefits of dispenser provision on child handwashing behavior and health, we felt it unethical to deprive participants in this study of the product. All households and classrooms in our survey sample were therefore provided with handsoap dispensers and liquid soap, precluding the presence of a control group against which to measure the direct household-level dispenser treatment effect. We instead rely on the existence of a classroom-level saturation effect to confirm the direct impact, since the former can only transpire if dispenser children are affected by the presence of a dispenser at home.

III. METHODS

III.A. *Outcomes*

Our primary outcome measures are as follows:

1) **Daily handwashing rates** are measured by and extracted from the time stamped sensor embedded in each handsoap dispenser. At each press of the dispenser, the sensor records the time of day, to the second, when the button is pressed. The identity of the user is unknown, but we proxy for distinct users by collapsing presses that occur two or fewer seconds apart into a single press. Daily handwashing rates are then calculated as the sum of all individual uses over the course of each twenty-four hour period.

   A. School handwashing behavior: Handsoap dispenser data for each class is collected biweekly. For classes who occupy the same classroom in different shifts (eg. 8am-12pm and 12pm-4pm), we match the time-stamped dispenser presses to the class shifts to distinguish between classes.

   B. Household handwashing behavior: Handsoap dispenser data for each household is collected monthly.

2) **Child health** data is collected in the form of self-reported monthly incidence of child diarrhea and respiratory illness. Incidence of loose stool and respiratory illness for sample children were collected at baseline and every month thereafter. Mothers were asked how many days each child had lose stool motion and symptoms of respiratory illness (cough, cold, runny nose) in the past two weeks.

III.B. *Data collection and timeline*

Data: Data was collected by local enumerators recruited by our partner survey organization in Gaibandha, Bangladesh. Baseline surveys were conducted in person both at the school and at the household level, but endline surveys were conducted only at the household level via phone due to the closure of schools and field work restrictions resulting from the COVID-19 pandemic.[9] The video intervention at schools was administered twice weekly following the week of the baseline survey. The enumerators in charge of visiting the households to collect sensor data were blind to the school-level edutainment treatment and the saturation treatment of the sample children in the households.

Timeline: A timeline of the experiment and relevant school events is depicted in Appendix Figure 1. The first phase of the experiment was conducted from October to December 2019. The school-level baseline survey was administered in September of 2019 and the household-level baseline survey in October of 2019.[10] Baseline survey administration was accompanied in both schools and homes by the installation of handsoap dispensers. Bangladesh public primary schools are closed on Fridays and national religious holidays. Grade 5 students left school by mid-November in order to prepare for their national advancement exam; all other students took final exams in the first two weeks of December, after which they had winter break for the remainder of the year. We therefore exclude all weekends and holidays from school-level analyses.

The second phase of the experiment commenced in the beginning of the new academic year, lasting from mid-January to mid-March of 2020. We maintained the randomization and all intervention details of the first phase, but we supplemented the school edutainment treatment with an additional video which underscored the importance of handwashing both at school and at home (described in greater detail below). The edutainment treatment assignment followed students into their new grade: because all schools had only one class per grade, classes were preserved as they advanced grade levels.[11]

9. Actual prevalence of COVID-19 cases was exceptionally low in rural Bangladesh during this period, and we document no impact of our interventions on likelihood of contracting COVID-19.

10. Due to constraints on the field, the edutainment treatment commenced two weeks before the household-level baseline survey was complete, leaving 520 households to have their baseline surveys administered after the first edutainment treatment had been delivered at school. As such, baseline household characteristics relevant to hygiene knowledge and behavior (the two sets of measures that may be impacted by the edutainment treatment) are dropped from the balance table for this subset of households, and regressions which include hygiene knowledge or behavior controls do not include these values for the 520 households surveyed after the first edutainment treatment.

11. In other words, a treated classroom that was in Grade 3 in 2019 would continue to be treated in Grade 4 in 2020; this posed minimal logistical difficulty since each school only had one class per grade. However, following cohorts over years meant that we lost the Grade 5 classes of 2019 (who moved onto secondary school in 2020), and as such do not appear in the school or household level data from January through March 2020. Grade 0 students of 2020 also do not appear in the data, as those students did not exist at the school during the time of randomization in 2019. Out of 775 household participant students, 119 were Grade 5 students in 2019. From the remaining 656 students, 608 students moved up a grade within our sample schools in 2020, and 48 non-Grade 5 students either moved to out-of-sample schools or repeated a grade within the same school. The 17 students who moved to out-of-sample schools were dropped from our sample (essentially considered as Grade 5 class students) and for the remaining 31 students who repeated a grade, their newly assigned treatment status is labeled as "treated" in the data only if their previous assignment in Phase 1 was "treated" and in Phase 2 they were assigned to a "control" class. In other words,

The final edutainment administration in schools occurred on Mar 14, 2020. While we had intended to continue collecting handwashing data for several months after the conclusion of the edutainment treatment in order to measure long-run effects, the onset of the COVID-19 pandemic led to the closure of all schools in mid-March and precluded further field work at schools or households for the safety of enumerators and study participants. As such, we were unable to continue providing households with soap, collecting sensor data, or conducting the endline survey in person. The endline survey for the household participants was instead conducted via phone in late April; all questions intended for the in-person survey were administered except for child anthropometric measures, which required physical engagement with the children.

III.C. *Empirical Strategy*

A. Edutainment treatment effect

To estimate whether the hygiene edutainment campaign shifted behavior within the classroom, we run the following regression:

$$Y_{ct} = \alpha_{ct} + \beta Treated_c + \gamma_t + \lambda_s + \delta_g + \epsilon_{ct} \tag{1}$$

where Y_{ct} is the classroom level handwashing rate for the classroom c on day t, $Treated_c$ is an indicator variable for whether the classroom is edutainment-treated, γ_t is a day fixed effect, λ_s is a school fixed effect, and δ_g is a grade-level fixed effect. We additionally control for the saturation treatment status of the classroom. In order to make comparable to the school-to-home treatment effect, we also present results in which the outcome Y_{ct} is divided by the number of students per class, yielding an approximation of the per-student impact of the edutainment treatment at school.[12]

B. School-to-home transmission

To estimate the presence of a school-to-home behavioral transmission, we run the following regression:

$$Y_{ht} = \alpha_{ht} + \beta Treated_h + \gamma_t + \lambda_s + \delta_a + \epsilon_{ht} \tag{2}$$

where Y_{ht} is the household level outcome for the household h on day t, $Treated_h$ is an indicator variable for whether the household has a child who attends an edutainment treated class, γ_t is a day fixed effect, λ_s is a school fixed effect, and δ_a is an age-level fixed effect. As above, we additionally control for the saturation treatment status of the child's classroom.

we interpret any exposure to treatment (given the initial randomization) as treated for the full two-phase duration of the experiment.

12. All specifications and outcome variables were prespecified in our preanalysis plan, available at https://www.socialscienceregistry.org/trials/4746. Deviations from this plan were minor and are described in the Appendix.

C. **Home-to-school transmission**

To estimate the presence of a home-to-school behavioral transmission, we run the following regression:

$$Y_{ct} = \alpha_{ct} + \beta Highsat_c + \gamma_t + \lambda_s + \delta_g + \epsilon_{ct} \tag{3}$$

where Y_{ct} is the class level outcome for classroom c on day t, $Highsat_c$ is an indicator variable for whether classroom c is a high saturation class, γ_t is a day fixed effect, λ_s is a school fixed effect, and δ_g is a grade-level fixed effect. We additionally control for the edutainment treatment status of the classroom (identical to equation (1), but with coefficient of interest on saturation).

IV. RESULTS

Appendix Table 2 presents the p-values for the difference in means, with school fixed effects, across a host of baseline observables between the edutainment treated and control samples and the dispenser saturation treated and control samples across the duration of the experiment.[13] Schools and households are balanced across the majority of observables, and regressions control for those features which are imbalanced across their respective treatment groups.

IV.A. *School edutainment treatment effect*

We first examine whether the hygiene edutainment campaign impacted handwashing behavior in the classroom. Figure II plots the hourly trends of handwashing behavior at schools for the edutainment treated and control classrooms. Handwashing rates across both groups predictably peak during students' two opportunities to eat, snack and lunch. Classes exposed to the edutainment campaign exhibit greater rates of washing throughout the day, both during and between these mealtimes. Figure III zooms out to the full duration of the experiment and plots average daily handwashing rates across treated and control classes: despite considerable variation across days, treated classrooms remain above control classrooms in handwashing performance over the course of the full experiment.

Columns 1-3 of Table I present the regression analog. Treated classrooms exhibit a 29% higher rate of handwashing than control classrooms ($p = 0.001$); this treatment effect increases to 35% with the inclusion of day, school, and grade-level fixed effects ($p = 0.000$). Appendix Table 3 examines effects by phase. In phase 1, edutainment treated classrooms exhibit a 19% higher rate of

13. We separate the two phases because the samples differ: in phase 2 of the experiment, the sample now excludes Grade 5 students, students who transferred to out of sample schools for the new academic year, and their households.

daily handwashing ($p = 0.009$); this effect increases to 107% in phase 2 ($p = 0.000$), during which washing in all classrooms declines, but substantially more so in control classrooms.[14]

IV.B. *School-to-home transmission*

The edutainment campaign significantly altered childrens' behavior of a generalizable skill in the classroom; we now examine whether this behavioral change was transmitted into their home environment. Table II illustrates the impact of the school edutainment treatment at the household level. We find no evidence of positive transmission across contexts. Rather, having a child from a treated classroom in the household reduces daily handwashing rates in the household by 9% ($p = 0.068$). The inclusion of day, school, and age-level fixed effects yields an estimated negative treatment effect of the school-level edutainment campaign on home washing of 7% ($p = 0.063$). Figure IV depicts these results graphically over the two phases of the edutainment experiment: households of treated students consistently perform below those of control students.

Is this decline in home handwashing meaningful relative to the increase in handwashing exhibited at school? Columns 4-6 of Table I approximates per-student changes in school-level handwashing due to the edutainment treatment by dividing classroom handwashing rates by the number of students per class. The average student in an edutainment-treated classroom washes 0.28 more times per day at school. According to Column 3 of Table II, however, she and her family wash a total of 0.37 fewer times per school day at home. In other words, the school edutainment intervention leads to a net *negative* effect on handwashing behavior during school days for a treated child and her family.

IV.C. *Home-to-school transmission effect*

An intervention that significantly raises handwashing at school leads to a substantial reduction in handwashing at home. Do we observe a parallel pattern for an intervention that improves handwashing at home, in the form of handsoap dispenser provision? Recall that we cannot directly estimate the impact of dispenser provision on washing at home given the absence of a no-dispenser control arm. We instead rely on previous work establishing the significant health impacts of household-level dispenser provision, and examine whether this intervention at the household impacts performance at school.

Columns 1-3 of Table III present the results. As in the school-to-home analysis, we find no evidence of positive transmission of handwashing behavior from the home into the school. Rather, classrooms in which a quarter of all students receive handsoap dispensers at home wash 15% less ($p = 0.022$) than classrooms with only two dispenser children. Results remain robust to the inclusion of time, school, and grade-level fixed effects, with a negative treatment effect of 11%. In

14. **hussam21a** documents a nearly identical magnitude of decline in handwashing rates in India within households with the same type of dispenser, suggesting that the decline is likely due to the novelty of the dispenser product rather than the context in which it was implemented.

other words, classrooms in which a larger proportion of students are enabled to wash their hands at home exhibit significantly lower washing at school.

The trends we observe over time further inform this story. Figure V plots the daily handwashing rate for high and low saturation classes over the course of the experiment, and Appendix Table 3 presents the regression analog, estimating effects separately by phase. The patterns are revealing: phase 1 is concurrent with the period of highest at-home handwashing among dispenser children (as evidenced in Appendix Figure 2), and is also when saturated classrooms exhibit the largest negative effect. Phase 2 is concurrent with substantially lower handwashing within the home, and is likewise the period during which we observe little, if any, negative transmission into saturated classrooms. In other words, evidence of negative behavioral transmission necessitates a strong 'first-stage' of a dispenser treatment effect in the home; while we cannot measure this effect directly given the mechanical absence of a dispenser control group, the level trends in household handwashing suggest that such a 'first-stage' diminished considerably by the beginning of the new school year in phase 2.

Is this reduction in school-level handwashing meaningful? If we make the conservative assumption that every student in a high-saturation classroom mimics the behavior of their dispensered classmates (an assumption of complete peer effects), being in a high-saturation classroom is associated with a reduction of approximately 0.1 washes per student per school day (Columns 4-6 of Table III). If we instead assume a world with zero peer effects, such that the documented classroom level impact is driven solely by a change in the behavior of dispenser children, receiving a dispenser at home is associated with a reduction of 0.47 washes at school per school day.[15] Although *ex ante* there is no reason that behavioral transmission from home to school caused by dispenser provision be comparable to that from school to home due to edutainment provision, this bounding exercise is a reassuring check on the magnitude of the effects we document, and suggests that the negative transmission of handwashing behavior from home to school is likewise substantial.

IV.D. Underlying mechanisms

The replication of negative behavioral transmission under two distinct interventions in the dual directions of school to home and home to school suggests that the effects we observe are not unique to a specific environment nor intervention, but rather tied to the behavior of handwashing itself. We consider two sets of mechanisms through which this negative transmission may transpire.

1. *Crowd-out*

We first consider a broad set of mechanisms which we convene under the term 'crowd-out.' Among them are the act of moral licensing and the strategy of target performance. Moral licensing is a

15. This back-of-the-envelope calculation is performed as follows: high saturation classrooms exhibit 3.31 more washes per school day than low saturation classrooms and have an average of 7 more students with dispensers at home than low saturation classrooms. $\frac{-3.31}{7} = 0.47$ fewer washes per additional dispenser student.

form of psychological bargaining with oneself, in which one permits herself some bad behavior - or absence of good behavior - after having performed a good deed: good behavior licenses one to become subsequently morally lax (Blanken, Ven N., and Zeelenberg (2015) and Merritt, Effron, and Monin (2010); see Luk-Zilberman (2021) for a review of empirical evidence of the phenomenon). In the case of handwashing, children who are exhorted by an edutainment campaign to (and in turn do) handwash at school may feel it acceptable to shirk in the effortful obligation later in the day, such as when they return home. Likewise, children who are compelled (either by parents or intrinsically) to use the handsoap dispenser to wash before breakfast may feel licensed to skip a wash before their snack or lunch at school.

Target performance generates a similar story. Analagous to the strategy of income targeting (Camerer et al. 1997), target performance suggests that actors have a maximum number of handwashing acts they are willing to invest the effort to perform within a given period of time. Should that period be a day, children who are compelled to wash in the morning at home will have fewer washes remaining until they have reached their target at school; those who are compelled to wash at school will have fewer washes remaining to complete their target upon returning home.

These two mechanisms are not an exhaustive list of behavioral motives behind crowd-out: Luk-Zilberman (2021)'s process of 'depletion,' in which individuals possess limited cognitive or effort capacity, or Bénabou and Tirole (2003)'s framework of extrinsic incentives that crowd out intrinsic motivation, yield identical patterns of negative behavioral transmission. Teasing apart these mechanisms requires reliable information on the underlying (and potentially subconscious) motivations of our child participants and is outside the scope of this study. We focus on the key temporal prediction which is shared across this body of crowd-out mechanisms: once an effortful action has been undertaken, it is less likely to be performed again.

Our time-stamped data on handwashing performance presents a unique opportunity to test for this temporal pattern. While crowd-out may transpire over a variety of temporal margins (a week, month, or the duration of the experiment),[16] one sensible margin of crowd-out is a school day. In other words, if the mechanism of crowd-out is operative, then we may expect the negative relationship with home handwashing rates to be strongest after edutainment-treated children have engaged in additional washing at school, rather than before they go to school or while they are at school, on a given day. Table IV illustrates this pattern: Column 4 of Panel A demonstrates that the bulk of the negative transmission effect indeed arises once children return home from school. We observe close to zero difference in handwashing between edutainment-treated and control students at home prior to school, despite a third of daily household-level handwashing occurring during this time among control households (implying the opportunity to reduce handwashing before school if one wished to). While Table IV presents results for total handwashing episodes within each specified time period, results are robust to transforming the outcome to hourly rates before, during, and

16. Indeed, the growing size of the negative transmission between phase 1 and phase 2 suggests that cumulative engagement in handwashing over the course of the experiment is likely to be one temporal margin along which participants trade off school v. home performance.

after school (Appendix Table 5). Reductions in handwashing in the homes of edutainment-treated children are driven primarily by the hours *following* exposure to the school environment.

2. *Cue-based habit formation*

The second mechanism we consider is that of cue-based habit formation (Wood and Neal 2007; Orbell and Verplanken 2010; Laibson 2001), in which repetitive behaviors become triggered by the sensory environments in which they are performed. The converse likewise holds: the absence of triggers can inhibit the behavior, and is therefore a way to break a habit. In other words, a behavior change intervention that is attached to a specific context may succeed in amplifying the behavior in the context of the intervention while diminishing it in all others.

Recent work (**hussam21a**; Wellsjo 2021) has established handwashing as a habit forming activity. In the context of hospitals in the U.S., Wellsjo (2021) further finds that the behavior is cued by entering highly frequented rooms, while in the context of households in rural India, **hussam21a** finds that the behavior may be cued by a specific time of year (winter) with its accompanying environmental triggers. We consider whether handwashing behavior, when motivated by an intervention delivered in the school environment, may become attached to the cue of the school at the expense of performance in the home.

A key prediction of the mechanism of cue-based habit formation, as distinct from that of crowd-out, is that the negative treatment effect for edutainment-treated children at the household should manifest even on days when children do not have school: days in which there is no opportunity for crowding out behavior. To examine this, we estimate the impact of the edutainment campaign on household washing during holidays and weekends. Results are presented in Column 3 of Table V. Indeed, we find that households of edutainment-treated children exhibit significantly lower rates of handwashing than their non-treated counterparts even on weekends and holidays, when crowding out from school consumption is not possible. In other words, the presence of the home cue, which, over the course of repeated (in)activity has been disassociated from handwashing, leads to lower handwashing in the homes of edutainment-treated children relative to control households regardless of whether the crowd-out mechanism has been engaged.

Recall, however, that our investigation of crowd-out found no difference in washing behavior at home during the morning hours of school days, prior to going to school (Column 2, Panel A of Table IV). The cue in question can therefore not be 'home' broadly construed. Instead, the negative behavioral transmission we document is likely to be driven by a combination of the crowd-out mechanism and a cue that is both environment- and time-specific. Children are first motivated to wash by the edutainment campaign at school, which raises school-level washing. A crowd-out mechanism such as target performance or moral licensing then leads to lower washing once they return home from school. As the school week proceeds, such repeated daily behavior develops into a cue-based habit, subsequently reducing handwashing at home over the weekend. Should this be the case, then the habit must be tied not only to the environment but also to a specific time of day:

morning hours, during which handwashing is not reduced during school days, should likewise see no reduction in handwashing on non-school days. Panel B of Table IV suggests that this is the case: during the morning hours of weekends and holidays that would fall in the 'before school' hours were they school days, we detect no significant reductions in handwashing rates at home among edutainment-treated children (despite, again, accounting for one third of total handwashing on these days among the control group). The negative impact on home handwashing is driven almost entirely by the remaining hours of the day. As with Panel A, this result is robust to transforming the outcome variable to hourly, rather than total, handwashing rates within each specified time period as well (Appendix Table 5: hourly handwashing rates are a statistically insignificant 5% lower than control households in the 'before school' hours, but a statistically significant 10% lower than control households thereafter, on holidays and weekends).

IV.E. *Potential confound: context-specific intervention*

While our findings are consistent with features of the behavior of interest - namely that the act of handwashing is characterized by crowd-out and cue-based habit formation - we consider here a feature of the experimental setting that may instead be driving our results. In particular, because children received the edutainment intervention at school, perhaps they understood hand hygiene to be a school-specific behavior. In other words, perhaps edutainment-treated students interpreted handwashing as an act that was intended for school, and not for the home, resulting in the negative edutainment treatment effect on home washing. We view this story as distinct from that of cue-based habit formation: behavior which is learned (in this case, incorrectly learned) can be unlearned through information provision; behavior which is the product of contextual triggers, however, cannot. This distinction between learned and subconscious motives to action is given theoretical exposition in Romer (2000).

We find this alternative story unlikely for three reasons. First, the content of the edutainment was weighted towards material that featured the home: within a typical week of content, 45% of content-time demonstrated washing within a home, 50% in location neutral sites (washing at a sink, playing in dirt), and 5% at a school. Second, the distinction between phase 1 and phase 2 was a direct effort to address this potential confound: in phase 2, we supplemented the existing content with a video featuring one author exhorting the students to wash their hands with soap both at school and at home. If the relative absence of household handwashing among edutainment students was a problem of misunderstanding regarding the objective of the intervention, in a context where the edutainment content was successfully altering school behavior, a supplementary message conveying the correct information about the home should remedy students' misunderstanding. Table VI presents the results of a difference-in-differences regression which estimates the impact of this adjustment to the intervention: we find that the video has no impact on handwashing among edutainment-treated students, neither at school nor within the household. Such students continue to wash significantly more at school and less at home than their control counterparts.

Most critically, we document negative behavioral transmission not only from the school into the home, but also from the home into the school. The latter result employs a distinct intervention that is not vulnerable to the potential artifact of context-specificity: children treated at home were 'treated' with handsoap dispensers, a product that they had access to in both the home and the school and therefore had no reason to interpret as a 'home-specific' technology.

IV.F. *Self-reported knowledge and behavior*

The presence of negative behavioral transmission across contexts, while evidenced in the dual directions of home to school and school to home, is nonetheless surprising. Priors, derived both from the limited existing literature on behavioral transmission (Hiramatsu et al. 2014; Tidwell et al. 2020) and the nature of early education curricula, incline towards the presence of positive transmission across contexts. Data collected at endline, six weeks after the conclusion of phase 2, offer some insight into where positive transmission of behavior from the school to the home may have been stymied, as well as how we might interpret existing studies which document such positive behavioral transmission across contexts.

As is demonstrated in Table VII, Panel A, children treated with the edutainment campaign do verbally relay what they have learned to their mother: mothers of treated children are substantially more likely to report that their child told them about the cartoons they saw at school and to volunteer that the cartoon content was related to handwashing. However, Table VII, Panel B suggests that little substantive information regarding handwashing was conveyed: mothers of treated children were no more likely to know when their children should wash their hands, what might happen if they do not wash, nor how to wash properly.

We observe a small subset of mothers of treated children (4% more) having learned – presumably from their child – where the most important sites of handwashing are (the school and the home). A similar margin appears on self-reported handwashing behavior: Table VII Panel C shows that mothers of treated children report washing 0.36 more times per day ($p = 0.063$), are 14% more likely to report washing with soap before they cook ($p = 0.023$), and 4% more likely to report washing with soap before they eat ($p = 0.032$).

We draw two lessons from this body of self-reported data. First, the inconsistency between reported handwashing behavior and dispenser data underscores how vulnerable self-reports are to experimenter demand effects: mothers of treated children report significantly better hand-hygiene, yet our objective and high-frequency measures suggest that these households in fact wash significantly *less* than their control counterparts. This observation suggests a reevaluation of a number of previous studies that report positive behavioral impacts from handwashing campaigns but rely only on self-reported behavior (Contzen, Pasquale, and Mosler 2015; Johansen et al. 2015; Hovi, Ollgren, and Savolainen-Kopra 2017, among others) and reiterates the necessity of objective data for behaviors otherwise vulnerable to demand effects. Were we to rely on our self-reported measures of handwashing rather than the sensor data in the household, we would document positive behavioral transmission of our edutainment program and, as a result, promote the scale-up of an intervention that in reality results in a net negative impact for treated children and their families.

Second, the absence of positive knowledge transfer from child to mother highlights a key barrier to the transfer of behavior into the home: family members may not gain substantive information from a child's school experiences. And while behavioral spillovers from the child to other family members may exist, our estimates suggest that they serve only to exacerbate the crowding-out effect: this is evidenced by the negative, though small and imprecise, impact of the edutainment program on home handwashing even during the hours that the child is at school (Table IV, Panel A, Column 3). This result lies in contrast to a body of literature that finds children to be effective vehicles through which social norms and behaviors of family members may evolve (Berniell, Mata, and Valdés 2013; Lundborg and Majlesi 2018), and especially to the recent focus on children in low-income countries as potential "change agents" in the home for hygiene and sanitation behaviors adopted at school (Olayiwole, Ezirim, and Okoro 2003; Bresee et al. 2016).

V. Child health and concluding remarks

Early education programs are grounded in an assumption of the positive transmission of behavior. Our results suggest that certain behaviors may instead be substitutes across contexts, with engagement in one site crowding-out engagement in another. At its worst, this mechanism may result in the negation of positive behavioral change, or a net-zero impact. However, when paired with the phenomenon of cue-based habit formation, a behavior change campaign that appears successful in one environment may in fact yield a negative impact on net.

What are the downstream consequences of this negative behavioral transmission across contexts? Though we are not powered to detect health impacts of the school-level edutainment treatment given its small net effect, our estimates of health impacts are qualitatively consistent with the negative impact of the program on total handwashing: we document a statistically insignificant *increase* in the incidence of loose stool and respiratory infection symptoms among edutainment-treated children (Table VIII). While noisy, the magnitude of this deteriorating health is large: both the incidence of loose stool and the presence of any symptoms of acute respiratory infection in the two week recall period increase by at least 50%.

Beyond the direct negative impact on child health, because both fecal matter and coughs and colds are common means of spreading bacterial and viral infections, negative behavioral transmission from the school into the home may have important consequences for vulnerable members of the household, whose health status we do not collect in this study. 31% of children in our sample live in a household with an adult over the age of 50 years in a setting where life expectancy is approximately 66 years (Islam et al. 2017). If children respond enthusiastically to a hand hygiene campaign at school, but consequently reduce washing in a home with elderly grandparents, an intervention deemed successful at school may produce substantial negative health spillovers in the home, especially in light of phenomena such as the COVID-19 pandemic.

Conversely, if schools are a center of behavioral spillovers via peer effects as well as health spillovers via physical proximity and play, one may want to ensure that encouraging hygienic practices at home does not unintentionally reduce such behavior in a site with greater externalities.[17] These remain necessarily empirical questions, for which we hope this study can serve as a template, underscoring the necessity of estimating intervention impacts across all sites of action before scaling up behavior change policy.

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17. Consider the recent debates around school reopenings in light of the global COVID-19 pandemic: public health experts recognize schools as potential hot zones for the spread of germs and handwashing as a critical preventive tool (CDC 2020).

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TABLES

TABLE I. Edutainment treatment at schools

	(1)	(2)	(3)	(4)	(5)	(6)
Edutainment treatment	7.278***	8.317***	8.881***	0.222***	0.263***	0.276***
	(2.070)	(1.501)	(1.607)	(0.0602)	(0.0475)	(0.0521)
Edutainment control mean	25.185	25.185	25.185	0.752	0.752	0.752
	[40.530]	[40.530]	[40.530]	[1.234]	[1.234]	[1.234]
Observations	12,427	12,427	12,427	12,427	12,427	12,427
Date FE	No	Yes	Yes	No	Yes	Yes
School FE	No	Yes	Yes	No	Yes	Yes
Grade FE	No	No	Yes	No	No	Yes

Notes. The unit of observation is class by day. Dependent variable for columns (1)-(3) is daily handwashing rate as measured by total number of soap dispenser presses per day per class. Dependent variable for columns (4)-(6) is total number of daily presses per class divided by the number of students in each class. We control for the saturation status of the classroom in all regressions and the class size in (1)-(3). Dates range from Oct 12th – Mar 15th, 2020 (22 weeks, with 5 weeks of vacancy between phase 1 and phase 2 and Fridays, national holidays, and winter break dropped). Robust standard errors clustered at the class level are reported in parentheses, and standard deviations are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1

TABLE II. Edutainment treatment at households

	(1)	(2)	(3)
Edutainment treatment	-0.456*	-0.347*	-0.371*
	(0.249)	(0.200)	(0.198)
Control mean	5.193	5.193	5.193
	[7.112]	[7.112]	[7.112]
Observations	90,856	90,856	88,910
Date FE	No	Yes	Yes
School FE	No	Yes	Yes
Age FE	No	No	Yes
Controls	No	No	Yes

Notes. The unit of observation is household by day. Dependent variable is daily handwashing rate as measured by total number of soap dispenser presses per day per household. Dates range from Oct 12th, 2019 - Mar 12th, 2020. All models control for the saturation treatment status of the classroom that the household's child belongs to. Controls in column 3 include baseline hygiene knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, whether we still need to use the soap even if hands appear clean, and the variables whose difference between the treatment group was significant in the baseline both for phase 1 and 2: whether the household has a latrine, treats drinking water, and mother washes her hands with soap before eating. Robust standard errors clustered at the class level are reported in parentheses, and standard deviations are reported in brackets *** p<0.01, ** p<0.05, * p<0.1

Edutainment treatment at households

	(1)	(2)	(3)
Edutainment treatment	-0.456*	-0.347*	-0.412***
	(0.249)	(0.200)	(0.077)
Control mean	5.193	5.193	5.193
	[7.112]	[7.112]	[7.112]
Observations	90,856	90,856	90,145
Date FE	No	Yes	Yes
School FE	No	Yes	Yes
Age FE	No	No	Yes
Controls	No	No	Yes

Notes. The unit of observation is household by day. Dependent variable is daily handwashing rate as measured by total number of soap dispenser presses per day per household. Dates range from Oct 12th, 2019 - Mar 12th, 2020. All models control for the saturation treatment status of the classroom that the household's child belongs to. Controls in column 3 include baseline hygiene knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, whether we still need to use the soap even if hands appear clean, and the variables whose difference between the treatment group was significant in the baseline both for phase 1 and 2: whether the household has a latrine, treats drinking water, and mother washes her hands with soap before eating. Robust standard errors clustered at the class level are reported in parentheses, and standard deviations are reported in brackets *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE III. Saturation treatment at schools

	(1)	(2)	(3)	(4)	(5)	(6)
Saturation treatment	-4.702**	-3.193**	-3.314**	-0.116*	-0.078*	-0.084*
	(2.027)	(1.404)	(1.317)	(0.060)	(0.044)	(0.043)
Saturation control mean	30.630	30.630	30.630	0.873	0.873	0.873
	[46.136]	[46.136]	[46.136]	[1.337]	[1.337]	[1.337]
Observations	12,427	12,427	12,427	12,427	12,427	12,427
Date FE	No	Yes	Yes	No	Yes	Yes
School FE	No	Yes	Yes	No	Yes	Yes
Grade FE	No	No	Yes	No	No	Yes

Notes. The unit of observation is class by day. Dependent variable for columns (1)-(3) is daily handwashing rate as measured by total number of soap dispenser presses per day per class. Dependent variable for columns (4)-(6) is total number of daily presses per class divided by the number of students in each class. We control for the edutainment status of the classroom in all regressions and the class size in (1)-(3). Dates range from Oct 12th – Mar 15th, 2020 (22 weeks, with 5 weeks of vacancy between phase 1 and phase 2, and Fridays, national holidays, and winter break dropped). Robust standard errors clustered at the class level are reported in parentheses, and standard deviations are reported in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE IV. Edutainment treatment effect at households throughout the day

	Panel A: School days			
	(1)	(2)	(3)	(4)
	All day	Before school	At school	After school
Edutainment treatment	-0.342*	-0.056	-0.090	-0.196*
	(0.203)	(0.087)	(0.088)	(0.116)
Control Mean	5.156	1.642	1.304	2.210
	[6.738]	[3.212]	[2.997]	[3.793]
Observations	70,111	70,111	70,111	70,111
Date FE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

	Panel B: Non-school days		
	(1)	(2)	(3)
	All day	Before “school”	At and after “school”
Edutainment treatment	-0.483**	-0.123	-0.360**
	(0.197)	(0.089)	(0.161)
Control Mean	5.332	1.586	3.746
	[8.348]	[3.059]	[7.014]
Observations	18,799	18,799	18,799
Date FE	Yes	Yes	Yes
School FE	Yes	Yes	Yes
Age FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes. The unit of observation is household by day. Dependent variable is daily handwashing rate as measured by total number of soap dispenser presses per day per household within the time range specified (the exact hours are specific to students' grade and school). Dates range from Oct 12th, 2019 - Mar 12th, 2020. Panel A includes only school days and Panel B includes only non-school days, where non-school days refer to Fridays, national holidays, and the winter break. All columns control for saturation treatment status, baseline hygienic knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, and whether there's still need for the soap even if hands appear clean. They also control for variables whose difference between the treatment group were significant in the baseline for both phases 1 and 2: whether the household treats drinking water, has a latrine, and the mother washes her hands with soap before eating. Robust standard errors clustered at the class level are reported in parentheses and standard deviations are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1

TABLE V. Daily patterns of edutainment treatment at households

	(1) All days	(2) School days	(3) Non-school days
Edutainment treatment	-0.371*	-0.342*	-0.483**
	(0.198)	(0.203)	(0.197)
Control Mean	5.193	5.156	5.332
	[7.112]	[6.738]	[8.348]
Observations	88,910	70,111	18,799
Date FE	Yes	Yes	Yes
School FE	Yes	Yes	Yes
Age FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes. The unit of observation is household by day. Dependent variable is daily handwashing rate as measured by total number of soap dispenser presses per day per household. Dates range from Oct 12th, 2019 - Mar 12th, 2020. Non-school days refer to days the students do not go to schools such as Fridays, national holidays, and winter break. All columns control for saturation treatment status, baseline hygienic knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, whether we still need to use the soap even if hands appear clean, and the variables whose difference between the treatment group was significant in the baseline both for phase 1 and 2: whether the household has a latrine, treats drinking water, and mother washes her hands with soap before eating. Robust standard errors clustered at the class level are reported in parentheses and standard deviations are reported in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE VI. Pre-post analysis of edutainment treatment

	(1) School	(2) Household
Edutainment Treatment	0.251***	-0.381
	(0.0849)	(0.231)
Post	-0.781***	-1.517***
	(0.0776)	(0.168)
Edu-treatment × Post	0.0502	0.0701
	(0.111)	(0.223)
Observations	12,427	88,910
School FE	Yes	Yes
Grade/Age FE	Yes	Yes

Notes. Dependent variable for column (1) is total number of dispenser presses per day per class. Dependent variable for column (2) is total number of dispenser presses per day per household. For column (1), we control for the classroom's saturation treatment status and the class size. For column (2), we control for the saturation treatment status of the student's class as well as baseline hygienic knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, and whether we still need to use the soap even if hands appear clean, as well as variables whose difference between the treatment group were significant in the baseline for both phases 1 and 2: whether the household treats drinking water, has a latrine, and the mother washes her hands with soap before eating. Robust standard errors clustered at the class level are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE VII. Endline measures of edutainment treatment

Panel A: Household knowledge of edutainment treatment				
	(1) Child talked to mother	(2) Shared the content with mother	(3) Mother described content correctly	(4) Handwashing topic
Edutainment treatment	0.544***	0.367***	0.432***	0.080**
	(0.059)	(0.091)	(0.078)	(0.032)
Control Mean	0.255	0.557	0.557	0.862
	[0.436]	[0.500]	[0.500]	[0.346]
Observations	609	351	351	609

Panel B: Household knowledge transmission					
	(1) When wash-child	(2) If no wash may get sick	(3) Handwash procedure	(4) Where wash-child	(5) When wash-mother
Edutainment treatment	-0.020	-0.010	0.001	0.037*	0.024
	(0.015)	(0.025)	(0.016)	(0.021)	(0.018)
Control Mean	0.967	0.931	0.905	0.931	0.909
	[0.176]	[0.254]	[0.293]	[0.254]	[0.288]
Observations	609	609	609	609	609

Panel C: Self reported Behavior transmissions				
	(1) Soap per day	(2) Soap before cook	(3) Soap before eat	(4) Child soap before eat
Edutainment treatment	0.357*	0.082**	0.038**	0.018*
	(0.190)	(0.035)	(0.017)	(0.011)
Control Mean	5.564	0.585	0.964	0.978
	[2.787]	[0.494]	[0.188]	[0.146]
Observations	609	609	609	609

Notes. Endline survey was administered via phone at the end of the intervention, 5 months after the start of the edutainment treatment. All models include school and age fixed effects and control for saturation treatment status and baseline hygiene knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, and whether we still need to use the soap even if hands appear clean. We also control for variables whose difference between the edutainment treatment group were significant in the baseline for phases 1 and 2: whether the household treats drinking water, has a latrine, and the mother washes her hands with soap before eating. Standard errors clustered at the class level in parentheses and standard deviations are reported in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Panel A

Column (1): "Did your child ever talk to you about watching a cartoon at the school?"

Column (2): "If previous question is 'yes', did s/he tell you about the content of the cartoon?"

Column (3): Content of the cartoon the mother describes is related to handwashing (descriptive)

Column (4): Mother correctly chose washing hands as the main topic of the cartoons (multiple choice)

Panel B

Column (1): "When are the most important times for your children to wash their hands?"

Column (2): "What could happen if your children don't wash their hands?"

Column (3): "What should you not do when you wash your hands?"

Column (4): "Where are the two important places for your children to wash their hands at?"

Column (5): "When should you wash your hands?"

Panel C

Column (1): "How many times a day do you wash your hands with water and soap? "

Column (2): "Do you wash your hands with soap before you cook?"

Column (3): "Do you wash your hands with soap before you eat?"

Column (4): "Do your children wash their hands with soap before they eat?"

TABLE VIII. Child Health Measures (ARI and Diarrhea symptoms in the last 2 weeks)

	(1)	(2)	(3)	(4)
	ARI		Diarrhea	
	Days	Binary	Days	Binary
Edutainment treatment	0.048	0.011	0.027	0.006
	(0.081)	(0.019)	(0.018)	(0.005)
Control mean	0.873	0.021	0.242	0.010
	[1.821]	[0.248]	[0.429]	[0.101]
Observations	2,004	2,004	2,004	2,004
Clustered SE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Round FE	Yes	Yes	Yes	Yes

Notes. Sample is 4 rounds of surveys administered every month after the baseline survey to the households. Outcome for Columns (1)-(2) is around incidence of acute respiratory symptoms (runny nose or cough); outcome for Columns (3)-(4) is around incidence of loose stool, as a symptom of diarrhea. 'Days' measures the total number of days of symptoms in the previous two weeks and 'Binary' is one if there were any symptoms in the previous two weeks and zero otherwise. All regressions include school and age fixed effects as well as fixed effects for suvey round. We control for baseline hygienic knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, and whether if there's still need to use the soap even if hands appear clean. We also control for variables whose difference between the edutainment treatment group were significant in the baseline for phases 1 and 2: whether the household treats drinking water, has a latrine, and the mother washes her hands with soap before eating. Standard errors clustered at the class level in parentheses and standard deviations are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1

FIGURES

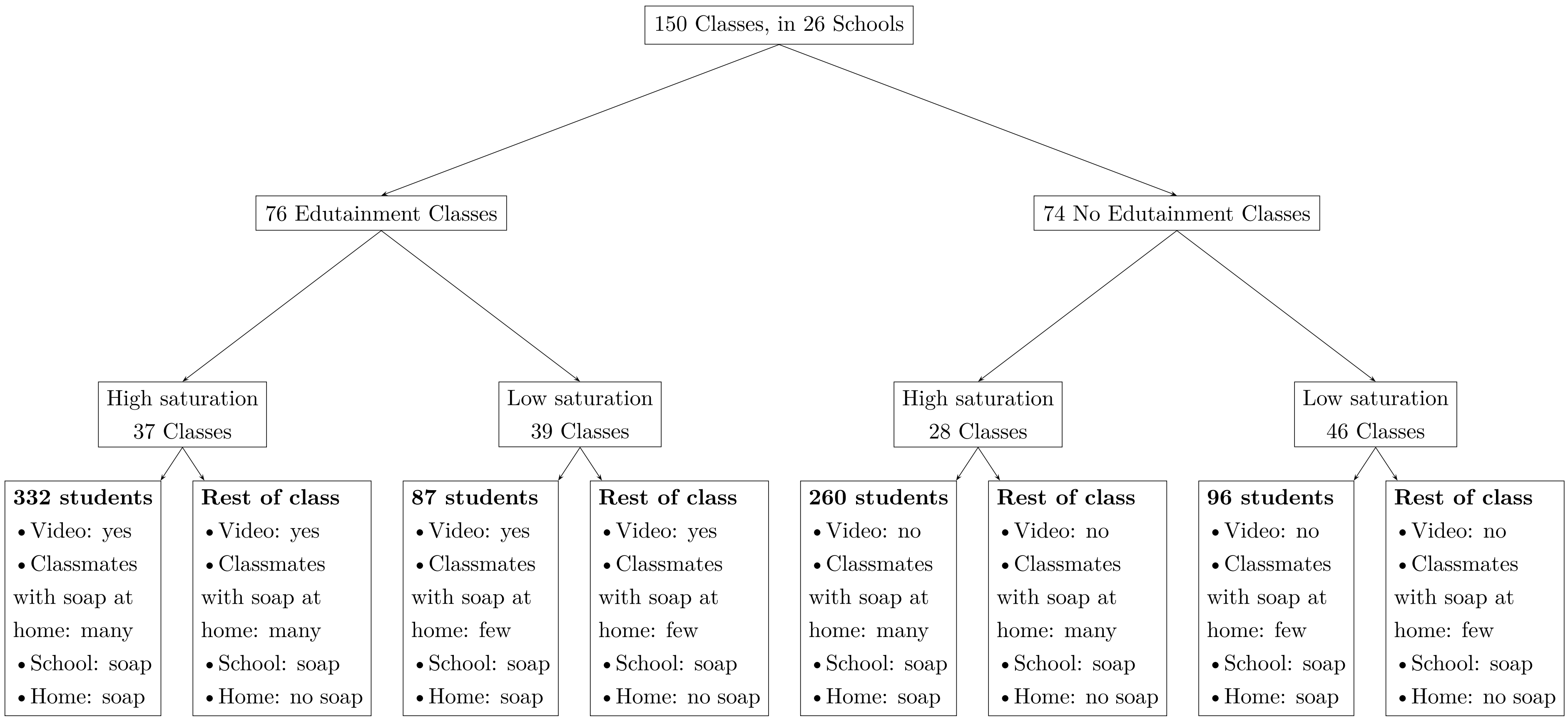


FIGURE I. Description of Full Sample

Notes. Full sample is composed of eight groups, divided according to video exposure (edutainment treatment group vs. edutainment control group), proportion of classmates with dispensers at home (high saturation treatment vs. low saturation treatment group), and whether the students themselves have soap dispensers at home. All groups have access to soap dispensers in classrooms, but only 775 randomly selected students have access to soap dispensers at home. At schools, the hand soap usage can thus be measured for all groups aggregated at the class level, while at households, the hand soap usage can only be measured for the randomly selected 775 students, aggregated at the family level. The identity of the individual dispenser user is unknown in both classrooms and households, but we proxy for distinct users by collapsing presses that occur two or fewer seconds apart into a single press.

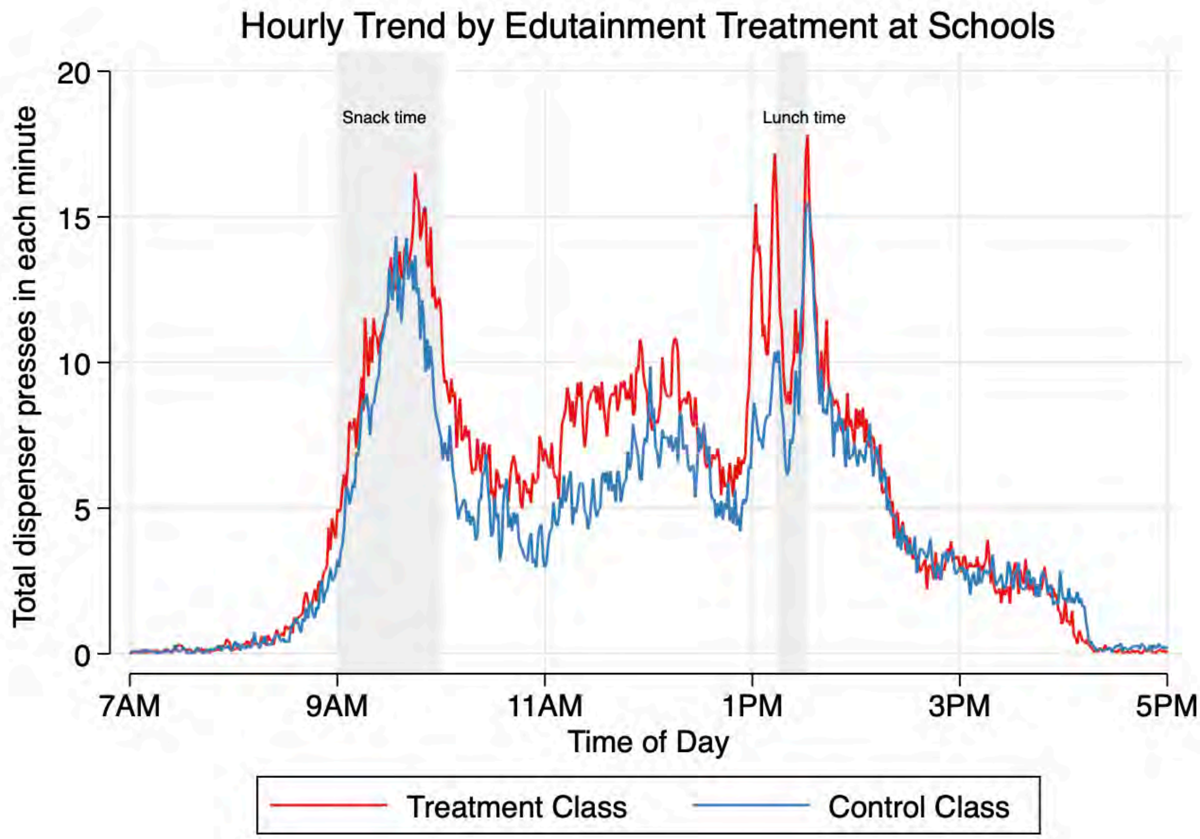


FIGURE II. Hourly trend of classroom dispenser use by edutainment treatment status

Notes. This figure plots the average number of soap dispenser presses in a class throughout a typical day in classrooms according to their edutainment treatment status. Note that only students in grades 3, 4, and 5 have lunch time, and lunch time is either at 1:15pm or 1:30pm depending on the school. Some students eat lunch at home and some at school. All students have snack time, mostly between 9:15am and 12:45pm.

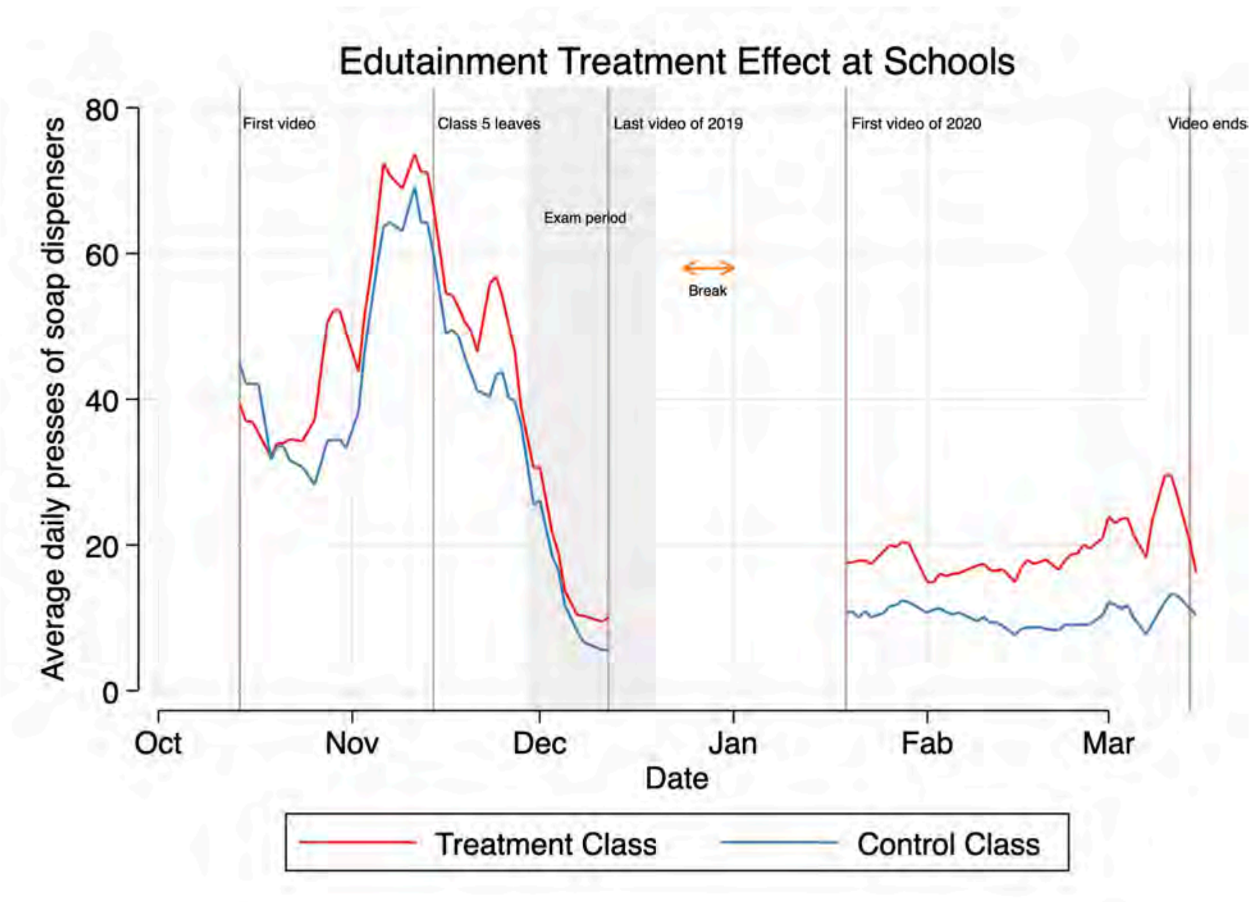


FIGURE III. Average classroom dispenser use by edutainment treatment status

Notes. This figure plots the moving average of total daily soap dispenser presses in classrooms over five days for 76 edutainment treatment classes and 74 edutainment control classes. Important events are marked. Dates range from Oct 12, 2019 to Mar 15, 2020 with non-school days (Fridays, national holidays, and winter break) dropped.

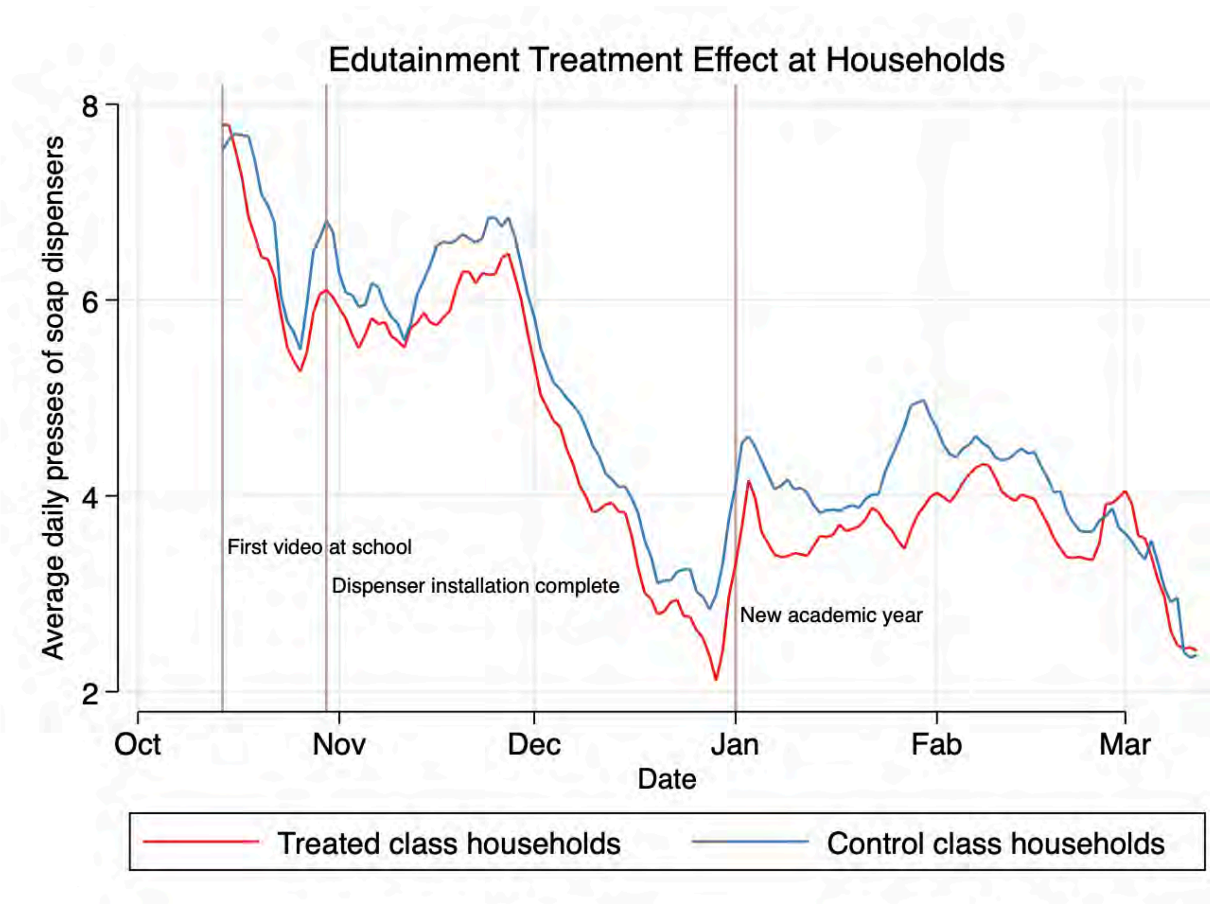


FIGURE IV. Average household dispenser use by edutainment treatment status

Notes. This figure plots the moving average of daily soap dispenser presses in households over five days by edutainment treatment status. We define edutainment treated households as households in which a child is enrolled in one of our edutainment treatment classes, and control households as households in which a child is enrolled in one of our edutainment control classes. Dates range from Oct 10, 2019 to Mar 12, 2020. Household of students who were in class 5 in 2019 and the students who move out of our sample schools starting new academic year no longer appear in the data beginning on Jan 1st, 2020.

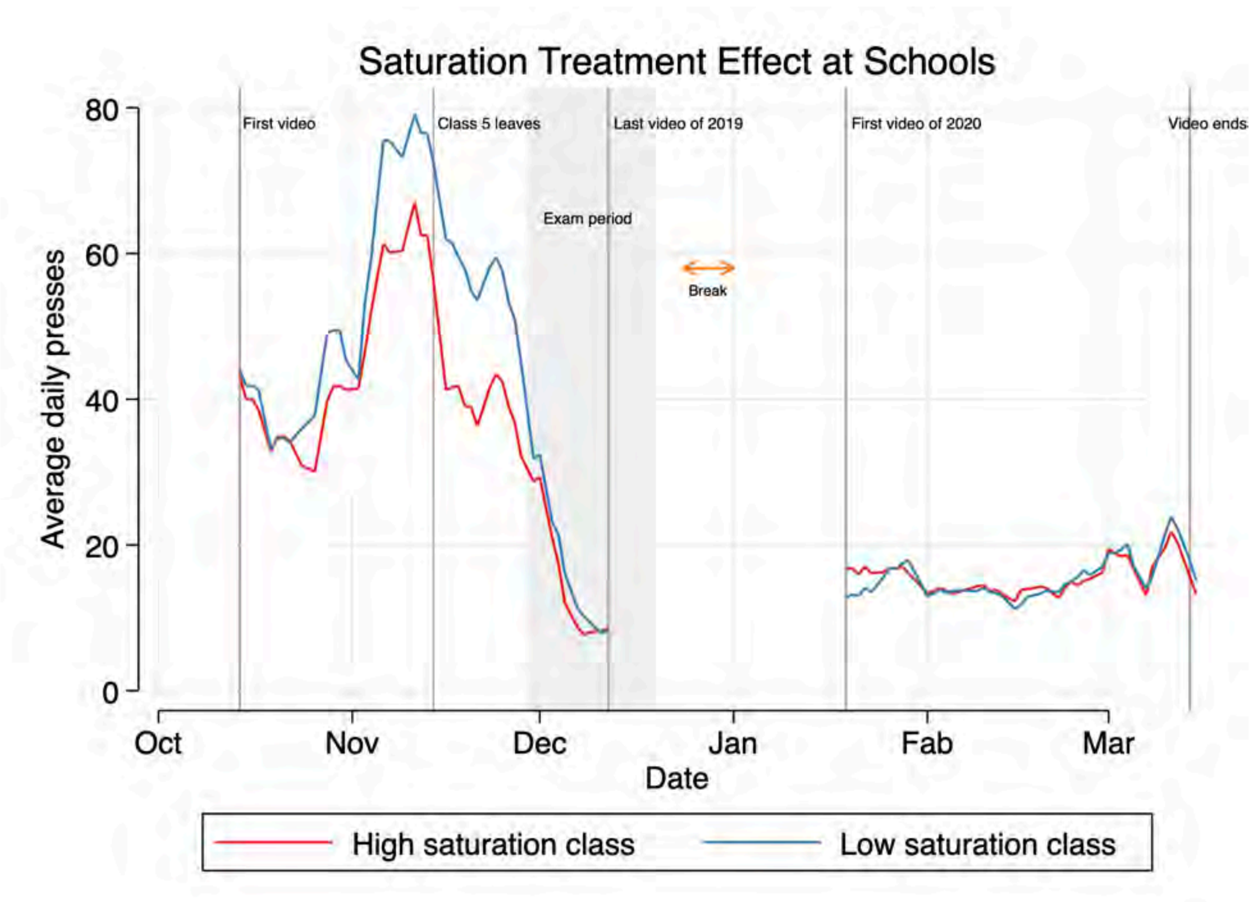


FIGURE V. Average classroom dispenser use by saturation status

Notes. This figure plots the moving average of number of soap dispenser presses over five days for 65 High saturation classes and 89 Low saturation classes. Important events are marked. Dates range from Oct 12, 2019 to Mar 15, 2020 with non-school days(Fridays, national holidays, and winter break) dropped.

A APPENDIX

Appendix Table I. Descriptive Statistics

	(1) Mean	(2) SD	(3) Obs
Class characteristics			
Grade	2.51	1.69	150
Female Teacher	0.71	0.46	150
Teacher's age	39.38	8.46	150
Teacher's education	13.17	1.06	150
Teacher's experience	14.94	9.67	150
Number of students	36.11	11.16	150
Household characteristics			
House ownership	0.99	0.10	756
Number of rooms	1.93	0.81	756
Distance to drinking water	2.12	1.24	756
Drinking water source is shallow tubewell	1.00	0.05	756
Doesn't treat drinking water	0.97	0.18	756
Has latrine	0.70	0.46	756
Number of family members	4.56	1.17	750
Agriculture occupation	0.28	0.45	756
Daily labor occupation	0.25	0.43	756
Islam	0.95	0.22	756
Mother's age at marriage	15.96	2.10	756
Mother's age	35.05	9.31	750
Mother is married	0.95	0.22	750
Mother's education	3.82	3.62	750
Age in months	9.02	1.93	756
Female	0.55	0.50	756
Months breastfed	25.99	4.67	756
Runny nose - past 2 weeks	2.59	2.15	756
Cough - past 2 weeks	1.34	1.82	756
Diarrhea - past 2 weeks	0.20	0.80	756
Can cold spread between people	0.22	0.41	251
Soap cleans germs from hands	0.70	0.46	236
Understands when to use soap	0.98	0.14	251
Need soap even when hands seem clean	0.70	0.46	251
Daily handwashing rate with soap	2.98	2.56	251
Wash with soap before cooking	0.17	0.37	251
Wash with soap before eating	0.24	0.43	251
House has soap	0.94	0.23	251
Children use soap before eating	0.27	0.45	251

Notes. Table reports descriptive statistics for the classroom and household samples at baseline. Unit of observation is class for class characteristics and households for the rest. Households whose baseline surveys were conducted after the first edutainment treatment at the schools was administered were excluded from the table for hygiene knowledge and behavior variables.

Appendix Table II. Balance Table

	(1) Phase 1 Edutainment	(2) Phase 2 Edutainment	(3) Phase 1 Saturation	(4) Phase 2 Saturation
Class characteristics				
Grade	0.288	0.136	0.446	0.638
Female Teacher	0.645	0.584	0.489	0.472
Teacher's age	0.652	0.871	0.766	0.946
Teacher's education	0.579	0.842	0.323	0.199
Teacher's experience	0.935	0.856	0.632	0.271
Number of students	0.285	0.158	0.109	0.155
Joint F-test (p-val)	0.825	0.391	0.606	0.554
Household characteristics				
House ownership	0.155	0.323	0.767	0.521
Number of rooms	0.907	0.790	0.990	0.858
Distance to drinking water	0.142	0.228	0.532	0.464
Drinking water source is shallow tubewell	0.900	0.973	0.451	0.421
Doesn't treat drinking water	0.251	0.039	0.225	0.096
Has latrine	0.016	0.040	0.904	0.861
Number of family members	0.718	0.531	0.699	0.558
Agriculture occupation	0.351	0.484	0.298	0.411
Daily labor occupation	0.235	0.183	0.512	0.956
Islam	0.704	0.606	0.278	0.526
Mother's age at marriage	0.878	0.582	0.208	0.828
Mother's age	0.495	0.255	0.433	0.836
Mother is married	0.371	0.557	0.090	0.048
Mother's education	0.912	0.535	0.202	0.142
Age in months	0.016	0.005	0.441	0.417
Female	0.531	0.623	0.285	0.638
Months breastfed	0.506	0.724	0.611	0.886
Runny nose - past 2 weeks	0.881	0.997	0.040	0.256
Cough - past 2 weeks	0.267	0.420	0.445	0.992
Diarrhea - past 2 weeks	0.225	0.429	0.265	0.477
Can cold spread between people	0.938	0.679	0.370	0.169
Soap cleans germs from hands	0.936	0.621	0.638	0.855
Understands when to use soap	0.263	0.158	0.705	0.691
Need soap even when hands seem clean	0.352	0.082	0.391	0.878
Daily handwashing rate w/ soap	0.120	0.238	0.227	0.053
Wash with soap before cooking	0.884	0.691	0.093	0.005
Wash with soap before eating	0.035	0.143	0.944	0.366
House has soap	0.281	0.308	0.858	0.713
Children use soap before eating	0.704	0.343	0.481	0.353
Joint F-test (p-val)	0.048	0.008	0.550	0.685

Notes. This table reports the p-value for the difference in means between the edutainment treated and control groups (columns 1 and 2) and the high saturation and low saturation groups (columns 3 and 4). Households whose baseline surveys were held after the first treatment at the schools was administered are excluded from the table for the hygiene knowledge and behavior outcomes. Measures for phase 2 excludes the original grade 5 students in 2019 and also the students who moved to out-of-sample schools in the new year. School fixed effects are included.

Appendix Table III. Per student edutainment and saturation effect at school by phase

	(1) Phase 1	(2) Phase 1	(3) Phase 1	(4) Phase 2	(5) Phase 2	(6) Phase 2
Edutainment treatment	7.468**	7.704***	7.243***	8.726***	8.769***	10.700***
	(3.309)	(2.598)	(2.724)	(1.578)	(1.179)	(1.190)
Saturation treatment	-7.262**	-4.911**	-4.990**	-1.025	-0.862	-1.031
	(3.217)	(2.426)	(2.346)	(1.641)	(1.284)	(1.157)
Edutainment control mean	37.510	37.510	37.510	9.970	9.970	9.970
	[49.775]	[49.775]	[49.775]	[13.908]	[13.908]	[13.908]
Saturation control mean	44.133	44.133	44.133	14.595	14.595	14.595
	[56.601]	[56.601]	[56.601]	[19.463]	[19.463]	[19.463]
Observations	6,664	6,664	6,664	5,763	5,763	5,763
Date FE	No	Yes	Yes	No	Yes	Yes
School FE	No	Yes	Yes	No	Yes	Yes
Grade FE	No	No	Yes	No	No	Yes

Notes. Dependent variable is total number of soap dispenser presses in each class. The unit of observation is class by day. We control for the saturation status and class size in all models. Dates range Oct 12th – Dec 31, 2019 for columns (1)-(3) and Jan 1st - Mar 15th, 2020 for columns (4)-(6) (total of 22 weeks, with 5 weeks of vacancy between phase 1 and phase 2 and Fridays, national holidays, and winter break dropped). Robust standard errors clustered at the class level are reported in parentheses, and standard deviations are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table IV. Edutainment treatment at households by phases

	(1)	(2)	(3)	(4)	(5)	(6)
	Phase 1	Phase 1	Phase 1	Phase 2	Phase 2	Phase 2
Edutainment treatment	-0.398	-0.369	-0.372	-0.477*	-0.374*	-0.432**
	(0.270)	(0.228)	(0.234)	(0.280)	(0.211)	(0.202)
Control mean	5.743	5.743	5.743	4.316	4.316	4.316
	[7.854]	[7.854]	[7.854]	[5.619]	[5.619]	[5.619]
Observations	54,909	54,909	53,737	35,947	35,947	35,173
Date FE	No	Yes	Yes	No	Yes	Yes
School FE	No	Yes	Yes	No	Yes	Yes
Age FE	No	No	Yes	No	No	Yes
Controls	No	No	Yes	No	No	Yes

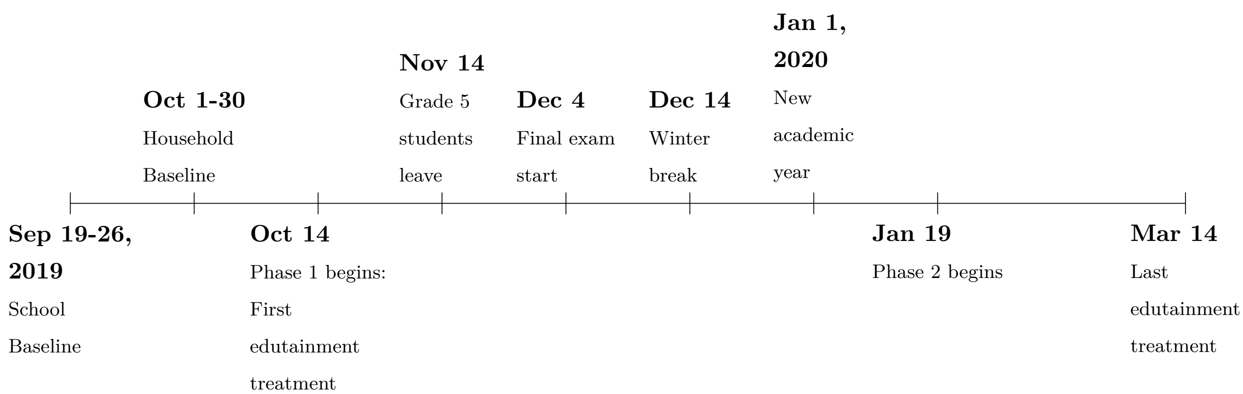
Notes. Dependent variable is total number of soap dispenser presses in each household. The unit of observation is household by day. Dates range Oct 12th - Dec 31st, 2019 for columns (1)-(3) and Jan 1st - Mar 12th, 2020 for columns (4)-(6). Controls in column 3 and 6 include the variables whose difference between the treatment group were significant in the baseline for both phase 1 and 2: whether the household has a latrine, whether the household treats drinking water, and the mother washes her hands with soap before eating. They also control for baseline hygienic knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, and whether we still need to use the soap even if hands appear clean. Robust standard errors clustered at the class level are reported in parentheses, and standard deviations are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table V. Hourly edutainment treatment effect at households

	Panel A: School days			
	(1)	(2)	(3)	(4)
	All day	Before school	At school	After school
Edutainment treatment	-0.021*	-0.007	-0.023	-0.023**
	(0.012)	(0.019)	(0.014)	(0.011)
Control Mean	0.303	0.407	0.288	0.258
	[0.396]	[0.826]	[0.674]	[0.433]
Observations	70,111	70,111	70,111	70,111
Date FE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

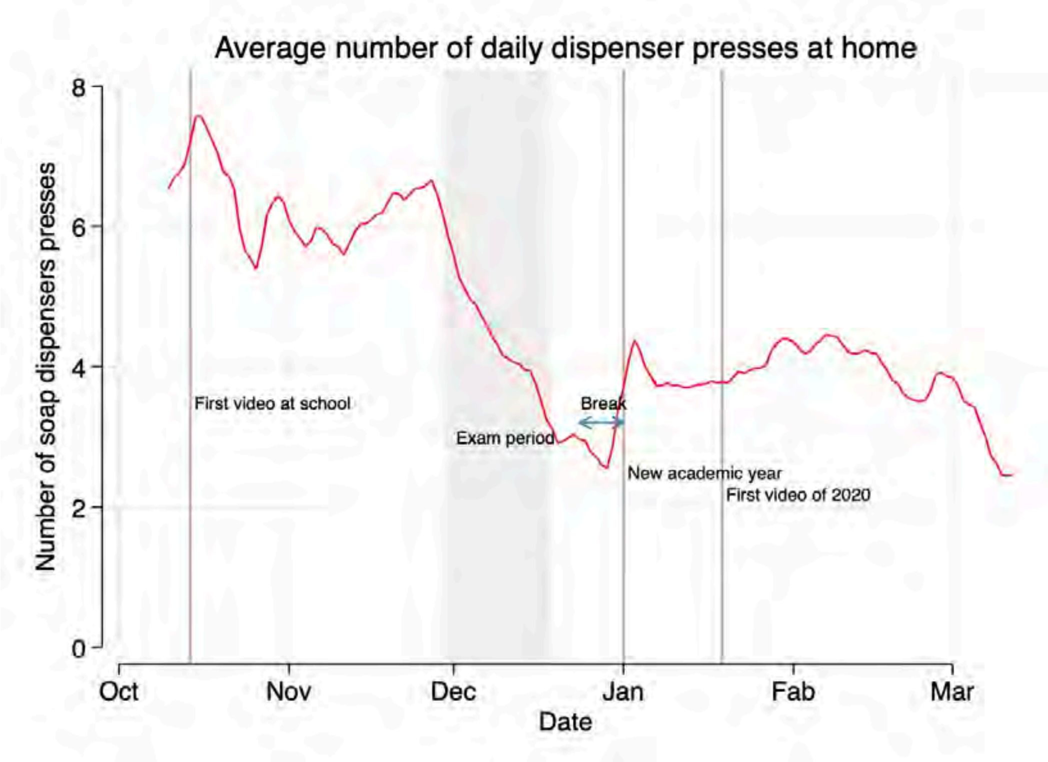
	Panel B: Non-school days		
	(1)	(2)	(3)
	All day	Before "school"	At and after "school"
Edutainment treatment	-0.027**	-0.020	-0.028**
	(0.012)	(0.018)	(0.011)
Control Mean	0.314	0.394	0.287
	[0.491]	[0.784]	[0.521]
Observations	18,799	18,799	18,799
Date FE	Yes	Yes	Yes
School FE	Yes	Yes	Yes
Age FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Notes. Dependent variable is total number of soap dispenser presses in the household during the time of the day specified, divided by the number of hours within that time period. The unit of observation is household by day. Dates range Oct 12th, 2019 - Mar 12th, 2020. Panel A includes only the school days and Panel B includes only the non-school days (Fridays, national holidays, and winter break). All columns control for baseline hygienic knowledge including whether cold can spread between people, how soap cleans hands, important occasions to wash hands with soap, and whether there's still need for the soap even if hands appear clean. They also control for variables whose difference between the treatment group were significant in the baseline for both phases 1 and 2: whether the household treats drinking water, has a latrine, and the mother washes her hands with soap before eating. Robust standard errors clustered at the class level are reported in parentheses and standard deviations are reported in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$



Appendix Figure I: Timeline of experiment and school events

Notes. Above figure shows the timeline of the experiment. Please note that the household baseline survey extended beyond the first date of the edutainment treatment. This is reflected in our baseline balance table, where the sample was restricted to households that were surveyed before the start of the edutainment treatment for hygienic behavioral and knowledge questions.



Appendix Figure II: Average daily handwashing rate at home

Notes. Above figure plots the average daily handwashing rate at the household level throughout the course of the experiment. Each point represents the average number of soap dispenser presses on a given day. Important dates are marked throughout the graph.

Experimental Design

- Sample households is 775 instead of 858[18]
- We add additional edutainment video of one of the authors instructing the students to wash their hands both at the school and home in the second half of the experiment

Collection of data and Outcomes of interest

- The baseline survey finished after we had started the edutainment treatment at schools
- Endline survey is collected via phone, instead of in-person visits
- We were unable to collect the anthropometric measures of the children at the endline, which was one of the primary outcomes of interest, as we were no longer operating in the fields due to spread of COVID

Specification

- School edutainment treatment effect
  - Mentioned, but specification now shown in the pre-anlaysis plan
- School to Home effect
  - We control for the saturation treatment status of the class
  - We use Lasso to select controls
- Home to School effect + Peer effect
  - We control for the saturation treatment status of the child in the household
  - We use Lasso to select controls
  - We do not normalize the number of presses by the number of household members (as specified in ‘Conditional household handwashing rate’ in the pre-analysis plan)

Appendix Figure III. Deviation from the pre-analysis plan

18. This is due to reasons such as being unable to locate the households or multiple siblings being selected as household sample child