Social Signaling and Childhood Immunization: A Field Experiment in Sierra Leone

Anne Karing*

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Abstract

There is little evidence that social signaling can be used as a policy tool to sustainably affect outcomes and on how to design signaling incentives most effectively. This paper investigates social signaling motives in the dynamic setting of childhood immunization in Sierra Leone. I introduce a verifiable signal - in the form of color-coded bracelets - which children receive upon timely vaccination, and implement a 26-month-long experiment in 120 clinics. I vary whether parents can signal timely completion of the first four or all five required vaccinations–an easier or more difficult action–altering the inferences others may make about their type of parent. I find that, upon observing a child with a bracelet, parents have more accurate knowledge about their vaccinations as they are less likely to underestimate them. Subsequently, parents are 13 percentage points more likely to timely complete all vaccines, when they can signal the more difficult action. In contrast, when bracelets convey compliance with the easier action, there is no effect on parents' immunization behavior. Parents respond strategically to the option value of signaling, adjusting their behavior nine months prior to realizing its benefits. My findings suggest that the opportunity to stand out can motivate individuals to exert greater effort even when the signaling benefits are uncertain and far in the future. Of policy importance, signals increase vaccine completion by 12 months of age at a cost of 1 USD per child, demonstrating that signaling incentives can be a powerful motivator to induce socially desirable behavior. *JEL codes:* D01, D82, I12, O10.

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1 Introduction

A growing literature argues that human choices cannot be separated from their social context: being seen taking an action by others matters as individuals care about their social image (Bénabou and Tirole 2006). The existence of these image concerns provides a promising avenue for public economics, one that is particularly relevant in low-resource settings, where formal enforcement and material rewards are often too costly to implement.

In this paper, I partner with the Ministry of Health and Sanitation of Sierra Leone to implement a large-scale field experiment that increases the social image returns to childhood vaccinations. I take advantage of the fact that, while vaccinating a child at some point may not be particularly costly, vaccinating on time can be. Specifically, I introduce a new and verifiable signal - in the form of color-coded bracelets - which allows parents to show to others that they vaccinated their children in a timely manner. I further vary how difficult it is to obtain the signal by linking it to two different points in the vaccine schedule: one that is easier to reach, timely completion of all vaccines until the fourth one which is due at 3.5 months of age, and one that is harder to reach, timely completion of all vaccines until the fifth and last one due at 9 months of age. The fourth vaccine marks the completion of the diphtheria, tetanus, and pertussis (DTP) series, while the fifth vaccine is the first dose of the measles vaccine. I use the experiment to answer two questions: How do social signaling incentives affect behavior in a real-life setting, where individuals make decisions dynamically? What is the optimal timing at which to increase social image concerns, and why?

The context of childhood vaccination in Sierra Leone is well-suited to examine the power of social image concerns to induce socially desirable behavior. First, there are strong social norms surrounding the importance of vaccination—79% of communities in my sample believe that parents who fail to vaccinate their children are negligent.[1] Second, whether a parent vaccinates their child is currently imperfectly observable, meaning there is scope to introduce a signal that improves observability. Third, childhood immunization is one of the most cost-effective ways of reducing under-five mortality and averts 2-3 million deaths every year from diseases such as diphtheria, pertussis, and measles (UNICEF 2019).[2] Timely vaccination is particularly important as the risk of infection and death from diseases is the highest for children under the age of one (CDC 2022). Yet, despite improvements in the availability and reliability of immunization services (UNICEF and WHO 2016), only 56% of children complete the first-year series of vaccinations and a

[1]During the baseline survey, community members in a group were asked about the barriers parents face in immunizing their children. Surveyors recorded the 3 most commonly named reasons.

[2]Vaccines also contribute to higher educational outcomes, reduced poverty, and lower household spending (Verguet et al. 2013; van der Putten et al. 2015). It is estimated that every \$ 1 invested in immunization programs, results in at least \$16 in net health and economic benefits (Ozawa et al. 2016).

significant number of children are vaccinated late (Sierra Leone DHS 2020). This pattern is common across many low-income countries.[3]

Building on this, I design a field experiment that is grounded in Bénabou and Tirole's theory of social signaling (2006; 2011), which posits that individuals' utility depends on the expectations that others form about their type based on their actions. I adapt the theory to include uncertainty about future costs shocks. My research exploits two features of childhood immunization. First, individuals have to take multiple actions, as children require five vaccinations before the age of one. Using this feature, I investigate how to design the placement of signals to be most effective in altering behaviors. It is unclear ex-ante where to place the signal in the sequence of vaccinations. A significant number of parents fail to timely vaccinate their children for four and five vaccines, but more succeed in doing so for the first four (74%) than for all five (57%). Theory predicts that placing the signal on a later vaccine that is costlier to achieve, is more informative about being a "caring" parent. Yet, it may fail to motivate parents if the action is far in the future and therefore seen as too difficult to complete. Conversely, placing a signal on an easier to complete vaccine singles out the few who do not take the action and may therefore be a stronger signal about being a "negligent" parent. Second, individuals make decisions over a long time horizon, from the first vaccination at birth to the last vaccination at nine months of age (WHO 2018). This feature allows me to test if allowing for signaling is a powerful enough motivator to change behavior given uncertainty. Unlike predictions that arise from a static model, the dynamic model predicts that parents will respond to the option value of signaling and timely complete earlier vaccines, even when it is uncertain whether they will be able to realize the signaling benefit. This supports the argument that placing the signal on the last vaccine can be more effective.

To study these predictions, I experimentally vary the placement of the signal, and with that the information that bracelets provided about the number of vaccines a child has completed on time. I randomly assign 120 clinics and their entire catchment area to either one of three bracelet treatments or a control group where no bracelets are handed out. This high level of randomization mitigated the risk of contamination, and ensured a common understanding of the signals within a certain geographic area.[4] In each of the first two bracelet treatments—hereafter Signal at 4 and Signal at 5 - children receive a yellow bracelet upon their first vaccination. In the Signal at 4 treatment, the yellow bracelet is exchanged for a green bracelet once a child completes all first four vaccines in a timely manner. In clinics assigned to the Signal at 5 treatment, the nurse exchanges the yellow bracelet for a green bracelet once a child completes all five vaccinations in a timely manner. Timely is defined as coming within 2.5 months of a vaccine's due date.

[3]For example, in India (India DHS 2020), Peru (Peru DHS 2015), and Indonesia (Indonesia DHS 2017), while 98, 91, and 91% of children, respectively, begin vaccinations, only 78, 62, and 65% complete the full first-year series.

[4]There is a total of 1,221 public clinics in Sierra Leone. The experiment covers 10% of these clinics.

In the third bracelet treatment, the Uninformative Bracelet, parents choose a yellow or green bracelet at the first vaccine, and the child keeps the same bracelet color for all subsequent vaccinations.

This design allows me to test how the value of signaling varies with the cost and benefit of actions, and isolate the partial effect of social image concerns from alternative mechanisms in a setting where individuals act sequentially and can observe others' choices. Specifically, I estimate the impact of signaling preferences by comparing the Signal at 4 and 5 treatments with the Uninformative Bracelet, holding constant the consumption value of bracelets and salience and reminder effects. The difference in effects between Signal at 4 and Signal at 5 provides insights into the optimal placement of signals: a larger increase in the share of children vaccinated on time in Signal at 5 compared to Signal at 4 suggests that parents place a higher value on signaling the costlier action. I can quantify the extent to which treatment effects are driven by social learning, by comparing the transition probability from vaccine four to five in Signal at 4 to that in the Uninformative Bracelet. Since, by design, there is no signaling benefit from completing the fifth vaccine in Signal at 4, a change in the transition probability would suggest that signals influenced individuals' beliefs about the usefulness of childhood immunization as a whole. Finally, the time variation between the various vaccinations allows me to examine the extent to which future signaling payoffs affect parents' decisions to vaccinate their child today.

A crucial assumption of the signaling hypothesis is that other people in the community update their beliefs about children's vaccinations upon observing bracelets, and that parents anticipate others' belief updating when making vaccine decisions for their child. To capture this learning, I collect detailed survey data on parents' knowledge about the bracelets, and their first- and second-order beliefs about children's vaccine status for a random subsample of 1,314 parents at endline. These data reveal that the bracelets are indeed useful in reducing widespread information asymmetries. Parents in the Control Group have accurate information about other children's vaccinations for at most 50% of children in their community. Similarly, parents believe that only 48% of other parents have knowledge about their own child's vaccinations. I find that parents use the bracelets to learn about other children's vaccinations. A child having a green bracelet increases the likelihood of other parents correctly knowing the number of vaccines the child has received by 18 and 37% (p=0.10 and p=0.02) in Signal at 4 and Signal at 5, respectively, compared to the Uninformative Bracelet. In contrast, parents find it harder to update negatively when an older child has a yellow bracelet in both Signal at 4 and Signal at 5 communities. I hypothesize that this asymmetry in learning is due to the fact that parents need to know a child's age and vaccine due date to recognize the yellow bracelet as a negative signal, making it a more difficult signal to learn from.

Having established that Signal at 4 and Signal at 5 lead to significant learning, I analyze their impact on behavior. I combine two rounds of survey data for 4,897 children and show that the signaling treatments combined lead to economically important but marginally significant increases in the share of children that are timely vaccinated for four and five vaccinations, increasing rates from 74 to 80% (p=0.07), and from 57 to 63% (p=0.08), respectively, over the Control Group. The average effects mask substantial heterogeneity across the two signaling treatments: Signal at 4 has a small, insignificant effect on the share of children who are timely vaccinated for four vaccines (2 percentage points, p=0.55), and has no impact on the timely completion of five vaccines. In contrast, Signal at 5 has a large effect on the share of children who were timely vaccinated for five vaccines (13.3 percentage points, p=0.001). This effect remains large and significant (10.5 percentage points, p=0.004) when comparing Signal at 5 to the Uninformative Bracelet, providing further evidence for social signaling being the primary mechanism.

The large effects of Signal at 5 compared to Signal at 4 suggests that parents place a higher value on signaling the timely completion of all five vaccines, consistent with parents mainly learning about others' actions from the green bracelet, which is a more informative signal about being a "caring" parent in Signal at 5. Survey data further supports the interpretation that Signal at 5 is a more valued signal: parents are significantly more likely to keep the bracelet in Signal at 5 compared to Signal at 4, and assign a greater importance to vaccine five than vaccine four for their children's health. Reassuringly, I find no significant differences in individuals' preferences for different vaccines across treatment and control groups, ruling out that the treatment effects are solely due to normative influence of signals or social learning.

My analysis then turns to examining the impact of Signal at 5 on earlier vaccines. Consistent with a dynamic model of decision-making under uncertainty, Signal at 5 also significantly increases the share of children who were timely vaccinate for four (10.3 and 8.2 percentage points, p=0.003 and p=0.004), three (7.2 and 4.4 percentage points, p=0.003 and p=0.03) and two vaccines (3.3 and 1.6 percentage points, p=0.009 and p=0.07), compared to the Control Group and Uninformative Bracelet, respectively. This shows that parents respond to a signaling benefit six to nine months in advance, without necessarily timely completing the later vaccines and realizing the benefit. The effects on earlier vaccines, along with the lack of treatment effects of Signal at 4, provide evidence against the alternative explanation of bracelets acting as vaccine-specific reminders.

The above analysis focused on whether children completed vaccinations in a timely manner. Policy makers might care about general vaccine completion, independent of timeliness, and to what extent the treatment effects last beyond one year of age. I find that Signal at 5 significantly increases the share of children that received later vaccines by the age of one year: from 92 to 95% (p=0.04) for vaccine four and from 69 to 78% (p=0.005) for vaccine five, compared to the Control Group. Treatment effects remain significant when compared to the Uninformative Bracelet and Signal at 4 treatment, neither of which had an impact on the number of vaccinations at one year of age. Signal at 5's impact partially persists at age 24 months: while rates for vaccines four and five plateau at 95 and 85% in the Control Group, Signal at 5 adds marginally significant increases of 2.3 and 5.1 percentage points (p=0.08 and p=0.09), respectively.

In the final section of this paper, I estimate a dynamic discrete choice model to quantify parents' valuation for signaling. For each clinic, I randomly selected two adjacent communities (0 to 2 miles away) and three far communities (2 to 5 miles away), creating a final sample of 597 communities located at different distances to clinics. Using distance to the clinic as a numeraire, I show that, on average, parents value signaling timely and complete vaccination equivalently to walking 6 to 7 miles.

Taken together, these findings are of substantive policy importance: a signal that allows parents to broadcast a costly action that is valuable for a child's health increases timely and complete vaccination to levels necessary for herd immunity, at a cost of less than USD 1 per child, far less than estimates from existing interventions.[5]

This paper makes four contributions. First, to my knowledge, this is the first field experiment designed to investigate social signaling in a dynamic setting where individuals take multiple high-stakes actions over a long period of time. Existing studies show that individuals are willing to incur considerable costs when faced with the decision to take an immediate action that allows them to signal their type to others (Bursztyn et al. 2017; Friedrichsen et al. 2018; Soetevent 2005). This begs the question whether these responses are strategic and reflect deliberate choices or are driven by emotions. My findings suggest that social image concerns can act like economic incentives, encouraging forward-looking behavior and costly actions in exchange for future payoffs, even when there is significant uncertainty about whether signaling benefits will be realized. My study also introduces a novel design, in which multiple signaling treatments are created and only the margin at which individuals can signal is varied, allowing me to control for alternative mechanisms. This design can be applied to other settings where individuals act sequentially and must take multiple actions, such as prenatal care visits or Covid-19 vaccinations.

Second, this study contributes to a nascent literature on field experiments that examine the mechanisms underlying social image concerns and how these can be shaped to motivate desirable behavior (Bursztyn et al. 2018, 2017; Bursztyn and Jensen 2017; Chandrasekhar et al. 2018). My experimental design moves beyond manipulating the visibility of actions (Ashraf et al. 2014; DellaVigna et al. 2016; Perez-Truglia and Cruces 2017; Kessler 2017; Karlan and McConnell 2014) by introducing multiple signals linked to different actions. This paper shows that social image effects can vary significantly

[5] Gibson et al. (2017) increase full immunization by 12 months of age from 82 to 90% by sending SMS reminders for vaccine two, three, four and five and providing a USD 2 incentive for each timely vaccination (total incentive cost of USD 8). Banerjee et al. (2010) find that offering one kg of raw lentils for each vaccine and metal plates upon completion of the full series increases vaccination rates in India from 18 to 39% (total incentive cost of USD 6.64).

with the cost of the action–they are strong when the action is costly enough to be informative about a desirable characteristic, and weaker otherwise, pointing to an important mechanism. Individuals are less likely to learn from negative signals about inactions as there is often greater uncertainty about their meaning. For example, a yellow bracelet, the absence of a voting sticker, or the lack of public information about donations may not be interpreted as a negative signal as it is unclear whether the person did not have the opportunity to take the action yet, or chose to not take it. In contrast, observing a positive signal removes any doubt about whether the action was taken. This asymmetry in learning could have important implications for the welfare effects of signals. If individuals are less likely to update negatively about others' actions, signals may primarily work through a social reward mechanism.

Third, this paper provides the first experimental evidence on social signaling in health and therefore contributes to a literature on incentives to increase the use of health services and public goods in low-income settings (Thornton 2008; Banerjee et al. 2010; Ashraf et al. 2014; Sato and Takasaki 2017; Karing and Naguib 2021). Previous studies have found large effects of cash and consumption incentives. For example, Banerjee et al. (2010) find that offering one kg of raw lentils for each vaccination and a metal plate upon completion of the full series increases vaccination rates in India from 18 to 39%. In contrast, my paper looks at immunization in a context where initial take-up is close to universal and completion rates are much higher than in India, identifying social signals as a potential low-cost way to address the "last-mile problem" of reaching immunization thresholds.

Fourth, the results of this paper have the potential to inform policy strategies for increasing the demand for complete and timely vaccination. Current immunization programs rely heavily on health campaigns and outreach activities to achieve target immunization levels, which consume a large share of total health expenditures and are often donor financed, potentially crowding out other investments needed to advance primary healthcare in low-income countries.[6] This study shows that social signals can increase parents' willingness to travel farther to receive vaccinations, providing relevant information to governments who face trade-offs between keeping health workers at central clinics to serve patients and mobilizing them to more remote areas. While most social signaling studies have been implemented in high-income countries, this study demonstrates the feasibility of implementing a more subtle behavioral intervention through government institutions in a low-resource setting.

The remainder of this paper is organized as follows. Section 2 provides an overview of the empirical setting. Section 3 discusses the theoretical framework and predictions. Section 4 describes the experimental design and its implementation. Section 5 through 7 present the experimental results. Section 8 quantifies the value of social signaling. Section 9 concludes.

[6] For example, in 2019, GAVI disbursed over USD 4 million to support Measles catch-up campaigns.

2 Context

This section provides information on the study context relevant to the experimental design, including a comparison of the benefits and costs of different vaccines and constraints to timely vaccination in Sierra Leone specifically.

2.1 Childhood Immunization

A child under the age of one needs to receive five routine vaccinations. The first vaccine is due after birth, followed by a three-dose series of vaccines protecting against diphtheria, tetanus, and pertussis (DTP). The three doses must be given one month apart, with the first given at 1.5 months and the last dose given at 3.5 months of age. The fourth vaccine therefore follows a series of closely spaced reminders to vaccinate and is due at a time when a child's health is at the forefront of parents' mind. The fifth vaccine is the first of a two-dose series protecting against Measles and is due at nine months of age (WHO 2018). Since the vaccine is scheduled almost six months after the fourth vaccine, it is the hardest to remember. For most children, the first two doses of DTP are sufficient to obtain protection against the diseases.[7] The first dose of Measles, on the other hand, is essential for children to be protected against the disease.

Despite increasingly high coverage rates in many low- and middle-income countries, a significant share of children are not fully protected for several months up to a year after their due date, due to delays in vaccination. In other words, vaccinating children on time is hard, which leads parents to postpone vaccinations to a later point. To counter these delays and achieve target levels of immunization, governments conduct resource intensive outreach campaigns (EPI 2014).

2.2 Low-Income Country Context of Sierra Leone

Sierra Leone is one of the poorest in the world, ranking 181 out of 188 in the Human Development Index (UNDP 2016). Women are the primary caregivers of children, taking them for vaccinations over 99.99% of the time (Appendix Table B1). About half of mothers (47%) in my study sample have no education, 31% have any primary education, and only 22% have any secondary education. Seventy three percent of mothers are engaged in farm work, and fewer than 12% possess a mobile phone.

The country has one of the highest infant and under-five mortality rates, with 75 and 134 deaths per 1,000 live births, respectively (Sierra Leone DHS 2020). Childhood immunization is one of the most cost-effective ways to reduce child mortality, and increasing

[7] The antibody level increases after the second dose of diphtheria toxoid and is much higher after the third dose; while most children have a base level of protection from the first two doses of DTP, the third dose is necessary for 94-100 percent of children to have protective antibody levels $>$ 0.01 IU/mL and reach herd immunity thresholds (WHO 2017).

timely and complete immunization in a country like Sierra Leone can have a particularly large impact. For instance, one third of all under-five diarrheal disease hospitalizations are caused by rotavirus, which can be prevented by an additional vaccine during the DTP series (PATH 2017). Furthermore, vaccination visits provide an opportunity to record children's weight, height, and overall development, making them the main point of contact for monitoring newborns' health and detecting issues such as malnutrition.

Vaccines are free of charge and readily available. At baseline, fewer than 14% of clinics in my study sample reported having a stock-out of one or more vaccines (Appendix Table B2, Panel A). Immunization services are offered on a fixed schedule, either on a weekly (66% of sample) or monthly (34% of sample) basis. The functionality of the supply side is reflected in communities' perceptions: 79% of communities name negligence of parents as one of the three most common reasons for delayed or missed vaccination (Appendix Table B2, Panel B). Lack of knowledge of the benefits of vaccination and distance to clinics were also reported by 65% and 42% of communities respectively. Importantly, child vaccination is a well-known technology: 94% of communities at baseline know that children need five vaccinations, and are aware of its importance for health.[8] Finally, reminders for vaccination exist in this context: nurses write children's next vaccine due date on their vaccination cards, and regularly remind parents in the community about upcoming vaccination days (e.g. through community health workers). In my sample, 95% of children have a vaccine card (Appendix Table B3, Panel B).

3 Conceptual Framework

I adapt Bénabou and Tirole's framework of social signaling (2011) and augment it to include uncertainty about future cost shocks to organize my analysis of how different signaling treatments affect immunization behavior. The model serves two purposes: first, it allows me to lay out the main objects that I will consider when introducing experimental variation and discussing results; second, it allows me to articulate predictions based on social signaling preferences in a dynamic setting.

3.1 Social Signaling with Uncertainty

There are five vaccines and in each period $t \in \{1, 2, 3, 4, 5\}$ a parent decides whether to complete period t vaccine. A vaccination is considered completed on time if it was taken in period t and previous vaccines were also completed on time, so that parents are effectively choosing a stopping point $a \in \{0, 1, 2, 3, 4, 5\}$. Taking a vaccine late or missing

[8] Individual surveys corroborate this finding: 96% of mothers attending vaccinations, who were randomly sampled for short surveys during their clinic visit, were aware that children under the age of one require five vaccinations.

it altogether is therefore an absorbing state. This maps onto my main empirical exercise, where I commonly focus on how many vaccines a child has taken on time.

Parents differ in their intrinsic motivation to look after their child's health, defined by their type υ, which is drawn from the distribution $G(v)$ and is private information. Parents receive a private benefit $b(t;\upsilon)$ from the period t vaccine, which is a function of her type.[9] Without loss of generality, I assume that parents with higher intrinsic motivation receive greater utility from each vaccination and therefore are more likely to vaccinate their child on time. In each period, parents face a cost $c(t)$ that comprises a time-varying component, common to all parents (e.g., travel and mental effort cost), and a random component ϵ_t, known only to a parent at time t when deciding whether to take their child for the next vaccine. This uncertainty rationalizes the fact that some parents intend to vaccinate their child for all vaccines but stop early, and that parents consider uncertainty over future cost when deciding to vaccinate in the current period.

The key part of the model are the reputational benefits and costs associated with the expectations that others will form about a parent's intrinsic motivation as actions become visible. My experiment aims to vary the likelihood that others observe information about the vaccination decision: in particular, the different treatments increase the likelihood $x \in [0,1]$ that others observe whether an individual has completed at least $r \in \{4,5\}$ vaccinations. For example, if $r = 4$, then others can observe that a parent chose to vaccinate her child for at least four vaccines, that is $a \geq 4$, or that she chose to vaccinate her child for fewer than four vaccines, that is $a < 4$. Given this information, others form expectations about a parent's type, that is: $E(\upsilon|a \geq r)$ or $E(\upsilon|a < r)$. The parameters λ and ω_r measure how much parents care about the expectations that others form about them and the social desirability of being seen as the type of parent who chooses $a \geq r$.[10,11] Taken together, a parent's utility in every period t can be described by:

$$\begin{aligned} \text{if vaccinate} \quad & u_t^v = b(t;\upsilon) - c(t) + \quad x\lambda\omega_r E(\upsilon|a \geq r) \cdot \mathbb{1}\{t = r\} \\ \text{if stop vaccinating} \quad & u_t^{nv} = x\lambda\omega_r E(\upsilon|a < r) \cdot \mathbb{1}\{t = r\} \end{aligned}$$

This gives the value function for a parent who has stopped vaccinating: $V_t^{nv} = \Sigma_\tau^5\, u_\tau^{nv}$. For a parent who has not yet stopped vaccinating, the value function is $V_t^v = u_t^v + \max\{V_{t+1}^{nv}, V_{t+1}^v\}$ for $t < 5$ and $V_5 = u_5^v$ for $t = 5$. This decision-problem is solved by backward recursion, with parents optimally deciding in each period according to the decision-rule: vaccinate if $V_t^v > V_t^{nv}$, and stop otherwise.

[9] I abstract from the externality benefits of vaccination since individuals in the context of my study predominantly think of vaccination as a private good and lack an understanding of externalities.

[10] Following the literature, I assume that $\lambda \geq 0$ and $\omega_r \geq 0$ given that the action $a \geq r$ is desirable.

[11] Individuals may want to be seen as parents who prioritize their children's health. However, not all actions may be equally valuable to demonstrate this. While vaccinating a child on time may be seen as a sign of responsible parenting, different vaccines may be viewed as differently important, and judgments may therefore vary.

3.2 Equilibrium Vaccination Decisions

In Bénabou and Tirole's static model, there exists a unique set of actions such that each individual chooses an optimal action $a^* = a(\upsilon)$, given the equilibrium actions of all other individuals.[12] This equilibrium is characterized by a cutoff type υ^* who is indifferent between vaccinating up to r and stopping before, such that all types above the cutoff choose to vaccinate for at least r vaccines and types below choose to vaccinate for fewer vaccines. My model differs in that it includes random shocks, but the same logic holds in expectation: for every period t, there exists a unique cut-off type $\hat{\upsilon}_t$ who is indifferent between vaccinating and stopping, for whom $E_{\epsilon_t}(V_t^v) = V_t^{nv}$ prior to receiving the shock ϵ_t. In equilibrium, others correctly forecast the cutoff types and update their expectations accordingly and the expectations rationalize the original cutoffs. The reputational gain that a parent realizes from choosing $a^*(\upsilon) \geq r$ is defined by the difference in the type expectations assigned to those who vaccinate up to r and those who do not, that is: $\Delta(\hat{\upsilon}_r) = E(\upsilon|a^* \geq r)$ - $E(\upsilon|a^* < r)$.

3.3 Testable Assumptions of Social Signaling

The model above requires three main assumptions for an increase in visibility x to have an impact on behavior. I will empirically verify these in the context of child vaccination in Section 5. First, individuals must have imperfect information about other parents' actions, so that increased visibility provides new information about their actions and subsequently allows for learning about types. Second, as visibility in actions increases, individuals must correctly observe other parents' actions more often than not, that is: $\Pr(a \geq r|a \geq r))$ - $\Pr(a \geq r|a < r) > 0$. And third, individuals must form expectations about parents' types conditional on the actions observed, that is: $\triangle(\hat{\upsilon}_r) = \mathrm{E}(\upsilon|a \geq r)$ - $\mathrm{E}(\upsilon|a < r) > 0$.

3.4 Predictions for Vaccination Behavior

Given these assumptions, there are three, fairly intuitive predictions that the dynamic model is making about parents' behavior as visibility in vaccination decisions increases.[13] I will test these predictions in Section 6. First, as visibility increases parents are more likely to timely vaccinate their children for (at least) r vaccines, if they value others' perceptions of their type ($\lambda > 0$) and see the action as socially desirable ($\omega_r > 0$). Second, parents are more likely to timely complete earlier vaccines, even if they fail to do so for all vaccines up to r, at which the signaling benefit occurs. Specifically, parents

[12]See Bénabou and Tirole (2011) for the set of conditions that ensure uniqueness. It is reasonable to assume that these are met in this setting.

[13]These predictions hold following the assumptions stipulated by Bénabou and Tirole (2011): $(1-\mu)$ $\upsilon_{\min} + \mu\bar{\upsilon} < c < (1+\mu)\upsilon_{\max} - \mu\bar{\upsilon}$ and monotonicity of $\upsilon + \mu\Delta(\upsilon)$, where $\mu = x\lambda\omega_r$.

choose to do so if the option value of signaling is sufficiently large for them to *expect* to timely vaccinate up to r, and will stop vaccinating (on time) before reaching r if they receive a too negative cost shock. Third, if the signaling threshold is set at four vaccines i.e., $r = 4$, parents are also more likely to timely vaccinate their child for five vaccines. Some parents who timely vaccinate up to four vaccines, receive a positive cost shock in $t = 5$, which makes it optimal for them to vaccinate further.

The model does not give a clear prediction regarding the relative effect of increasing the visibility of timely completion for the first four versus all five vaccinations. However, it identifies the main factors that influence the direction of this effect: $\Delta(\hat{v}_r) = E(v|a \geq r)$ - $E(v|a < r)$ and ω_r. Firstly, the type inferences and reputational gains from signaling the timely completion of four ($r = 4$) versus five ($r = 5$) vaccines might differ. If the action is costlier–as is vaccinating timely up to vaccine five–the cut-off type will increase, leading others to form higher expectations of those who take the action. Conversely, for a less costly action–such as the timely vaccination up to vaccine four–a larger share of parents will take the action and the cut-off type will be lower, leading others to make worse inferences about those who do not take the action. The net reputational gain may increase or decrease with the share of parents taking the action, depending on whether the reputation of vaccinating parents improves by more or less than the reputation of those who default deteriorates.[14] Secondly, the extent to which parents value the timely completion of vaccine four versus vaccine five more or less, will affect the degree to which parents see the action as valuable for signaling their care for their children's health. The prediction is that the greater the social desirability of an action ω_r, the stronger the impact of an increase in visibility on the proportion of children who get timely vaccinated.

The model assumptions, its mechanism and main result predictions remain the same when looking at the decision to take a child for a vaccines, independent of timeliness.

4 Experimental Design

In this section, I first introduce the experimental treatments, and explain how they are used to test the theoretical predictions. Next, I describe the randomization of clinics and communities. I then provide information about the timeline of the experiment and the different data sources I collected. Finally, I discuss balance checks and compliance with the implementation protocol.

[14]This follows from Bénabou and Tirole (2011), and that the assumptions for an interior equilibrium are met, with the conditions stated above.

4.1 Experimental Treatments: Bracelets as Signals

To create visibility in actions, I experimentally introduce a signal - in the form of color-coded bracelets that children receive upon vaccination at public clinics. The bracelets create an opportunity for parents to publicly signal that they correctly vaccinated their child. Specifically, I introduce experimental variation in two ways to test the theoretical predictions of the model: (1) I increase the visibility of vaccination decisions; (2) I exploit the fact that children need to receive multiple vaccinations and place signals at points in the vaccine schedule that are either easy or hard to reach. Figure 1 displays the specific bracelet treatments that health workers implement at each of the five vaccinations. I randomize clinics into the following four experimental groups:

> **Signal at 4:** Children receive a yellow "1st visit" bracelet when coming for the first vaccine. Children keep the same bracelet for vaccines two and three. If a child comes timely for all vaccines up to vaccine four (by age six months), health workers exchange the yellow bracelet for a green "4th visit" bracelet. If a child comes late, the bracelet is exchanged for an identical yellow "1st visit" bracelet. At vaccine five, irrespective of timeliness, the bracelet is exchanged for a new and identical bracelet to the one last received.
>
> **Signal at 5:** Children receive a yellow "1st visit" bracelet when coming for the first vaccine. Children keep the same bracelet for vaccines two and three, and the bracelet is exchanged for an identical yellow "1st visit" bracelet at vaccine four. If a child comes timely for all vaccines up to vaccine five (by age 11 months), health workers exchange the yellow bracelet for a green "5th visit" bracelet. If a child comes late, the bracelet is exchanged for an identical yellow "1st visit" bracelet.
>
> **Uninformative Bracelet:** Parents choose a green or yellow "1st visit" bracelet when coming for the first vaccine. Children keep the same bracelet for vaccines two and three. At vaccines four and five the bracelet is exchanged for a new identical "1st visit" bracelet of the originally chosen color.
>
> **Control Group:** Children do not receive any bracelets at vaccinations.

In all three signaling treatments actions are grouped into two signals. In Signal at 4, others can only tell whether a child was timely vaccinated for four or more vaccines, or whether a child received fewer than four vaccines or took them late. In Signal at 5, the bracelets allow others to observe if a child received all five vaccines on time, or fewer or took them late. The Uninformative Bracelet allows parents to signal that their child started vaccination but provides no information about the completion of later vaccinations and their timeliness.

I tie the bracelets in Signals at 4 and 5 to timely vaccinations to increase the value of the signal: while vaccinating a child at some point may not be very costly, vaccinating on time can be. Timely vaccination is also the most desirable health outcome: the risk of disease infection and death is the highest for younger children and earlier vaccination ensures that children receive frequent enough check-ups for other health issues.[15] The decision to introduce signals for the timely completion of all vaccines until the fourth and fifth is motivated by the fact that drop-out or late vaccination is highest for these vaccines and the potential for signaling therefore highest.

Appendix Figure A1 shows the actual bracelets that were given out at clinics. All bracelets were made out of silicone and were size-adjustable so that they could comfortably fit the wrist of a child between the ages of zero and 12 months. The latter was key for the experimental design i) as it made the bracelet a *durable* signal that could be observed by others and allow for comparisons beyond the time of the vaccination, and ii) so that the size of the bracelet would not be informative about the number of vaccinations a child has completed.[16] Over the course of the experiment, a total of 36,000 bracelets were handed out by health workers. Children that were born before the start of the experiment and had already started vaccinations, received their first bracelet when coming for their next vaccination. Appendix D Figures D1, D2, D3 and D4 display the messages that clinic staff were trained in to give to mothers when handing out or exchanging the bracelets. Each clinic was given a laminated hard copy of the messaging card.

4.2 Identifying Effects

The combined effect of increased salience (e.g. reminder effects), consumption utility, social learning or normative influence, and social signaling preferences is captured by the comparison of the share of children vaccinated on time for four and five vaccines in the Control Group compared to Signals at 4 and 5.

The comparison of Signal at 4 and Signal at 5 to the Uninformative Bracelet at vaccines four and five allows me to isolate the effect of social signaling preferences on vaccination decisions. I implement bracelet hand outs and exchanges in all three signaling treatments at the same vaccines in order to hold constant any additional consumption utility of bracelets. By distributing bracelets and using the colors green and yellow in all three signaling treatments, I further hold constant salience and reminder effects that are due to (1) the general visibility of vaccinations through bracelets, and (2) the introduction of new colors over time. In other words, the only difference remaining is what actions can

[15] Delays in vaccination put infants and young children at the highest risk of falling ill and dying from these diseases: one out of five children who get diphtheria under the age of 5 dies (WHO 2017), and pertussis predominantly affects children younger than 12 months (CDC 2022).

[16] As a child's wrist grows, even in the absence of a change in bracelet color, a too small bracelet that no longer fits, could otherwise be informative about whether a child is up-to-date with its vaccinations.

be signaled, that is, the timely completion of a specific vaccine. If the green bracelets in Signal at 4 and Signal at 5 treatments acted as vaccine-specific reminders for vaccines four and five, we would expect to see a significant increase in the share of children taking these vaccines. However, we would not expect increases in earlier vaccinations.

A larger increase in the share of children who are timely vaccinated for four or five vaccines in Signal at 5 compared to four vaccines Signal at 4 implies a higher social signaling value in Signal at 5 compared to Signal at 4: $\lambda\omega_4\Delta(\hat{\upsilon}_4) < \lambda\omega_5\Delta(\hat{\upsilon}_5)$.[17] This could be due to two reasons: differences in (i) the type expectations that others form upon observing the timely completion of four versus five vaccines, such that Signal at 4 is less informative about different types, that is, $E(\upsilon|a \geq 4) - E(\upsilon|a < 4) < E(\upsilon|a = 5) - E(\upsilon|a < 5)$, or (ii) the social desirability parameter of how much society values the timely completion of four and five vaccines, that is, $\omega_4 < \omega_5$.

An increase in the share of children who timely complete earlier vaccines (vaccines one, two, or three for Signal at 4; vaccines one, two, three, or four for Signal at 5), without transition probabilities from vaccines three to four and four to five respectively equaling one, demonstrates that individuals make decisions dynamically and under uncertainty. Parents who timely vaccinate their children for earlier vaccines due to an increase in the future value of vaccination but do not make it on time to vaccine four (for Signal at 4) or vaccine five (for Signal at 5), must have *targeted* their timely completion but stopped earlier or vaccinated late due to unforeseen cost shocks.

Finally, I can quantify the extent to which treatment effects are driven by social learning, by comparing the transition probability from vaccine four to five in Signal at 4 to that in the Uninformative Bracelet. If individuals have incorrect priors over the share of parents that vaccinate their children, and are uncertain about the benefits of vaccination, observing signals about timely take-up of four or five vaccines, could lead them to update their beliefs about take-up levels and the usefulness of vaccinations, or the social norms surrounding vaccinations. Similarly, health workers giving a "reward" to parents for vaccination, could act as a signal about the importance of vaccinations for children's health. By design, parents in the Signal at 4 treatment have no signaling incentive to timely complete five vaccines, as green bracelets do not allow for a distinction between parents who took their children for four vaccines, versus those who went for five. An increase in the share of children timely vaccinated at vaccine five could therefore be due to two reasons: (i) if uncertainty plays an important role, some parents who now timely complete vaccine four in Signal at 4 receive a positive cost shock and also take vaccine five; (ii) parents learn from signals about the take-up of vaccinations in their community (if previously held incorrect beliefs) and the benefits of vaccinations, leading them to also increase their

[17] Taking a child timely for five vaccines is by definition costlier than taking a child timely for four vaccines, hence a higher timely take-up of five vaccines in Signal at 5 compared to four vaccines in Signal at 4 implies a higher signaling value.

valuation of vaccine five. To distinguish (i), which still falls within the predictions of the signaling model, from (ii) which is an alternative behavioral mechanism, I can compute the transition probability between vaccines four and five. If I observe an increase in the transition probability in Signal at 4 treatment relative to the Uninformative Bracelet, it strongly suggests that learning is a relevant alternative mechanism.

To address concerns regarding learning about social norms, the take-up level or the importance of vaccine five in Signal at 5 compared to the Uninformative Bracelet or Control Group, I elicit individuals' beliefs about aggregate take-up levels of vaccines in their community and their preferences for the different vaccinations. I use both survey measures to test for differences across arms.

4.3 Clinic Randomization and Community Selection

Treatment was randomized at the clinic level so that every child living in the catchment area of a clinic was eligible for the same bracelet treatment. In total, I selected 120 clinics across four of Sierra Leone's 14 districts to be part of the study. To randomly draw 120 clinics from the pool of 243 public clinics across the four districts, I used an acceptance-rejection method whereby I randomly picked clinics, checked their acceptability based on their overlap with already selected clinics, and if accepted, added them to the selected sample. This process was repeated until it had selected the requisite number of clinics. If no acceptable clinic remained before completion, the whole process was restarted. Each clinic had a 5 mile radius as catchment circle. A clinic was considered acceptable if its catchment circle did not leave any of the already selected clinics' non-overlapping catchment circle smaller than 35% of its area. Clinics were then randomly assigned, stratified over the four districts and two implementation waves, to the three different bracelet treatments and the Control Group.[18] Appendix Figure A2 shows the geographic span of the experiment across the four districts in Sierra Leone and the final selection of clinics. At the start of the study, in each clinic, surveyors selected - using in-field randomization - two communities at close distance (0 to 2 miles) and three communities at far distance (2 to 5 miles) from the clinic, from the pre-specified non-overlapping catchment area of each clinic. Appendix Figure A3, the upper map, shows the non-overlapping catchment areas and the lower map provides an example map for one of these clinic areas, that surveyors were given for the in-field community selection. In total, the experiment included 597 communities. I excluded one clinic in the urban part of Western Area Rural from the analysis as the experiment implementation and data collection were seriously impeded by turn-over of clinic staff, relocation of selected communities and deficiencies in monitoring and data collection by a surveyor.

[18] The experiment was phased in in two waves: 44 clinics started implementation between mid-June and mid-July 2016 and 76 clinics started implementation between end of September and end of November 2016.

4.4 Information Treatment

While such a high level of randomization significantly increased the logistical demands of the experiment, it was key to reducing the risk of incorrect implementation by health workers, and to creating a common understanding of the meaning of the bracelets.

At the start of the experiment, surveyors visited 597 of the selected communities to hold an information meeting with the community. The objective was to highlight the health and economic benefits of timely and complete vaccinations, to discuss existing barriers, and in signaling treatments, to inform a wide range of community members about the bracelets and create common knowledge about their meaning (see Appendix D Figures D5 and D6 for the scripts used by surveyors for the information meetings). The average meeting attendance was 43 people, with almost all meetings being attended by a health representative, e.g. a community health worker (94%) and a community leader, e.g. chief (98% of meetings). Surveyors held a second information meeting in each community two to four months later, to reiterate the importance of vaccinations and explain the meaning of the bracelets, now that clinics were handing them out.

4.5 Experiment Timeline and Data

Below, I detail the timeline of the experiment implementation and the main data collection activities.

Jun '16 - Nov '16	**Start of the Experiment:** baseline clinic and community survey; training of 348 government health workers across 120 clinics in messaging to parents and implementation of bracelets; information meetings about the benefits of vaccination and meaning of bracelets in 597 communities including close to 25,000 adults.
Jul '16 - Aug '18	**Clinic implementation:** health workers hand out bracelets as part of regular monthly or weekly routine vaccination services at clinics.
Jul '16 - Jan '18	**Monitoring of implementation:** surveyors regularly visit clinics to verify the correct hand out and exchanges of bracelets, messages given to parents, and recording of vaccine visits; training of new clinic staff in implementation; digitization of administrative records; follow-up information meetings in communities.
Sep '17 - Jan '18	**Listing survey:** comprehensive listing of 14,061 children in 597 communities to collect immunization data.
Feb '18 - Apr '18	**Endline data collection:** in-depth surveying of 1,323 parents and collection of administrative clinic data.
Dec '20 - Jul '21	**Follow-up survey:** revisiting and surveying of 5,030 children.

I use several data sources for the analysis:

1) *Baseline clinic and community survey data:* surveys with nurses in charge of study

clinics and community members who participated in information meetings. This data is used to check for balance on clinic and community characteristics across control and treatment groups, and for control variables.

2) *Listing survey data (first round):* surveys with parents of children capturing residence status, date of birth, vaccinations received and dates, ownership and wearing of bracelets. This data is used to estimate treatment effects on timely and complete vaccinations, verify the correct handout of bracelets by clinics, and estimate the accuracy of mothers' beliefs about other children's bracelet and number of vaccinations.

3) *Follow-up survey data (second round):* surveys with parents of children who were less than one year old at the time of the original listing, capturing new vaccinations and their dates. This data is used to increase the final outcome sample.[19]

4) *Endline data:* in-depth survey of a random sample of parents. This data is used to estimate the effects of treatments on first- and second-order beliefs about other children's vaccinations, their bracelets and color, and preferences and knowledge about vaccinations. Appendix C details how endline respondents were sampled.

5) *Administrative clinic records:* digitized vaccination records from study clinics including vaccines received, date of vaccination, whether the child received a bracelets and its color. This data is used to monitor the handout of the bracelets on an ongoing basis, and to verify the accuracy of mothers' beliefs about other children's vaccine status.

4.6 Sample Definition and Randomization Checks

My main outcome was collected in two rounds: the listing survey and the follow-up survey. In the first round, I listed 14,061 children, of which 8,480 were eligible to be part of the study sample. Eligibility was defined by being born when the experiment was implemented and monitored, that is between July 2016 and December 2017; and attending one of the 119 study clinics for immunizations. I listed a larger number of children than those who were eligible to be included in the analysis to test for balance in vaccination outcomes prior to the experiment and to mitigate the risk of enumerators missing children who were born around the eligibility cut-off. I surveyed 1,857 eligible children who were 12 months or older at the time of the listing survey–meaning I observed their full vaccination history. In the second round, I re-surveyed 3,040 eligible children who were older than 12 months at the time of the follow-up survey, leading to a final analysis sample of 4,897 children.[20]

Appendix Table B3 Panel A describes the characteristics of my main analysis sample and shows that the success rate of re-surveying children was similar across control and

[19]The follow-up survey was delayed by one year due to the COVID-19 pandemic and its implementation took considerably longer due to restrictions in field work.

[20]Appendix Figure A4 illustrates the flow of the sample from the listing survey to the sample used for the analysis of treatment effects.

treatment groups, ranging between 69 and 73%. A sizable share of children (17%) had moved at the time of the follow-up survey. The primary reasons for moving were economic opportunities (for 55%) and family or community conflict (for 30% of moved parents).[21] I find no evidence for that attrition created a bias in treatment effects. Appendix Table C1 shows that there are no significant differences in treatment effects for vaccines one through four between attrited and non-attrited children at the time of the listing survey.

Appendix Tables B1, B2, and B3 report the randomization checks for the main analysis sample, the endline sample, and for the selected clinics and communities. Pairwise comparisons between control and treatment groups show that all study groups are well-balanced on key characteristics. Given the large number of comparisons, I find, as expected, that a few coefficients are statistically significant at the 10% (21 out of 378) and 5% (13 out of 378) levels. The F-tests for joint significance always yield p-values greater than 0.10 except for the share of children who moved at the time of the listing and the follow-up. Notably, there are some differences in clinic population size, with the Uninformative Bracelet having on average smaller clinic populations compared to Signal at 4 and 5 clinics. I control for population size in all my analyses, so these imbalances should not affect my results. In Appendix Table B3 Panel C, I test for differences in pre-trends for timely vaccination for vaccines one, two and three and find no statistically significant differences. Appendix Table B1 shows that there are no significant differences on socio-demographic characteristics among endline respondents and that the elicitation of beliefs was equally well implemented across arms. Lastly, Appendix Table B2 shows that there are no significant differences in the implementation of the experiment or surveys across arms.

4.7 Compliance with Implementation Protocol

To verify if health workers correctly handed out and exchanged bracelets, surveyors asked each parent to report the bracelet color that was given to the child during vaccination, and the number of vaccines the child had received by that time. Figure 2 shows the fraction of children in each group that received a yellow, green, or no bracelet, conditional on the number of vaccines received. In bracelet treatments, almost every child had a bracelet (93.5%), with no significant differences across arms. In the Uninformative treatment, there is no overall significant relationship between the number of vaccines a child has received and the reported bracelet color (see Appendix Table B4, columns 5 and 6). We can see that the majority of individuals prefer the color yellow over the color green with 52.3 and 29.8% of parents choosing it when coming for the first vaccine, respectively.

[21] The share of children moved increased between the listing and the follow-up survey since most children were younger than one year of age at the time of the listing survey and older than three years at follow-up. The probability of parents moving sharply increases once a child is one year of age or older: only 13% of parents moved when the child was younger than one year.

For Signal at 4 and Signal at 5, there is a clear relationship between child's bracelet color and the number of vaccinations received: there is a large increase, up to 61% for Signal at 4 and 70% for Signal at 5, in the share of children with a green bracelet at vaccines four and five, respectively. Children who received vaccine four and/or five but had a yellow bracelet either came late for the vaccine or health workers missed to give the correct bracelet. Therefore, a yellow bracelet on an older child provides a noisy signal about the number of vaccines received. Conversely, almost no child (1.8%) is reported to have received a green bracelet before the signaling threshold, and few children received it when coming late (Appendix Figure A5). A green bracelet is therefore a highly informative signal about a child having timely received vaccine four or five in the Signal at 4 and Signal at 5 treatments. There is no significant difference in the share of incorrectly handed out bracelets between Signal at 4 and Signal at 5 treatments.[22]

5 Beliefs: Do Signals Lead to Learning About Types?

Bracelet aim to create an opportunity for parents to show that they vaccinated their children on time. For this to work, individuals must (1) learn about others' actions from signals, and (2) form expectations about others' types conditional on the signals observed. For learning to take place, two assumptions have to be met: bracelets are publicly visible and their colors are well understood; parents have imperfect information about other children's vaccinations. In this section, I empirically verify these mechanisms and assumptions.

5.1 Method

I first elicit individuals' first- and second-order beliefs about vaccination decisions and the perceptions of others' types. Each mother at endline is asked about five other children in her community, randomly sampled from the children born since the start of the experiment. If a mother did not recognize the name of a child, she was given the name of a different child until she identified five other children.[23] For each child, a mother was asked her relationship to the child's mother, the number of vaccines received, whether the child had a bracelet and the bracelet color, and the mother's beliefs about the respondent's child's vaccine and bracelet status. First-order beliefs about other mothers' vaccination decisions were incentivized with a small reward (3 US Cents) for each child they cor-

[22]Furthermore, there are no significant differences in the implementation of bracelet exchanges across bracelet treatments (see Appendix Table B17).

[23]On average, respondents were asked about 6.1 other children and recognized 4.2 children in control group clinics. Sixty three percent of respondents were able to recognize five children. Only 12% recognized fewer than three other children. For those who recognized fewer, communities were often smaller and had fewer than five children in the relevant age range. There are no significant differences in the average number of children recognized or number of children asked about across arms (see Appendix Table B1).

rectly guessed the number of vaccines for. Second-order beliefs were not incentivized, since verifying the correctness of answers would have required surveying all mothers in the community. Since I only elicit mothers' beliefs about children who were born since the study started, there are fewer older children than younger children in the sample and thus fewer observations for later vaccines. To measure perceptions, each mother was asked about others' concerns about the child's vaccination, and their perceptions of her type conditional on her child's vaccine status. For the analysis of perceptions, the sample remains constant, as these questions are not specific to a particular child, and therefore age category.

Second, I assess the accuracy of first-order beliefs about other children's vaccinations. I do so by linking respondents' answers with vaccine outcomes from the listing, endline and follow-up survey, or the administrative clinic records.

5.2 Do Individuals Learn from Signals about Others' Actions?

5.2.1 Visibility and Understanding of Bracelets

Bracelets are highly visible in all three bracelet treatments (Table 1). For 91% of children, mothers report knowing whether they have a bracelet. In Signals at 4 and 5, mothers are significantly more likely (10.6 and 8.2 percentage points with $p<0.01$, respectively) to recall a child's bracelet color and do so correctly (12.2 and 15.1 percentage points with $p<0.01$, respectively) compared to the Uninformative Bracelet means of 80 and 50%. I look at recall by bracelet color specifically and find that these increases are driven by parents being more likely to know the color when a child has a green bracelet. Importantly, reported visibility is not driven by reverse inference. For almost all children (95%), respondents say that they know the child has a particular color bracelet because they saw the bracelet on the child, or because they saw the child receiving the bracelet at the clinic (Appendix Table B5).[24] Consistent with first-order beliefs, mothers in the Uninformative Bracelet believe that 76% of other mothers know about their own child's bracelet color, while in Signals at 4 and 5 mothers believe that 81 and 82% of other mothers have knowledge.

Parents appear to effectively use the colors of bracelets to infer the number of vaccines a child has received in signaling treatments. The left panel of Figure 3 shows the probabilities mothers assign to a child having completed at least four or five vaccines, conditional on having a yellow or green bracelet. The almost perfectly overlapping yellow and green bars in the Uninformative Bracelet demonstrate that there are no systematic differences in the probabilities that mothers assign to children having completed vaccines four and

[24] Only for 10% of children respondents state that they know from the number of vaccines the child has or because every child receives a bracelet.

five, when comparing children with yellow bracelets to those with green bracelets.[25] In contrast, for Signal at 4 and Signal at 5, I observe large and significant differences in the probabilities assigned: mothers in Signal at 4 believe that only 50% of children with a yellow bracelet completed vaccine four, compared to 87% of children with a green bracelet - an increase by 36 percentage points (p=0.00) compared to the Uninformative Bracelet. For Signal at 5, changes in beliefs are driven by the green bracelet, and are muted for the yellow bracelet: mothers believe that 36% of children with a yellow bracelet and 77% of children with a green bracelet completed vaccine five, compared to 41 and 53% in the Uninformative treatment - a net increase of 29 percentage points (p=0.002). Notably, mothers in Signal at 4 are also more likely to believe that a child completed vaccine five when wearing a green bracelet (10 percentage points, p=0.00), though significantly less so than in Signal at 5 (42% of the Signal at 5 effect, p=0.049).

The right panel of Figure 3 displays the true probabilities of vaccine completion and reveals that individuals' beliefs are consistent with the truth. Mothers in Signals at 4 and at 5 correctly recognize that some children with a yellow bracelet came for vaccines four and five (either because of untimeliness or implementation errors). The comparison also shows that mothers do not fully update their beliefs in response to green bracelets: the probabilities assigned to a child having attended vaccine four in Signal at 4, and vaccines four and five in Signal at 5 should have been one. Further, mothers in Signal at 5 do not respond to yellow bracelets when they should.

5.2.2 Information Asymmetries and Learning about Actions

I find large information asymmetries among respondents in the Control Group (Appendix Table B6). Mothers have accurate knowledge about the number of vaccinations received for at most 50% of children in their community.[26] Similarly, mothers believe that at most 48% of other mothers in their community have knowledge about their own child's vaccination.

Signaling bracelets increased mothers' knowledge about the vaccine status of other children. Table 2 displays how inferences from bracelet colors translate into knowledge and change the types of errors mothers make. Using the same sample as in Figure 3, I report treatment effects for Signals at 4 and 5, compared to the Uninformative treatment, for children ages 3.5 to 9 months who are eligible for vaccine four but are not yet due for vaccine five (columns 1 to 3) and for children ages 9 to 12 months who are eligible

[25]The difference between the yellow and green bars for vaccine five in the Uninformative treatment is marginally significant at 10%. The actual vaccination outcomes displayed on the right panel, Truth, also show a small gap in the probability of having completed vaccine five for children who have a yellow compared to those who have a green bracelet which can explain the effect in beliefs.

[26]Inaccurate knowledge is equally driven by mothers under- (27%) and overestimating (25%) the number of vaccinations other children completed, suggesting that they are randomly guessing.

for vaccine five (columns 4 to 6).[27] Reassuringly, I find no significant differences in mothers' likelihood of accurately knowing other children's number of vaccinations, when a child has a yellow or a green bracelet in the Uninformative treatment. In contrast, in Signals at 4 and 5 a child having a green bracelet leads to sizable improvements in correct knowledge by 18 and 37% (p=0.10 and p=0.02), respectively, compared to the Uninformative treatment. These effects are driven by mothers being significantly less likely to underestimate children's number of vaccinations, with decreases of 9.9 (p=0.02) and 20.7 percentage points (p=0.00), respectively.[28] A child having a yellow bracelet, however, has no impact on mothers' accurate knowledge, and therefore acts no differently than the yellow bracelet in the Uninformative treatment (see p>0.1 for UI Yellow = S5 or S4 Yellow). This is consistent with the finding that mothers in Signal at 5 do not update their beliefs based on the yellow bracelet. Mothers fail to recognize that the yellow bracelet on an older child, is a sign that the child did not complete vaccine five on time (i.e. failed to obtain the green). For Signal at 4, this suggests that when mothers make inferences based on the yellow bracelet, they make more mistakes.[29] Mothers fail to recognize that a yellow bracelet on an older child can indicate that a child did complete the vaccine, but did so late. I view this as evidence that the yellow bracelet is a more difficult signal to learn from: parents had to know both the age of a child and a vaccine's due date in order to interpret the signal correctly.

These results are corroborated by the treatment effects on second-order beliefs displayed in columns 7 and 8: mothers in Signal at 5 are significantly more likely (23 percentage points, p=0.01) to believe that other mothers know about their own child's vaccinations when their child has a green bracelet, while in Signal at 4 mothers are only marginally more likely to believe that others have knowledge (12.4 percentage points, p=0.08) when their child has a yellow bracelet.[30,31]

[27] I focus on children in the earlier age range to assess the impacts of Signal at 4, and look at older children when assessing the impacts of Signal at 5, as these are the periods when bracelets would be most informative about timely vaccination.

[28] Column 3 shows that conditional on observing a young baby (3.5-9 months) with a green bracelet in Signal at 5, mothers are more likely to overestimate the number of vaccines a child has, that is, thinking that the child has five vaccines when indeed it only has four vaccines. Because very few children in this age range had a green bracelet in Signal at 5, a few implementation errors and mother's wrong recall of the bracelet color are driving this effect.

[29] I find suggestive evidence that the yellow bracelets in Signal at 4 make mothers more likely to underestimate children's number of vaccinations compared to the Uninformative Bracelet (6.1 percentage points, p=0.21) and Signal at 5 (7.3 percentage points, p=0.08).

[30] I report all estimates without controls in Appendix Table B7 and find similar results in effects and significance except for the yellow bracelet effect on second-order beliefs in Signal at 4, which is no longer significant.

[31] Appendix Table B6 shows that when combining the effects of both bracelets, Signal at 5 increases overall knowledge by 10.5 and 7.5 percentage points compared to the Control Group and the Uninformative treatment (p=0.03 and p=0.09, respectively), mapping onto a 16.5 and 10.7 percentage points increase in second-order beliefs compared to the Control Group and the Uninformative treatment (p=0.02 and p=0.13, respectively). Signal at 4 leads to no significant improvements in actual knowledge in either groups, but increases perceived knowledge compared to the Control Group by 13 percentage points

5.3 Do Individuals Learn from Actions about Types?

Mothers believe community members form different opinions about them - in terms of their intrinsic motivation - depending on the vaccinations that their child completed (Figure 4).[32] Almost all mothers (92%) state that others would view them as "caring" if they took their child for all vaccinations, and "careless" if they missed any, verifying the underlying mechanism completion of more vaccines is linked to higher types. In contrast, fewer believed that others link their vaccine decision to their knowledge about benefits (e.g. "know of importance", or "are ignorant") or cost-factors (e.g. "are too busy with work", or "too poor to travel to the clinic"). These answers also shed light on the question of what individuals are trying to signal to others when making actions visible (Bursztyn and Jensen 2017). There are two alternative signals mothers might want to send in my context: (i) their child is healthy and does not pose a threat to other children ($\sim$ inference about child's health status); (ii) they look after their child's health ($\sim$ inference about responsible parent). I find little evidence to support the first. The majority of mothers view vaccines as beneficial only to their own child's health and lack an understanding of the externalities of vaccination. Specifically, fewer than 20% of mothers across all arms believe that other, unvaccinated children can be harmful to their own child's health, or that their child could be harmful to others if not vaccinated (see Appendix Table B9).[33] Importantly, I find no differences across arms in who parents believe is going to judge them (Appendix Table B8), or the opinions that others will form about them (Appendix Table B10 and B11). This suggests bracelets did not alter social norms.[34]

Taken together, the results show that parents in Signals at 4 and 5 use the color of bracelets to learn about other children's vaccine status, and believe that others make different inferences about their type of parent depending on their vaccine decisions. The results also highlight an important barrier to learning about others' actions from signals: parents find it difficult to take into account other children's ages and vaccine due dates, making the absence of a positive signal difficult to interpret. Contrary to the theory's assumption that individuals update their beliefs in response to both positive and negative

(p=0.01).

[32]Appendix Table B8 shows that community members are one of four main reference groups mothers believe are concerned about their child's vaccinations. 61 and 65% of mothers respectively name their husband/father of the child and family members as individuals who are concerned, and name second, with 30 and 35% respectively, regular community members and community health workers/nurses.

[33]When asked why other children can pose a risk to their child when not being vaccinated, or why their child could be harmful to others if not vaccinated, mother state reasons such as: "Because if she is not immunized, she can transfer diseases like measles if she happens to contact it". When asked why vaccinating their own child cannot help others, common answers were: "Because they do not have the same body, or same blood" or "Because the vaccines in my child won't jump and help other children".

[34]Beyond the opinions that mothers believe others form about them as parent, they also name specific actions that they believe others take. Seventy four percent of mothers (Appendix Figure A6) believe that others would scold them if they missed vaccinations, while 22% said they would be praised in the community and people would speak well about them.

signals, parents learn more from positive signals.

6 Behavior: Do Signals Affect Vaccination Choices?

The main outcome of the experiment is the share of children vaccinated in a timely manner for a given vaccine. The experimental design allows for a direct test of the effect of social signaling preferences on the outcome. Having established that bracelets in Signal at 4 and Signal at 5 were informative about parents' actions and their types, this subsection tests to what extent parents' ability to signal changes their behavior.

6.1 Empirical Strategy

My preferred specification for the main outcome is:

$$Vaccine_i = \alpha + \beta T_{j(i)} + \delta X_i + \rho_{s(i)} + \varepsilon_i \tag{1}$$

in which Vaccine$_i$ denotes the binary outcome variable for a child i being vaccinated for $a \in \{1, 2, 3, 4, 5\}$ vaccines on time, that is by the age of three months for vaccine one, four months for vaccine two, five months for vaccine three, six months for vaccine four, and 11.5 months for vaccine five; $T_{j(i)}$ are treatment indicators for Signal at 4, Signal at 5, and the Uninformative Bracelet assigned at the clinic level (j); X_i denotes the control variables of distance to the clinic, clinic population size, the mother's ability to recall the child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey; and $\rho_{s(i)}$ denotes the strata fixed effects. Standard errors are cluster bootstrapped at the clinic level. The timeliness cut-offs were determined following WHO guidelines that state that the DTP series should be completed by six months of age (WHO 2018).[35] I allow for an equal 2.5 months buffer window for each vaccine such that for vaccine one, which is due at birth or shortly thereafter, the timeliness cut-off is set at three months, for vaccine two which is due at 1.5 months, the timeliness cut-off is set at four months, etc. In this context, a buffer is necessary: clinics in Sierra Leone do not offer vaccinations services daily, but instead have weekly or monthly vaccine days (Appendix Table B2).

In my main specification, I code children that received a given number of vaccines before the timeliness cut-off as one and zero otherwise. I consider alternative cut-offs to test the sensitivity of the results to my choice of cut-offs (Appendix Table B13). In the later part of the analysis, I further investigate the effect of signals on complete vaccination by the age of one year, independent of the time at which a child received a vaccine.

[35]There is no strict guidelines for the Measles vaccine, however children are recommended to get it between nine and 12 months of age in LMICs due to high infection risks (Carazo et al. 2020).

In the main analysis, I use a constant sample of 4,897 children who I observe for all vaccine outcomes up to the age of 12 months. Results are robust to including children for whom I only observe part of their vaccine history (Appendix Table B14). The discussion of the empirical results follows the theoretical predictions outlined in Section 3.

6.2 Effect of Signals on Timely Completion of 4 and 5 Vaccines

I find strong evidence that signals increased timely vaccinations when they are linked to a costly action. Panel A of Appendix Table B12 shows the combined effect of Signals at 4 and 5 on the share of children timely vaccinated for all five vaccines over the Control Group. Timely vaccination levels in the Control Group reveal a sharp drop-off between vaccines three and four (11.8 percentage points), and vaccines four and five (17.4 percentage points), illustrating the scope for parents to signal the timely completion of these vaccines. The signaling treatments led to an increase in the share of children vaccinated timely for vaccines four and five from 73.9 to 79.9% and from 56.5 to 63.1%, reducing the drop-off by 51 and 38%, respectively compared to the Control Group. While the differences are only marginally significant at the 10% level, they are economically important.

The effects mask substantial heterogeneity. Panel A of Table 3 shows treatment responses for each signal separately: Signal at 4 led to a small and insignificant increase of 2 percentage points (p=0.59) for four vaccines, and had no impact on the timely completion of five vaccines. Signal at 5, on the other hand, led to a significant and large increase of 10.3 percentage points (p=0.003) on four vaccines, and 13.3 percentage points (p=0.001) on five timely vaccines. A comparison between the Uninformative treatment and the Control Group reveals that the effect of bracelets as a material incentive and reminder is limited: I find small and insignificant treatment effects of the Uninformative Bracelet of 2.1 (p=0.56) and 2.8 (p=0.52) percentage points for vaccines four and five respectively. The effects of Signal at 5 for four and five vaccines remain large and significant (8.2 and 10.5 percentage points with p=0.004 for both) when compared to the Uninformative Bracelet, providing compelling evidence for social signaling preferences.[36] Bracelets as signals of timely completion of five vaccines increased completion of the DTP series by six months of age to levels necessary to reach herd immunity for diphtheria.[37] In the Control Group, this level is only attained at 12 months, meaning Signal at 5 provided treatment communities with six months of herd immunity at the time when children are most at risk of contracting the disease.

The treatment effects on timely completion of five vaccines are explained by two forces: children are more likely to take vaccine five on time and children who would anyways

[36]I report all estimates without controls and find very similar results and significance levels (Appendix Table B15, Panel A).

[37]Herd immunity for diphtheria requires 83 to 85% (Anderson and May 2013) of the population to be vaccinated with all three doses.

come timely for vaccine five, are now more likely to take vaccine four on time.[38] These responses are rational given that the receipt of the green bracelet was conditional on the timely completion of all vaccines up to vaccine number five.

The treatment effects of Signal at 5 on timely vaccinations are robust to using different timeliness cut-offs (Appendix Table B13). When imposing a stricter cut-off of 4.5 and five months for vaccine four, and ten and 11 months for vaccine five, treatment effects of Signal at 5 only change minimally and remain similarly significant compared to all other groups.

Lastly, I investigate whether treatment effects are limited to cohorts who were first exposed to the bracelets. Appendix Figures A7 and A8 plot the time trends of the average treatment effects on timely completion of four and five vaccines and shows that Signal at 5 had consistently large effects. Treatment effects persist for children born more than one year after the start of the experiment, ruling out that novelty effects drive results.

6.3 Effect of Signal at 5 on Timely Completion of Earlier Vaccines

In addition to the treatment effects at five and four vaccines, Signal at 5 also led to significant increases in the share of children that were vaccinated timely for three (7.2 and 4.4 percentage points, p=0.009 and p=0.03) and two (3.3 and 1.6 percentage points, p=0.003 and p=0.07) vaccines compared to the Control Group and Uninformative Bracelet (Panel A of Table 3). The pattern of treatment responses reveals that parents were more likely to vaccinate their children for earlier vaccines, without necessarily making it to five vaccines. That is, parents responded to a signaling benefit at vaccine five (~ option value of signaling) six to nine months in advance, without being able to necessarily realize the benefit. These effects are consistent with the theoretical predictions from the signaling model discussed in Section 3 where individuals make decisions dynamically under uncertainty. More generally, these responses imply that parents aim to complete later vaccines on time, but come late or drop out early due to unforeseen cost shocks.

Column 6 combines the reduced form treatment estimates for all five vaccinations. Signal at 5 significantly increased the average number of vaccines completed timely from 4 to 4.4, over the Control Group and from 4.1 to 4.4 over the Uninformative Bracelet - an increase by 9 and 6% (p=0.001 and p=0.005), respectively.

[38] Appendix Table B16 helps quantify the two effects by displaying treatment effects without conditioning on the timely completion of prior vaccines. Looking at vaccine five, I first observe a large jump in the Control Group mean from 57 to 66%, indicating that a non-negligible proportion of children do not come timely for vaccine four, but come on time for vaccine five. Second, the treatment effect of Signal at 5 on timely take-up of vaccine five explains 66% of the overall effect on timely completion of five vaccines (8.7 over 13.3 percentage points), while the remaining 35% comes from children, who were already completing vaccine five on time, and are now also getting vaccine four on time.

6.4 Extensive Margin Effects of Signals

Signals were tied to timeliness of every vaccine up until vaccine four or five. However, policy makers may be interested in determining whether signals are only effective in improving timely vaccination, or if they also increase the number of completed vaccines over a longer time horizon at 12, 18 and 24 months of age. My sample declines for the later ages, as it only includes children who were surveyed during the follow-up survey.[39]

I observe the same pattern of results in vaccine completion at one year of age as I do for timely vaccination (Panel B of Appendix Table B12 and Table 3), and the effects persist for the completion of later vaccines at two years of age (Table 4). Almost all children in the Control Group receive the first three vaccines by 12 months of age, with levels of completion at 99.3, 98.4 and 95.9%. However, there is still a substantial drop-off at vaccines four and five, with 91.7 and 68.6% of children completing those by one year of age. Signal at 5 not only led to intertemporal shifts, encouraging parents to vaccinate their children more timely, but also resulted in increases on the extensive margin, with more children being vaccinated by the age of one: shares increase by 3.5 and 9.4 percentage points for four and five vaccines, respectively, compared to the Control Group (p=0.04 and p=0.005), and 2.7 and 6.5 percentage points, respectively, compared to the Uninformative treatment (p=0.08 and p=0.03). Signal at 5 increases the total number of vaccines received to 4.7, from an average of 4.5 and 4.6 in the Control Group (p=0.005) and Uninformative treatment (p=0.04), respectively.[40] The treatment effects on vaccine five remain large and statistically significant at 18 months at 6.1 percentage points (p=0.05) and marginally significant at 24 months at 5.1 percentage points (p=0.09). For vaccine four, effects remain marginally significant at 24 months at 2.3 percentage points (p=0.08). Effect sizes are also large when compared to the Uninformative treatment (3 to 5 percentage points), but I am only powered to detect such differences for vaccine four. Of substantive policy importance, bracelets as signals raised vaccination rates for four vaccines (i.e., the DPT series) to the herd immunity level for whooping cough five and eight months earlier than in the Control Group and Uninformative treatment, respectively.Herd immunity against whooping cough requires 92 to 94% of children to be vaccinated (Anderson and May 2013).

[39]The effects at 12 months show that the sub-sample is comparable to the full sample. Control levels for vaccine four and five are slightly higher in this sub-sample due to attrition of children who had moved or died during the follow-up survey (balanced across arms), which resulted in a positive selection of children with better vaccination outcomes.

[40]I report all estimates without controls and find very similar coefficients and significance levels (Appendix Table B15, Panel B).

6.5 Optimal Placement of Signals

The strong treatment effects of Signal at 5, compared to Signal at 4, suggest that individuals place a higher value on signaling having completed all five vaccines in a timely manner. According to the theory, this difference in valuation could be due to differences either in (i) type expectations $\Delta(\hat{v}_r)$ or (ii) the social desirability of actions ω_r. In terms of (i), Signal at 5 is a more informative signal about being a "caring" parent as it requires the timely completion of one additional vaccine—which only 57% of parents achieve, compared to Signal at 4—which 74% achieve. On the other hand, Signal at 4 is a more informative signal about being a "negligent" parent, as fewer children fail to complete the first four vaccines on time (26% compared to 43% for the fifth vaccine). Yet, because the yellow bracelet is a more difficult signal to interpret, these negative inferences and the potential social stigma do not materialize. Instead, individuals in both signaling treatments primarily learn about other parents' actions from the green bracelets. While parents have to exert greater effort to obtain the green bracelet in Signal at 5, it renders it a stronger signal about parents' motivation to look after their children's health. This, combined with the fact that parents make decisions dynamically, i.e. they respond to the option value of signaling, makes Signal at 5 a more effective signal in changing behavior for earlier and later vaccinations, including vaccine four. The survey data further supports this interpretation. Children in Signal at 5 are 10.4 percentage points less likely to have lost their bracelet, compared to children in Signal at 4 (p=0.002, see column 3 Appendix Table B17). [41] Second, parents assign a higher importance to vaccine five than vaccine four (Table 5). To capture differences in social desirability, I asked mothers at endline what they considered to be the most (and second most) important vaccine. Mothers consider the fourth vaccine overall to be the least important among the five and rank vaccine five as the second most important vaccine after vaccine one. These preferences, taken at face value, suggest that parents see it as more socially desirable to be perceived as someone who took their child for an "important" vaccine than a vaccine of low value to the child's health. These differences in social desirability likely amplify (attenuate) the value parents assign to Signal at 5 (Signal at 4).

This raises the question: how informative is Signal at 4 about a child having received vaccine five? Put differently, if Signal at 4 is as informative about the completion of vaccine five, as is Signal at 5 then we would expect to see similar treatment effects for both. Signal at 4 does not carry precise information about the completion of vaccine five since 17% of children come timely for the fourth vaccine but not the fifth, and 10% of

[41] This result is not driven by the fact that more time would have passed since a child received the green bracelet in Signal at 4 compared to Signal at 5. I find that children 3.5 to 6.5 months old, age at which they would have most recently received their signaling bracelet in Signal at 4, are 27% more likely to have lost their bracelet compared to children in Signal at 5 (column 4, p<0.01). When children are nine to 12 months old, the gap in the share of children who lost their bracelet in Signal at 5 compared to Signal at 4 widens to 18.2 percentage points (p=0.007)

children come timely for the fifth vaccine but not the fourth. Table 2 shows that Signal at 4 has positive but insignificant impacts on parents' knowledge of other children's receipt of vaccine five (columns 4 to 6) and on their beliefs about others' knowledge of their own children's vaccine status (column 8), compared to the Uninformative Bracelet. Compared to Signal at 5, coefficients are a third to half the size with p-values between 0.01 and 0.29. This makes clear that Signal at 4 did not act as a signal for the completion of vaccine five. I interpret these results as evidence that attaching a signal to a more costly action can be more effective at influencing behavior.

7 Alternative Mechanisms

The experimental design does not account for two potential ways in which Signal at 5 could have affected behavior: first, vaccine-specific reminders, and second, social learning about the benefits and costs of vaccinations and the social norms surrounding vaccines.

It is difficult to separate the effects of vaccine-specific reminders from the effects of signaling, as actions become publicly visible.[42] The results of my experiment, however, do not suggest that the bracelets in the Signal at 5 treatment act as a reminder for vaccine five. If this were the case, I would expect to see similar treatment effects for Signal at 4 on vaccine four. Furthermore, I would not expect to observe increases in timely vaccinations for vaccines two, three, and four in Signal at 5.

Signal at 5 may have led to changes in the perceived benefits and costs of specific vaccines through social learning. For example, seeing health workers distribute green bracelets may have caused some parents to perceive vaccine five as more important. The data do not support this explanation. I find no significant differences in individuals' preferences for different vaccines between the control and treatment groups (Table 5), indicating that the observed treatment effects are not due to parents learning about the importance of vaccine five. Additionally, vaccine-specific learning would not explain the treatment effects on earlier vaccines.

I find some evidence that mothers in Signal at 5 held more positive views about the benefits and harms of vaccines. While a majority of respondents in the Control Group (88.7%) view vaccines as beneficial for their child's health, mothers in Signal at 5 were 6.3 percentage points more likely (p=0.02) to say that vaccines are helpful, rather than helpful and harmful for their child's health, compared to all other groups (see column 1 in Appendix Table B9). This shift in perceptions may be due to mothers who had a negative experience being more likely to return for the fifth vaccine due to the Signal at

[42] To control for these reminder effects, it would have been necessary to provide an additional treatment in the form of a private reminder for vaccine five. This was logistically not feasible (see the low phone ownership in Appendix Table B1). Karing et al. (2021) found that, even in the presence of SMS reminders, treatment effects from signaling persisted.

5 treatment, and therefore basing their view on a more positive set of experiences.[43]

Finally, the signals may have changed perceptions of the social norm for vaccine uptake by altering beliefs about the proportion of children who are vaccinated for a given vaccine. To test this hypothesis, I asked endline respondents how many children out of ten (where ten is a random sample of children) in their community had completed a given vaccine at age one year. I find that Control Group respondents on average underestimate the percentage of children who completed vaccines (Appendix Table B18). Respondents in both Signals at 4 and 5 believe that the share of children completing vaccines two, three, four, and five was higher, by 4 to 5 percentage points, respectively. These increases are only marginally significant or insignificant when compared to the Control Group, and insignificant when compared to the Uninformative Bracelet. Importantly, the magnitude of these effects is small and, given that the learning effects are very similar for Signal at 4 and Signal at 5, it is very unlikely that these changes in perceptions drive the main effects observed.

8 Quantifying The Private Value of Social Signaling

To quantify the value of social signaling while accounting for i) the dynamic nature of decision-making, in which parents respond to the option value of social signaling, and ii) the effects of type selection at later vaccines, I formally estimate a dynamic discrete-choice model. I use distance to the clinic as a numeraire to price out the value of social signaling. To do this, in this section, I first demonstrate the reduced-form relationship between distance and its impact as a cost on vaccination outcomes. Next, I set up the dynamic model and estimate the relevant parameters.

8.1 Reduced Form Estimates

Appendix Figure A9 plots a bin scatter of the average number of timely vaccines completed against the travel distance from communities to clinics, separately for the Control Group and Signal at 5. Distance has a linear effect on the number of vaccinations completed: in the Control Group, the total number of timely vaccines completed declines from 4.4 at zero miles to 3.6 vaccines at five miles. Figure 5 shows the effect of distance on the share of timely vaccinated children by vaccine. Each vaccine graph plots a bin scatter of the share of children timely vaccinated (for vaccines 2, 3, 4, and 5) against the distance from communities to clinics, separately for the Control Group and Signal at 5. It is evident again that distance has a linear effect on the share of children vaccinated for each vaccine. Importantly, both figures make it clear that Signal at 5 mitigated the negative effect of distance, increasing the share of children vaccinated at four miles to

[43] The DTP (fourth) vaccine causes fever more frequently than the Measles (fifth) vaccine.

that of children vaccinated at zero miles. In other words, the reduced form results show that Signal at 5 increased parents' willingness to walk for a given vaccine by four miles distance to the clinics.

It is important to note that distance was not exogenously varied in this experiment, so we should be concerned about the effect of distance on vaccination behavior being confounded by other observable or unobservable characteristics. While I cannot account for the latter, Appendix Tables B19 and B20 show that the inclusion of relevant observable characteristics, such as mothers' education, economic status, or the birth order of children, does not have a significant effect on the impact of distance on vaccinations in the endline sample.

8.2 Structural Model Estimation of Social Signaling Utility

Following the discussion of the model of signaling under uncertainty in Section 3.2, I empirically specify the flow utility of timely vaccination at time $t \in \{1, 2, 3, 4, 5\}$ as follows:

$$u_{it} = v_i - \kappa D_i - \eta_t + S_4 T_{4i} \mathbb{1}\{t = 4\} + S_5 T_{5i} \mathbb{1}\{t = 5\} + \epsilon_{it}. \quad (2)$$

The model includes two dimensions of unobservable heterogeneity: (i) ϵ_{it} cost or taste shocks which are independent and identically distributed following the logistic distribution, and (ii) individuals differ in their type v, which is assumed to be randomly drawn from a normal distribution in period zero and is persistent across time t. The mean μ_v and variance σ_v of the type distribution is identified in the structural estimation as I observe individuals making decisions across multiple periods. Further, the model includes two dimensions of observable heterogeneity: (i) individuals' travel distance D_i which discretely varies from zero to five miles and (ii) the signaling treatments T_{4i} and T_{5i} which are exogenously assigned. The parameter κ captures the marginal disutility of one additional mile distance to the clinic. The parameters S_4 and S_5 capture the social signaling utility $\lambda \omega_r \Delta(\hat{v}_r)$ and η_t denotes the disutility of a vaccine in period t. I set η_t such that the relative size of η_t and $\eta_{t'}$, $t' \neq t$, is proportional to the relative self-reported importance that individuals assign to different vaccines (shown in Table 5), that is $\eta_t = \alpha \mathbb{1}(t = 2) - 3\alpha \mathbb{1}(t = 3) - 4\alpha \mathbb{1}(t = 4) - \alpha \mathbb{1}(t = 5)$.

The reduced form effects of the Signal at 5 treatment on earlier vaccines operate solely through an option value. The implied valuation must be filtered through individuals' expectations about the probability that they will receive the signaling payoff by making it timely for all vaccines. At $t = 5$, there is no option value component left and the problem becomes a static one that can be solved through backward recursion. However, the valuation is that of a non-random subset of individuals, rather than the type population as a whole. To compute the signaling valuation from the reduced form, it is necessary to link together all the choice probabilities and treatment effects, while accounting for the change in the type population at each t. The structural framework allows me to do this, and I estimate the model using maximum likelihood.

Table 6 presents the results from the structural estimation, with column 1 showing the parameters from an estimation where I compare the shares of children vaccinated timely in Signal at 5 and Signal at 4 to those in the Control Group, and column 2 showing the parameter estimates comparing both signaling treatments to the Uninformative Bracelet. Taking the ratio of the parameters S_5 and κ gives an estimate of the social signaling utility in miles. On average, parents' valuation of social signaling is equivalent to 6 to 7 miles walking distance to the clinic. In other words, at the mean walking distance of 2 miles to a clinic, the opportunity to signal the timely completion of all vaccines increases parents' willingness to take their child for three additional vaccinations.

9 Conclusion

A growing literature shows that social image concerns play an important role in a variety of economic settings (Becker 2022; Karlan and McConnell 2014; Friedrichsen et al. 2018). This paper demonstrates the potential for social signaling incentives to affect behavior in a policy relevant setting, specifically in the domain of childhood vaccination, and shows how governments can effectively design these incentives.

My analysis yields three important takeaways. First, it shows that individuals are willing to take meaningful actions to signal that they are good parents. They are 9 percentage points more likely to complete all routine immunizations by the time their child reaches one year of age. This suggests that social signaling incentives can act as an informal enforcement mechanism to increase contributions to public goods. Second, I introduced variation in the actions that parents can signal and show that the placement of signals can lead to large differences in behavior. My results indicate that signals are more effective when placed on a costlier action that is highly informative about individuals' intrinsic motivation. This finding is relevant to the design of signaling incentives for other preventive or curative health behaviors that require multiple visits (e.g., prenatal care check-ups). By conditioning the signal on the timely completion of all vaccines up to the one signaled, I show that the opportunity to stand out motivates parents to exert greater effort even when the associated signaling benefits occur far in the future. My findings further suggest that individuals learn more from positive than negative signals, similar to the findings from Karing et al. (2021). Future research should investigate further to what extent the impacts of signaling incentives are driven by social reward or stigma concerns, as this has important implications for the social welfare consequences of these types of incentives (Butera et al. 2022). Third, I show that parents' responses to signals are consistent with decision-making under uncertainty. Parents respond to the option value of signaling by timely vaccinating their children for earlier vaccines, without necessarily making it timely to the final vaccine and capturing the benefit. It is a question for future research whether a non-linear incentive scheme, where a signaling benefit is only provided at completion of all vaccines is the best design, or if a more linear scheme with signals at multiple points would result in further reductions in drop-off. On the one hand, signaling benefits might be smaller if there is less scope for parents to distinguish themselves from others; on the other hand, if the variance of cost shocks is large, even a smaller signaling benefit at each vaccine could compensate parents for unexpected cost shocks.

Overall, the findings of this study have important implications for public policy. Signals increased immunization rates to levels necessary for herd immunity at a cost of less than USD 1 per child, and I find suggestive evidence that their effects persist when children reach 24 months of age. This demonstrates that a subtle behavioral intervention can address a problem pertinent to many low-income countries: scarcity of trained health workers and therefore a need for low-cost interventions that increase demand for health services at clinics.

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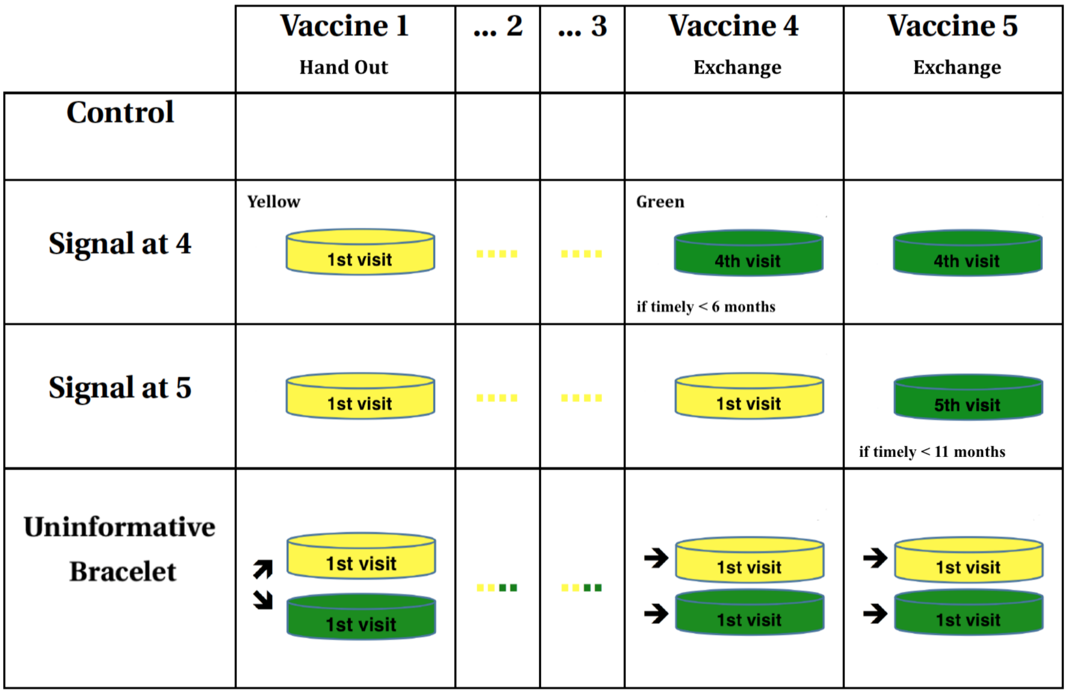

Figure 1: Experimental Treatment Groups

Notes: This figure displays the four different experimental groups and the bracelet hand out and exchanges that take place at each of the five vaccinations.

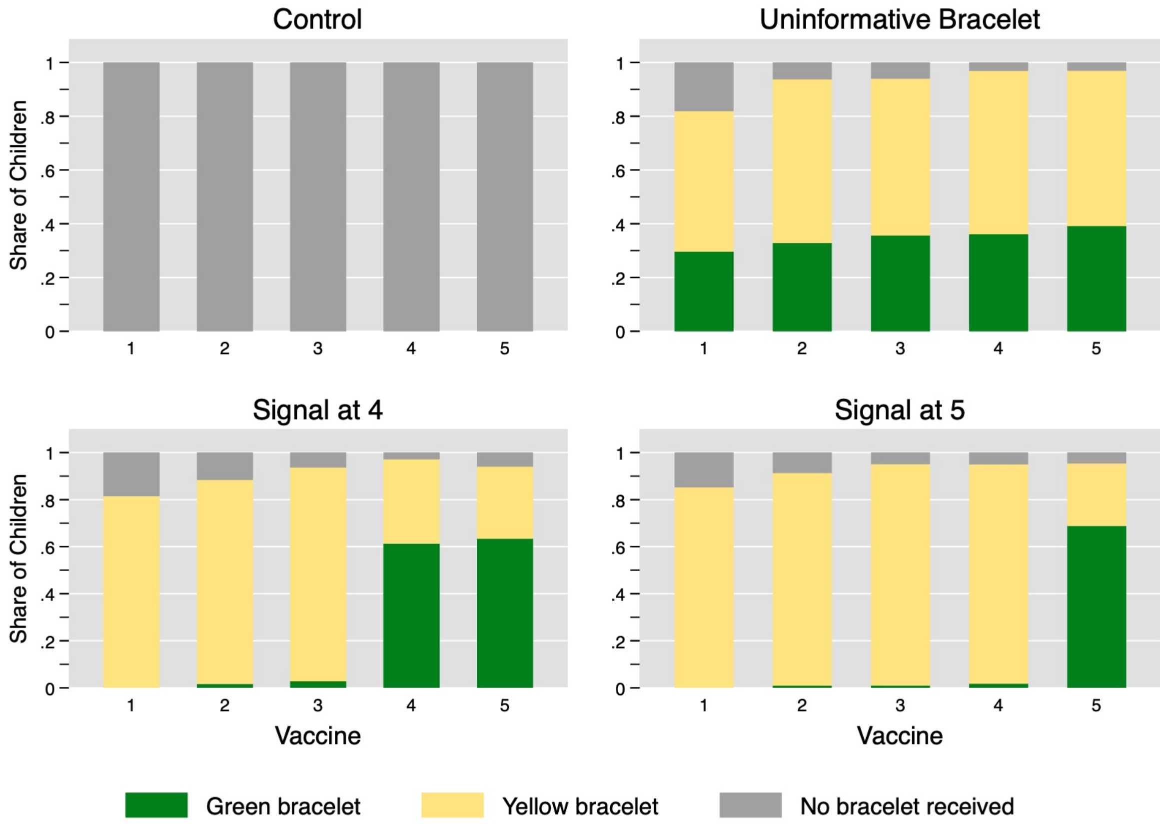

Figure 2: Correct Hand Out of Bracelets by Treatment Groups

Notes: This figure displays the share of children with a green, yellow, or no bracelet conditional on the number of vaccines a child has received, separately for each experimental group. The sample includes 7,066 children (Control $N = 1,669$, Uninformative $N = 1,607$, Signal at 4 $N = 2,008$, Signal at 5 $N = 1,782$) that were born during the experiment, surveyed during the listing, and had received at least one vaccine. Surveyors asked each parent the color of bracelet they received upon vaccination, and recorded all vaccines the child had received up to that point.

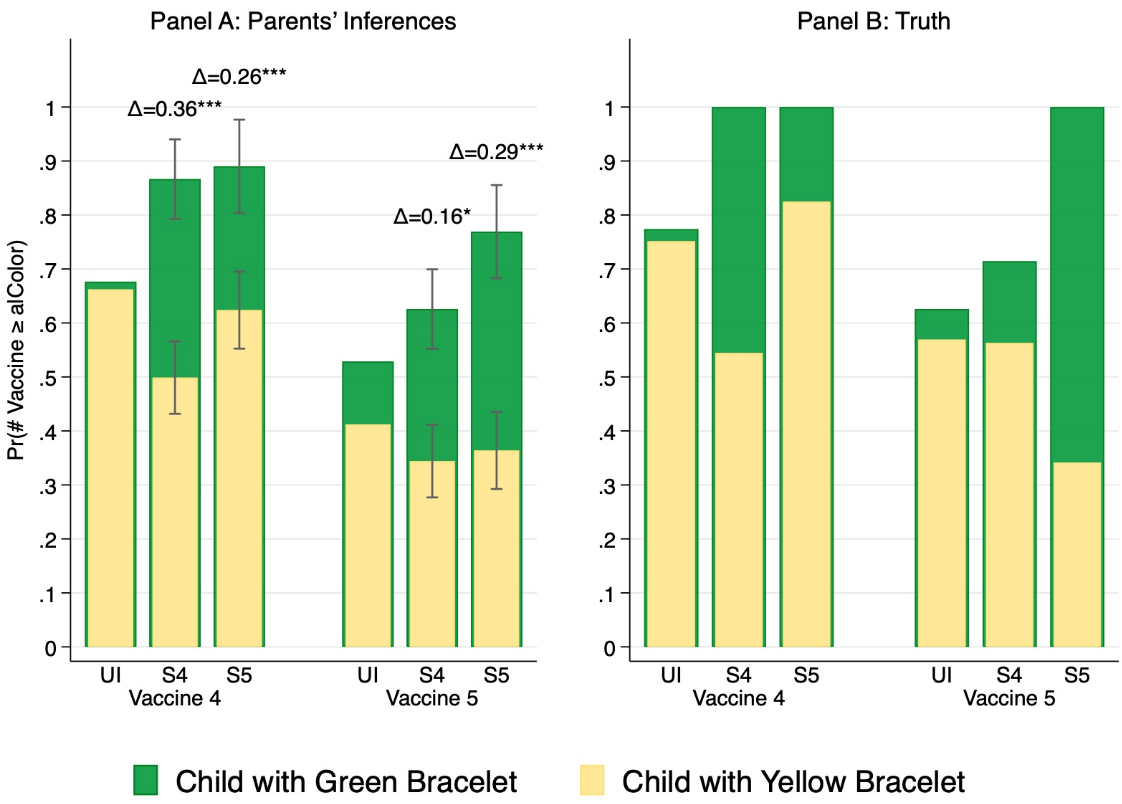

Figure 3: Parents' Inferences about other Children's Vaccinations From Bracelet Colors

Notes: This figure shows endline respondents' beliefs about the number of vaccinations a child received conditional on the color of bracelet. Beliefs are shown by vaccine, and by treatment, where UI = Uninformative Bracelet, S4 = Signal at 4, S5 = Signal at 5. The yellow and green bars show the conditional probability of a child having received (at least) 4 or 5 vaccines conditional on the respondent observing the child having a yellow or green bracelet. Δ denotes the difference between the two conditional probabilities. The samples used for each vaccine include all children age 3.5 to 9 months for vaccine four ($N = 1,866$), and 9 to 12 months for vaccine five (Vaccine 5 $N = 1,147$). The confidence intervals (at 95 percent) for Signal at 4 and Signal at 5, on the green and yellow bars respectively, are shown for the difference in beliefs in the signaling treatments compared to those in the Uninformative Bracelet. Estimating the probabilities in a regression framework, I control for the mean take-up level of Vaccine 4 or 5 at the clinic, a child's age and birth order, mother's age, level of education, primary economic activity, and her relationship to the other mother. All controls are demeaned. All regressions include strata fixed effects. Standard errors are clustered at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

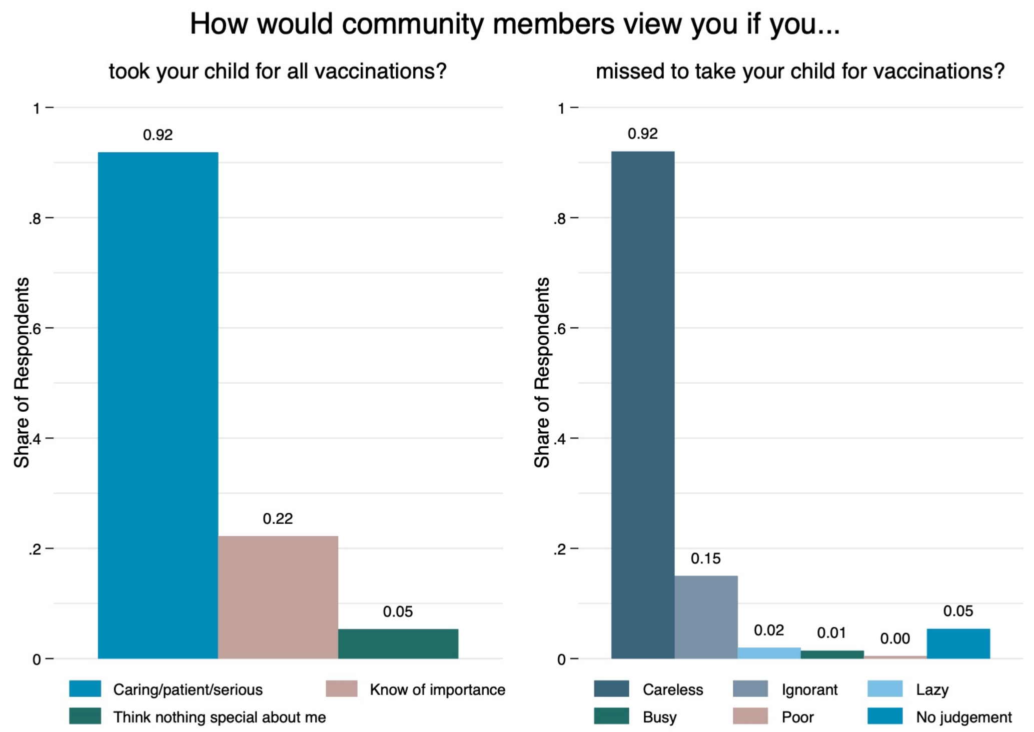

Figure 4: Reputational Costs and Benefits

Notes: This figure shows mothers' beliefs about the inferences that community members would make, conditional on observing that they took their child for all vaccinations or missed any. The sample includes all endline survey respondents (N=1,314). There are no significant differences across experimental groups as shown in Tables B10 and B11.

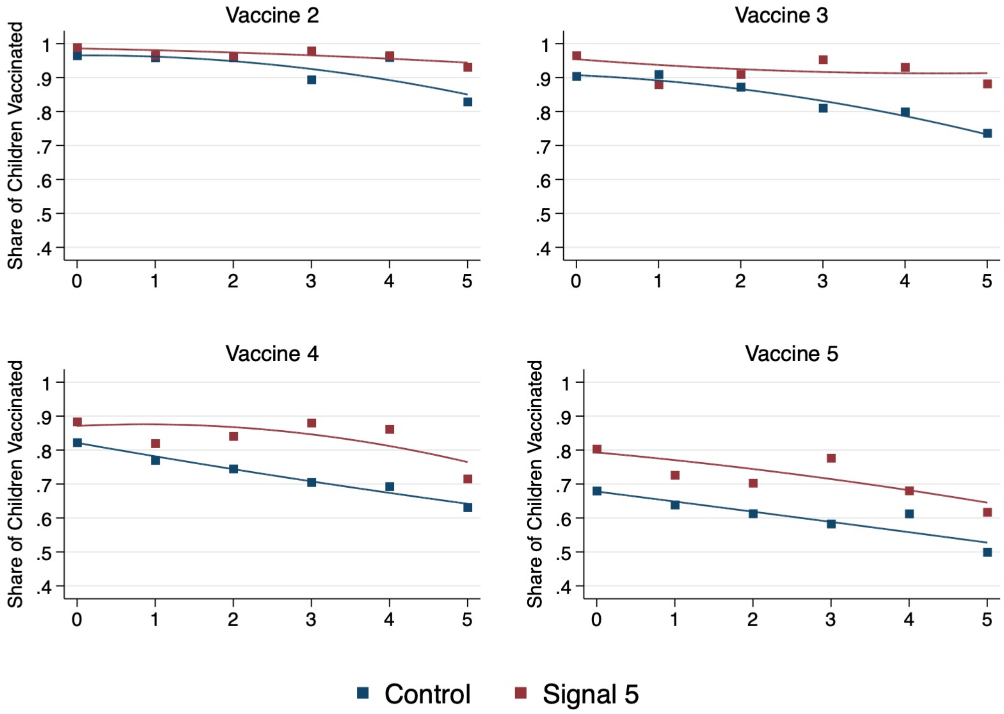

Figure 5: The Effect of Distance to the Clinic on Timely Vaccination

Notes: The graph shows the effect of distance on the share of timely vaccinated children by the number of vaccinations, using the main analysis sample ($N = 2,378$). Each vaccine graph plots a bin scatter of the share of children vaccinated against the distance from communities to clinics, separately for the Control Group and Signal at 5.

Table 1: The Visibility of Bracelets by Treatment Group

Dependent variable:	**Know if other child has a bracelet** (1)	**Know other child's bracelet color** (2)	**Others know if own child has a yellow or green bracelet** (3)	**Correct knowledge: other child has a bracelet** (4)	**Correct knowledge: other child's bracelet color** (5)
Signal at 4	0.035*	0.106***	0.051	0.054*	0.122***
	(0.020)	(0.022)	(0.038)	(0.032)	(0.047)
Signal at 5	0.011	0.082***	0.066	0.058	0.151***
	(0.020)	(0.024)	(0.040)	(0.037)	(0.056)
Uninformative Bracelet Group mean	0.896	0.802	0.755	0.832	0.496
Observations	3145	3145	2872	1170	1170
p(S4 = S5)	0.230	0.298	0.675	0.909	0.645
Controls	Yes	Yes	Yes	Yes	Yes

Notes: This table shows endline respondents' first- and second-order beliefs about the visibility of bracelets (columns 1-3), and how correct their knowledge is (columns 4-5). The unit of observation is a respondent-other mother pair. Know if other child has bracelet is a dummy variable that equals one if the respondent answered "Yes" or "No" and zero if she answered "Don't know". Know other child's bracelet color equals one if the respondent answered "Yellow" or "Green" and zero if she answered "Don't know". Others know if own child has a green or yellow bracelet is a dummy variable that equals one if the respondent answered "Yes" and zero if she answered "No" or "Don't know". All regressions include strata-fixed effects and demeaned control variables for the mother and child. For the mother, we control for the her age, the level of her education, whether her primary economic activity is farming, and her relationship to the other mother respondent. For the child, we control for the birth order and the age of the child. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: The Effects of Signals on Vaccine Knowledge and Second-Order Beliefs by Bracelet Color

Dependent variable:	**Number of vaccines of other children**						**Others know number of vaccines of own child**	
	Correct	**Underestimate**	**Overestimate**	**Correct**	**Underestimate**	**Overestimate**		
Vaccine take-up period	3.5-9 months			9-12 months			3.5-9 months	9-12 months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Signal at 4	0.094*	-0.099**	0.004	0.078	-0.069	-0.009	-0.034	0.118
	(0.057)	(0.041)	(0.043)	(0.068)	(0.062)	(0.046)	(0.067)	(0.078)
Signal at 5	-0.040	-0.146***	0.185*	0.171**	-0.207***	0.037	0.155	0.230**
	(0.099)	(0.055)	(0.099)	(0.074)	(0.059)	(0.048)	(0.145)	(0.091)
Signal at 4 × Yellow Bracelet=1	-0.154**	0.160***	-0.006	-0.057	0.106	-0.050	0.158*	-0.093
	(0.066)	(0.062)	(0.046)	(0.089)	(0.086)	(0.057)	(0.095)	(0.106)
Signal at 5 × Yellow Bracelet=1	0.055	0.134*	-0.189*	-0.180*	0.215***	-0.035	-0.156	-0.198*
	(0.096)	(0.069)	(0.101)	(0.099)	(0.082)	(0.058)	(0.147)	(0.107)
Yellow Bracelet=1	0.040	0.006	-0.046	0.044	0.033	-0.077*	-0.094	0.076
	(0.046)	(0.048)	(0.037)	(0.058)	(0.057)	(0.041)	(0.074)	(0.063)
Mean Uninformative Bracelet	0.526	0.250	0.224	0.455	0.310	0.235	0.619	0.474
Observations	1623	1623	1623	1004	1004	1004	1968	1196
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
p(S4 Green = S5 Green)	0.145	0.325	0.055	0.184	0.012	0.293	0.161	0.194
p(S4 Yellow = S5 Yellow)	0.136	0.083	0.941	0.701	0.691	0.213	0.042	0.942
p(UI Yellow = S4 Yellow)	0.279	0.213	0.975	0.769	0.626	0.227	0.083	0.778
p(UI Yellow = S5 Yellow)	0.758	0.785	0.912	0.887	0.899	0.965	0.990	0.673

Notes: The table shows endline respondents' knowledge about other children's vaccinations and second-order beliefs about a mother's own child's vaccinations, conditional on bracelet color. The unit of observation is a respondent-other mother pair. Columns (1)-(6) show regression results of a binary variable for correct knowledge of the number of vaccinations another child has received on treatment indicators for Signal at 4, Signal at 5, with the Uninformative Bracelet as excluded category. The outcome in each column is coded one if respondents correctly guessed, under-, or over-guessed the number of vaccines the other child has. The Signal at 4 and 5 treatment indicators are interacted with the respondents' belief about the bracelet color the other child has, with the excluded category being green. Columns (7) and (8) show regression results of a binary variable for respondent's belief about another mother's knowledge of their child's number of vaccinations. The outcome variable is coded one if a respondent answered "Yes", zero otherwise. I exclude from this analysis mothers who either did not think the child had a bracelet, or could not remember if they did, or its color (N=545). I run the same analysis with the full sample find that the results do not change. The bottom rows give the p-values from a test that the effect of the green and yellow bracelets in Signal at 4 are equivalent to those in Signal at 5, and that the yellow bracelet in the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or Signal at 5 (S5). All regressions include strata-fixed effects and demeaned control variables for the mother and child. For the mother, we control for the her age, the level of her education, whether her primary economic activity is farming, and her relationship to the other mother respondent. For the child, we control for the birth order and the age of the child. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: The Effects of Signals on Timely and Complete Vaccination, Separated by Treatment

Dependent variable:	1 Vaccine	2 Vaccines	3 Vaccines	4 Vaccines	5 Vaccines	Total # of vaccines
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4	-0.005	0.007	0.009	0.020	0.004	0.034
	(0.009)	(0.014)	(0.025)	(0.037)	(0.041)	(0.114)
Signal at 5	0.008	0.033^{***}	0.072^{***}	0.103^{***}	0.133^{***}	0.351^{***}
	(0.007)	(0.013)	(0.024)	(0.035)	(0.041)	(0.107)
Uninformative Bracelet	0.008	0.017	0.028	0.021	0.028	0.100
	(0.007)	(0.012)	(0.024)	(0.036)	(0.043)	(0.108)
Distance	-0.003^{**}	-0.009^{***}	-0.017^{***}	-0.027^{***}	-0.030^{***}	-0.086^{***}
	(0.001)	(0.003)	(0.003)	(0.004)	(0.005)	(0.014)
Control Group mean	0.979	0.940	0.858	0.740	0.567	4.042
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.097	0.383	0.374	0.989	0.487	0.481
$S_5 > 0$: p(UI = S5)	0.981	0.070	0.030	0.004	0.004	0.005
p(S4 = S5)	0.075	0.008	0.001	0.004	0.000	0.000
Joint F-Test	0.220	0.009	0.003	0.002	0.000	0.000
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4	0.002	0.009^{**}	0.013	0.019	0.033	0.075
	(0.003)	(0.004)	(0.009)	(0.017)	(0.033)	(0.057)
Signal at 5	0.002	0.009^{**}	0.019^{**}	0.035^{**}	0.094^{***}	0.159^{***}
	(0.003)	(0.004)	(0.008)	(0.016)	(0.033)	(0.057)
Uninformative Bracelet	0.003	0.010^{***}	0.011	0.008	0.029	0.061
	(0.003)	(0.004)	(0.008)	(0.017)	(0.035)	(0.059)
Distance	0.000	-0.000	-0.002^{**}	-0.008^{***}	-0.015^{***}	-0.025^{***}
	(0.000)	(0.001)	(0.001)	(0.002)	(0.004)	(0.006)
Control Group mean	0.993	0.984	0.959	0.917	0.687	4.541
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.499	0.804	0.807	0.445	0.890	0.754
$S_5 > 0$: p(UI = S5)	0.547	0.950	0.225	0.075	0.031	0.039
p(S4 = S5)	0.971	0.863	0.328	0.172	0.017	0.033
Joint F-Test	0.575	0.055	0.132	0.132	0.016	0.019
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) through (5) of this table, shows results from a linear probability model of the binary outcome variable for a child being vaccinated for 1, 2, 3, 4, or 5 vaccinations on treatment indicators for Signal at 4, Signal at 5 and Uninformative Bracelet, with the Control Group as the excluded category. Column (6) shows the results for the total number of vaccines a child has received. Panel A shows the results for timely vaccination by the age of 3, 4, 5, 6 and 11.5 months, respectively. For a child to be coded as timely for a given number of vaccines, they need to have been timely for all those vaccines. Panel B shows the results for vaccination by the age of 12 months, simply counting the total number of vaccines a child has received. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), identifying social signaling preferences, and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned controls for distance to the clinic, clinic population size, the mother's ability to recall the child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: The Effects of Signals on Complete Vaccination by 12, 18, and 24 months

Dependent variable:		**4 Vaccines**			**5 Vaccines**	
	by 12 months	by 18 months	by 24 months	by 12 months	by 18 months	by 24 months
	(1)	(2)	(3)	(4)	(5)	(6)
Signal at 4	0.012	0.013	0.017	0.024	0.028	0.034
	(0.018)	(0.014)	(0.014)	(0.039)	(0.032)	(0.032)
Signal at 5	0.028*	0.021	0.023*	0.085**	0.061**	0.051*
	(0.017)	(0.014)	(0.013)	(0.040)	(0.031)	(0.030)
Uninformative Bracelet	-0.009	-0.003	-0.004	0.010	0.013	0.021
	(0.020)	(0.016)	(0.015)	(0.042)	(0.034)	(0.031)
Control Group mean	0.936	0.951	0.952	0.736	0.828	0.848
Observations	3040	3040	3040	3040	3040	3040
$S_4 > 0$: p(UI = S4)	0.275	0.285	0.123	0.686	0.640	0.653
$S_5 > 0$: p(UI = S5)	0.042	0.094	0.047	0.036	0.135	0.303
p(S4 = S5)	0.214	0.404	0.517	0.038	0.208	0.532
Joint F-Test	0.156	0.277	0.147	0.061	0.202	0.402
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows results from a linear probability model with binary outcome variables for a child being vaccinated for 4 or 5 vaccines by 12, 18, or 24 months on a treatment indicator for Signal at 4, Signal at 5 and Uninformative Bracelet with the omitted category being the Control Group. Each vaccine outcome is coded to one if a child completed 4 or 5 vaccines, by ages 12, 18, or 24 months, and zero otherwise. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. All regressions include the distance from the community to the clinic, the clinic population size, and the mother's ability to recall the child's last vaccine. Regressions include strata-fixed effects and standard errors are clustered at the clinic-level. Standard errors are bootstrapped 1000 times. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: The Effect of Signals on Preferences for Different Vaccinations

Dependent variable:	**Vaccine 1**	**Vaccine 2**	**Vaccine 3**	**Vaccine 4**	**Vaccine 5**	**All vaccines**
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Most Important Vaccine					
Signal at 4	-0.024	-0.013	0.006	-0.015	0.012	0.042
	(0.050)	(0.010)	(0.004)	(0.011)	(0.026)	(0.050)
Signal at 5	-0.022	-0.007	0.003	-0.019*	0.011	0.039
	(0.055)	(0.013)	(0.004)	(0.011)	(0.031)	(0.045)
Uninformative Bracelet	-0.019	0.001	0.010*	-0.008	-0.013	0.038
	(0.048)	(0.012)	(0.006)	(0.013)	(0.024)	(0.044)
Control Group mean	0.687	0.024	-0.000	0.024	0.108	0.146
Observations	1314	1314	1314	1314	1314	1314
S_4 > 0: p(UI = S4)	0.907	0.170	0.596	0.521	0.259	0.921
S_5 > 0: p(UI = S5)	0.956	0.525	0.328	0.264	0.370	0.977
p(S4 = S5)	0.965	0.642	0.604	0.596	0.957	0.947
Joint F-Test	0.964	0.441	0.160	0.313	0.658	0.760
Panel B:	Second Most Important Vaccine					
Signal at 4	-0.025	0.032	-0.003	0.032	-0.024	-0.006
	(0.026)	(0.060)	(0.032)	(0.029)	(0.051)	(0.019)
Signal at 5	0.024	0.091	-0.031	0.003	-0.066	-0.007
	(0.036)	(0.057)	(0.028)	(0.026)	(0.048)	(0.019)
Uninformative Bracelet	-0.010	0.025	-0.027	0.025	0.013	-0.016
	(0.024)	(0.056)	(0.027)	(0.029)	(0.047)	(0.017)
Control Group mean	0.098	0.378	0.107	0.057	0.315	0.032
Observations	1075	1075	1075	1075	1075	1075
S_4 > 0: p(UI = S4)	0.480	0.898	0.402	0.796	0.439	0.495
S_5 > 0: p(UI = S5)	0.296	0.202	0.891	0.360	0.086	0.511
p(S4 = S5)	0.140	0.274	0.342	0.232	0.358	0.944
Joint F-Test	0.471	0.383	0.576	0.536	0.345	0.776

Notes: This table shows results from a linear probability model of the binary outcome variables for vaccine 1, 2, 3, 4 or 5, or all vaccines being considered as most (Panel A) and second most (Panel B) important vaccine on treatment indicators for Signal at 4, Signal at 5 and Uninformative Bracelet, with the Control Group as excluded category. The sample includes all endline survey respondents (N=1,314). For all columns, the bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or to Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to the Signal at 5. Last is the joint hypothesis test of all three bracelet treatments. Regressions include strata-fixed effects. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Structural Estimation Results Dynamic Discrete-Choice Model

Parameter:	**Estimate**	**SE**	**Estimate**	**SE**
	Compared to Control Group		Compared to Uninformative Bracelet	
	(1)	(2)	(3)	(4)
S_5	0.642	0.098	0.498	0.098
S_4	–0.027	0.111	–0.196	0.113
κ	–0.09	0.012	–0.085	0.012
μ_v	1.801	0.078	1.893	0.081
σ_v	–0.49	0.067	–0.475	0.068
α	–0.259	0.028	–0.265	0.029
Signaling utility $\frac{S_5}{\kappa}$	**7.13 miles**		**5.86 miles**	

Notes: This table shows the parameters estimated from the dynamic-discrete choice model. S_5 and S_4 denote the parameters capturing the signaling utility of treatments Signal at 5 and Signal at 4, κ denotes the parameter measuring the marginal disutility of walking one mile, μ_v and σ_v capture the mean and standard deviation of the normal type distribution. The sample used for the estimation is the main analysis sample. Regular standard errors are reported (not clustered). Columns (1) and (2) report parameter estimates, with the effect of Signals at 4 and 5 being compared to the Control Group and Columns (3) and (4) from the comparison to the Uninformative Bracelet.

A Online Only Supplementary Figures

Figure A1: Different Bracelets handed out across Three Signaling Treatments

Notes: The image displays the bracelets that health workers give out at clinics: the yellow "1st visit" bracelet is used in Signal at 4, Signal at 5 and the Uninformative Bracelet; the green "1st visit" bracelet is given to children in the Uninformative treatment; the green "4th visit" bracelet is given to children in the Signal at 4 and the green "5th visit" bracelet to children in the Signal at 5 treatment.

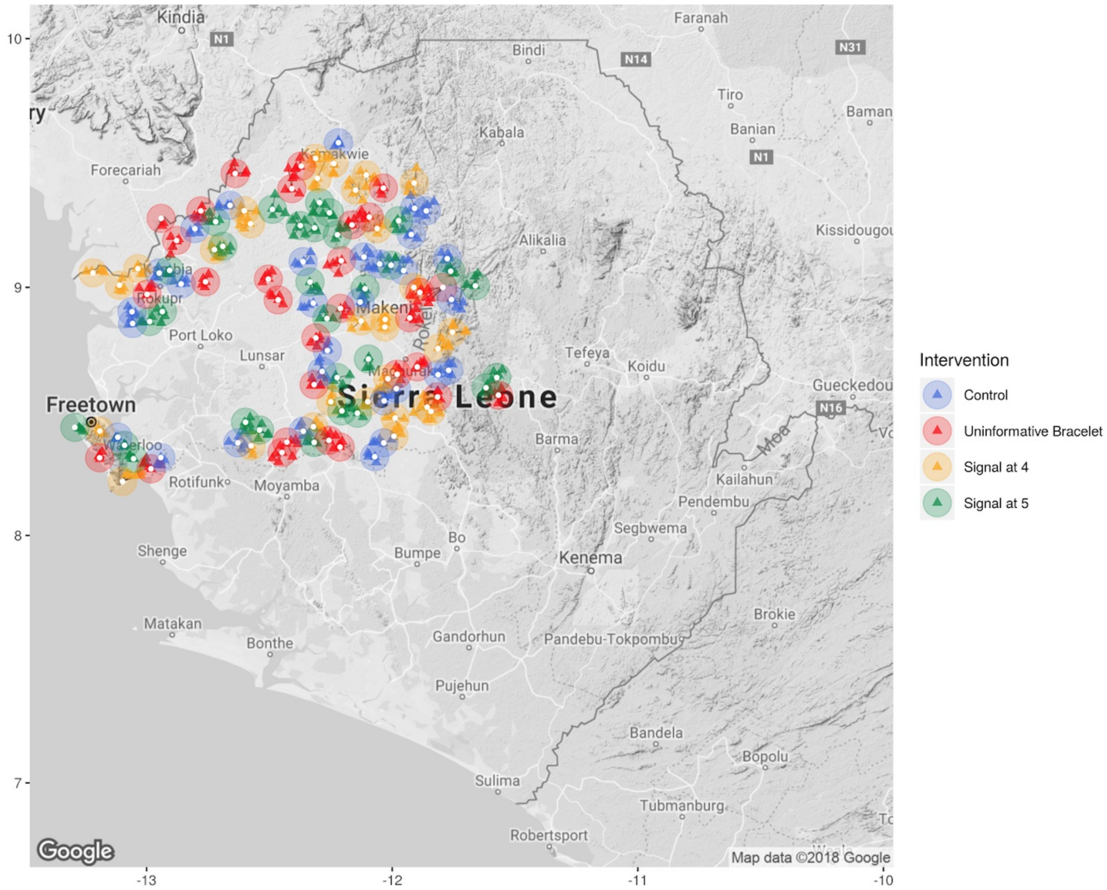

Figure A2: Clinic Randomization

Notes: This figure is a map of Sierra Leone that shows the geographic span of the experiment, with 120 clinics, that is 10% of Sierra Leone's public clinics, being randomized into the four different experimental groups. The clinic randomization was stratified by district. Four out of Sierra Leone's 14 districts were selected for the experiment in collaboration with the Ministry of Health and Sanitation of Sierra Leone, based on the criteria: i) baseline vaccination rates, ii) Ebola affectedness, iii) reliability of the supply side of immunization, and iv) other ongoing interventions. To avoid spillovers, the set of 120 clinics was chosen from a sample of 243 clinics, using an algorithm that ensured that each selected clinic had a catchment radius of 5 miles, of which at least 35% of the area was non-overlapping with any adjacent clinic's catchment area.

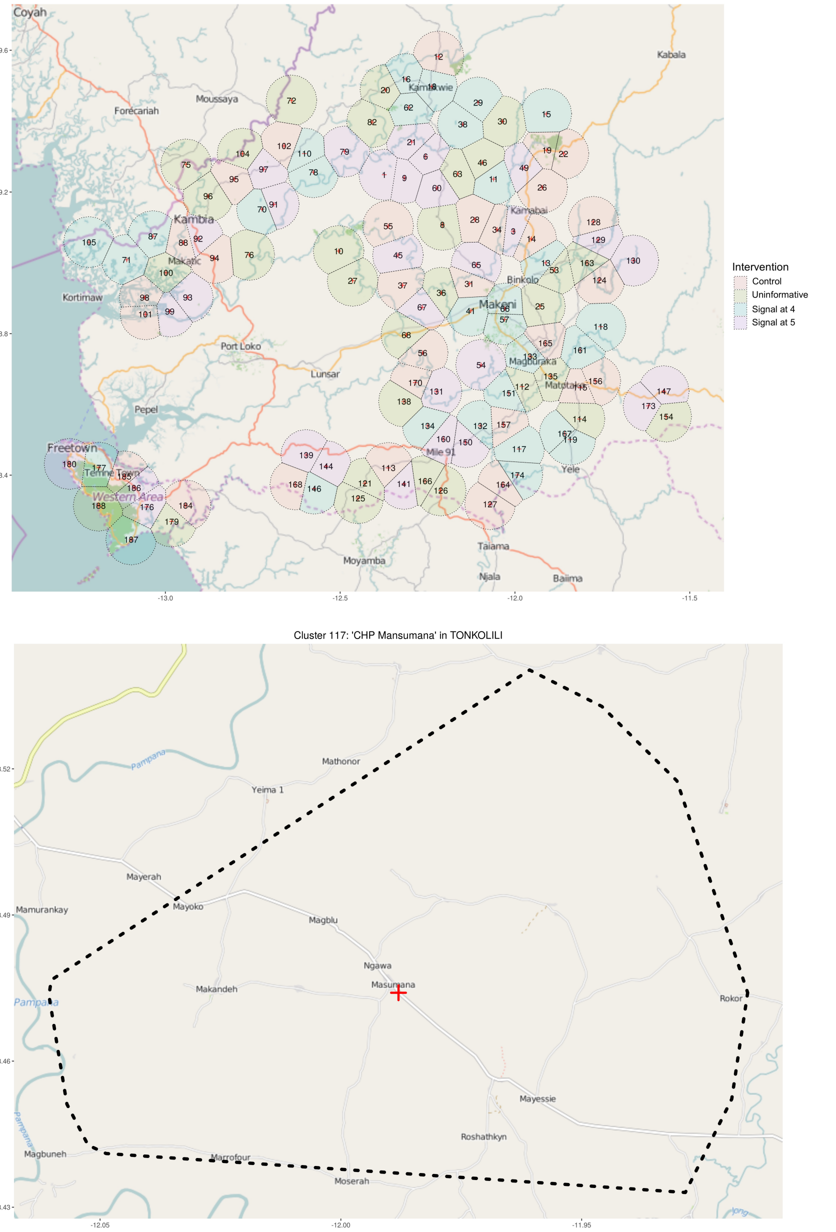

Figure A3: Process of Community Selection

Notes: The upper map displays the 120 selected clinics and their non-overlapping catchment areas, with radius of five miles around each clinic. The bottom map displays one out of the 120 maps that surveyors were subsequently given. At baseline, surveyors obtained a list of all catchment communities from clinic staff. For each clinic, surveyors selected five communities, using in-field randomization. A community was considered as eligible for selection if it (i) was primarily served by the clinic, instead of by another close-by clinic, (ii) had at least ten dwelling units (a dwelling unit comprises on average of three to four households) and (iii) was not an outreach point, that is, a community where health workers would regularly travel to to vaccinate children. Among the five communities, one was by default the clinic community. In addition, one other close (located 0-2 miles from the clinic) community and three far communities (located 2-5 miles from the clinic) were randomly selected. For clinics that had fewer than three far or two close communities, surveyors were asked to replace the community with another close or far community instead.

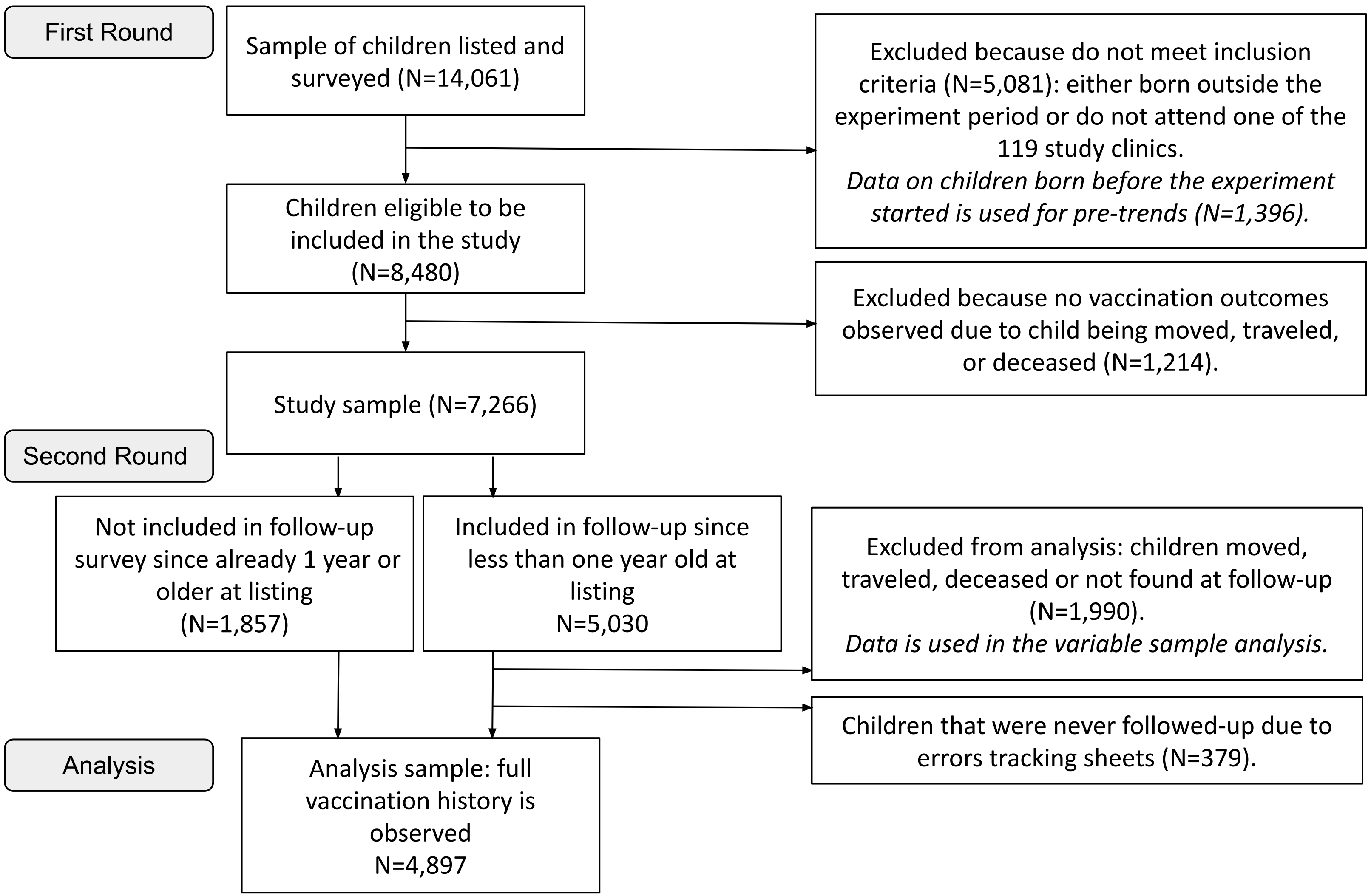

Figure A4: Final Sample Flow Diagram

Notes: This flow chart illustrates the sample sizes and exclusion criteria for each of the two rounds of data collection, the listing and follow-up surveys. It provides further detail on the sample definition for the main analysis described in Section 4.6.

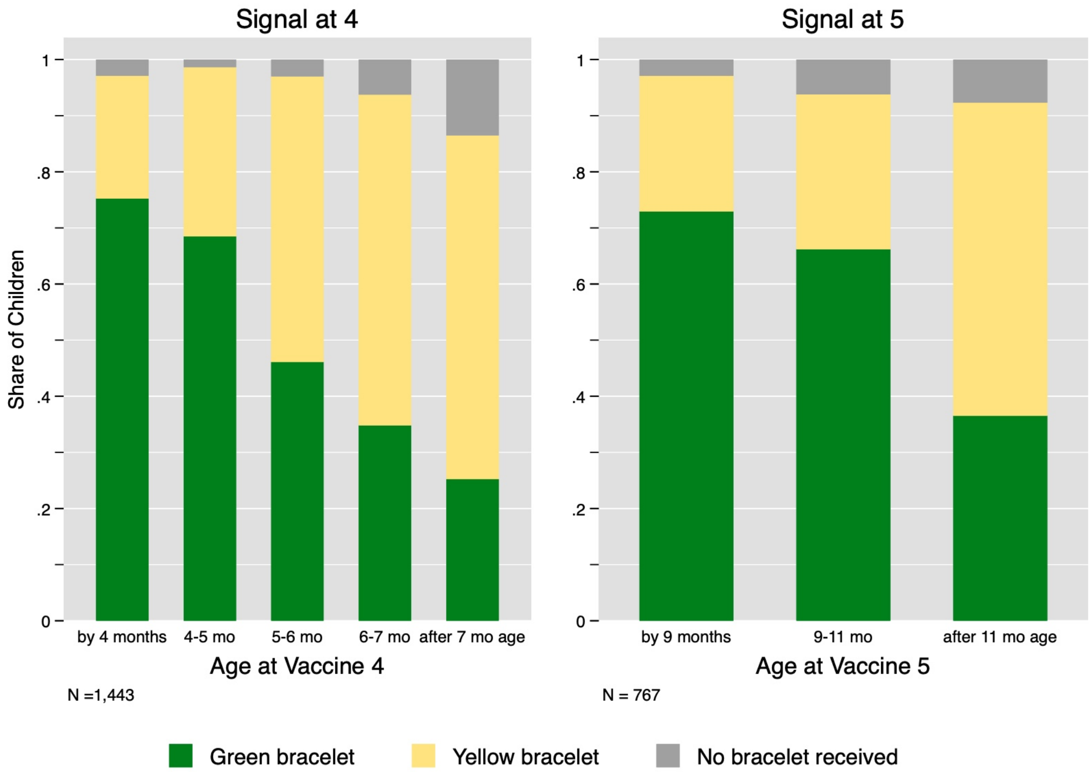

Figure A5: Hand Out of Green Bracelets in Signals at 4 and 5 according to Timely Vaccination

Notes: This figure shows the share of children with a green or yellow bracelet according to the time they took vaccines four and five in Signal at 4 and Signal at 5 treatments. Health workers were instructed to give the child a green bracelet if they came for vaccine four before six months of age (Signal at 4) and vaccine 5 before 11 months of age (Signal at 5). If a child came after this time, health workers were instructed to exchange their yellow bracelet for a new yellow "1st visit" bracelet instead. The sample includes children that were born during the experiment and surveyed during the listing. The panel on the left (Signal at 4) shows that the probability of receiving a green bracelet is monotonically decreasing in the age at which the child took vaccine four, from 75.2% if the vaccine was taken by four months age, to 68.7, 46.1, 34.8 and 25.2% if the child received the vaccine by 5, 6 or 7 months, or after 7 months age. The panel on the right (Signal at 5) shows a similar pattern: the probability of receiving a green bracelet decreases in the age at which the child comes for vaccine five, from 72.9% if the vaccine was taken by 9 months of age, to 66.2 and 36.5% by 11 months and after 11 months of age.

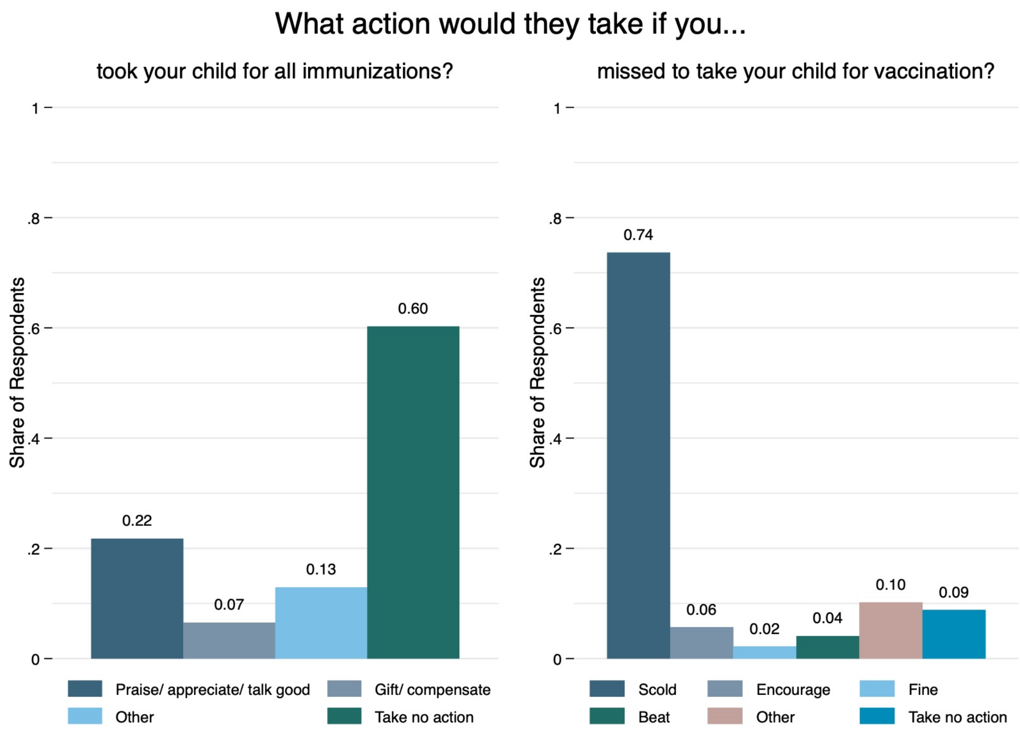

Figure A6: Reputational Costs and Benefits in terms of Actions

Notes: This figure shows mothers' beliefs about the actions that community members would take, conditional on observing that they took their child for all vaccinations or missed any. The sample includes all endline survey respondents (N=1,314). There are no significant differences across treatment arms.

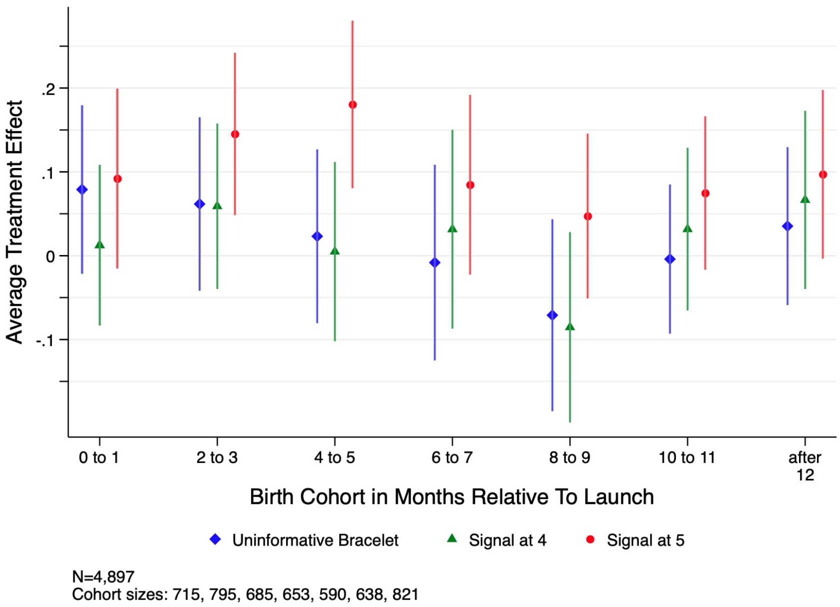

Figure A7: Treatment Effects by Birth Cohorts for Timely Vaccination - Vaccine 4

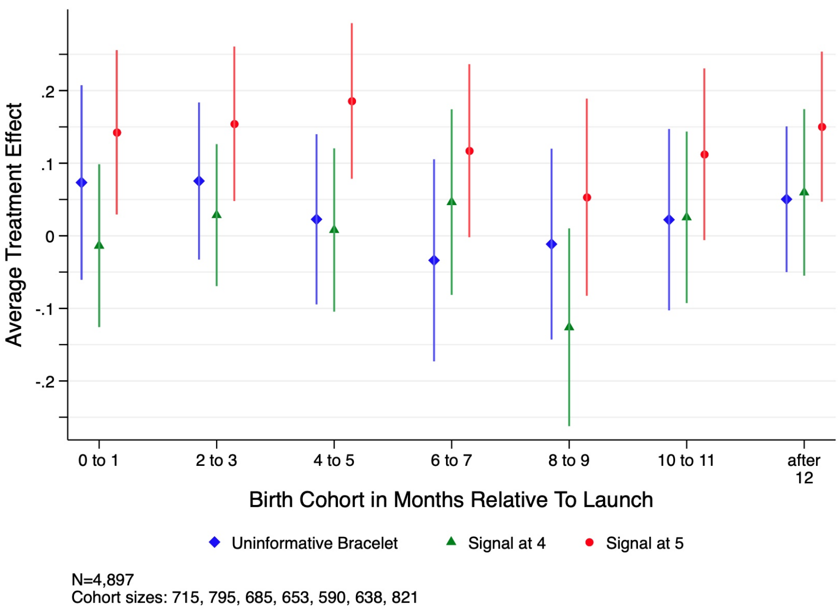

Figure A8: Treatment Effects by Birth Cohorts for Timely Vaccination - Vaccine 5

Notes: Figures A7 and A8 plot the average treatment effects of Signal at 4, Signal at 5 and the Uninformative Bracelet treatment compared to the Control Group on timely vaccination of four and five vaccines, respectively, by birth cohorts. Children are binned into birth cohorts of two months. With the exception of cohort 8-9, treatment effects for Signal at 5 are consistently high between 8 and 17 and 11 and 19 percentage points for four and five vaccines, respectively. For Signal at 4, treatment effects are consistent over time, ranging between -1 and 6 percentage points for vaccines four and five, respectively. For the Uninformative Bracelet, treatment effects are slightly more variable, ranging between -1 and 7 percentage points for four vaccines and -5 and 8 percentage points for five vaccines.

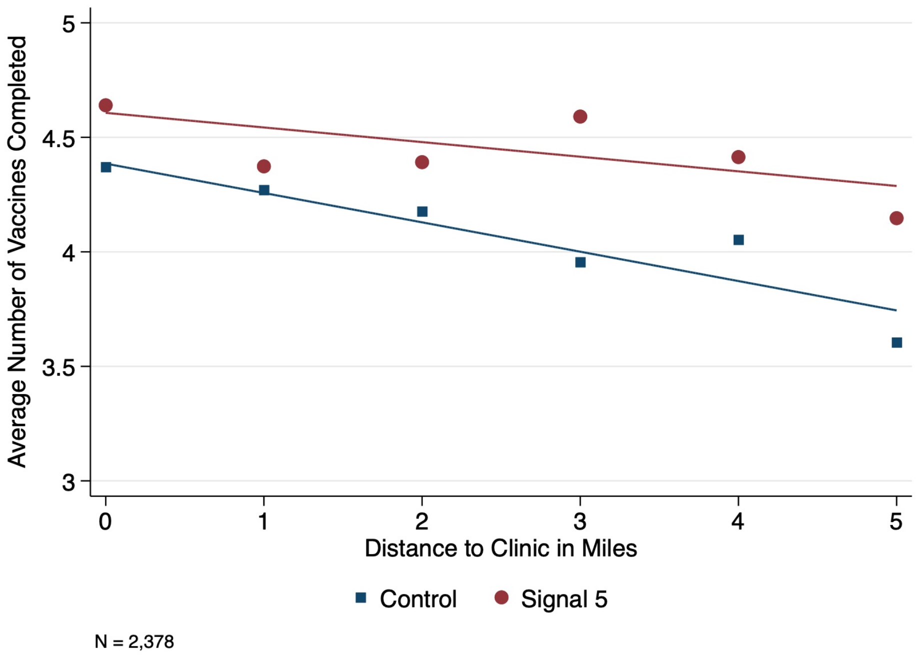

Figure A9: The Effect of Distance on the Total Number of Timely Completed Vaccines

Notes: The graph plots a bin scatter of the average number of timely vaccines completed against the travel distance from communities to clinics, separately for the Control Group and Signal at 5. The sample used for the estimation is the main analysis sample. The plot shows that distance has a linear effect on the number of timely vaccinations completed in the Control Group. Signal at 5 mitigated the negative effect of distance: the average total number of timely completed vaccines at 4 miles is approximately the same as the average number completed at zero miles in the Control Group.

B Online Only Supplementary Tables

Table B1: Characteristics of Endline Survey Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				t-test differences				
	Control			[p-value]				
Variable	**Mean/(SE)**	**(C)-(UI)**	**(C)-(S4)**	**(C)-(S5)**	**(UI)-(S4)**	**(UI)-(S5)**	**(S4)-(S5)**	**F-Test**
Panel A: Endline characteristics								
Interviewed the mother of the child	0.988	-0.012	-0.009	-0.009	0.003	0.003	0.000	0.112
	[0.006]	[0.031]	[0.165]	[0.065]	[0.308]	[0.330]	[0.737]	
Mother age (in years)	26.225	-0.275	-0.120	0.056	0.155	0.331	0.176	0.934
	[0.436]	[0.578]	[0.861]	[0.834]	[0.753]	[0.500]	[0.698]	
Is married	0.607	0.078	0.120	0.061	0.042	-0.017	-0.059	0.218
	[0.042]	[0.095]	[0.056]	[0.350]	[0.580]	[0.609]	[0.184]	
Temne ethnicity	0.515	-0.083	-0.043	-0.131	0.040	-0.048	-0.088	0.584
	[0.081]	[0.415]	[0.733]	[0.197]	[0.524]	[0.589]	[0.312]	
Limba ethnicity	0.269	0.074	0.069	0.091	-0.006	0.016	0.022	0.789
	[0.074]	[0.478]	[0.548]	[0.330]	[0.940]	[0.796]	[0.735]	
Lived in community for over 1 year	0.967	0.008	-0.009	-0.001	-0.017	-0.010	0.008	0.643
	[0.009]	[0.524]	[0.446]	[0.665]	[0.172]	[0.445]	[0.581]	
Observations		656	677	657	657	637	658	
Education								
Has no education	0.432	-0.062	-0.046	-0.035	0.016	0.027	0.011	0.454
	[0.030]	[0.101]	[0.246]	[0.205]	[0.805]	[0.439]	[0.844]	
Has some primary education	0.325	0.064	-0.002	0.018	-0.066	-0.046	0.020	0.125
	[0.027]	[0.025]	[0.871]	[0.555]	[0.058]	[0.129]	[0.589]	
Has some secondary education	0.243	-0.003	0.048	0.017	0.051	0.020	-0.031	0.598
	[0.029]	[0.888]	[0.286]	[0.396]	[0.144]	[0.646]	[0.454]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Occupation & Assets								
Works on farm	0.754	0.009	0.023	0.062	0.014	0.052	0.039	0.537
	[0.032]	[0.921]	[0.671]	[0.317]	[0.571]	[0.081]	[0.678]	
Has a mobile phone	0.112	0.006	0.000	-0.041	-0.005	-0.047	-0.042	0.282
	[0.022]	[0.734]	[0.961]	[0.444]	[0.618]	[0.019]	[0.150]	
Floor (1=Cement/Tile, 0=Mud)	0.331	-0.015	-0.049	-0.045	-0.035	-0.030	0.004	0.707
	[0.032]	[0.742]	[0.252]	[0.510]	[0.434]	[0.451]	[0.897]	
Roof (1=Corrugated iron, 0=Thatch)	0.896	0.041	-0.009	-0.016	-0.050	-0.057	-0.007	0.213
	[0.024]	[0.133]	[0.548]	[0.829]	[0.062]	[0.032]	[0.946]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Child characteristics								
Birth order of child	3.308	-0.186	-0.114	-0.068	0.072	0.118	0.046	0.546
	[0.100]	[0.143]	[0.366]	[0.412]	[0.608]	[0.457]	[0.835]	
Age of child (in months)	8.539	0.190	0.025	0.332	-0.165	0.142	0.307	0.503
	[0.191]	[0.552]	[0.987]	[0.073]	[0.549]	[0.557]	[0.289]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Panel B: First- and Second-Order Beliefs								
Number of children asked about	6.065	-0.466	-0.684	-0.493	-0.218	-0.027	0.191	0.481
	[0.384]	[0.242]	[0.095]	[0.291]	[0.607]	[0.776]	[0.507]	
Number of children recognized	4.154	0.066	-0.206	-0.197	-0.272	-0.263	0.009	0.100
	[0.115]	[0.981]	[0.125]	[0.024]	[0.118]	[0.090]	[0.945]	
Observations		656	677	657	657	637	658	
Clinics		60	60	59	60	59	59	
Set of controls: Sample 3.5-12 months								
Age of the mother interviewed	26.526	0.420	-0.030	0.098	-0.450	-0.323	0.127	0.797
	[0.457]	[0.412]	[0.963]	[0.824]	[0.318]	[0.510]	[0.753]	
Has some primary education	0.299	0.037	-0.034	0.010	-0.071	-0.027	0.044	0.489
	[0.029]	[0.320]	[0.638]	[0.879]	[0.128]	[0.380]	[0.390]	
Has some secondary education	0.256	0.013	0.066	0.035	0.053	0.022	-0.031	0.513
	[0.035]	[0.808]	[0.191]	[0.311]	[0.176]	[0.635]	[0.389]	
Works on farm	0.761	-0.019	-0.000	0.069	0.018	0.087	0.069	0.111
	[0.034]	[0.568]	[0.773]	[0.146]	[0.690]	[0.015]	[0.102]	
Close relationship to the other mother	0.414	-0.051	-0.012	0.029	0.038	0.080	0.042	0.238
	[0.027]	[0.267]	[0.705]	[0.531]	[0.304]	[0.023]	[0.213]	
Birth order of child	3.350	-0.108	-0.128	-0.056	-0.020	0.052	0.072	0.795
	[0.097]	[0.412]	[0.388]	[0.440]	[0.826]	[0.842]	[0.621]	
Observations		2140	2227	2204	2179	2156	2243	
Clinics		60	60	59	60	59	59	

Notes: This table summarizes socio-economic characteristics of endline survey respondents. I report the control group mean and pairwise mean differences for each variable and treatment group. Below the pairwise mean differences, I report the p-value from the t-test difference. The final column reports the joint significance level of treatment indicators in a regression with strata-level fixed effects. The values displayed for t-tests and F-tests are p-values. Standard errors are clustered at the clinic level.

Table B2: Description of Clinic and Community Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				t-test differences				
	Control			**[p-value]**				
Variable	**Mean/(SE)**	**(C)-(UI)**	**(C)-(S4)**	**(C)-(S5)**	**(UI)-(S4)**	**(UI)-(S5)**	**(S4)-(S5)**	**F-Test**
Panel A: Clinic characteristics								
Baseline characteristics								
# of staff involved in immunization	2.900	0.167	0.233	-0.134	0.067	-0.301	-0.368	0.884
	[0.435]	[0.654]	[0.607]	[0.526]	[0.989]	[0.856]	[0.596]	
Weekly vaccination services	0.700	0.100	0.067	0.010	-0.033	-0.090	-0.056	0.792
	[0.085]	[0.432]	[0.553]	[0.900]	[0.736]	[0.447]	[0.651]	
Stockout of vaccines in the past 2 months	0.200	0.100	0.067	0.062	-0.033	-0.038	-0.005	0.683
	[0.074]	[0.187]	[0.387]	[0.813]	[0.802]	[0.733]	[0.963]	
Observations		60	60	59	60	59	59	
Experiment implementation								
Timing of intervention roll-out (# of days relative to first clinic)	83.867	-0.933	-7.400	-11.099	-6.467	-10.166	-3.699	0.229
	[10.949]	[0.832]	[0.136]	[0.094]	[0.208]	[0.278]	[0.797]	
Time spent in communities for information meetings (in days)	1.867	-0.100	-0.333	-0.168	-0.233	-0.068	0.166	0.765
	[0.298]	[0.950]	[0.485]	[0.914]	[0.417]	[0.838]	[0.240]	
Time spent to list all babies in communities (in days)	3.300	0.000	0.167	-0.045	0.167	-0.045	-0.211	0.888
	[0.254]	[1.000]	[0.558]	[0.950]	[0.628]	[0.907]	[0.474]	
# of clinic monitoring visits during immunization services	7.300	-0.900	-1.500	-0.769	-0.600	0.131	0.731	0.118
	[0.494]	[0.235]	[0.020]	[0.205]	[0.296]	[0.979]	[0.237]	
Observations		60	60	59	60	59	59	
Service indicators collected throughout implementation								
Received a food supplement for child at last immunization visit	0.023	-0.004	-0.032	0.005	-0.028	0.009	0.037	0.165
	[0.009]	[0.771]	[0.057]	[0.742]	[0.092]	[0.473]	[0.037]	
Received a bednet at last immunization visit	0.062	0.023	0.021	0.013	-0.002	-0.010	-0.008	0.478
	[0.011]	[0.183]	[0.279]	[0.496]	[0.859]	[0.622]	[0.688]	
Gave money to the nurse at last immunization visit	0.146	0.006	-0.031	-0.014	-0.036	-0.020	0.016	0.895
	[0.031]	[0.815]	[0.531]	[0.793]	[0.486]	[0.758]	[0.768]	
Amount given to the nurse at last immunization visit (in Leones)	1605.556	242.063	-268.413	-361.111	-510.476	-603.175	-92.698	0.828
	[384.588]	[0.688]	[0.620]	[0.590]	[0.503]	[0.529]	[0.917]	
Immunization service was shifted in the last 2 months	0.083	-0.017	-0.045	-0.011	-0.028	0.005	0.034	0.668
	[0.021]	[0.446]	[0.225]	[0.721]	[0.472]	[0.913]	[0.402]	
Stockout of vaccines in the past 2 months	0.089	-0.012	0.032	0.022	0.044	0.034	-0.009	0.267
	[0.021]	[0.526]	[0.129]	[0.300]	[0.105]	[0.306]	[0.738]	
Observations		60	60	59	60	59	59	
Panel B: Community Characteristics								
Close community distance to clinic (in miles)	0.938	-0.076	0.019	0.050	0.095	0.126	0.031	0.499
	[0.066]	[0.456]	[0.948]	[0.990]	[0.218]	[0.238]	[0.832]	
Observations		154	154	160	148	154	154	
Clinics		60	60	59	60	59	59	
Far community distance to clinic (in miles)	3.667	-0.083	-0.073	-0.159	0.010	-0.075	-0.086	0.704
	[0.108]	[0.508]	[0.456]	[0.213]	[0.848]	[0.724]	[0.441]	
Observations		142	139	129	149	139	136	
Clinics		58	57	56	57	56	55	
Community knowledge								
Know # of vaccines required	0.951	-0.002	0.006	0.045	0.007	0.047	0.039	0.380
	[0.022]	[0.973]	[0.838]	[0.098]	[0.754]	[0.127]	[0.172]	
Observations		291	289	281	294	286	284	
Clinics		60	60	59	60	59	59	
Community knowledge								
Negligence from parents	0.817	-0.018	0.071	0.062	0.089	0.081	-0.008	0.642
	[0.050]	[0.916]	[0.225]	[0.397]	[0.213]	[0.768]	[0.731]	
Lack of knowledge of benefits	0.642	-0.001	0.015	-0.028	0.015	-0.027	-0.042	0.867
	[0.074]	[0.602]	[0.778]	[0.998]	[0.892]	[0.577]	[0.616]	
Distance to clinic	0.400	-0.050	-0.049	0.036	0.000	0.085	0.085	0.417
	[0.058]	[0.380]	[0.299]	[0.936]	[0.984]	[0.173]	[0.143]	
User fees	0.225	0.032	0.072	0.056	0.040	0.023	-0.017	0.794
	[0.061]	[0.897]	[0.688]	[0.564]	[0.617]	[0.542]	[0.929]	
Staff attitude	0.117	-0.003	-0.095	-0.002	-0.093	0.001	0.093	0.550
	[0.046]	[0.839]	[0.102]	[0.514]	[0.130]	[0.529]	[0.722]	
Observations		229	238	238	227	227	236	
Clinics		48	49	50	47	48	49	

Notes: This table summarizes relevant clinic and community characteristics collected at baseline and throughout the experiment. In Panel A, the unit of observation is a clinic. The clinic-level immunization service indicators under *Baseline characteristics* are collected by enumerators in a survey with the nurse in-charge of a respective clinic at baseline of the experiment. In Panel B, the information is reported on community level. The community characteristics were collected during the information meetings at the start of the experiment. I report the control group mean and pairwise mean differences for each variable and treatment group. Below the pairwise mean differences, I report the p-value from the t-test difference. The final column reports the joint significance level of treatment indicators in a regression with strata-level fixed effects. The values displayed for t-tests and F-tests are p-values. Standard errors are clustered at the clinic level.

Table B3: Characteristics of Main Analysis Sample

Variable	(1) Control Mean/(SE)	(2) (C)-(UI)	(3) (C)-(S4)	(4) (C)-(S5)	(5) (UI)-(S4)	(6) (UI)-(S5)	(7) (S4)-(S5)	(8) F-Test
		t-test differences [p-value]						
Panel A: Sample Definition								
Regular listed child	0.863	0.012	-0.008	0.015	-0.020	0.002	0.023	0.507
	[0.017]	[0.571]	[0.510]	[0.837]	[0.135]	[0.851]	[0.357]	
Traveled child	0.083	0.004	0.004	-0.002	0.000	-0.006	-0.006	0.977
	[0.011]	[0.906]	[0.791]	[0.929]	[0.832]	[0.782]	[0.836]	
Moved child	0.030	-0.011	0.006	-0.008	0.017	0.003	-0.014	0.045
	[0.006]	[0.287]	[0.153]	[0.913]	[0.007]	[0.504]	[0.063]	
Deceased child	0.025	-0.005	-0.002	-0.004	0.004	0.001	-0.003	0.861
	[0.005]	[0.612]	[0.868]	[0.723]	[0.414]	[0.754]	[0.745]	
Observations		3997	4378	4171	4309	4102	4483	
Listed child eligible for follow-up	0.730	0.000	-0.010	0.020	-0.011	0.020	0.030	0.475
	[0.015]	[0.946]	[0.598]	[0.369]	[0.564]	[0.282]	[0.102]	
Found & surveyed at follow-up	0.705	0.015	-0.025	-0.008	-0.039	-0.023	0.016	0.169
	[0.015]	[0.274]	[0.095]	[0.832]	[0.015]	[0.222]	[0.299]	
Traveled at follow-up	0.054	0.004	0.005	0.016	0.000	0.012	0.011	0.472
	[0.007]	[0.656]	[0.718]	[0.248]	[0.824]	[0.230]	[0.285]	
Moved at follow-up	0.172	-0.017	0.016	-0.000	0.032	0.017	-0.016	0.078
	[0.013]	[0.238]	[0.075]	[0.896]	[0.007]	[0.116]	[0.106]	
Deceased at follow-up	0.046	-0.001	0.009	-0.008	0.010	-0.007	-0.017	0.130
	[0.006]	[0.761]	[0.249]	[0.321]	[0.084]	[0.402]	[0.030]	
Was not found at follow-up	0.026	-0.002	-0.005	-0.002	-0.004	0.000	0.004	0.777
	[0.009]	[0.634]	[0.344]	[0.757]	[0.257]	[0.570]	[0.592]	
Observations		3238	3598	3351	3536	3289	3649	
Clinics		60	60	59	60	59	59	
Panel B: Sample Characteristics								
Age of child (in days)	236.692	2.806	4.858	1.433	2.052	-1.373	-3.425	0.928
	[5.625]	[0.776]	[0.612]	[0.617]	[0.870]	[0.647]	[0.474]	
Child has a vaccine card	0.953	-0.003	0.009	0.006	0.013	0.010	-0.003	0.756
	[0.009]	[0.843]	[0.365]	[0.491]	[0.298]	[0.496]	[0.832]	
Observations		2261	2586	2378	2519	2311	2636	
Vaccine Card is of good quality	0.830	0.019	0.008	-0.039	-0.011	-0.058	-0.047	0.309
	[0.032]	[0.755]	[0.700]	[0.231]	[0.971]	[0.081]	[0.101]	
Observations		1415	1786	1583	1651	1448	1819	
Mother's ability to recall last vaccine	0.863	-0.050	-0.041	-0.060	0.009	-0.010	-0.019	0.746
	[0.031]	[0.360]	[0.586]	[0.238]	[0.748]	[0.859]	[0.579]	
Observations		2261	2586	2378	2519	2311	2636	
Distance to clinic (in miles)	2.171	-0.229	-0.158	0.009	0.071	0.238	0.167	0.281
	[0.090]	[0.084]	[0.200]	[0.820]	[0.539]	[0.092]	[0.717]	
Communities		296	292	288	296	292	288	
Clinic population	66.833	3.667	-12.700	-6.615	-16.367	-10.282	6.085	0.197
	[5.491]	[0.653]	[0.199]	[0.492]	[0.097]	[0.064]	[0.643]	
Clinics		60	60	59	60	59	59	
Panel C: Pre-trends in vaccination outcomes								
Vaccine 1	0.970	0.018	0.014	0.000	-0.004	-0.018	-0.014	0.590
	[0.011]	[0.263]	[0.384]	[0.796]	[0.932]	[0.301]	[0.306]	
Observations		654	713	633	763	683	742	
Vaccine 2	0.911	0.025	0.004	-0.010	-0.021	-0.035	-0.014	0.604
	[0.019]	[0.336]	[0.611]	[0.832]	[0.797]	[0.175]	[0.372]	
Observations		510	539	491	575	527	556	
Vaccine 3	0.778	-0.038	-0.038	-0.029	-0.001	0.009	0.010	0.962
	[0.046]	[0.571]	[0.812]	[0.932]	[0.890]	[0.797]	[0.944]	
Observations		377	394	362	429	397	414	
Clinics		38	38	38	38	38	38	

Notes: This table summarizes relevant sample characteristics. The sample under Panel A consist of all children eligible to be included in the study, and for whom vaccination outcomes were captured during the listing. The panel shows balance on reasons for why vaccination outcomes could not be captured, eligibility for a follow-up, and status of the child/ sample attrition at follow-up. Panel B shows balance on the characteristics of the sample used in the main specification of Tables 3 and B12. In Panel C, I implement randomization checks on the immunization rates of children that were born before the start of the experiment and that resided in 76 of the study clinics. Due to budget constraints, I could only collect vaccine information for children born as early as January 2016. This allows me to access pre-trends for vaccines 1, 2 and 3 but not for vaccines 4 and 5. I report the control group mean and pairwise mean differences for each variable and treatment group. Below the pairwise mean differences, I report the p-value from the t-test difference. The final column reports the joint significance level of treatment indicators in a regression with strata-level fixed effects. The values displayed for t-tests and F-tests are p-values. Standard errors are clustered at the clinic level.

Table B4: Verifying the Correct Implementation of Bracelets, Regression Results for Figure 2

Dependent variable:	**Signal at 4**		**Signal at 5**		**Uninformative Bracelet**	
	Green	**Yellow**	**Green**	**Yellow**	**Green**	**Yellow**
	(1)	(2)	(3)	(4)	(5)	(6)
Vaccine 2	0.015	0.055	0.016***	0.046	0.035	0.092
	(0.010)	(0.050)	(0.006)	(0.038)	(0.057)	(0.070)
Vaccine 3	0.023	0.095*	0.017**	0.078**	0.057	0.068
	(0.018)	(0.055)	(0.007)	(0.038)	(0.049)	(0.062)
Vaccine 4	0.612***	-0.448***	0.028***	0.070**	0.064	0.080
	(0.036)	(0.075)	(0.007)	(0.032)	(0.055)	(0.058)
Vaccine 5	0.629***	-0.501***	0.697***	-0.592***	0.090	0.056
	(0.042)	(0.073)	(0.036)	(0.051)	(0.056)	(0.055)
Mean Vaccine 1	0.002	0.810	-0.008	0.860	0.298	0.523
p(Vaccine 3 = Vaccine 4)	0.000	0.000	0.183	0.649	0.847	0.759
p(Vaccine 4 = Vaccine 5)	0.642	0.110	0.000	0.000	0.368	0.407
Observations	2008	2008	1782	1782	1607	1607

Notes: This table shows the regression results of a binary variable for a green or yellow bracelet on the total number of vaccines a child has received, by treatment group (shown in Figure 2). I include strata fixed effects and cluster standard errors at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B5: How Mothers Know about the Color of the Bracelet

	How do you know that this baby has a green/yellow bracelet?			
Dependent Variable:	**Saw bracelet on child**	**Saw child getting bracelet**	**Everyone gets a bracelet**	**Right # of vaccines**
	(1)	(2)	(3)	(4)
Signal at 4	-0.064	0.028	-0.009	0.078***
	(0.047)	(0.048)	(0.021)	(0.019)
Signal at 5	-0.065	0.032	0.034	0.068***
	(0.044)	(0.053)	(0.026)	(0.014)
UI Group Mean	0.826	0.365	0.047	0.001
Observations	2627	2627	2627	2627
p(S4 = S5)	0.994	0.949	0.093	0.656

Notes: This table summarizes bracelet knowledge at endline. The unit of observation is a respondent-other mother pair. I asked respondents in the Uninformative Bracelet, Signal at 4, and Signal at 5 clinics, whether they knew that the other mother's baby has a bracelet, and if so, how they know about whether the baby has a green or yellow bracelet. Outcome variables equal one if the respondent mentioned the respective choice, and zero otherwise. Each respondent was able to provide multiple reasons. In this table, I focus on the top 4 responses, excluding those with very low frequencies (less than 5% for the whole sample). The excluded reasons which were cited by more than 1% are "Mother showed me the bracelet" named by 1.9%, and "Because of the age of the child" named by 1.4%. In all regressions, I include strata-fixed effects, demeaned controls for the mother and child. For the mother, we control for the the age of the mother, the level of her education, whether her primary economic activity is farming, and her relationship to the other mother respondent. For the child, we control for the birth order and the age of the child. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B6: The Effects of Signals on Vaccine Knowledge and Second-Order Beliefs

Dependent variable:	**Know # of vaccines of other children**		**Others know # of vaccines of own child**	
Age in months	3.5-9 months	9-12 months	3.5-9 months	9-12 months
	(1)	(2)	(3)	(4)
Signal at 4	0.040	0.084	0.130^{**}	0.113
	(0.041)	(0.051)	(0.053)	(0.070)
Signal at 5	0.048	0.105^{**}	0.075	0.165^{**}
	(0.042)	(0.049)	(0.058)	(0.074)
Uninformative Bracelet	0.021	0.026	0.080	0.058
	(0.040)	(0.051)	(0.055)	(0.074)
Control Group mean	0.497	0.429	0.481	0.468
Observations	2622	1592	2756	1627
$S_4 > 0$: p(UI = S4)	0.651	0.242	0.290	0.389
$S_5 > 0$: p(UI = S5)	0.540	0.088	0.929	0.111
p(S4 = S5)	0.860	0.672	0.279	0.403
Joint F-Test	0.655	0.106	0.104	0.126
Controls	Yes	Yes	Yes	Yes

Notes: The table shows endline respondents' knowledge about other children's vaccinations and second-order beliefs about a mother's own child's vaccinations. The unit of observation is a respondent-other mother pair. Columns (1) and (2) show regression results of a binary variable for correct knowledge of the number of vaccinations another child has received on treatment indicators for Signal at 4, Signal at 5, and Uninformative Bracelet, with the Control Group as excluded category. The outcome in each column is coded one if respondents correctly guessed the number of vaccines the other child has. Columns (3) and (4) show regression results of a binary variable for respondent's belief about another mother's knowledge of their child's number of vaccinations. The outcome variable is coded one if a respondent answered "Yes", zero otherwise. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or of Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to that of the Signal at 5. Last is a joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned control variables for the mother and child. For the mother, we control for the her age, the level of her education, whether her primary economic activity is farming, and her relationship to the other mother respondent. For the child, we control for the birth order and the age of the child. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B7: The Effects of Signals on Vaccine Knowledge by Bracelet Color (without Controls)

Dependent variable:	**Number of vaccines of other children**						**Others know number of vaccines of own child**	
	Correct	**Under**	**Over**	**Correct**	**Under**	**Over**		
Vaccine take-up period	3.5-9 months			9-12 months			3.5-9 months	9-12 months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Signal at 4	0.128**	-0.116***	-0.013	0.074	-0.054	-0.020	-0.039	0.128
	(0.059)	(0.040)	(0.050)	(0.066)	(0.058)	(0.048)	(0.066)	(0.082)
Signal at 5	0.018	-0.176***	0.158	0.160**	-0.201***	0.042	0.128	0.179*
	(0.100)	(0.055)	(0.099)	(0.075)	(0.058)	(0.060)	(0.146)	(0.105)
Signal at 4 × Yellow Bracelet=1	-0.208***	0.189***	0.019	-0.058	0.102	-0.044	0.143	-0.156
	(0.068)	(0.063)	(0.047)	(0.088)	(0.081)	(0.057)	(0.098)	(0.104)
Signal at 5 × Yellow Bracelet=1	0.004	0.168**	-0.171*	-0.175*	0.198**	-0.023	-0.155	-0.211*
	(0.098)	(0.070)	(0.100)	(0.096)	(0.080)	(0.063)	(0.151)	(0.119)
Yellow Bracelet=1	0.046	0.001	-0.047	0.023	0.029	-0.051	-0.070	0.103
	(0.046)	(0.049)	(0.037)	(0.059)	(0.055)	(0.048)	(0.076)	(0.066)
Mean Uninformative Bracelet	0.519	0.253	0.228	0.469	0.308	0.223	0.616	0.484
Observations	1623	1623	1623	1004	1004	1004	1968	1196
Controls	No	No	No	No	No	No	No	No
p(S4 Green = S5 Green)	0.246	0.198	0.072	0.221	0.005	0.239	0.227	0.593
p(S4 Yellow = S5 Yellow)	0.058	0.049	0.575	0.684	0.517	0.096	0.047	0.956
p(UI Yellow = S4 Yellow)	0.175	0.138	0.858	0.824	0.517	0.203	0.169	0.735
p(UI Yellow = S5 Yellow)	0.677	0.852	0.649	0.815	0.955	0.743	0.671	0.687

Notes: This table shows the same regression results as Table 3 without control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B8: Reference Groups for Social Signaling

	Who is concerned about your child's vaccinations?				
Dependent Variable:	**Anyone concerned**	**Father of child**	**Family member**	**Nurse/CHW**	**Community member**
	(1)	(2)	(3)	(4)	(5)
Signal at 4	0.003	0.033	-0.004	-0.047	0.051
	(0.013)	(0.042)	(0.048)	(0.055)	(0.047)
Signal at 5	-0.033*	0.057	-0.010	-0.024	0.063
	(0.019)	(0.041)	(0.049)	(0.052)	(0.049)
Uninformative Bracelet	-0.003	0.050	-0.038	0.000	-0.000
	(0.015)	(0.042)	(0.047)	(0.058)	(0.051)
Control Group mean	0.974	0.583	0.624	0.382	0.272
Observations	1314	1314	1314	1314	1314
$S_4 > 0$: p(UI = S4)	0.688	0.684	0.513	0.439	0.352
$S_5 > 0$: p(UI = S5)	0.138	0.863	0.579	0.680	0.248
p(S4 = S5)	0.050	0.538	0.921	0.695	0.820
Joint F-Test	0.261	0.524	0.862	0.803	0.461

Notes: At endline we asked respondents "Is there anyone in your community or your house who is concerned about your child's immunization?". If the respondent answered "Yes", we asked "Who will be concerned?". Each respondent was able to provide multiple reference groups. Column (1) is a binary indicator which is equal to one if a respondent confirmed that someone in her community is concerned about her child's immunizations, and zero otherwise. Columns (2)-(5) display regression results for the different groups a respondent could subsequently mention. All regressions include strata-fixed effects and demeaned controls for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B9: Private and Social Benefits of Vaccination, Knowledge of Externalities

Dependent Variable:	**Vaccinations are helpful for my own child's health** (1)	**My child's vaccination can be helpful for other children in the community** (2)	**My child can be harmful to others if she/he is not immunized** (3)	**Other children can be harmful to my child if not immunized** (4)
Signal at 4	0.002	-0.030	-0.003	0.001
	(0.031)	(0.088)	(0.040)	(0.049)
Signal at 5	0.063**	-0.024	-0.073*	-0.060
	(0.027)	(0.084)	(0.038)	(0.043)
Uninformative Bracelet	-0.001	0.009	-0.034	-0.063
	(0.029)	(0.082)	(0.037)	(0.042)
Control Group mean	0.887	0.255	0.177	0.225
Observations	1314	1314	1314	1314
$S_4 > 0$: p(UI = S4)	0.938	0.606	0.339	0.121
$S_5 > 0$: p(UI = S5)	0.011	0.657	0.212	0.942
p(S4 = S5)	0.029	0.948	0.040	0.156
Joint F-Test	0.022	0.947	0.132	0.220
Controls	Yes	Yes	Yes	Yes

Notes: At endline we asked respondents, "Do you think that vaccination is helpful, harmful or both for your child?". Column (1) displays regression results where the outcome variable is binary and equal to one if the respondent said "Helpful" and zero if the respondent answered "Both, helpful and harmful" or "Harmful". Fewer than 1% of mothers said that vaccination is harmful to their child. Column (2)-(4) displays respective survey questions, with the outcome being coded as one if answered "Yes", and zero otherwise. In the overall sample, 19.5% said that "their child can be harmful to others if she/he is not immunized", while 15% said that "other children can be harmful to my child if not immunized". I control for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. All regressions include strata-fixed effects. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B10: Others' Inferences about Types Conditional on Vaccination Decisions

Dependent Variable:	**Is anyone concerned about your child's immunization?**	**How would they view you if you missed to take your child for immunization?**					
		Careless	**Ignorant**	**Lazy**	**Busy**	**Poor**	**No judgement**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Signal at 4	0.003	0.005	-0.051	-0.015	-0.013	0.006	-0.004
	(0.013)	(0.019)	(0.032)	(0.011)	(0.013)	(0.005)	(0.012)
Signal at 5	-0.033*	-0.005	-0.047	-0.003	-0.019	0.010*	0.002
	(0.019)	(0.020)	(0.035)	(0.012)	(0.012)	(0.006)	(0.013)
Uninformative Bracelet	-0.003	-0.009	-0.015	-0.009	0.004	0.004	0.001
	(0.015)	(0.023)	(0.037)	(0.013)	(0.019)	(0.004)	(0.014)
Control Group mean	0.974	0.954	0.183	0.027	0.022	-0.000	0.021
Observations	1314	1270	1270	1270	1270	1270	1270
$S_4 > 0$: p(UI = S4)	0.688	0.543	0.292	0.646	0.345	0.739	0.712
$S_5 > 0$: p(UI = S5)	0.138	0.875	0.388	0.674	0.194	0.360	0.952
p(S4 = S5)	0.050	0.609	0.897	0.330	0.536	0.555	0.650
Joint F-Test	0.261	0.922	0.365	0.564	0.322	0.185	0.969

Notes: At endline, we asked respondents the question "Is there anyone in your community or your house who is concerned about your child's immunization?". If the respondent replied with "Yes", we continued to ask "Who will be concerned?" and further "How would these community members you named, view you the caregiver if you missed to take your child for immunization?". In this table, I summarize the results wherein I generate indicators which are equal to one in case the respondent mentioned the respective answer, and zero otherwise. Then, I regress the binary outcome variable on the treatment indicator in a regression with demeaned control variables for for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. All regressions include strata-fixed effects and standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B11: Inferences about Types Conditional on Vaccination Decisions

	How would community members view you if you... took your child for all vaccinations?		
Dependent Variable:	**Caring/patient/serious** (1)	**Know of importance** (2)	**Think nothing special about me** (3)
Signal at 4	-0.003	-0.032	-0.007
	(0.020)	(0.059)	(0.013)
Signal at 5	0.004	-0.044	-0.005
	(0.022)	(0.063)	(0.014)
Uninformative Bracelet	0.014	-0.025	-0.006
	(0.019)	(0.065)	(0.015)
Control Group mean	0.947	0.255	0.025
Observations	1270	1270	1270
$S_4 > 0$: p(UI = S4)	0.385	0.897	0.975
$S_5 > 0$: p(UI = S5)	0.642	0.746	0.942
p(S4 = S5)	0.728	0.828	0.905
Joint F-Test	0.833	0.912	0.959

Notes: At endline we asked respondents "Is there anyone in your community or your house who is concerned about your child's immunization?". If the respondent answered "Yes", we continued to ask "Who will be concerned?" and "How would these community members view you if you missed to take your child for vaccinations? or ... took your child for all vaccinations?". I generate binary outcome variables, equal to one if the respondent named the respective answer, and zero otherwise. Regressions include strata-fixed effects and demeaned controls for the age of the mother, her level of education, her main economic activity, and the birth order of the child that she is interviewed about. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B12: The Combined Effects of Signals at 4 and 5 on Timely and Complete Vaccination, Separated by Treatment

Dependent variable:	**1 Vaccine** (1)	**2 Vaccines** (2)	**3 Vaccines** (3)	**4 Vaccines** (4)	**5 Vaccines** (5)	**Total # of vaccines** (6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4 and 5	0.001	0.020	0.040*	0.060*	0.066*	0.187*
	(0.007)	(0.013)	(0.023)	(0.033)	(0.038)	(0.103)
Uninformative Bracelet	0.007	0.016	0.027	0.020	0.027	0.097
	(0.007)	(0.012)	(0.024)	(0.036)	(0.043)	(0.108)
Distance	-0.003**	-0.009***	-0.017***	-0.026***	-0.029***	-0.083***
	(0.001)	(0.003)	(0.003)	(0.004)	(0.005)	(0.014)
Control Group mean	0.979	0.940	0.857	0.739	0.565	4.038
Observations	4897	4897	4897	4897	4897	4897
p(Signals = UI)	0.287	0.709	0.517	0.130	0.237	0.275
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4 and 5	0.002	0.009**	0.016**	0.026*	0.062**	0.116**
	(0.003)	(0.004)	(0.008)	(0.015)	(0.031)	(0.054)
Uninformative Bracelet	0.003	0.010***	0.011	0.008	0.028	0.060
	(0.003)	(0.004)	(0.008)	(0.017)	(0.035)	(0.059)
Distance	0.000	-0.000	-0.002**	-0.008***	-0.014***	-0.024***
	(0.000)	(0.001)	(0.001)	(0.002)	(0.004)	(0.006)
Control Group mean	0.993	0.984	0.959	0.917	0.686	4.539
Observations	4897	4897	4897	4897	4897	4897
p(Signals = UI)	0.415	0.843	0.418	0.168	0.205	0.195
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Columns (1) through (5) of this table, shows results from a linear probability model of the binary outcome variable for a child being vaccinated for 1, 2, 3, 4, or 5 vaccinations on treatment indicators for Signal at 4 and 5 combined and Uninformative Bracelet, with the Control Group as the excluded category. Column (6) shows the results for the total number of vaccines a child has received. Panel A shows the results for timely vaccination by the age of 3, 4, 5, 6 and 11.5 months, respectively. For a child to be coded as timely for a given number of vaccines, they need to have been timely for all those vaccines. Panel B shows the results for vaccination by the age of 12 months, simply counting the total number of vaccines a child has received. Regressions include all children from the main analysis sample. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signals at 4 and 5 (Signals), identifying social signaling preferences. Last is the joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned controls for distance to the clinic, clinic population size, the mother's ability to recall the child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B13: Effects of Signals on Timely Vaccination Using Different Cutoffs

Dependent variable:	**4 Vaccines**			**5 Vaccines**			
Age cutoff	4.5 months	5 months	6 months	10 months	11 months	11.5 months	12 months
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Signal at 4	0.047	0.038	0.020	-0.009	-0.008	0.004	0.021
	(0.051)	(0.047)	(0.037)	(0.041)	(0.043)	(0.041)	(0.042)
Signal at 5	0.142***	0.126***	0.103***	0.123***	0.130***	0.133***	0.140***
	(0.047)	(0.045)	(0.035)	(0.042)	(0.041)	(0.041)	(0.042)
Uninformative Bracelet	0.065	0.052	0.021	0.039	0.030	0.028	0.038
	(0.050)	(0.046)	(0.036)	(0.043)	(0.043)	(0.043)	(0.042)
Distance	-0.031***	-0.033***	-0.027***	-0.029***	-0.029***	-0.030***	-0.029***
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
Control Group mean	0.500	0.606	0.740	0.445	0.552	0.567	0.584
Observations	4897	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.695	0.706	0.989	0.173	0.281	0.487	0.620
$S_5 > 0$: p(UI = S5)	0.065	0.046	0.004	0.033	0.007	0.004	0.005
p(S4 = S5)	0.024	0.015	0.004	0.000	0.000	0.000	0.000
Joint F-Test	0.011	0.014	0.002	0.001	0.000	0.000	0.001
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the same regressions for four and five vaccines as in Panel A of Table 3, using different timeliness cut-offs. For 4 vaccines, I show results by age 4.5, 5, and 6 months. For 5 vaccines by 10, 11, 11.5, and 12 months of age. I regress the binary outcome variable on a treatment indicator for Signal at 4 and 5, with the omitted category being the Control Group. All regressions include strata-fixed effects and demeaned controls for distance to the clinic, clinic population size, the mother's ability to recall the child's last vaccine, and a vaccine-specific binary indicator that controls for the data source, i.e. whether the vaccine information was collected during the listing or follow-up survey. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B14: Effects of Signals on Timely- and Complete Vaccination by Age One Year (Variable Sample)

Dependent variable:	1 Vaccine	2 Vaccines	3 Vaccines	4 Vaccines	5 Vaccines	Total # of vaccines
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4	-0.006	0.011	0.004	0.016	0.001	0.031
	(0.009)	(0.014)	(0.025)	(0.037)	(0.041)	(0.114)
Signal at 5	0.014*	0.041***	0.074***	0.111***	0.130***	0.350***
	(0.008)	(0.013)	(0.023)	(0.034)	(0.040)	(0.106)
Uninformative Bracelet	0.008	0.021*	0.022	0.019	0.028	0.104
	(0.007)	(0.012)	(0.023)	(0.035)	(0.043)	(0.107)
Control Group mean	0.972	0.927	0.846	0.714	0.557	4.021
Observations	6569	6354	6143	5909	4923	4923
$S_4 > 0$: p(UI = S4)	0.064	0.346	0.378	0.904	0.440	0.433
$S_5 > 0$: p(UI = S5)	0.376	0.025	0.006	0.002	0.006	0.005
p(S4 = S5)	0.017	0.002	0.000	0.001	0.000	0.000
Joint F-Test	0.060	0.001	0.000	0.000	0.000	0.000
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4	0.002	0.009**	0.013	0.019	0.033	0.075
	(0.003)	(0.004)	(0.009)	(0.017)	(0.033)	(0.057)
Signal at 5	0.002	0.009**	0.019**	0.035**	0.094***	0.159***
	(0.003)	(0.004)	(0.008)	(0.016)	(0.033)	(0.057)
Uninformative Bracelet	0.003	0.010***	0.011	0.008	0.029	0.061
	(0.003)	(0.004)	(0.008)	(0.017)	(0.035)	(0.059)
Control Group mean	0.993	0.984	0.959	0.917	0.687	4.541
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.499	0.804	0.807	0.445	0.890	0.754
$S_5 > 0$: p(UI = S5)	0.547	0.950	0.225	0.075	0.031	0.039
p(S4 = S5)	0.971	0.863	0.328	0.172	0.017	0.033
Joint F-Test	0.575	0.055	0.132	0.132	0.016	0.019
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the same regression results as in Table 3, using a variable sample of all children old enough to be assessed as timely or late for each given vaccine, no matter their age at the time I last observed them. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B15: Effects of Signals on Timely- and Complete Vaccination by Age One Year (without Controls)

Dependent variable:	**1 Vaccine**	**2 Vaccines**	**3 Vaccines**	**4 Vaccines**	**5 Vaccines**	**Total # of vaccines**
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Effects of Signals on Timely Vaccination					
Signal at 4	-0.005	0.008	0.008	0.015	-0.006	0.019
	(0.008)	(0.013)	(0.024)	(0.036)	(0.040)	(0.110)
Signal at 5	0.007	0.031**	0.069***	0.098***	0.127***	0.335***
	(0.007)	(0.013)	(0.024)	(0.035)	(0.041)	(0.107)
Uninformative Bracelet	0.006	0.014	0.026	0.019	0.028	0.092
	(0.007)	(0.013)	(0.025)	(0.036)	(0.043)	(0.110)
Control Group mean	0.979	0.940	0.859	0.745	0.576	4.049
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.112	0.501	0.378	0.903	0.298	0.392
$S_5 > 0$: p(UI = S5)	0.915	0.056	0.029	0.004	0.005	0.004
p(S4 = S5)	0.087	0.009	0.001	0.002	0.000	0.000
Joint F-Test	0.288	0.015	0.003	0.002	0.000	0.000
Controls	No	No	No	No	No	No
Panel B:	Effects of Signals on Vaccination by Age One Year					
Signal at 4	0.002	0.008**	0.011	0.013	0.021	0.054
	(0.003)	(0.004)	(0.008)	(0.016)	(0.033)	(0.057)
Signal at 5	0.001	0.009**	0.018**	0.032*	0.091***	0.150***
	(0.003)	(0.004)	(0.008)	(0.017)	(0.034)	(0.058)
Uninformative Bracelet	0.002	0.009**	0.011	0.008	0.033	0.064
	(0.002)	(0.004)	(0.008)	(0.019)	(0.037)	(0.063)
Control Group mean	0.990	0.981	0.958	0.918	0.700	4.546
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.661	0.852	0.887	0.745	0.644	0.811
$S_5 > 0$: p(UI = S5)	0.571	0.936	0.285	0.093	0.041	0.051
p(S4 = S5)	0.877	0.925	0.219	0.086	0.005	0.011
Joint F-Test	0.758	0.099	0.172	0.145	0.012	0.018
Controls	No	No	No	No	No	No

Notes: This table shows the same regression results as in Table 3, without control variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B16: The Effect of Signals on Timely Vaccination, Separate by Treatment (non-absorbing definition; with controls)

Dependent variable:	**Vaccine 1** (1)	**Vaccine 2** (2)	**Vaccine 3** (3)	**Vaccine 4** (4)	**Vaccine 5** (5)	**Total # of vaccines** (6)
Signal at 4	-0.005	0.009	0.016	0.024	0.015	0.080
	(0.009)	(0.012)	(0.023)	(0.034)	(0.033)	(0.080)
Signal at 5	0.008	0.032***	0.072***	0.092***	0.087***	0.213***
	(0.007)	(0.011)	(0.022)	(0.031)	(0.033)	(0.076)
Uninformative Bracelet	0.008	0.013	0.031	0.015	0.018	0.064
	(0.007)	(0.011)	(0.022)	(0.033)	(0.036)	(0.081)
Distance	-0.003**	-0.006***	-0.015***	-0.024***	-0.016***	-0.039***
	(0.001)	(0.002)	(0.003)	(0.004)	(0.004)	(0.009)
Control Group mean	0.979	0.950	0.871	0.772	0.663	4.347
Observations	4897	4897	4897	4897	4897	4897
$S_4 > 0$: p(UI = S4)	0.097	0.719	0.438	0.777	0.922	0.795
$S_5 > 0$: p(UI = S5)	0.980	0.013	0.026	0.004	0.024	0.016
p(S4 = S5)	0.075	0.008	0.002	0.009	0.004	0.011
Joint F-Test	0.220	0.003	0.002	0.003	0.010	0.006
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the same regression results as in Panel A of Table 3, but timeliness for each vaccine is assessed independently from timeliness of previous vaccines. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B17: Additional Information on Bracelet Retention and Correct Hand Out

Dependent variable:	**Child wears bracelet**	**Bracelet was exchanged**	**Child lost bracelet**		
			Full Sample	3.5-6.5 months	9-12 months
	(1)	(2)	(3)	(4)	(5)
Signal at 4	-0.067	0.033	0.024	0.064	0.031
	(0.062)	(0.073)	(0.047)	(0.059)	(0.080)
Signal at 5	-0.018	-0.083	-0.080*	-0.051	-0.151**
	(0.059)	(0.068)	(0.041)	(0.048)	(0.072)
Uninformative Bracelet mean	0.397	0.633	0.213	0.124	0.319
Observations	3278	613	803	250	283
p(S4 = S5)	0.451	0.125	0.002	0.014	0.007

Notes: This table shows results from a linear probability model of the binary outcome variables for a child wearing a bracelet during the listing survey (column 1), whether a child's bracelet was exchanged when she came for vaccine 4 or 5 (column 2), and whether a child had lost her bracelet at endline (column 3-4), on Signal at 4 and Signal at 5 treatment indicators, with the Uninformative Bracelet as the omitted category. Column (1) includes children that were born during the experiment, surveyed during the listing, and for whom surveyors could see the wrist of during the survey. The sample in used for (2) does the same but conditions on a child having received four or five vaccines (as otherwise the child would not have been eligible for an exchange of the bracelet). The sample used for (3)-(5) includes all endline respondents in bracelet treatments. Columns (4) and (5) include children 3.5 to 6.5 and 9 to 12 months old, as these are the ages at which children would have most recently received their signaling bracelet in Signal at 4 and Signal at 5, respectively. When asking parents during endline, why the child is not wearing the bracelet, the most common answer was that they are afraid of the child losing the bracelet by biting on it or playing with it. Parents further report that the child wears the bracelet when going to the clinic or on special occasions, when visiting relatives or at community events. All regressions include strata-fixed effects and demeaned ANC dummies to control for the design of the experiment. Standard errors are clustered bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B18: Aggregate Beliefs

Dependent variable:	**Vaccine 1** (1)	**Vaccine 2** (2)	**Vaccine 3** (3)	**Vaccine 4** (4)	**Vaccine 5** (5)
Signal at 4	0.213	0.495*	0.425	0.463	0.442
	(0.239)	(0.272)	(0.277)	(0.285)	(0.318)
Signal at 5	0.279	0.515*	0.505*	0.355	0.453
	(0.244)	(0.272)	(0.291)	(0.298)	(0.328)
Uninformative Bracelet	-0.115	0.158	0.279	0.153	0.237
	(0.263)	(0.303)	(0.283)	(0.295)	(0.307)
Control Group mean	8.991	7.783	7.022	6.454	5.547
Observations	1255	1255	1255	1255	1255
$S_4 > 0$: p(UI = S4)	0.111	0.201	0.581	0.298	0.528
$S_5 > 0$: p(UI = S5)	0.054	0.162	0.410	0.513	0.513
p(S4 = S5)	0.690	0.923	0.753	0.703	0.973
Joint F-Test	0.226	0.163	0.331	0.397	0.450
Controls	Yes	Yes	Yes	Yes	Yes

Notes: This table shows for 1,255 endline respondents their beliefs about how many out of 10 fellow community members would take their child for immunization to the clinic. We exclude the answers of 59 respondents, for whom enumerators indicated that they did not understand the question. The bottom rows give the p-values from a test that the effect of the Uninformative Bracelet (UI) is equivalent to the effect of Signal at 4 (S4) or of Signal at 5 (S5), and that the effect of Signal at 4 is equivalent to the effect of Signal at 5. The last row is a joint hypothesis test of all three bracelet treatments. All regressions include strata-fixed effects and demeaned controls for the age of the mother, whether her primary economic activity is farming, her level of education, as well as the birth order of the child. Standard errors are cluster bootstrapped (1000 repetitions) at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B19: Correlation of Distance and Socio-Economic Characteristics

Dependent variable:	**3 Vaccines** (1)	**4 Vaccines** (2)	**5 Vaccines** (3)	**3 Vaccines** (4)	**4 Vaccines** (5)	**5 Vaccines** (6)
Distance 1 mile	0.034	0.003	-0.019	0.052	0.023	-0.015
	(0.048)	(0.054)	(0.069)	(0.048)	(0.051)	(0.069)
Distance 2 miles	-0.043	-0.070	-0.109	-0.041	-0.066	-0.109
	(0.045)	(0.058)	(0.071)	(0.042)	(0.053)	(0.071)
Distance 3 miles	-0.015	-0.035	-0.084^{*}	-0.022	-0.042	-0.076
	(0.032)	(0.036)	(0.047)	(0.032)	(0.035)	(0.048)
Distance 4 miles	-0.024	-0.052	-0.125^{*}	-0.019	-0.049	-0.126^{*}
	(0.046)	(0.051)	(0.068)	(0.042)	(0.046)	(0.066)
Distance 5 miles	-0.130^{**}	-0.157^{**}	-0.129^{*}	-0.132^{**}	-0.165^{***}	-0.132^{*}
	(0.057)	(0.068)	(0.072)	(0.053)	(0.061)	(0.076)
Child age				0.000^{***}	0.000^{***}	0.000
				(0.000)	(0.000)	(0.000)
Birth order				-0.017	-0.035^{**}	-0.035^{*}
				(0.013)	(0.015)	(0.021)
Mother age				-0.000	0.002	0.005
				(0.003)	(0.003)	(0.004)
Floor cement				0.050^{**}	0.063^{**}	0.068
				(0.025)	(0.029)	(0.042)
Roof corrugated iron				-0.046	-0.040	0.029
				(0.037)	(0.051)	(0.063)
Has any education				0.021	0.029	0.067^{**}
				(0.018)	(0.021)	(0.028)
Works on farm				0.078^{*}	0.095^{*}	0.078
				(0.045)	(0.054)	(0.091)
Trader				0.065	0.041	0.034
				(0.045)	(0.060)	(0.095)
Constant	0.837^{***}	0.765^{***}	0.755^{***}	0.681^{***}	0.521^{***}	0.506^{***}
	(0.027)	(0.028)	(0.033)	(0.094)	(0.112)	(0.147)
Outcome Mean	0.837	0.765	0.755	0.681	0.521	0.506
Observations	1101	1033	668	1101	1033	668

Notes: This table shows the effect of distance on timely completion of 3, 4, and 5 vaccines comparing treatment effects from regressions without and with covariates. The sample includes all children (age 4 months and above, to be counted for vaccine 3 etc.) whose parents were surveyed at endline and for whom I therefore observe socio-economic characteristics. Columns (1)-(3) show regression results without covariates, and columns (4)-(6) results with covariates. The covariate child age is coded in days, mother age in years; the variable birth order takes values 1 through 6. The variables Floor cement, Roof corrugated iron, Has any education, Works on farm and Trader are indicator variables that take value one if the respondent's floor is made of cement etc. and zero otherwise. The distance variable takes the values 0 to 5 miles. All regressions include strata-fixed effects. Standard errors are clustered at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B20: Test of the Equality of Distance Coefficients from Table B19

	Distance 1 mile	**2 miles**	**3 miles**	**4 miles**	**5 miles**
	(1)	(2)	(3)	(4)	(5)
5 Vaccines	-0.007	0.000	-0.012	0.000	0.004
	(0.016)	(0.014)	(0.012)	(0.017)	(0.015)
Observations	668	668	668	668	668
4 Vaccines	0.007	0.006	-0.002	0.006	0.000
	(0.007)	(0.008)	(0.008)	(0.010)	(0.010)
Observations	1033	1033	1033	1033	1033
3 Vaccines	0.002	0.001	-0.004	-0.002	-0.002
	(0.005)	(0.006)	(0.006)	(0.008)	(0.007)
Observations	1101	1101	1101	1101	1101

Notes: This table tests for the equality of the coefficients from the regressions of 3, 4, and 5 vaccines on distance dummy variables with and without covariates (see B19), using seemingly-unrelated estimation. The table displays the difference in coefficients and associated p-values. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C Additional Information on Sampling

Sampling of Endline Respondents

I used the listing data (N = 14,061 children) as sampling frame for endline respondents. Before randomly drawing the mothers to be surveyed, I restricted the sample, excluding:

- Children who had permanently moved or were traveling at the time of the listing exercise and were therefore not present in the community, or had died (N = 1,975).
- Children who did not attend any of the study clinics for immunization services. This was the case for communities where multiple clinics were accessible at a similar walking distance. Mothers would normally go for immunization services at the same clinic where they went for prenatal care (N = 1,330).
- Children who were born before January 1, 2017, that is, before the experiment started in all 120 clinics and all selected communities were visited for information meetings (N= 4,812).
- Communities with fewer than three babies (N = 127).

This resulted in a final sample of 5,817 children across 490 communities. I then applied a two-stage randomization: Firstly, I randomly drew four communities for each clinic, stratified by distance, two close and two far communities. Since some clinics had fewer than four communities, this led to a sample of 401 communities, with 205 close and 196 far communities across 120 clinics. Secondly, I randomly drew 10 mothers from the set of close communities and 10 mothers from the set of far communities for each clinic (i.e. 20 mothers per clinic). From the set of ten mothers, I randomly selected six mothers to be surveyed and four mothers to serve as replacements in case a mother could not be found, moved or was deceased. In total 1,323 mothers across 383 communities were surveyed at endline, with a mean of 11 respondents, balanced across arms. In my analysis, I exclude one clinic in Western Area Rural which had serious implementation issues, resulting in a final endline sample of 1,314 respondents.

Follow-up Sample Attrition

I test for differences in vaccination behavior between children who attrited at follow-up and those I was able to resurvey. I do so by looking at their vaccination outcomes for vaccines one through four at the time of the listing, that is, when I observed both groups. If children who are less likely to respond to the bracelet incentives, are more likely to attrit, my treatment effect estimates would be biased upward. Table C1 suggests that this concern is unwarranted. Control Group children who were found at follow-up are on average more likely to be vaccinated timely for vaccines one, two and four, compared to those who attrited. Yet, there are no significant differences in treatment effects between found and attrited children for Signal at 4 and the Uninformative Bracelet. For Signal at 5, treatment effects for found children are slightly smaller compared to attrited children for vaccines one and two, suggesting that, if anything, attrition would lead me to finding smaller impacts for Signal at 5.

Table C1: Differences in vaccination outcomes between attrited and non-attrited children at the time of the listing

Dependent variable:	**Vaccine 1** (1)	**Vaccine 2** (2)	**Vaccine 3** (3)	**Vaccine 4** (4)
Found	0.035**	0.055**	0.018	0.074*
	(0.014)	(0.022)	(0.032)	(0.043)
Uninformative Bracelet	-0.012	0.017	-0.009	0.005
	(0.017)	(0.030)	(0.044)	(0.051)
Signal at 4	-0.011	0.008	-0.013	-0.004
	(0.019)	(0.030)	(0.042)	(0.054)
Signal at 5	0.020	0.051*	0.067	0.128**
	(0.017)	(0.029)	(0.041)	(0.053)
Found × Uninformative Bracelet	0.003	-0.017	0.056	-0.023
	(0.019)	(0.033)	(0.051)	(0.062)
Found × Signal at 4	-0.013	-0.008	0.051	0.028
	(0.019)	(0.027)	(0.043)	(0.063)
Found × Signal at 5	-0.042**	-0.050*	0.001	-0.026
	(0.019)	(0.030)	(0.048)	(0.061)
Not found in Control Group	0.954	0.884	0.791	0.606
Observations	3462	2914	2443	1933

Notes: This table shows results from a linear probability model of a binary outcome variable for a child being vaccinated timely for 1, 2, 3, or 4 vaccinations on the interaction between a binary indicator that is one if the child was found and surveyed at follow-up, and zero otherwise (i.e. if moved or traveled, deceased or not found). Among the 5,030 children that were followed up, 3,462 children were 3 months or older at the time of the listing survey and I therefore observe their vaccination outcomes. Standard errors are clustered at the clinic level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D Implementation Materials

Social Incentives for Child Immunization

Instruction and messaging card

Give out bracelets to babies that are 15 months or younger and come for immunization.

Schedule	Bracelet type	Comment
Hand out BRACELET at **1^{st} visit: BCG**	**1^{st} visit** **1^{st} visit**	**Give YELLOW OR GREEN BRACELET** to EVERY CHILD that comes OR already came for **1^{st} vaccine visit.** Allow the caregiver to choose the preferred color.
Exchange BRACELET at: **4^{th} and 5^{th} visits:** **- Penta3** **- Measles I**	**1^{st} visit** **1^{st} visit**	**EXCHANGE the previous BRACELET for a NEW ONE of the SAME color at EACH of the 4^{th} and 5^{th} vaccine visit.**

Please give the following messages to the caregiver.

Show the bracelets to the caregiver and say – we give the YELLOW or GREEN bracelet for the 1^{st} vaccine visit. The bracelets have 1^{st} visit written on them.

YELLOW or GREEN BRACELET – FOR 1^{st} vaccine visit

At BCG	• I give you the YELLOW / GREEN bracelet because you came for 1^{st} vaccine visit. • When you come onto the 4^{th} and 5^{th} vaccine visit I will exchange the bracelet to a NEW one of the same color.
At Penta1, Penta2, Penta3, Measles I or II	• I give you the YELLOW / GREEN bracelet **not** because of this visit but because you came for 1^{st} vaccine visit. • When you come onto the 4^{th} and 5^{th} vaccine visit I will exchange the bracelet to a NEW one of the same color.

YELLOW or GREEN BRACELET – FOR EXCHANGE at 4^{th} or 5^{th} vaccine visit

At Penta3, Measles I	• I exchange your bracelet to a new one of the same color because you came for the 4^{th} / 5^{th} vaccine visit.

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Figure D1: Clinic Staff Messaging Cards, Uninformative Bracelet

Social Incentives for Child Immunization

Messaging card

Please give the following messages to caregivers.

Show the bracelets to the caregivers and say – we give the YELLOW bracelet for the 1^{st} vaccine visit; we give the GREEN bracelet to a child that comes TIMELY for 4^{th} vaccine visit. The bracelets have 1^{st} and 4^{th} visit written on them.

YELLOW BRACELET – FOR 1^{st} vaccine visit

At BCG	• I give you the YELLOW bracelet because you came for 1^{st} vaccine visit. • When you come TIMELY onto the 4^{th} vaccine visit I will exchange the bracelet to a GREEN bracelet.
At Penta1, Penta2	• I give you the YELLOW bracelet **not** because of this visit but because you came for 1^{st} vaccine visit. • When you come TIMELY onto the 4^{th} vaccine visit I will exchange the bracelet to a GREEN bracelet.

GREEN BRACELET – For TIMELY 4^{th} vaccine visit, at 14 weeks (~3.5 months)

At Penta3	• I give you the GREEN because you came ON TIME for the 4^{th} vaccine visit. • When you come for the 5^{th} vaccine visit I will exchange the bracelet to a NEW one of the same color.
At Measles I or II	• I give you the GREEN **not** because of this visit but because you came ON TIME for the 4^{th} vaccine visit. • When you come for the 5^{th} vaccine visit I will exchange the bracelet to a NEW GREEN bracelet.
Defaulter Message	
At Penta3, Measles I or II	• You don't get GREEN bracelet because you did **not** come ON TIME for 4^{th} vaccine visit. I give you a NEW YELLOW. • When you come for the 5^{th} vaccine visit I will exchange the bracelet to a NEW YELLOW bracelet.

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Figure D2: Clinic Staff Messaging Cards, Signal at 4

Social Incentives for Child Immunization

Messaging card

Please give the following messages to caregivers.

Show the bracelets to the caregivers and say – we give the YELLOW bracelet for the 1st vaccine visit; we give the GREEN bracelet to a child that comes TIMELY for 5th vaccine visit. The bracelets have 1st and 5th visit written on them.

YELLOW BRACELET – FOR 1st vaccine visit

At BCG	• I give you the YELLOW because you came for 1st vaccine visit. • When you come TIMELY onto the 5th vaccine visit I will exchange the bracelet to a GREEN bracelet.
At Penta1, Penta2, Penta3	• I give you the YELLOW bracelet **not** because of this visit but because you came for 1st vaccine visit. • When you come TIMELY onto the 5th vaccine visit I will exchange the bracelet to a GREEN bracelet.

GREEN BRACELET – For TIMELY 5th vaccine visit, at 9 months

At Measles I	• I give you the GREEN because you came ON TIME for the 5th vaccine visit.
At Measles II	• I give you the GREEN **not** because of this visit but because you came ON TIME for the 5th vaccine visit.
Defaulter Message	
At Measles I or II	• You don't get GREEN bracelet because you did **not** come ON TIME for 5th vaccine visit. I give you a NEW YELLOW bracelet.

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Figure D3: Clinic Staff Messaging Cards, Signal at 5

Notes: In both Signal at 4 and Signal at 5, clinic staff were told to continue reminding parents of their children's due dates as they would normally do (e.g. to come for vaccine five at 9 months of age, as indicated on the messaging cards), but allow for a small delay in vaccination when giving out the green bracelet, as per the design's timeliness cut-offs (Figure 1).

Social Incentives for Child Immunization

General rules for bracelet distribution

Actions to be taken by the clinic staff, please.

If the baby loses the bracelet:

- Register the baby in the Pikin Register, as you would normally do. And indicate bracelet loss with “L” in column of bracelet color.
- Do NOT replace the bracelet!
- Tell mother to bring the lost bracelet to the clinic if she finds it and say that you will exchange it for new one then.

If the baby left the bracelet at home:

- Do NOT give the baby a new bracelet!
- If the baby is due for a bracelet exchange, tell mother that bracelet will be exchanged when she comes back with the old bracelet.

If baby’s parent does not want baby to wear the bracelet:

- Register the baby in the Pikin Register, as you would normally do. And indicate bracelet refusal with “R” in column of bracelet color.
- Explain to caregiver that bracelet is meant to help remind her/him to take the child for immunizations.

If baby comes with bracelet from other baby:

- Verify that the bracelet is not the baby’s bracelet but belongs to another child.
- Take the bracelet from the child and keep it in the bracelet return back. Give the child its own correct bracelet.

If baby’s parent prefers the other color:

- Tell the parent you give out the bracelet according to set RULES. Go to messaging card and read out the message.

SICI 2016

Figure D4: General Rules for Handout of Uninformative, Signal at 4 and Signal at 5 Bracelets

Sensitization on Child Immunization

ARM 1

Sensitization on Child Immunization

- New programme for pikin immunization implemented by the Ministry of Health and Sanitation through the Child Health/EPI Programme and District Health Management Team (DHMT). Innovations for Poverty Action (IPA) supports MoHS and DHMT with the implementation and research on program.
- IPA is a research organization based in Freetown. IPA has done extensive work alongside Government Ministries in Health, Agriculture and Education.

Facilitator Please Note

- That you must have your sensitization assessment community form open and fill it alongside
- Encourage participation by all
- Moderate the training very well and focus more on the key areas

The Key Idea

- The MoHS and clinic staff in partnership with IPA, have agreed to engage in community awareness raising and sensitization on immunization as a way to encourage caregivers to take their children for timely and complete immunization.

Importance of Immunization

- Some people may not exactly know how valuable immunizations are for a child and the community's health and well-being.
- Immunizations can prevent your child from diseases.
- It will make your child grow healthy.
- It reduces household spending on seeking health care services when the child falls ill.
- It reduces the spread of diseases among children and other community members.
- Every caregiver should take their child for 6 immunization visits between 0 to 15 months old. Plus another 2 visits for Vitamin A and deworming pills.

Immunization Schedule

- **Facilitator:** explain the immunization schedule to the participants. **Showing the growth card** and when immunizations are at the clinic.

Figure D5: Script for Information Meetings in Control Group Communities

What are the barriers to Immunization

Facilitator: Ask them to come up with reasons why people don't bring their children for immunization. You can add the following if not mentioned by a participant:

1) Ignorance about the importance of immunization
2) Forgetfulness about the dates to come for vaccine
3) Little interest in child issues
4) Transport cost for long distances

7

What are the barriers to Immunization

- 5) Laziness
- 6) Too busy with other work
- 7) Supply related issues, vaccine not in stock, nurse not around
- 8) Afraid of needles or perceived side effect
- 9) Cultural beliefs about vaccinations

8

Addressing the barriers to immunizations

- **Facilitator** ask: Do caregivers in your communities face some or all of the challenges outlined? Have them discuss these points and state which are relevant in their own communities.
- If yes: How can we address them in a non-punitive way?

- **Facilitator:** Allow them to come up with suggestions.

9

Recap on Presentation

- Now we want to go over what we discussed so far.
- Recap on the importance of immunizations.
- Recap on the challenges on immunizations and its solution.
- Recap on the number of vaccine visits and schedule.

10

Dissemination Strategy

- Now we are about to talk on how to take the awareness raising and sensitization information to other members of our community so everyone will learn and know about the immunizations.

Facilitator: Ask participants on what ways they may want to pass the sensitization message to others?

11

Concluding Statements

- Clinic in-charge or any staff (if Central VDC meeting)
- Rep from community (if Community meeting)
- Village chief
- Facilitator

12

Social incentives for Child Immunization

ARM 4

1

Social incentives for Child Immunization

- New programme for pikin immunization implemented by the Ministry of Health and Sanitation through the Child Health/EPI Programme and District Health Management Team (DHMT). Innovations for Poverty Action (IPA) supports MoHS with the implementation and research on program.
- IPA is a research organization based in Freetown. IPA has done extensive work alongside Government Ministries in Health, Agriculture and Education.

2

Facilitator Please Note

- That you must have your sensitization assessment community form open and fill it alongside
- Encourage participation by all
- Moderate the training very well and focus more on the key areas

3

Immunization Schedule

- **Facilitator:** explain the immunization schedule to the participants. **Showing the growth card** and when immunizations are at the clinic.

4

Bracelets as Social Incentives

- The MoHS, DHMT and clinic staff in partnership with IPA, have agreed to introduce colorful bracelets as an encouragement for caregivers to take their children for timely and complete immunization.
- Bracelets will be given as token of recognition for certain vaccine visits to show that child has progressed well in the schedule.

5

How are the bracelets given out?

Clinic staff have full instructions on how to give the bracelets to the children.

- A yellow bracelet is given for the 1st immunization visit a child makes. The yellow bracelet shows the child has successfully begun immunizations.
- A yellow bracelet is given for the 1st immunization visit a child has made.
- A green bracelet is given for a TIMELY 5th immunization visit a child makes. The green bracelet shows that the child has progressed well in the schedule.
- A green bracelet is given for a TIMELY 5th immunization visit a child has made.

6

Figure D6: Script for Information Meetings in Bracelet Communities

How is the bracelet exchanged?

- The yellow bracelet will be exchanged to a new yellow bracelet, when the child comes for 4th visit.
- The yellow bracelet will be exchanged to a green bracelet when the child comes TIMELY for the **5th visit** and brings the yellow bracelet.
- The yellow bracelet will NOT be exchanged for a green bracelet if the child comes late for the 5th visit. Instead, the child will receive a new yellow bracelet.
- Every child who comes for immunization to the clinic will receive a bracelet.

7

What do the bracelets mean?

- When you see a child with yellow bracelet, it means the child has gone for at least 1st visit for immunization. The child has begun immunizations.
- When you see a child with green bracelet, it means the child went on time for timely 5th visit for immunization. You will not be able to tell whether the child has come for 6th immunization visit.
- It is the caregiver's and everyone's responsibility to ensure their children are immunized.
- ANY Questions!

8

The Bracelet Song

- The bracelets come with a song to remind caregivers and everyone on what the bracelets are for and how they are given.

9

Role Play

- Now we are going to have a drama that will further explain what the bracelet stands for and how it should be given.
- Facilitator and Female Member role play.
- Facility and a Male role play.
- Ask participants what they learned from the role play.

10

Dissemination Strategy

- Now we are about to talk on how to take the bracelet information to other members of our community so everyone will learn and know about the bracelet.
- **Facilitator:** Ask participants on what ways they may want to pass the sensitization message to others?

11

Importance of Immunization

- Some people may not exactly know how valuable immunizations are for a child and the community's health and well-being.
- Immunizations can prevent your child from diseases.
- It will make your child grow healthy.
- It reduces household spending on seeking health care services when the child falls ill.
- It reduces the spread of diseases among children and other community members.
- Every caregiver should take their child for 6 immunization visits between 0 to 15 months old. Plus another 2 visits for Vitamin A and deworming pills.

12

What are the barriers to Immunization

Facilitator: Ask them to come up with reasons why people don't bring their children for immunization. You can add the following if not mentioned by a participant:

1) Ignorance about the importance of immunization
2) Forgetfulness about the dates to come for vaccine
3) Little interest in child issues
4) Transport cost for long distances

13

What are the barriers to Immunization

- 5) Laziness
- 6) Too busy with other work
- 7) Supply related issues, vaccine not in stock, nurse not around
- 8) Afraid of needles or perceived side effect
- 9) Cultural beliefs about vaccinations

14

Addressing the barriers to immunizations

- Facilitator Ask: Do caregivers in your communities face with some or all of the challenges outlined?
- If yes: How can we address them in a non-punitive way?

- Facilitator: Allow them to come with suggestions.

15

Concluding Statements

- Clinic in-charge or any staff (if Central VDC meeting)
- Rep from community (if Community meeting)
- Village chief
- Facilitator

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