Learning From Neighbors:

Social Learning About Child Feeding During Diarrheal Episodes

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ABSTRACT. Population-level behavior change requires information and new ideas that spread beyond the confines of targeted beneficiaries of programmatic interventions. Using Demographic and Health Surveys (DHS) data from six countries (Bolivia, Indonesia, Madagascar, Nepal, the Philippines and Tanzania), we examine mothers' ability to correctly respond to the question regarding whether a child with diarrhea should be given more fluids, the same amount of fluids, or less fluids. Controlling for usual correlates—including women's education, media exposure, number of children, age, and household economic status—we find that the fraction of a woman's neighbors (that is, those in the same sampling cluster) that answer correctly substantially raises the likelihood that the woman herself will also respond correctly. With a single cross section it is difficult to determine whether this represents direct social learning or some other cluster specific effect, for example, that all neighbors were exposed to the same conditions. However, there are two pieces of evidence that strongly suggest direct social learning as an explanation. First, the impact is much smaller and (in Bolivia, Nepal and Tanzania) insignificant in urban areas. Second, controlling for all other cluster characteristics—including average education and wealth—does not drive out the direct cluster less household knowledge term. Broad-based impact depends in part upon development professionals' ability to understand and encourage knowledge diffusion and social learning about optimal health behaviors.

Introduction

Population-level improvements in health depend not only upon the extent to which direct beneficiaries of development programs accept new ideas about behaviors, but also upon the spread of information to the general population. Information transmission occurs through a variety of channels including behavior change, communication activities mounted by public and private entities, and interpersonal communication. While policy makers and program planners are able to design and disseminate information to select audiences, they have generally been less successful at identifying and capitalizing upon social networks to bring about large-scale diffusion of information and behavior change. This may be so because social networks and the diffusion of innovations are poorly understood (Goldman, Pebley and Beckett 2001 note there has been little demographic research on the diffusion of innovative health ideas in "Southern" countries). Additionally, programs may fail to explicitly encourage direct program beneficiaries to share new health knowledge with others. In this paper, we examine the issue of diffusion of health information and show that women whose neighbors possess correct information about how much children should drink during episodes of diarrhea are themselves much more likely to be knowledgeable about fluid intake during illness episodes. We also show this association persists even after adjusting for such individual and household correlates as maternal age, education, media exposure, and household economic status as well as cluster level observables.

I) Framework and review of the literature

This section lays the groundwork for examining the impact of neighbor's knowledge on one's own knowledge. We first provide several simple definitions and a review of the existing literature on diffusion of information and adoption of new practices.

I.A) Framework

While we are interested in the broad question of how individuals come to adopt useful innovations on the basis of new information and what role direct, individual-to-individual transmission of new information plays in changing practices, we begin with a much narrower question. The narrower, empirically feasible, question we address is how individuals' *reported* beliefs about a *question of fact* are related to the reported beliefs of their neighbors. Even for this limited objective we need a framework for describing how individuals' beliefs are affected by the receipt of messages from various sources.

Beliefs and messages. If we start with a simple factual proposition X, we can characterize the belief of person P in proposition X by an intensity score $B^P(X)$ that ranges from zero (maximal certainty that X is false) to 1 (maximal certainty that X is true), with 0.5 implying no belief at all. Person P's beliefs will depend on his or her experience (E) and on messages (M) from various sources. The extent to which messages will change person P's beliefs depends on the credibility for P of source J with respect to the topic area of X:

$$B^P(X(E,\mathbf{B},\mathbf{M}) \mid M^J(X)) - B^P(X(E,\mathbf{B},\mathbf{M})) = f(\textit{credibility } J, Z)$$

Suppose further that individuals report that their belief exceeds some threshold, B. The likelihood that P learns "X is true" via direct social connections depends on the likelihood

of the true message and the credibility of the source. The likelihood that someone to whom P is socially connected transmits a true message about X to P is a function of the number of connections P has, the intensity of the connection (where intensity is measured by the frequency of communication), and the likelihood that the person to whom P is connected possesses the correct information. Person P's belief in the message is also a function of the credibility that P places in the source of the message with regard to the topic of X.

The source of information also affects individuals' exposure to and use of new knowledge. Impersonal sources of information, including mass media, generally reach more individuals and can be particularly effective in creating knowledge and establishing social norms. Alternatively, interpersonal communication such as support groups and household visits by health promoters, as well as other forms of interpersonal contact, is likely to reach fewer people but may be more strongly associated with improved knowledge and health behaviors (Goldman et al., 2001).

From belief to practices. Accepting information and adopting new behaviors are complex processes that, according to diffusion theory include knowledge, persuasion, decision-making, implementation and confirmation (Rogers, 1995)[1]. Numerous studies indicate that knowledge does not necessarily translate into practice (Pinfold, 1999; Stanton and Clemens, 1987; Curtis et al., 1993). In a study about HIV/AIDS prevention among US youth, Middlestadt and colleagues (1996) identified a range of determinants of consistent condom use—including perceptions about the consequences of using a condom, facilitators and barriers to condom use, and social norms. As Rogers points out

[1] We are aware of Manski's (1993) argument that we have not isolated endogenous from exogenous social effects. Despite this lack of identification, this paper reports striking empirical results, subject to available data.

(1995), consequences are the perceived changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation. Historically, program planners and implementers, including change agents at the field level, have assumed that the consequences of engaging in a given behavior will be perceived as positive. Consequently, individuals' perceptions of consequences are often ignored (Rogers, 1995). Additionally, consequences may be difficult to measure. Likewise, survey research methods may be inappropriate for fully assessing the range of consequences associated with engaging in a particular behavior.

Most individuals evaluate an innovation not on the basis of scientific research by experts, but through subjective evaluations of near-peers who have adopted innovations (Rogers, 1995). Previous research (Rogers, 1995) indicates that individuals are more likely to hear about information if their networks are large, are centrally located within local social networks, and are composed of weak ties with others who are differently positioned in the social structure. In contrast, members of dense networks usually receive little information from outside sources. Because they often hear of innovations later, they are generally late adopters (Valente, 1995).

Even if individuals possess correct information, they may not practice a given behavior if the innovation itself is difficult to understand and not "trialable." Moreover, if the results of trying an innovation are not clearly visible to others, individuals are less likely to attempt a new practice. In our case, the innovation (giving the same amount or more liquids during episodes of diarrhea) is easy to understand and trialable, but results are difficult to monitor.

I.B) Empirical Literature on social diffusion of information

Several authors (Valente, 1995; Rogers, 1995; Watts, 1999) provide an extensive review of the literature on diffusion of information. In brief, numerous traditions—including anthropology, sociology, public health, marketing, and geography—have contributed to a greater understanding of information-sharing about new ideas. Much of the anthropological literature focuses on the intercultural transfer of technology and the consequences for societies of adopting new innovations. Historically, sociology has concentrated on the innovation-decision process, roles of communication sources in conveying information, differing rates of adoption and the characteristics of various adopter categories. More than 50 years after publication, a study on the diffusion of hybrid corn in Iowa (Ryan and Gross, 1950) continues to influence research methods and thinking about the diffusion of innovations. Findings from public health research on diffusion of innovations indicate that early adopters transmit experiences through interpersonal networks and influence the rate of acceptance of later adopters.

Family Planning. A considerable subset of public health literature focuses on information-sharing regarding family planning. Berelson and Freedman's classic study in Taiwan (1964) points to the importance of interpersonal communication (including home visits by change agents) in increasing the use of family planning methods and in reducing pregnancy rates. Their research underlines the importance of developing a critical mass of individuals who can generate personal motivation and social support for adoption of innovations. The marketing literature distinguishes between the influences of mass media and interpersonal, word-of-mouth contact. Marketing tools forecast adoption of innovations. Social marketing uses marketing to encourage individuals to purchase

products such as oral rehydration salts and family planning methods (including condoms) and to adopt other healthy behaviors. Among other contributions, geography elucidates how space affects diffusion. Given the breadth of research on family planning and the relevance of changes in health practices to improving liquid intake during episodes of diarrhea, we briefly review findings from studies in both disciplines.

Rogers and Kincaid (1981) report that in Korea, individuals whose discussion networks largely adopted contraception were themselves far more likely to contracept than individuals whose networks had not tried family planning. Montgomery and Casterline (1993) study the evolution of attitudes towards family planning and show that reference groups play an important role in the spread of information and women's adoption of family planning methods. While these studies point to the importance of social influences, it is not clear whether the effect was via social contacts who conveyed factual information or whether the social contacts modified preferences directly, for example, by demonstrating the benefits of smaller families. In the case of Taiwan, the evidence is not clear; however, Montgomery and Casterline (1993) conjecture that information about new forms of fertility control must have been the dominant theme initially, followed by the social and economic benefits of smaller families.

It may be that couples' level of discussion with reference group members—as opposed to their perceptions of the contraceptive behavior of the reference group—plays a greater role in influencing beliefs and behaviors. Evidence from Kenya (Rutenberg and Watkins, 1997) indicates that the discussions women have with others about family planning are detailed and of sufficient depth that individuals learn of others' opinion about and use of family planning. Rutenberg and Watkins (1997) also point out that the

source of information and social proximity are important determinants of whether women use family planning. In Kenya, nurses are seen as crucial resources for complicated technical information clients need in order to use methods correctly. However, providers are socially distant from rural women. As a result, women often consult women whose bodies and circumstances are more like their own.

Hygiene Practices. In contrast to the successful introduction of the intrauterine device in Taiwan, several early seminal studies on hygiene indicate that innovative behaviors did not become widely diffused. Wellin (1955) describes the efforts of change agents who worked intensively for two years to encourage Peruvian mothers to boil their water. Change agents were only able to convince 5% of caregivers to boil their water. Wellin (1955) conjectures that culture played an important part in discouraging local residents from boiling water. Boiled water was considered "hot" and consequently, appropriate only for the sickly. A more recent study from Egypt (Belasco, 1989) suggests that few women used pumps to obtain clean water, opting instead for dirty canal water. Women failed to adopt this technological innovation for a variety of reasons. Not nearly as many pumps were installed as originally promised. Pumps broke and were not fixed. Water had a "chemical" or "medicinal" taste to users and was perceived to weaken sex drive and contribute to infertility. Additionally, obtaining water meant waiting in long lines.

In a study on communication channels for promoting hygiene behaviors in Thailand, Pinfold (1999) found that school children were the only message channel that showed a significant association with behavior change. Pinfold (1999) also notes that

some villages had a particularly strong sense of community spirit and that in such villages, the task of promoting hygiene behaviors was relatively easy.

In a study on the diffusion of ideas about personal hygiene in Guatemala, Goldman and colleagues (2001) distinguish between interpersonal and impersonal contacts as mechanisms for sharing information and influencing norms. Results from their research provide evidence of diffusion through social contacts, particularly through interpersonal exchanges. For example, interpersonal ties (including whether the respondent had relatives abroad or in the capital and whether the respondent or a family member was active in community organizations) were important determinants of beliefs about hygiene and contamination, even after adjusting for women's education, socioeconomic status, ethnicity, and a range of community characteristics, including migration abroad, bus service and distance to Guatemala City. Goldman et al (2001) also found that interpersonal social contacts both within and outside of the community significantly increased the likelihood that women attribute diarrhea to contamination (pathogen-related) but not to hygiene (dirtiness). With respect to the impact of social contacts on actual hygiene behaviors, only one measure of interpersonal contact (having relatives abroad or in Guatemala City) was associated with observed cleanliness. However, a range of community-level variables (regular bus service, living in larger areas and residing in areas closer to Guatemala City) were linked with cleanliness.

I.C) The Programmatic Literature on Diffusion of Information

Results from several applied research studies indicate minimal spread of information or subsequent behavior change. For example, Munshi and Myaux (2003) use programmatic family planning data in Bangladesh to argue that the existence of multiple equilibria cause individuals to respond slowly to external interventions, while communities have widely varying responses to the same stimulus. In a study on the impact of Freedom from Hunger's "credit with education" strategy in Ghana, MkNelly and Dunford (1998) found little evidence suggesting spillover of knowledge and behaviors between members of credit groups and women from the same villages who did not participate in credit groups. Non-participants from program communities were about as likely as controls to be knowledgeable about a range of health behaviors and to practice those behaviors. On the other hand, credit group members were considerably more likely than non-participants from program communities and controls to practice optimal behaviors including giving colostrum, waiting to introduce water and watery foods into the child's diet, using a bottle to feed their infants, and giving oral rehydration salts (ORS) solution to children suffering from diarrhea. Results from a Save the Children study in Mali (Castle, 1997) provide similar results. Non-participants from program communities and controls were about as likely to hear about and be able to recite the recipe for ORS, to give ORS, to know the causes of malaria and to practice good hygiene. Alternatively, children who participated in Save the Children's village school program were considerably more likely to possess correct information about each of these topics and to practice optimal health behaviors.

Findings from a study on the impact of mother-to-mother support groups in Guatemala by Dearden and colleagues (2002) indicate that after approximately one year, La Leche League staff members were able to improve rates of exclusive breastfeeding among mothers who directly participated in League activities. However, there were few differences in breastfeeding behaviors—including any breastfeeding, current breastfeeding, exclusive breastfeeding, and bottle use—between program and control communities overall, suggesting little spillover effect, at least in the short-term.

II. Using Feeding During Diarrheal Episodes to Examine Social Learning

The standard Demographic and Health Surveys (DHS) contain a hypothetical question: "When a child has diarrhea, should one give him a smaller amount of liquid, the same amount, or more liquids than usual?"[2] The possible (prompted) answers are "more fluids", "less fluids", "same amount of fluids" and "don't know." This question is excellent for examining knowledge diffusion and social learning for a number of reasons.

First, diarrhea is a common condition and is the cause of considerable morbidity (including malnutrition) and hence, given the high prevalence of diarrhea, the correct answer to the question is reasonably important to each caregiver. Second, there is a paucity of research regarding information sharing and health in Southern countries. Third, little is known about the extent to which caregivers share correct information about infant and child feeding in general or if they share best practices for ensuring that children experiencing diarrhea stay well-nourished.

Diarrhea remains the number one cause of death to children 1 to 60 months of age, contributing to 22% of all deaths worldwide (Black, Morris, Bryce, 2003). A recent

[2] For example: " ?Cuando un niño tiene diarrea, se le debe dar menor cantidad de LIQUIDOS, igual cantidad, o mayor cantidad de lo usual?" Bolivia DHS (1994), p. 234.

study (Jones et al., 2003) estimates that more under-5 deaths from any cause could be prevented through the appropriate use of oral rehydration therapy than through any other interventions. Frequent episodes of diarrhea are associated with undernutrition, poor growth, decreased immune response and death (Lanata and Black, 2001). Clinical trials in Peru, Romania and Europe (Brown et al., 1988; Nanulescu et al., 1995; Sandhu et al., 1997) indicate the importance of giving children suffering from acute diarrhea full-strength diets shortly after illness onset. Bilateral and multi-lateral organizations, including the US Agency for International Development and the World Health Organization recommend offering increased fluids and food to sick children, including those experiencing diarrhea (BASICS, 2001; WHO, 2001)[3]. Based on DHS estimates, the average Bolivian child will face almost 24 episodes of diarrhea in the first three years of his or her life.[4] The average Malagasy child will face more than 20 episodes of diarrhea in the same time period, while the average Filipino child will face 8 episodes.

[3] While currently we only examine fluids we plan to extend to food practices as well.
[4] If a child has a 30 percent chance of diarrhea in any two week period, then the expected incidence in three years would be would be .3*26*3=23.6.

Table 1: Frequency of reported diarrhea in the last two weeks, by age of child				
	less than 1	age 1	age 2	average 0-3
Bolivia	25.4%	41.2%	24.6%	30.4%
Indonesia	8.5%	12.5%	10.1%	10.4%
Madagascar	22.1%	32.0%	24.3%	26.2%
Nepal	30.5%	38.7%	21.7%	30.3%
The Philippines	10.9%	13.8%	6.3%	10.3%
Tanzania	19.8%	23.2%	14.8%	19.3%
Source Analysis of DHS.				

The question about how much liquid to give during diarrhea is also an excellent candidate for studying diffusion of knowledge because a factually correct answer exists and is uniform across individuals. Due to the high risk of dehydration, giving less fluid is an unambiguously wrong answer (UNICEF 2003). The medically accepted practice is that it is always good to raise fluid intake during and after episodes of diarrhea since doing so reduces the risk of dehydration with its severe and potentially fatal consequences. The question on fluid intake during episodes of diarrhea is in contrast to some studies which examine opinions, attitudes or preferences about which there is no objectively "correct" answer or questions about which there is a great deal of heterogeneity. When examining preferences or behaviors, it is difficult to distinguish between social learning and other social influences. For example, women who have considerable social contact with mothers who have few children may be more likely to express a preference for, and have, fewer children. It is possible that these women have

"learned" from the experience of their peers. But it is also possible that having few children is attributable to their desires to conform to the opinions and behaviors of a "reference group." With respect to farming practices, even within geographically limited areas, there is a great deal of local heterogeneity—in soil conditions, in reliability of access to irrigation and in access to labor—such that what is optimal for one farmer may not be optimal for his or her neighbor.

The question about fluid intake has a uniform and factually correct response; however, the answer is not "obvious" nor can the answer be immediately inferred from direct experience. Howard Gardner's theory of the "unschooled mind" (1991) argues that children operate with "intuitive" models that are based on "common sense" and experience[5]. There is also an "intuitive" biology on which common sense health practices are based. It is not obvious how to respond to an episode of diarrhea. One "intuitive" model might be to increase fluid intake to replace the excess amount of fluids being lost. Another plausible model suggests that if fluid output is excessive, then limiting fluid intake might help the child.

Additionally, the advantage of giving as much or more liquids is not immediately apparent. Parents and other caregivers may not be able to discern the often subtle changes that occur in children's health nor ascribe such changes to giving more liquids. As Das and Sanchez-Paramo (2003) indicate, nearly all cases of diarrhea are "self-limiting;" hence, the difference in outcomes between correctly giving increased fluids and

[5] For instance, Gardner (1991) argues that most people operate with an Aristotelian, not Newtonian, intuitive physics as their experience is that objects do *not* tend to remain in motion but rather slow down and stop without continued impetus.

incorrectly failing to give more fluids is probably quite close.[6] It would be difficult for an individual woman to infer from direct observation of her own children, or even from observing other cases, that the correct treatment is "more fluids". These two arguments imply that knowledge of the correct response is likely to be "learned" from some source and not simply "intuited" or "inferred" from experience. Table 2 shows that there are a considerable number of women who give the wrong answer: 16% of women in both Bolivia and Madagascar say "less fluid" should be given during episodes of diarrhea.

[6] Parents' perceptions of treatment outcomes may be close to equal; however, since parents want to know the correct treatment and because the potential adverse outcome (death) is severe, the gain in knowing information that would produce even small differences is large.

Table 2: Responses to hypothetical and actual behavior, in percents				
Fraction responding to hypothetical	Fraction	Of which those whose reported behavior matched	Fraction	Of which those whose reported behavior matched
	Bolivia		Indonesia	
Give less	16.0	69.3	12.2	62.1
Same	19.0	57.0	20.0	61.6
Give More	63.3	72.7	66.4	77.2
	Madagascar		Nepal	
Give less	16.6	72.3	17.8	18.9
Same	10.0	49.2	53.6	23.2
Give More	72.2	82.0	27.5	10.7
	The Philippines		Tanzania	
Give less	14.3	74.6	15.4	38.1
Same	16.8	75.4	15.9	62.1
Give More	68.7	77.4	67.1	75.8
Source: Analyses of DHS.				

The hypothetical question about liquid intake during diarrhea is informative because there is a cross check on reported knowledge: actual behavior. Before women are asked the hypothetical question about liquids they are questioned about whether their child had an episode of diarrhea in the previous two weeks. If their child had an episode, mothers are asked a series of questions about that episode, including questions about fluid intake. There is a strong association between the hypothetical answer and the behavior.

Of Bolivian mothers that reported "more fluids" in the hypothetical question 73% gave more fluids, 16% gave the same amount, and only 10% gave less fluid. Of mothers who reported a hypothetical answer of "less fluids", 69% actually gave less fluid. Nepal is the only country in our study where the hypothetical answer and actual behavior do not match (Table 2).

Finally, this question is of interest because information about appropriate fluid intake is valuable to each caregiver; consequently, there is no reason not to share it, since benefits from this knowledge are not zero sum. In many instances, information conveys an advantage, which would reduce incentives to share. However, in this case, the better health of another woman's child imposes no costs to the knowledgeable caregiver and may, in fact, increase his or her prestige.

III. Empirical determinants of knowledge of correct treatment

Demographic and Health Surveys (DHS) have been conducted in over 60 countries in three rounds between 1984 and 2001. Data is collected on maternal and child health, nutrition, fertility and family planning at household and individual levels. In all results presented here, the sample is nationally representative of women aged 15-49 living in urban and rural areas.

In this paper, we use unweighted data on wives and female heads of household giving us a sample with 600 geographic clusters in Bolivia (1994) and 260 clusters in Madagascar (1997). Sample sizes ranged from just under 3,000 women in Nepal to over 22,000 women in Indonesia.

With respect to limitations of the survey, there are two problems with question placement. First, before they are asked the knowledge question, the subset of mothers

who have had a sick child within the previous two weeks will have heard questions on practice (for each ill child), including: Did you give your ill child more/same/less fluids and foods?, Did you give ORS to the ill child?, What else did you give?, and Who did you ask for treatment help? However, it seems unlikely that these questions will have created a systematic bias among mothers with sick children regarding our theoretical treatment question.

For these analyses, we consider "more" and "same" to be correct answers. In probit regressions, we include individual variables, the fraction of the sampling cluster, which answered the question correctly, and the cluster averages of all of the variables included at the individual level.

III.A) Individual and households determinants of knowledge

Before moving to the question of social learning, we must first address other ways in which women may have learned the appropriate treatment, including education, literacy, and exposure to the media. Additionally, one could conjecture that women who have more children or who are older will have had, all else equal, more opportunities to learn. In Bolivia and Madagascar, nearly all of these factors are associated with the probability of a correct response regarding fluid intake during diarrhea and are statistically significant.

Maternal education, literacy, age, and media exposure. Maternal education has a large impact on child health and mortality, both in aggregate and individual data. The underlying mediating mechanisms—lower rates of disease, better treatment when sick, and greater autonomy in decision-making have been debated (Caldwell 1979, Cleland and van Ginneken 1988). In particular, it is not clear whether education has a direct effect

because of what is learned in school or whether the acquisition of learning skills allows women to accumulate knowledge. Glewwe (1997) using data from Morocco finds that the impact of schooling on mothers' health behaviors appeared to be the result of direct knowledge learned in school as part of the curriculum, not general knowledge nor the ability to acquire knowledge. In our results we find a little of both in Bolivia, Madagascar, and Nepal. Education (mother's years of formal schooling completed) has a direct effect, but literacy also has distinct effects so that, even for a given level of education, women who report greater ability to read are more likely to know the right answer.

There is a minor effect of the total number of children ever born in Tanzania, Madagascar and the Philippines, but the impact is insignificant. Age also plays a small role at times (results not shown).

Media exposure. Media exposure also has a large impact on knowing the correct answer regarding liquid intake during diarrheal episodes in urban Bolivia and Indonesia, and in the rural Philippines. It is not clear whether this represents a truly causal impact of media (i.e., women learn directly from the media) or whether this variable captures another aspect of women's lives. Certainly media exposure at the individual level is an endogenous choice variable so it is not clear exactly what this represents. Results from a recent study on the impact of social marketing on women's knowledge and use of multivitamins in Santa Cruz, Bolivia indicates that women learn directly from the media (Warnick, in press).

Table 3a: Probit regressions including cluster less household fraction correct, individual and household variables, and cluster averages of all variables						
	Bolivia			Madagascar		
	All	Urban	Rural	All	Urban	Rural
Fraction Correct in Cluster	0.116* (0.030)	0.009 (0.041)	0.218* (0.057)	0.285* (0.039)	0.121* (0.040)	0.385* (0.056)
Individual and household variables						
Education (Years of Schooling)	0.008* (0.002)	0.004* (0.002)	0.020* (0.006)	0.011* (0.002)	0.004* (0.002)	0.016* (0.004)
Reads Easily	0.048* (0.020)	0.037 (0.022)	0.043 (0.042)	0.028 (0.018)	-0.009 (0.011)	0.043 (0.026)
Reads with Difficulty	0.013 (0.013)	0.006 (0.015)	0.006 (0.029)	0.029* (0.012)	-0.020 (0.026)	0.050* (0.017)
Exposure to Media Index	0.321* (0.100)	0.321* (0.087)	0.126 (0.243)	0.145 (0.098)	0.072 (0.084)	0.162 (0.151)
Total Children Ever Born	0.002 (0.002)	0.003 (0.002)	0.006 (0.004)	0.005* (0.002)	0.009* (0.002)	0.003 (0.003)
Education of Husband	0.001 (0.001)	0.001 (0.001)	0.002 (0.002)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Wealth Index	0.011* (0.005)	0.004 (0.005)	0.031* (0.014)	-0.008 (0.005)	-0.005* (0.002)	0.007 (0.011)
Urban Residence	0.017 (0.017)			0.009 (0.014)		
Statistically Significant Variables not reported	Age, Age^2		Age, Age^2, c_media	c_media		c_media
N	4805	2996	1809	3381	1120	2261
Cluster averages included?	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.1126	0.1001	0.0575	0.1488	0.2322	0.1086

Coefficients are marginal effects (not probit coefficients). Standard errors are in parenthesis.
Suppressed variables include cluster averages (denoted for example c_media), Age, and Age^2.
* coefficients are statistically different from zero at the 5% significance level

Table 3b: Probit regressions including cluster less household fraction correct, individual and household variables, and cluster averages of all variables						
	Tanzania			Nepal		
	All	Urban	Rural	All	Urban	Rural
Fraction Correct in Cluster	0.271* (.044)	0.0896 (0.069)	0.325* (0.055)	0.354* (0.056)	-0.123 (0.144)	0.373* (0.062)
Individual and household variables						
Education (Years of Schooling)	0.002 (0.002)	0.003 (0.004)	0.002 (0.003)	0.010* (0.004)	0.009 (0.005)	0.014* (0.005)
Reads Easily	0.072* (0.020)	0.034 (0.040)	0.081* (0.024)	-0.020 (0.028)	-0.051 (0.042)	-0.019 (0.033)
Reads with Difficulty	0.028 (0.017)	0.030 (0.021)	0.024 (0.022)	0.073* (0.021)	0.011 (0.060)	0.078* (0.022)
Exposure to Media Index	-0.196 (0.272)	0.017 (0.257)	-0.545 (0.424)	0.632 (0.338)	0.439 (0.485)	0.774 (0.423)
Total Children Ever Born	0.005* (0.002)	-0.005 (0.003)	0.010* (0.003)	-0.005 (0.004)	-0.008 (0.009)	-0.003 (0.003)
Education of Husband	0.000 (0.001)	0.002 (0.003)	0.000 (0.001)	-0.000 (0.000)	0.001 (0.001)	-0.000 (0.000)
Wealth Index	-0.000 (0.005)	-0.004 (0.003)	0.017 (0.013)	-0.002 (0.006)	0.002 (0.008)	-0.004 (0.008)
Urban Residence	0.006 (0.017)			-0.048 (0.029)		
Statistically Significant Variables not reported	c_media				c_wealth c_reads_dif	
N	3669	1023	2646	2975	502	2473
Cluster averages included?	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.0605	0.0880	0.0540	0.0562	0.1301	0.0543

Coefficients are marginal effects (not probit coefficients). Standard errors are in parenthesis.
Suppressed variables include cluster averages (denoted for example c_media), Age, and Age^2.
* coefficients are statistically different from zero at the 5% significance level

Table 3c: Probit regressions including cluster less household fraction correct, individual and household variables, and cluster averages of all variables						
	Indonesia			Philippines		
	All	Urban	Rural	All	Urban	Rural
Fraction Correct in Cluster	0.417* (0.015)	0.277* (0.278)	0.493* (0.018)	0.368* (0.028)	0.323* (0.039)	0.379* (0.039)
Individual and household variables						
Education (Years of Schooling)	0.004* (0.001)	0.001 (0.001)	0.005* (0.001)	0.009* (0.002)	0.012* (0.003)	0.006* (0.003)
Reads Easily	0.010 (0.007)	0.004 (0.012)	0.011 (0.010)	-0.006 (0.024)	0.005 (0.049)	-0.003 (0.031)
Reads with Difficulty	-0.012 (0.008)	-0.004 (0.014)	-0.017 (0.010)	-0.005 (0.023)	-0.001 (0.047)	-0.001 (0.028)
Exposure to Media Index	0.087 (0.078)	0.314* (0.104)	-0.017 (0.104)	0.336 (0.180)	-0.079 (0.285)	0.574* (0.236)
Total Children Ever Born	-0.001 (0.001)	0.001 (0.001)	-0.001 (0.001)	0.005* (0.002)	0.008* (0.003)	0.003 (0.003)
Education of Husband	0.000 (0.000)	0.000 (0.001)	0.000 (0.001)	0.003 (0.003)	0.007 (0.005)	0.001 (0.004)
Wealth Index	0.010* (0.002)	0.005* (0.002)	0.013* (0.003)	-0.000 (0.004)	0.002 (0.005)	-0.003 (0.005)
Urban Residence	0.019* (0.005)			0.009 (0.011)		
Statistically Significant Variables not reported	c_wealth c_reads_eas		c_wealth Age, Age^2	c_educ c_wealth	c_educ	c_wealth Age, Age^2 c_Age, c_Age^2
N	22566	6680	15886	7173	3056	4117
Cluster averages included?	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.0990	0.0694	0.0852	0.0507	0.0715	0.0391

Coefficients are marginal effects (not probit coefficients). Standard errors are in parenthesis. Suppressed variables include cluster averages (denoted for example c_media), Age, and Age^2. * coefficients are statistically different from zero at the 5% significance level

Household characteristics. Measured wealth of the household (using a principal components index of asset ownership and characteristics of the house as in Filmer and Pritchett 2000) has a modest effect on correct knowledge in Bolivia and Indonesia. Mothers residing in urban areas are more likely than rural residents to be

informed—but the effect is only significant in Indonesia. Interestingly, the husband's education plays no role at all.

III.B) The role of neighbor's knowledge

The first cut in examining social learning is to examine whether or not women who live in clusters in which other women are more likely to know the correct response are themselves more likely to know the right answer, adjusting for individual and household variables. Of course, this is not direct evidence of social learning, but it is consistent with social learning.

If we include the average fraction correct in each cluster (excluding the woman reporting) we get absolutely large (from .116 in Bolivia to .368 in the Philippines) and statistically significant estimated association in all six countries. In Madagascar, if the fraction of other women living in the cluster who answer correctly is higher by one standard deviation (15.5 percentage points), then the likelihood that a woman living in that cluster also answers correctly (controlling for all of her characteristics) is 4.42 percentage points higher. This is a substantial effect—roughly equivalent to the impact of four additional years of schooling (..011*4=.044) (keeping in mind this is the partial effect of schooling not including its impact via improved literacy). A 10% increase in the cluster (less respondent) fraction correct increases the likelihood of a correct answer by about the equivalent of improving the woman's literacy from "cannot read" to "reads with difficulty"—2.9 percentage points vs. 2.8 percentage points, respectively.

We cannot prove that these effects are the result of social contacts and social learning as we lack an adequate identification strategy (for some ideas, see below). But there are aspects of the data that suggest the effect might be a result of social learning.

First, it is possible that there are cluster-specific characteristics, e.g. women are more likely to be informed in wealthier clusters or clusters with high education (independent of the fraction which responds correctly). However, when we included the cluster averages of all control variables and the fraction right, none of the cluster variables has any explanatory power and the fraction right continues to come through strongly[7].

Second, it is a plausible conjecture that a sampling cluster in a rural area is more likely to include people who interact socially that in an urban area in which social interactions are plausibly less determined by proximity (although if a rural area is sufficiently sparsely populated, interactions could be limited so that while all interactions are with neighbors these interactions are relatively few in number). If the social learning effect is mediated by direct social contacts, then the effect should be lower in urban areas than in rural areas. This is strikingly true in the estimates for all six countries. In Bolivia, the cluster effect of fraction correct in the urban sample is only .009 and not significant while the cluster effect in rural areas is .218—24 times larger than the urban effect and statistically significant. Media exposure has a much larger impact in urban areas as opposed to rural areas (.321 vs. .126), and is only significant in urban areas. In Madagascar the rural effect (.385) is three times larger than the urban effect (.121). This does not imply that social learning is smaller or less important in urban areas; however, living in close proximity is likely to be a much poorer proxy for the likelihood of social contact. This is consistent with a social learning explanation.

If what we have observed thus far can be explained by social learning, then it should be interactive—that is, greater social contacts with individuals who are informed

[7] Unreported regressions with cluster effects suggest a large amount of variation associated with clusters.

should be informative. As it is, we do not have any direct information on social contacts from DHS surveys. One way to get around this issue is to use variables that we conjecture are related to the likelihood of social contact—for example, age and ethnicity, and examine whether the impact of other women is interactive.

We feel that the most plausible alternative to social learning to explain our results is that something actually happened in the cluster that affected women's knowledge. Suppose that in one cluster the rural health post or clinic has particularly effective outreach. In such a situation, one would expect a correlation among women across villages (clusters) due to that fact even in the absence of social learning. We are also working on how to distinguish that effect from the social learning effect.

Conclusion and planned extensions

The beauty of working with the DHS is that, once one has a particular estimate, it is easy to replicate that same set of estimates across a substantial number of countries. This allows an important check of robustness of results (and avoids "publication bias" and suggests generalizability). We plan to create a relatively large number of country estimates of the type we have reported here for the six countries as an indicator of the diffusion of information across various countries, as well as regions within countries. The main problem of course is the usual problem of identification, in the sense of distinguishing social learning from other possible explanations of the existing cluster effects.

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