Reverse Inter-Generational Transmission of Information: A Study of Hand Sanitizer Gel in Cambodia*

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Abstract

We conduct a lab-in-the-field experiment to study information transmission from children to their parents and how it influences their decision-making. We aim to promote the usage of an alcohol-based hand sanitizer, by teaching children its benefits and then test whether (*i*) information has been transmitted to parents and (*ii*) information has an impact on the decision to purchase the hand gel. Moreover, in addition to a lecture on the benefits of the hand gel, our intervention implements a hands-on experience where children use the product. We show that the average treatment effect of our intervention has a positive effect on parents' information. Moreover, we use an instrumental variable approach to show that higher information implies a higher probability to purchase more hand gel. Finally, based on a heterogeneity analysis, we observe that the positive effect of our treatment is much stronger on the subset of parents who had some handwashing training in the past.

Keywords: Alcohol-based sanitizer; Handwashing; Cambodia

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1 Introduction

Inter-generational information transmission is a typical way to share knowledge, skills, and values from parents to their children (Kuczynski and Parkin, 2007). Moreover, although less common, it is also true that children can share knowledge with and influence their parents (Ambert, 2001; Kuczynski and Parkin, 2007; Knafo and Galansky, 2008; Istead and Shapiro, 2014; Boström and Schmidt-Hertha, 2017). We will refer to this mechanism of information transmission from children to parents as *reverse inter-generational* transmission (RIGT). RIGT of information has been studied in the context of waste segregation (Maddox et al., 2011) , education about wetlands (Damerell et al., 2013; Rakotomamonjy et al., 2015), energy saving (Boudet et al., 2016), traffic behavior (Ben-Bassat and Avnieli, 2016), medical checkups (Celis et al., 2017), climate change awareness (Lawson et al., 2019; Parth et al., 2020), and sanitation (O'reilly et al., 2008; Lewis et al., 2018).

So far, the literature has mainly focused on the RIGT of (pure) information acquired by children. In this study, we add a hands-on experience, so that children can better transmit information to their parents. More importantly, we also test whether this possibly new information is persuasive enough to influence parents' decision-making.[1] If this influence is significant, it has the potential to improve and expand the set of policy making tools.

To measure the effects of Knowledge (K) and Knowledge + Experience (K+E), we conduct a lab-in-the-field experiment in Phnom Penh, Cambodia. Our subjects are students from 7th to 9th grade at

[1]Although information transmission is important for behavioral change, there may be other alternative approaches. Hussam et al. (2017) attempt to create a habit formation for handwashing. However, it was difficult to measure long-term behavioral chance; indeed, Caro-Burnett et al. (2021) show that "learning" may have a stronger long-term impact than habit formation. Guiteras et al. (2016) study the effects of (negative) emotions, social pressure, and availability of soap on handwashing; and found that only the provision of soap had a measurable effect. Spears (2014) shows that people may not demand handwashing soap because of a cost to "consider" the product, and the investment decision to consider the product depends on the price itself. Biran et al. (2014) study how "emotional drivers" affect handwashing behavior.

Trapeang Sala Secondary School.[2] The intervention consisted on either (pure) information about the benefits of using an alcohol-based hand sanitizer or the same information plus an additional session of a real life experience using the hand gel.

According to the Center for Disease Control (CDC), the act of keeping our hands clean is one of the most important steps we can take to avoid getting and spreading diseases.[3] This statement became especially relevant with the onset of the COVID-19 pandemic. Both the World Health Organization (WHO) and the CDC recommend using a hand sanitizer with more than 60% alcohol concentration. Moreover, the gel version of a hand sanitizer has several advantages compared regular soap (and particularly important for controlling enveloped diseases, such as COVID-19 Nuwagaba et al., 2020), and it is a dominant substitute in areas where clean water is scarce (Luby et al., 2010; Pickering et al., 2013).

In our intervention, we measured two outcomes: the parents' level of information about hand gel and, more importantly, their decision to purchase it. To measure the level of information (acquired), we picked two of the key points explained to children during the intervention (points 3 and 4 in Table 1), and then asked those same key points to their parents. Using a standard average treatment effect (ATE) approach, we show that parents of children in groups K and K+E are, respectively, up to 21 and 29 percent points more likely than the control group to respond both questions correctly.

The influence in decision-making is measured by the amount of units purchased from us at a discounted price. To study the decision to purchase as a function of the available information, we take several considerations into account. First, conditional on a certain level of information, our treatment should have no predictive power. Second, we do not have reliable relevant covariates (only

[2]There is evidence suggesting that teenagers, rather than young children, are more likely to influence their parents (Vollebergh et al., 2001).

[3]CDC (2020).

self-reported) such as education, income, etc. Thus, any estimation of the effect of information on the decision to purchase would be biased. To solve this issue, we use an instrumental variables approach. The natural candidates to be used as instruments are our treatment groups, since they are exogenous and have a predictive power on the parents' available information. Moreover, since the purchased units and our measure of information are discrete, instead of the usual two-stage least squares (2SLS), we use a two-stage ordered probit-ordered probit.

The remainder of this paper is structured as follows: Section 2 describes the intervention in detail and the process of data collection. In Section 3, we present our identification strategy. In Section 4 we show our main results and discuss heterogeneity analysis. Finally, we conclude in Section 5.

2 Experiment Design

We conducted a lab-in-the-field experiment in the rural area of Phnom Penh, Cambodia, from November 16, 2019 to November 27, 2019. Our subjects are students (and their parents) from 7th to 9th grade at *Trapeang Sala Secondary School*. In those three classes, there were 551 registered students. Because we are interested in the RIGT of information, in cases of multiple registered siblings, we only kept the oldest one for our study. In addition, some students were absent from the intervention; thus, we randomized our treatments over 389 students.

We randomly assigned the students to one of three groups. The knowledge group (group K, n=132) was given a brief lecture on infectious diseases that are usually transmitted by hand, as well as four benefits of using hand sanitizer, described in Table 1. The knowledge + experience group (group K+E, n=125) attended an identical lecture, and in addition, was given the opportunity to experience the hand gel. Finally, the control group (group C, n=132) did not receive any treatment.

Table 1: Information explained to children during lecture

1.	Alcohol-based sanitizer can effectively kill germs
2.	It is easy to carry
3.	It does not require water, and it is a substitute for soap
4.	The gel dries in 20 seconds, and thus, there is no need for towel

After the information session, all groups were instructed on how to purchase up to five discounted 50 ml hand sanitizer bottles from us.[4] The procedure was to give their parents a form to be filled specifying how many bottles they want to buy, and then bring back, the next day, the form with the payment.[5] The information lecture lasted about 10 minutes, the handwashing experience lasted about 5 minutes, and the explanation about how to purchase the discounted hand sanitizer lasted less than five minutes.[6] The attendees were given the order form and asked to go back home as soon as the intervention was over, in order to avoid information spillovers. However, we believe that the only reasonable direction of the spillover would be from treated to non-treated children. Thus, even if spillovers were present, the effects would actually increase the purchases of the control group. This would, in turn, increase the validity of our findings.

The next morning, students submitted the filled forms and cash to purchase the hand sanitizer. From the 389 students, 72 did not bring back their purchase form. We then provided a questionnaire to be filled by the parents of the students, asking them demographic information and a hidden quiz on basic hygiene including two of the benefits of hand gel from Table 1 (which are the variables we care about). Because this questionnaire asked for personal information that only parents know, we are confident that parents (and not their children) filled it. Students were told that if this questionnaire was filled and returned, they would receive school supplies as an incentive. Moreover, all students

[4] We offered a 50% discount, and the final price was approximately 0.5 USD.

[5] Although we could not check who filled the forms, the fact that money from low-income households was being handed to us is an indicator that parents were the ones who filled the forms.

[6] See A1 for the poster used during lecture.

received the questionnaire, even those who did not submit their purchase form.

From the 389 students, 61 do not have data about the information transmitted to parents, either because they did not bring back their purchase form or because those questions were missing. Thus we have information transmission data from 328 parents. Moreover, from those 328 parents, we can consider separately households who did not submit their purchase form, and thus we end up with 303 observations. In addition, independently of the previously mentioned issues, out of the 389 students, 71 participated on a late intervention due to conflicting schedules. However, since the conflicting schedules is exogenous, and there was no communication between students, this should not affect our results. On the other hand, we strongly believe that the event of not bringing back to school the purchase form may have been intentional in many cases. In summary, the number of students who participated only in the first day lecture, returned the purchase form, and have data on parents' learning is 248. We take into account these potential issues in Section 4.

We summarize the most relevant characteristics of children and parents in Table 2. We note that there is large heterogeneity between previous hand hygiene experience of parents of children in groups K and K+E. While almost 65 percent of parents in group K had formal hand hygiene training, only half of parents in group K+E received such training. We will explore this heterogeneity in our analysis. Nevertheless, although some parents had previous training with handwashing, there was virtually nobody using gel sanitizer.

3 Identification Strategy

To measure information transmission due to our intervention, our questionnaire had a hidden quiz to the parents of the children, where we asked two specific question from the information we explicitly

Table 2: Summary of statistics

Students' Characteristics

Variable	Obs	Mean	Std. Dev.	Range
Age	248	13.225	1.158	11 - 17
Gender	Female	Male		Total
Share	61.69%	38.31%		
Obs	153	95		248
Grade	7th Grade	8th Grade	9th Grade	Total
Share	44.35%	35.08%	20.56%	
Obs	110	87	51	248

Parents' heterogeneity

	Treatment group			
Did you receive formal training in hand hygiene in the last 3 years?	C	K	K+E	Total
Yes	59.6%	64.9%	50.0%	
No	40.4%	35.1%	50.0%	
Obs	89	77	76	242
	Treatment group			
What methods do you use for hand washing?	C	K	K+E	Total
Soap and Water	94.3%	90.9%	94.9%	
Only Water	3.4%	7.8%	5.1%	
Others (mud and water, ashes and water, gel, etc)	2.3%	1.3%	0.0%	
Obs	87	77	78	242

Only participants who submitted the purchase form and participated on the first intervention day. C= control group, K= knowledge group and $K+E$= knowledge + experience group. Some parents did not fill some questions.

provided to their children. Namely, we asked about points 3 and 4 from Table 1:

Q1. The hand sanitizer gel is a substitute for soap and does not require water. Answer *true* or *false*.

Q2. The hand sanitizer gel does not require a towel because it dries in:

a) 5 seconds

b) 10 seconds

c) 15 seconds

d) 20 seconds

We evaluate RIGT using two measures: the number of correct quiz answers ($Y_1 = 0, 1, 2$), or a dichotomous variable indicating whether both quiz answers were correct ($Y_2 = 0, 1$).

To estimate the effect of our treatment we use either a linear regression or a probit model. The linear model to explain the information that parent of child i has is:

$$Information_i = \beta_0 + \beta_1 group(K)_i + \beta_2 group(K + E)_i + \epsilon_i \tag{1}$$

where $Information_i$ is either Y_1 or Y_2, $group(K)_i$ is a dichotomous variable that equals one if child i belongs to the treatment group K and zero other wise. Similarly, $group(K + E)_i$ is a dichotomous variable that equals one if child i belongs to the treatment group $K + E$ and zero otherwise. For the ordered probit model, the unobserved latent variable (auxiliar variable) is given by (1), and there are either two or one cutoff points for Y_1 and Y_2, respectively.

Finally, the decision to purchase bottles of hand gel is also a discrete variable. Because of that, we also use either a linear model or an ordered probit. Let us denote the purchased units by Q_i. Then, we are interested in how the purchase decision depends on the (acquired) information. Moreover, we believe that a "reduced form" approach that measures the direct effect of our treatment on the purchase decision is not the correct model specification. The reason is that conditional on a level of information, the treatments should have no predictive power. Thus, a reduced form model (purchase as a function of the treatments) would introduce bias, and a model with all observable (purchase as a function of information and treatments) would introduce too much noise. Thus, we are interested in the following specification:

$$Q_i = \gamma_0 + \gamma_1 Information_i + \epsilon_i \tag{2}$$

We note that in equation (1), the error term ϵ is independent from the treatment groups, as they are randomly assigned. On the other hand, the error term in equation (2) is not necessarily independent from the information measure. The reason is that there are unobservable covariates that may have predictive power over the decision to purchase and are also potentially correlated to the amount of information, such as education and income. Thus a simple ordered probit approach could yield biased estimations of the γ parameters.

In order to solve this issue, we use an instrumental variable approach. Instead of the usual two-stage least-squares, we use a two-stage ordered probit-ordered probit. That is, since our treatment groups are exogenous, we use the probit version of equation (1) as a first stage to capture exogenous variation of the information measure to be used as an explanatory variable in equation (2).[7]

4 Results

We measure the effect of RIGT of information on two outcomes: whether information was transmitted and whether this (newly acquired) information can influence parents' decision to purchase hand gel. Moreover, for the information transmission, we want to distinguish whether the children attended only the lecture session or they additionally experienced the hand gel.

[7] Note that the model misses information by using Y_1 or Y_2 instead of the actual information acquired represented in (1), which is not fully observed. This is taken into account when calculating the standard errors.

4.1 Information Transmission

The first question we answer is whether parents actually learned from the information transmitted by their children. Our estimations for equation (1) are shown in Table 3.

Table 3: Information transmitted to parents

	Number of correct answers (Y_1)			All answers correct (Y_2)		
	Least squares		O-probit	Least squares		O-probit
knowledge (K)	0.216***	0.246***	0.762***	0.195***	0.215***	0.788***
	(0.0632)	(0.0724)	(0.237)	(0.0513)	(0.0603)	(0.237)
knowledge+experience	0.289***	0.338***	1.486***	0.248***	0.294***	1.489***
(K+E)	(0.0543)	(0.0621)	(0.324)	(0.0464)	(0.0522)	(0.329)
constant	1.664***	1.637***		0.705***	0.681***	
	(0.0502)	(0.0596)		(0.0415)	(0.0491)	
mean dep. variable	1.82	1.82	1.82	0.84	0.84	0.84
observations	328	248	248	328	248	248
only submitted forms		✓	✓		✓	✓
only planned intervention		✓	✓		✓	✓
$(K+E)-K$	0.072	0.091*	0.724*	0.052	0.078*	0.700*
	(0.043)	(0.044)	(0.353)	(0.036)	(0.039)	(0.356)

The outcome variables are Y_1, the number of correctly answered questions regarding points 3 and 4 from Table 1, and Y_2, a dichotomous variable indicating whether both questions were correct. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Huber-White robust errors are displayed in parenthesis.

Compared to the control group, both treatments have a positive and statistically significant effect. This means that children in either the pure knowledge or the knowledge plus experience groups transmitted more information to their patents. For example, column (2) estimates the marginal effect of the treatments on the number of correct answers to the hidden quiz on the subset of subjects who participated on the first day of the intervention and submitted their purchase form, including "zero purchased units." The coefficients show that out of two quiz questions, parents in group K had an average of 0.24 more correct answers relative to the control group. Similarly, parents in group $K + E$

had an average of 0.33 more correct answers relative to the control group. Thus, the average number of correct answers by group were 1.63, 1.87 and 1.97 out of two for groups C, K and $K+E$, respectively.

The interpretation for column (5) is almost identical. It estimates the marginal effect of the treatments on having both answers to the hidden quiz correct on the subset of subjects who participated on the first day of the intervention and submitted their purchase form, including "zero purchased units." The mean dependent variable tells us that 84% of parents answered both questions correctly in the entire sample, and those same shares are 68.1%, 89.6% and 97.5% for groups C, K and $K+E$, respectively.

Moreover, when we compare groups K and $K+E$, we observe that the marginal additional effect of "experience" is always positive, and statistically significant on the subset of subjects who participated on the first day of the intervention and submitted their purchase form.

To interpret the probit coefficients, we need to calculate the marginal effects. Since Y_2 is dichotomous, the computation is the same as the linear model case. For instance we already computed the probabilities for the positive outcome case ($Y_2 = 1$). Table 4 also shows the probabilities of the negative outcome from column (6) of Table 3. The probability distribution for Y_1 can be found on Appendix Table A1.

Table 4: Probabilities of having both quiz answers correct

	$P(Y_2 = 0 \mid Treatment)$	$P(Y_2 = 1 \mid Treatment)$
control	0.319	0.681
knowledge	0.104	0.896
knowledge+experience	0.025	0.975

Distribution of acquired information according to the probit model estimated in column (6) of Table 3.

4.2 Information and Purchase Decision-Making

In the previous section, we established that information was effectively being transmitted through RIGT. Moreover, the hands-on experience has a positive and significant effect relative to the only lecture group. The second question we want to answer is whether this new information is persuasive enough to influence the parents of the subjects. Parents were allowed to purchase up to five bottles of gel at a discounted price. We want to model the purchase decision as a function of information. However, there are two potential issues. First, some parents may have already had information about the benefits of using hand sanitizer. Second, by chance, although there seems to be no experience with hand gel, previous handwashing training is existent and heterogeneous across the treatment groups assigned, as Table 2 indicates.

To show the magnitude of this bias, we estimate both a regular ordered probit and an instrumented ordered probit. As instrument, we use our treatment groups, which are exogenous, and affect the information parents have, as shown in the previous section. Moreover, because both, purchasing and information, are discrete variables, instead of the usual 2SLS approach, we use a two-stage ordered probit-ordered probit. In addition, we do a heterogeneity analysis in Section 4.3.

The upper panel of Table 5 shows the estimations of the intended model: purchased bottles of gel as a function of information, while the lower panel shows the first stage only in the case of the instrumented regressions. Columns (1) and (2) show that, although information has a positive effect in all cases, as expected, a non-instrumented approach underestimates the results and its coefficient is not statistically significant. On the other hand, columns (3) and (4) show that both measures of information are positive and have a significant effect. As previously done, to interpret the results, we need to estimate the marginal effects and calculate the probabilities of each possible purchase option, between zero and five units.

Table 5: Purchase decision and information

	not-corrected		Instrumented	
main regression				
number of correct quiz answers (Y_1)	0.295		0.759**	
	(0.162)		(0.256)	
both quiz answers correct (Y_2)		0.370		1.010**
		(0.203)		(0.332)
first stage				
knowledge (K)			0.762**	0.788***
			(0.237)	(0.237)
knowledge + experience (K+E)			1.486***	1.489***
			(0.324)	(0.329)
mean dep. variable	2.149	2.149	2.149	2.149
observations	248	248	248	248
first stage F-stat			15.955	15.915

All specifications are ordered probit and use only participants who submitted the purchase form and participated on the first intervention day. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Huber-White robust errors are displayed in parenthesis.

We focus on the case of Y_2, but the Y_1 can be computed on a similar fashion. First, we want to report how information affects the distribution of the purchased units. The probit model in Table 5 estimates five thresholds that define regions for which the purchase decision will be determined by where the right-hand-side of equation (2) lies. The thresholds for column (4) of Table 5 are shown on Appendix Table A2. We use the marginal effect of Y_2 in column (4) and equation (2) to compute the mass probabilities of purchasing Q units given information Y_2, which are shown in Table 6.

We can see that the likelihood of purchasing more units increases with the information measure Y_2. For instance, the probability of not buying any units is 17.96% for parents who responded at least one of the quiz questions wrong, and 2.7% for parents who got both questions correct. Conversely, the

Table 6: Marginal Effects from the two-stage double probit

	$P(Q\|Information)$					
	Q=0	Q=1	Q=2	Q=3	Q=4	Q=5
Y_2=0	17.96%	55.38%	18.36%	4.52%	1.38%	2.40%
Y_2=1	2.70%	32.25%	29.68%	13.23%	5.50%	16.64%

Distribution of purchased units, according to column (4) from Table 5.

probability to buy five units is 2.4% for parents who got at least one question wrong, and 16.64% for parents who got both questions right.

Next, we want to compute the effect of our treatments on purchase via information transmission. To do so, we make the assumption that conditional on information, the treatments do not have predictive power over the purchased quantity. Formally: $P(Q|Information, Treatment) = P(Q|Information)$. Indeed, more than an assumption, we believe this is the correct approach to compute the intended effect of our intervention, as opposed to a reduced form that models purchase as a function of the treatment groups, which would have alternative interpretations such as unintentional advertising or social pressure on children.[8] Thus, we calculate the probability of purchasing Q units conditional on the treatment as follows:

$$\begin{aligned} P(Q|Treatment) &= \sum_{Y_2} P(Q|Y_2, Treatment)P(Y_2|Treatment) \\ &= \sum_{Y_2} P(Q|Y_2)P(Y_2|Treatment) \end{aligned} \tag{3}$$

Based on equation (3), we can use Tables 4 and 6 to compute the desired probabilities, which are displayed in Table 7. This table shows the probability to purchase Q units given the treatment group.

[8]Just for reference, a reduced form is presented in Appendix Table A3.

We can see that both treatment groups, and especially K+E, have a higher probability to purchase more units compared to the control group. For instance, the probability to buy one or less units is 47.2%, 38.92% and 35.91% for treatment groups C, K and K+E, respectively. Similarly the probability to buy four or more units is 16.28%, 20.23% and 21.68% for treatment groups control, K and K+E, respectively.

Table 7: Distribution of hand gel demand conditional on the treatment

	$P(Q\|Treatment)$					
	Q=0	Q=1	Q=2	Q=3	Q=4	Q=5
control	7.57%	39.63%	26.07%	10.45%	4.19%	12.10%
knowledge	4.29%	34.66%	28.50%	12.32%	5.07%	15.16%
knowledge+experience	3.08%	32.83%	29.40%	13.01%	5.40%	16.28%

Distribution of purchased units, conditional on the treatment, calculated using equation (3), and Tables 4 and 6.

4.3 Heterogeneity

As shown in Table 2, group $K + E$ had a much lower previous training in hand hygiene relative to the other groups. Indeed, as shown in Appendix Table A4, this difference is statistically significant. Thus, we study whether this heterogeneity has an effect on subjects. Nevertheless, this analysis was not pre-specified when designing the experiment. Tables 8 and 9 replicate the probit specifications for information acquisition and purchase decision, respectively.

Columns (1) and (2) of Table 8 only looks at parents who did not receive any formal training in handwashing in the previous three years. Although the average effect of either treatment on information acquisition is positive, there is a lot of noise. Thus, the result in statistically insignificant. On the other hand, columns (3) and (4) show that there are positive effects on the subset of parents who had

Table 8: Heterogeneity analysis on information transmission

	No handwashing training		Some handwashing training	
	Y_1	Y_2	Y_1	Y_2
knowledge	0.224	0.361	1.043***	1.009***
	(0.443)	(0.446)	(0.275)	(0.289)
knowledge+experience	0.818	0.853	1.791***	1.772***
	(0.487)	(0.501)	(0.455)	(0.461)
mean dep. variable	1.911	0.921	1.759	0.787
observations	101	101	141	141

We replicate columns (3) and (6) of Table 3 under heterogeneous samples. All specifications are ordered probit and use only participants who submitted the purchase form and participated on the first intervention day. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Huber-White robust errors are displayed in parenthesis.

some handwashing training. Moreover, as previously shown, the effect of knowledge plus experience is larger than the effect of pure knowledge. This first result seems to point out the existence of some sort of complementarity or reinforcement between information of children and their parents.

Similarly, columns (1) and (2) of Table 9 show that there is no significant effect of information on the purchase decision in the subset of parents who had no previous formal handwashing training. On the other hand, columns (3) and (4) of Table 9 show that more information increases the quantity of hand gel purchased by parents.

The results in Tables 8 and 9 hint that information transmission is more effective when there is already some related knowledge present in parents; i.e although there is probably no knowledge of hand gel, some parents had received handwashing training before. In addition, purchased units only increase when there is some previous knowledge in parents. In other words, parents who did not receive formal handwashing training did not benefit from information transmitted from their children. Moreover, within the group of parents without previous handwashing training, information does not have predictive power on purchase decision-making. Conversely, better information transmission increased

Table 9: Heterogeneity analysis on purchase decision

	No handwashing training		Some handwashing training	
main regression				
number of correct quiz answers (Y_1)	-0.384		0.920***	
	(1.331)		(0.275)	
both quiz answers correct (Y_2)		0.381		1.185**
		(0.919)		(0.373)
first stage				
knowledge	0.224	0.361	1.043***	1.009***
	(0.443)	(0.446)	(0.275)	(0.289)
knowledge + experience	0.818	0.853	1.791***	1.772***
	(0.487)	(0.501)	(0.455)	(0.461)
mean dep. variable	2.2277	2.2277	2.1277	2.1277
observations	101	101	141	141
first stage F	1.410	1.491	12.296	11.011

We replicate columns (3) and (4) of Table 5 under heterogeneous samples. All specifications are two-stage ordered probit-ordered probit, and use only participants who submitted the purchase form and participated on the first intervention day. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Huber-White robust errors are displayed in parenthesis.

the number of purchased units in the subset of parents who already had some handwashing training, even if that training was not on hand gel.

5 Conclusions

In this study, we assessed the impact of reverse inter-generational transmission of information, i.e. from school children to their parents, and whether this information affects parents' decision-making. To achieve this, we implemented a lab-in-the-field experiment focused on the benefits of hand hygiene and gel sanitizer to Cambodian school children. We show that both treatments, knowledge and knowledge plus experience, have a positive effect on the quiz taken by the parents about the benefits of the hand gel. Namely, while the control group was about 68% likely to answer both quiz questions correctly, the pure knowledge group was about 90% likely to do so; and, more importantly, the knowledge plus experience group was about 98% likely. Moreover, the fact that (*i*) the quiz was hidden in the middle of a questionnaire, and (*ii*) the questionnaire itself asked parents for information that only they should know, strengthens our claim that the parents themselves filled out the forms.

We also show that the information parents acquire regarding the benefits of hand gel affects their decision to purchase this product. We used an instrumental variable approach to estimate the impact that information has on the decision to purchase hand gel. We show that, indeed, better information significantly increases the probability to purchase more units. Moreover, we use the marginal effects from both main results to compute the probability distributions of purchased quantities as a function of the treatments. Moreover, we discuss why our results computed the true effect of the treatment on purchased units, while a "reduced form" that models purchased quantity directly as a function of the treatments would introduce a bias. The reason is that although treatments are exogenous, what really drives the decision to purchase hand gel is the information, not the treatment itself. Therefore, the issue with a reduced form is the specification of the model.

Remarkably, our hands-on treatment has a marginal improvement compared to the purely theoretical treatment in both, information transmission and the decision to purchase hand gel. Indeed, we believe that on large scales, a few percentage points are measurable, and more so during a pandemic like the one currently devastating the entire world. On the other hand, more experimental evidence on hands-on treatments is needed. The unexpected outcome that our control group had a 68% chance of answering both quiz questions correctly suggests that it would be interesting to conduct similar interventions where the information is less basic.

Based on whether parents had previous formal training on handwashing, but not gel sanitizer, we perform a heterogeneity analysis. On the one hand, we observe that the group of parents without previous training barely benefited from the information and did not purchase more units of hand gel. On the other hand, the group of parents who had formal training on handwashing benefited from the information transmitted by their children. Moreover, within this latter group, better information translated in a higher number of discounted hand gel purchases. We believe the reason for this large difference between subsamples could be that the information transmitted from children also reminded parents of their previous training in handwashing. Thus, our treatment could complement and may have reinforced and strengthened existing information.

Our intervention, which was conducted in November 2019, had an unanticipated perfect timing because of two reasons. First, due to the COVID-19 pandemic, it would have been impossible to conduct our experiment in the near future. More importantly, also because of the pandemic, our intervention became especially relevant since we show that with a simple and at almost zero cost intervention on children, we can change real life economic behavior of parents. This is relevant for public health and policy implementation in low income countries.

Our results show that information flows from children to their parents, especially when parents have some previous education on the issue. Moreover, the hands-on experience has an additional positive and statistically significant effect, relative to the pure knowledge treatment, on information transmission and parents' decision making. Both results hint toward the effectiveness of hands-on coordinated training sessions with parents and children, either simultaneous or sequential; which have relevant policy implications and are interesting approaches for future research.

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Appendix

Table A1: Probability distribution on the number of correct quiz answers

	$P(Y_1 = 0 \mid Treatment)$	$P(Y_1 = 1 \mid Treatment)$	$P(Y_1 = 2 \mid Treatment)$
control	0.048	0.267	0.684
knowledge	0.008	0.099	0.893
know.+exp.	0.001	0.024	0.975

Distribution of acquired information according to the probit model estimated in column (3) of Table 3.

Table A2: Threshold from the probit estimation in column (4) of Table 5

	C_1	C_2	C_3	C_4	C_5
threshold	-0.917***	0.623**	1.385***	1.777***	1.978***
	(0.354)	(0.301)	(0.294)	(0.294)	(0.298)

If the right-hand-side of equation (2) is between C_k and C_{k+1}, the number of purchased units is k, where $C_0 = -\infty$ and $C_6 = +\infty$.

Table A3: Reduced form for purchased units

	Least squares		Ordered probit	
knowledge	0.362	0.519*	0.257	0.464**
	(0.199)	(0.211)	(0.143)	(0.168)
knowledge+experience	0.172	0.405*	0.118	0.359*
	(0.197)	(0.214)	(0.141)	(0.168)
constant	1.828***	1.857***		
	(0.133)	(0.145)		
mean dep. variable	1.743	2.149	1.743	2.149
observations	328	248	328	248
only submitted forms		✓		✓
only planned intervention		✓		✓

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Huber-White robust errors are displayed in parenthesis.

Table A4: Did you receive formal training in hand hygiene in the last 3 years? yes=1, no=0.

knowledge	0.123
	(0.0654)
knowledge+experience	-0.0696
	(0.0675)
constant	0.550***
	(0.0456)
observations	323
(K+E)-K	-0.19**
	(0.004)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Huber-White robust errors are displayed in parenthesis.

Figure A1: Poster used during children's lecture