

ISSN No. 2454 – 1427

CDE
September 2017

The Impact of Adult Education on Knowledge, Self-Awareness and Confidence: Evidence from a Randomized Controlled Trial in India

Ashwini Deshpande

Email: ashwini@econdse.org

**Department of Economics
Delhi School of Economics**

Christopher Ksoll

Mathematica Policy Research

Annemie Maertens

University of Sussex

Vinitha Varghese

Tara Akshar Research Project

Working Paper No. 279

<http://www.cdeds.org/pdf/work279.pdf>

CENTRE FOR DEVELOPMENT ECONOMICS

DELHI SCHOOL OF ECONOMICS

DELHI 110007

**The Impact of Adult Education on Knowledge, Self-Awareness and Confidence:
Evidence from a Randomized Controlled Trial in India**

Ashwini Deshpande¹, Christopher Ksoll², Annemie Maertens³ and Vinitha Varghese⁴

September 2017

Abstract

Using the random assignment of illiterate women to an adult literacy and numeracy program - Tara Akshar - in Uttar Pradesh in north India, we attempt to gauge the effect of adult education on knowledge, self-awareness and confidence. We find that participation in the program increases women's knowledge about their community, as well as about issues related to their health and education. Following the knowledge test, we ask women to guess the number of correct answers. Comparing their actual number of correct answers with their own estimation of correct answers, we find that participation in the program reduces their over-confidence, and makes women more aware of how much they actually know. Finally, we find an increase in women's self-reported confidence to approach and talk to persons of authority (e.g., teachers, doctors).

JEL codes: I20; J16; O53

Keywords: Adult Education; Women; India; Knowledge; Over-Confidence; Confidence

¹ Professor of Economics at Delhi University, ² Researcher at Mathematica Policy Research, ³ Senior lecturer at the University of Sussex, ⁴ Research Assistant, Tara Akshar Research Project. The corresponding author is Deshpande (ashwini@econdse.org). We would like to thank the field staff of Awadh Research Foundation (ARF), Lucknow, who helped us with fieldwork. We are grateful to our team of research assistants: Sakshi Bharadwaj, Uday Raj Anand, Sahib Singh Tulsi, Sukriti Verma, and Meghna Bohidar, for their excellent inputs at all stages of the project. We benefited from comments from Melanie Khamis, Rachel Heath, Anukriti S., Shing-Yi Wang, Laura Schechter, Adriana Kugler and seminar participants at IFPRI- Washington DC. This project has been funded by the Social Sciences and Humanities Research Council (SSHRC) of Canada [grant number 435-2013-1913]. Baseline data-collection was partially supported by the IKEA TA+ project through its Monitoring and Evaluation budget. Any errors and omissions are our own.

1. Introduction

There is ample evidence to show that female literacy and education have an important instrumental value, beyond their intrinsic value. They are associated with a range of improved health and educational outcomes for the women and their families. Maternal education improves children's educational outcomes, for instances, through increased scores for children (Andrabi, Das, & Khwaja, 2012; Banerji, Berry, & Shotland, 2017). Maternal education also has a significant positive impact on longer term health outcomes of children (Aslam and Kingdon, 2012); specifically in terms of reduced infant and child mortality (Masset and White, 2003); or lower malnutrition among pre-school children (Kassouf and Senauer, 1996). It has been argued that the benefits of female education extend beyond their immediate families; that female education has contributed towards creating a more literate workforce and improved economic growth and development (Sticht and McDonald, 1990). Research into the mechanisms producing these positive impacts finds that improvement in children's health and education indicators comes about as a result of shifting bargaining power of women within households as a result of education (Handa, 1996), or their improved status in society (Gakidou, Cowling, Lozano, & Murray, 2010).

Most of this literature focuses on women with school education. However in countries like India, where the percentage of adults who are illiterate is 26 percent, illiteracy is largely a female phenomenon: the female adult illiteracy rate is 34 percent, compared to 18 percent for men (Census of India 2011). What happens when adult illiterate women acquire literacy? Does adult literacy have similar beneficial effects as education acquired during early life, both on the neo-literate women, as well as on their families? We have been investigating this issue as a part of a larger research project.

In this paper, we are seeking to answer a very specific question. We investigate how an adult literacy and numeracy program, Tara Akshar Plus (TA+), implemented among illiterate women in the north Indian state of Uttar Pradesh, affects women's knowledge of the locality, health and educational matters; their awareness of the accuracy of this knowledge; and their confidence in dealing with persons of authority. We focus on these particular outcomes for the following reasons. One, qualitative interviews preceding the quantitative data collection indicated that women cited increase in their knowledge, awareness and confidence among the main secondary benefits of the program. Two, we believe knowledge, awareness and confidence would be key inputs in individual decision-making. Despite their instrumental importance, there are few studies examining how knowledge, awareness and confidence are established, and in particular at the role of adult education in shaping these attributes. This is both due to measurement issues, viz., measuring these intermediate, subjective, outcomes is

not straightforward; as well as due to difficulties in determining causality, specifically, there is likely to be reverse causality. For instance, it might be the case that more knowledgeable and self-aware women are likely to obtain adult education, because they are more aware of its benefits, rather than the other way around. Additionally, an empirical estimation of the relationship between knowledge and confidence on the one hand, and education on the other would be prone to omitted variable bias – there are likely to be a range of factors shaping knowledge and confidence on which we may not have data. For instance, more conservative families might both provide women with fewer opportunities to interact with the outside world, thereby reducing a woman’s knowledge and levels of confidence to interact with authorities; and might not allow women to participate in literacy programs. In this particular case of omitted variables, the omission of such factors would under-estimate the effect of adult education on self-confidence.

Our study was set up to meet some of these challenges. First, we use a randomized controlled trial design in which we randomly assigned half of the women in our sample to an adult literacy and numeracy program, which was the treatment. This random assignment ensures that the estimates we obtain can be interpreted causally, as the treatment group and control group were similar in observables, and hence any post-treatment differences between the two groups can be attributed to the program. We combine this randomization with a unique panel data collection, collecting data on the women in our sample before the treatment, immediately after the treatment, and one year after the treatment. In order to test the impact of the programme on knowledge and confidence, we conducted a knowledge test, where our respondents were rewarded for each correct response. After completing this knowledge test, each respondent was asked to estimate the correct number of responses. We use the difference between respondents’ self-assessment and the actual number of correct answers as a measure of awareness about their own knowledge. In addition to gauging confidence about the knowledge test, we also asked about the respondents’ confidence in dealing with persons of authority, such as teachers, doctors, etc.

Our main results are as follows. We find that the program increases knowledge of locality, health and educational issues substantially. The women in the treatment group had a score that was higher than the score of the control group by around 56 percent. Additionally, the program increases self-awareness, specifically, it decreased over-confidence by a relative risk ratio of around 0.3. Finally, we find that participation in Tara Akshar increases confidence dealing with persons of authority by 6 to 7 percent.

Most studies on adult literacy programmes focus on the first-order effects, viz., literacy². There are a few notable exceptions that examine the positive impact of adult female education going beyond literacy, for instance, on child mortality (Blunch, 2013) or women's empowerment, mothers' participation in child learning, and increased the presence of educational assets in the home (Banerji et al, 2017). Our study contributes to this small branch of literature, providing valuable evidence on the second-order effects of adult literacy programmes.

The rest of the paper is organized as follows. Section 2 contains a review of the related literature. Section 3 outlines the setting, including the adult education program, the sample, data collection and some descriptive statistics. Section 4 contains the empirical specification and results. Section 5 concludes with a discussion.

2. Review of Literature

We focus this paper on the effects of Tara Akshar Plus (TA+), an adult literacy and numeracy program for women, on the participants' knowledge of the locality, health and educational matters, their awareness of the accuracy of this knowledge, and their confidence in dealing with persons of authority.

Education of mothers and their increased knowledge about health-related facts and issues can be expected to affect investment in health and education within households. We know that a mother's knowledge of the benefits of breastfeeding or the nutritional content of certain food items has positive effects on the health of her children (Glewwe 1999, and Block 2004). Similarly, investing in the education of one's children is typically accompanied by awareness about the benefits and returns to education (Maertens 2013).

Glewwe (1999) finds that school education increases overall health knowledge in Morocco; Agüero and Bharadwaj (2014) find evidence on the role of school education in awareness of HIV prevention among Zimbabwean women; Andalón, Williams, & Grossman, (2014) document the effects of school education on Mexican women's knowledge and use of contraception.

² This paper is a part of a research project that examines multiple aspects of the TA programme. One of the outputs of the project is an evaluation of the first-order effects of the programme (Deshpande, Desrochers, Ksoll, & Shonchoy, 2017).

While this research demonstrates the role of school education on knowledge, there is virtually no evidence on whether newly acquired adult literacy in the case of illiterate women increases their knowledge³. Note that we cannot extend findings from school education into adult education. First, the duration of adult education is often much shorter, a few weeks or months versus six to eight years. Second, the targeted population is different, adults versus children. Hence, extrapolating the evidence from standard early life education to adult education would be misguided.

We estimate not only the effect of the literacy program on knowledge, but also on how self-aware the women are about the accuracy of their knowledge. We focus on this latter aspect as we believe that the awareness of the accuracy of one's knowledge can also be expected to affect health and educational outcomes. Misplaced confidence in one's knowledge, especially in incorrect knowledge, can misguide health and educational investments. While these effects have, to our knowledge, not been documented in a developing country setting, the effect of this over-confidence⁴ on entrepreneurial and political decision-making in the United States have been well established (see Moore and Healy 2008 for a review on the effects on entrepreneurial failure and Ortoleva and Snowberg 2015 for effects on political decision-making).

Finally, we study confidence, and in particular confidence dealing with persons of authority. While confidence might have largely an intrinsic value, confidence in one's dealings with persons of authority can also impact health and educational investment, albeit more indirectly, by removing some of the socio-cultural barrier to approach persons of authority, and

³ Blunch (2013) provides indirect evidence, as the literacy program leads to lower child mortality, which could be due – if there are no concurrent investments that occur with the literacy program – to the increased knowledge of female participants.

⁴ The psychology literature distinguishes between three types of over-confidence (see Moore and Healy 2008 for an overview): (1) over-precision, which refers to the situation when people's assessment of the accuracy of the information they have, for example about their own ability, is an over-estimate (Steen 2011); (2) over-estimation, which refers to a situation in which people think their performance is better than it actually is (Clark and Friessen 2009), and (3) over-placement, which refers to a situation in which people systematically estimate their own performance to be better than that of others (De Bondt and Thaler 1995). Using this terminology, we focus on the concept of over-estimation.

in particular medical personnel and teachers, which in turn can increase and improve the effectiveness of investments in health and education. To our knowledge, there are no studies documenting these effects of education on confidence in a causal manner.

3. Experimental Setting, Sample and Data

3.1 The Tara Akshar Adult Education Program

The Tara Akshar Plus (TA+) programme is a female adult literacy and numeracy programme implemented by the international NGO, Development Alternatives (DA). It is one of three instruction methods recognized and sponsored by the Indian government under its National Literacy Mission. Computer-aided instructors implement TA+ in an interactive manner in small groups of 10 women learners. The program builds on insights from cognitive psychology and uses memory tricks to teach the alphabet. It runs for approximately two months, six days a week for two hours per day. The program is designed to impart functional literacy in Hindi (the local language), as well as basic numeracy. The instruction relies on examples drawn from daily life, based on nutrition, health matters, education, politics and marriage. Often the instructors are non-local men from the city; being an interactive program, this means that the women engage with, often for the first time, men outside their immediate social network. Over 150,000 women across northern Indian states of Bihar, Jharkhand, Uttar Pradesh, Haryana, Delhi/NCR, Madhya Pradesh, Uttarakhand and Rajasthan have participated in TA since 2007.

TA+ consists of two components. One is Tara Akshar, the literacy component, which consists of 120-minute long computer-based instruction sessions, practice sessions and assessment on learners' ability to recognize Hindi characters, to write words, phrases and sentences and to apply the acquired reading and writing skills beyond the program coverage.⁵ The second component of TA+ is Tara Ganit, the numeracy program. Each session is 105 minutes long, consisting of an instruction session, some practice sessions and evaluation tests on counting, addition, subtraction, multiplication and division.⁶

⁵ Each session involves the following activities: a) 4 minutes of watching a video; b) 12 minutes of learning using big flash cards with letters, characters, syllables or words; c) 20 minutes of writing practice; d) 20 minutes of learning using small flash cards to facilitate recall of letters, characters, syllables or words introduced; e) 10 minutes of identification of the letters, characters, syllables or words by the learner on a computer; f) another 20 minutes of writing practice; g) 10 minutes of quizzes and practice through peer learning; and h) 4 minutes of a follow-up video.

⁶ Each session consists of the following activities: a) 13 minutes on a story; b) 10 minutes of learning using big flash cards, c) 12 minutes of writing practice, d) 10 minutes of learning using small flash cards recalling numbers

After the completion of the 56 days of learning, the learners are required to practice the skills acquired, along with their classmates in post-learning reading clubs called 'Gyan Choupalik'. This phase lasts for six months and is led by a 'TA Saheli' (TA friend) who is given periodic training by the NGO. Each session lasts for 2-3 hours and involves the following activities: a) 45 minutes of reading, b) 45 minutes of writing, c) 45 minutes of games, and d) 45 minutes of mathematics practice.

3.2 Sample and Randomization

Our sample was collected from nine villages of Sant Ravidas Nagar (Badohi) district of Uttar Pradesh in north India. For the purpose of our study, DA drew a list of illiterate women in the age group of 15-45 from each hamlet in every village (a hamlet is a sub-division of a village). These women were asked if they were willing to participate in the TA+ program. 431 women expressed interest in being a part of the programme.

Each list of potential participants was entered in a public lottery to determine who would be assigned to the treatment group (i.e., enrolled in TA+). In practice, the names of all potential participants were written on pieces of paper and placed in a tombola from which members of the public (usually children) drew the participants in the treatment group (this lottery happened in each hamlet). After the treatment group was chosen, the remaining women were assigned numbers and placed on a waiting list.

However, some women who had been selected for the treatment group did not participate, sometimes because other household members did not permit the women to do so. Based on their rank on the waiting list, these women were replaced by others. Any woman on the lottery lists who was invited to participate in TA+ was considered a treatment respondent. The remaining women on the waiting list—who were not contacted—constitute the control group. The women who formed the control group were invited to participate in TA+ in a subsequent round of classes.

Thus, we had 241 women in the treatment group and 190 women in the control group. Table 1 gives the numbers of women in the treatment and control groups.

introduced, e) 10 minutes of identification of the numbers by the learner on the computer software, f) 10 minutes of teaching learners on how to write numbers alphabetically, g) 10 minutes of repeating the digits taught and h) 30 minutes of writing practice.

3.3 Data

Prior to the data collection among the sample of 431 women, we conducted qualitative data through semi-structured interviews with women who were not part of our sample, but who had completed the program prior to 2014. During these qualitative interviews, women who participated in the program emphasised that the program had not only increased their ability to read, write and count, but, resulted in a higher degree of confidence. The results of the qualitative interviews guided us in focusing and designing the following base, mid and endline surveys and tests.

We collected baseline data in April-May 2014. Women who were assigned to treatment status were invited to participate in the TA+ program during June/August, 2014. We followed this up with midline data in August-September 2014. The endline data was collected in April-May 2015. The data collection included a household questionnaire, a woman's questionnaire and a "knowledge test". Attrition from base to mid- and endline was limited. Out of the 431 midline respondents, we could not meet with 28 respondents in endline. For this study, we use the baseline data on household composition and assets, a midline "knowledge test" and an endline section of the woman's questionnaire on confidence.

In the midline survey, we measured knowledge through a "knowledge test" which consisted of a series of twelve questions, covering local geography and politics, education, health and hygiene, and some basic mathematical calculation questions. These questions are presented in the protocol in Appendix 1. The respondents were informed at the outset that they would be rewarded for correct answers, and as reward received one pencil for each correct answer. They were also told that they could exchange their pencils with other educational items. The exchange rate was one notebook or a ruler for two pencils, and a sharpener or an eraser for one pencil. Each pencil was priced Rs.2.5 (about 4 cents) in the local market, which represents about 10 percent of the daily wage.

We define the number of correct answers (out of 12) as the "knowledge score". After the respondent answered all the questions, we asked her to estimate how many answers she thought she had answered correctly. To encourage the respondent to carefully consider this question, she was rewarded – at the end of the game - with a notebook valued at Rs.5 (about 8 cents or 20 percent of the daily wage), if her estimate varied by one unit from her knowledge score, or with two notebooks if her estimate matched the knowledge score.

We defined a "self-awareness score" as the gap between the estimate of number of correct answers and the actual number of correct answers. We characterised the respondent to

be over-confident, if the estimated number of correct answers exceeded the actual number of questions answered correctly.

In addition to knowledge and the awareness of knowledge, we also collected information on one dimension of self-confidence, in particular, confidence in dealing with other people. In the base and endline surveys, we asked the respondent how confident they felt in dealing with ten different people of authority. The respondent had to choose between the following options: 'cannot even imagine dealing with the person', 'will never deal with the person', 'not confident [in dealing with the person]', 'somewhat confident [in dealing with the person]' or 'very confident [in dealing with the person]' as their response.

The ten people of authority on whom we based our questions included male and female shopkeeper, contractor, ASHA⁷ worker (social worker, always female), Anganwadi worker (local health care provider, always female), village head, bank employee and male and female doctor or nurse. We assigned 0 for the lowest level of confidence, which is when the respondent expressed that she cannot even imagine dealing with this person. A score of 1 was assigned for the response 'will never deal with that person', a score of 2 for 'not confident in dealing with that person', a score of 3 for 'somewhat confident in dealing with that person' and a score of 4 for the highest level of confidence as captured by the response 'very confident in dealing with that person'. A summation of these scores across the ten different questions yields the 'confidence score' of the respondent (out of 36).

3.4 Descriptive Statistics

Some descriptive statistics of the sample can be seen in Table 2. Women are on average 36 years old, with 90 percent being currently married. The overwhelming majority of the women are from lower-ranked caste groups (48 percent from Scheduled Castes and another 48 percent from Other Backward Classes). Virtually all women reported some land-ownership by the household (98 percent). 75 percent women reported their main housework. A comparison of the treatment and control groups reveals that the sample is balanced on almost all characteristics. We discuss details of baseline balance in Section 4 below.

Table 3 presents the summary of the knowledge, self-awareness, and the confidence scores. The average knowledge score is 5.17 out of 12 (with a standard deviation of 2.86). Appendix Table 1 shows the percentage of correct answers for each question separately. Within

⁷ ASHA is an acronym for Accredited Social Health Activist, who is a accredited social health worker, appointed by the Ministry of Health and Family Welfare, as a part of the National Rural Health Mission.

the set of computational questions, the proportion of correct answers is higher for the ones which are phrased in a way that the women can relate with their day-to-day activities (for instance, question no. 8 – “What is the main cause of diarrhoea?”), than the ones which are about more “distant” affairs (e.g. question number 10 – “What is the capital of India?”).

The average estimated knowledge score, i.e., the respondent’s estimate of the number of questions correct is 6.03 out of 12 (with a standard deviation of 3.32).⁸ The difference between the estimated and the actual knowledge score gives us the degree to which the respondent over/under-estimates her score. Table 4 shows that 53% of our sample over-estimated their scores, 31% under-estimated and only 16% could completely accurately estimate their knowledge scores. We derived a ‘self-awareness’ score ranging from 0-12 from the difference (in absolute value) between the estimate and the knowledge score, assigning a value of 0 if the difference is maximum and 12 if there is no difference. The average self-awareness score is 2.38 with a standard deviation of 2.14 (Table 3).

The average confidence score, at endline, is 27 out of 36 (with a standard deviation of 5.13).⁹ Appendix Table 2 presents the details. The proportion of women who claimed to be very confident in dealing with persons of authority was highest when the person in question was a female doctor/nurse, an Anganwadi or ASHA worker (who are always female) or a female shopkeeper. For the remaining persons of authority namely male shopkeeper, contractor, village head, bank employee and male doctor or nurse, the highest proportion of response was that the women are merely a little confident in dealing with each of them.

4. Regression Analysis and Results

To establish the effect of the TA+ program, we start with a simple regression specification, testing the null hypothesis of zero effect of TA+ as follows:

$$y_{ij} = \alpha + \beta_{ITT}TA_{ij} + u_j + \varepsilon_{ij} \quad (1)$$

⁸ There are 12 respondents who did not give a response for the estimation question although they participated in the knowledge test.

⁹ This excludes 5 respondents who felt could not answer the questions in this section.

where y_{ij} denotes the outcome variable of interest (e.g., the knowledge score) of woman i in hamlet j .¹⁰ TA_{ij} equals 1 if the woman belongs to the treatment group and 0 if she belongs to the control group, u_j denotes a hamlet fixed effect and ε_{ij} denotes the regression error. The estimate of β_{ITT} captures the (intent-to-treat) causal effect.

Our empirical strategy to identify β_{ITT} relies on the successful randomization into a treatment and control group. This implies that the treatment and control group should be comparable at baseline. This will allow us to attribute any changes between treatment and control group at the midline and endline stage to the TA program. As such, in the results section we first provide balance tests.

To improve the efficiency of the estimation, i.e., to reduce the variance on the estimators, in a second specification, we include control covariates, denoted by a vector X_{ij} including age of the woman, marital status of the woman, occupation of the woman, caste category, acreage land owned of the family, number of family members, children and infants.

$$y_{ij} = \alpha + \beta_{ITT}TA_{ij} + \gamma X_{ij} + u_j + \varepsilon_{ij} \quad (2)$$

Inclusion of these control variables reduces the variance of the β_{ITT} coefficient estimate, which might allow us to better pick up any treatment effects.

As not all women in the treatment group participated in the classes and some in the control group did, i.e., the women did not always comply with their assigned status, the variable β_{ITT} captures the so-called “intent-to-treat” effect. Out of 241 women who were assigned the treatment status, 65 did not participate in the TA program; 8 women from the control group were able to participate in the TA program that year (see Table 1). This implies that the estimated coefficients do not provide an accurate assessment of the effect of the program, i.e., they under-estimate the program effects. In order to deal with this issue, we use an instrumental variable strategy. In a first stage we investigate to what extent participation was increased by assignment to the TA treatment group. This is shown in Equation (3a):

¹⁰ The women are linked to their hamlet because the lottery for participation in the TA program was implemented at this level (i.e., for each hamlet, we divided all the candidates up in two groups: a treatment group and a control group).

The size of the treatment group was determined by the number of places available in the TA program in that hamlet. As both the number of places available, as well as the number of candidates vary by hamlet, the ratio of treatment to control individuals varied by hamlet. This implies that the probability of being selected for the treatment group for the sample as a whole is not random, but rather depends on the hamlet. We follow Duflo, Glennerster, & Kremer, . (2008) and in all regression specification add hamlet fixed effects.

$$Prob(ij = 1) = Normal^P(\theta + \tau TA_{ij} + \vartheta X_{ij} + \pi_j + \delta_{ij}). \quad (3a)$$

In a second stage, we use the predicted values instead of treatment assignment in the second stage, adjusting the standard errors to take into account the reduction in variance in the predicted variable.

$$y_{ij} = \alpha_{IV} + \beta_{IV} T^{\wedge}A_{ij} + \gamma_{IV} X_{ij} + \mu_{IVj} + \varepsilon_{IVij}. \quad (3b)$$

The parameter β_{IV} captures the impact of the program for those induced into the treatment, by treatment assignment, i.e., this is the treatment effect on the treated.

Moving on to the results, we start with a balance test in Table 2. Table 2 – Columns (2), (3) and (4) -- presents the results of a balance test where we test for differences between the treatment and control group at baseline. Columns (2) and (3) present the mean (and standard deviation) for the control and treatment group, respectively. Column (4) tests whether these differences are statistically significant. In particular, it presents the coefficient from a regression of the dependent variable on an “intention-to-treat indicator” and hamlet fixed effects. We see that the sample is matched evenly on most characteristics; the only statistically significant difference is in the caste composition, where we appear to have more SC/ST members in the control group (and correspondingly fewer members of the OBC category). Because the percentage of caste members is slightly different in the treatment and control groups, we include caste as a control covariate for the second specification. We discuss the empirical results on our outcomes of interest in the following.

Impacts on knowledge. Table 5 shows the effect of the TA+ program on the knowledge score. Recall that the knowledge score is out of 12 questions, with an average score of 5.17 (and a standard deviation of 2.86). Columns (1) and (2) present the estimates of the average intent-to-treat effect, respectively without and with control covariates. Columns (3) and (4) present the estimate of the average treatment-effect-on-the-treated, also respectively without and with control covariates, using an instrumental variable estimation. We find statistically significant effects of the TA+ program, both with and without controls, on the knowledge score. Assignment to the treatment group, on average, increases the knowledge score increases by 1.8 (statistical significant at the 1% level). Participation in the TA+ program increases the knowledge score by, on average, 2.9 (also statistically significant at the 1% level). This is a program effect of about 56 percent. In Appendix Table 3, we present the results for the individual questions. We find a statistically significant effect for almost all questions.

Impacts on self-awareness. Table 6 shows the effect of the TA+ program on the self-awareness score. Recall that this is a score out of 12 and that a smaller score indicates a better awareness. Again, columns (1) and (2) present the estimates of the average intent-to-treat effect, respectively without and with control covariates. Columns (3) and (4) present the estimate of the average treatment effect on the treated, also respectively without and with control covariates, using an instrumental variable estimation. We do not detect any significant effect of the TA+ program on self-awareness at standard levels of significance.

Impacts on over-confidence. In Table 7 we test for the impact of TA+ on over-confidence, i.e., over-estimation of one's knowledge score. We use a multinomial logit specification, which treats the dependent variable as being chosen from a set of outcomes, rather than a cardinal variable (such as distance). The dependent variable takes the outcomes of "under-estimate", "correct estimate" and "over-estimate" (as in Table 4). The base category (not reported) is "under estimate". As an exact correct estimate is rather unlikely, we define "correct estimate" in a more flexible manner in columns (3) and (4): Accurate estimate here implies that the respondent's estimate is within a bandwidth of two units from her actual score. Over-estimate here implies that the estimate is greater than the actual score by at least more than 2 units and under-estimate implies that the estimate is smaller than the actual score by at least more than 2 units. We report the odds ratio, rather than the coefficient, so that a zero impact would imply an odds ratio of 1. Being invited to participate in the TA+ program decreases the odds of a correct or over-estimate compared to an under-estimate by a factor of 0.35 to 0.27. In Appendix Table 4 we present the results of an OLS and Instrumental Variable Estimation using as dependent variable the difference (as opposed to the absolute difference in Table 6) between the estimate and the actual number of correct answers. Note that a positive difference refers to over-estimation, while a negative difference refers to under-estimation. We find that participation in the TA+ program decreases this difference, i.e., participation in the TA+ program decreases over-estimation and increases under-estimation.

Impacts on confidence. In Table 8, we show the effects of TA+ on the confidence score. Recall that this is a score out of 36, with an average of 26.85 (standard deviation of 5.13). Again, columns (1) and (2) present the estimates of the average intent-to-treat effect, respectively without and with control covariates. Columns (3) and (4) present the estimate of the average treatment effect on the treated, also respectively without and with control covariates, using an instrumental variable estimation. We find statistically significant effects of the TA+ program, both with and without controls, on the confidence score. Assignment to the treatment group, on average, increases the knowledge score increases by 1.2 to 1.0 (statistical significant at the 5% level). Participation in the TA+ program increases the knowledge score by, on average, 1.9 to 1.6 (also statistically significant at the 5% level). This is a program effect of 6 to 7 percent.

5. Concluding Comments

Adult education is a common policy tool in the developing world where many never attend formal schooling. India set up the National Literacy Mission (NLM) in 1988 with the goal of imparting functional literacy to all non-literate persons in the 15-35 age group. The NLM defines functional literacy as the achievement of a composite set of objectives namely self-reliance in the 3Rs (reading, writing and arithmetic), awareness of causes of deprivation and participation in the process of development to improve their condition, improvement of skills to enhance economic status and general well-being and assimilation of values of national integration, environmental conservation, gender equality, observance of small family norms etc.¹¹ However, the NLM, consistent with international experience, has struggled with poorly constructed curricula (e.g., not adapted to adult audiences), insufficiently trained teachers, a lack of teaching materials and possibly ensuing poor attendance rates and poor performance.

Given the poor record of the NLM (Kapur and Murthi, 2010), as well as the desirable positive impacts of adult literacy, we find that a program such as TA+ fulfills a vital need by filling a vacuum. We find that the TA+ training has positive impacts beyond literacy, particularly on knowledge and confidence of women. In addition to several other positive benefits, we find that women are less likely to be (erroneously) over-confident in their general knowledge, implying that they are aware of the possibility that there is a larger knowledge pool with which they are not very familiar, and that they *might* be wrong. This reduction in over-confidence is also associated with a general increase in confidence levels when dealing with persons of authority.

There could be multiple reasons why we find these results. It is, for instance, possible that women could become more knowledgeable because they learned something in the TA+ program itself, or because literacy allows them to access information, or because the program increased their social network. Similarly, women could become more confident because they have spent so much time with other women in a group setting, because their literacy skills increased or because they were re-affirmed throughout the program by their teacher. This newfound confidence in turn could encourage women to reach out and acquire new information. Indeed, we do find that participation in TA+ increases literacy and numeracy. This result confirms the widespread evidence from the impact of women's participation in self-help groups (SHGs). Brody et al (2015), in a broad overview across a variety of cultural contexts,

¹¹ http://www.nlm.nic.in/nlmgoals_nlm.htm, accessed on December 14, 2015.

find that participation in a community-based program such as SHGs has a positive effect on women’s empowerment and makes them more self-confidence. If we accept that women’s knowledge, bargaining power and more general position in the household affects the households decision-making process, and more particularly investment in health and education (see, for instance, Udry, 1996; Lundberg and Pollack, 1996), changing women’s ‘decision making tools’ can be expected to have longer term effects on the family.

These results indicate that an adult literacy program might have far-reaching effects on the participants’ lives beyond just changing their ability to read, write and count. Participants in TA+ display better knowledge of their surroundings, higher confidence levels and better self-awareness. It is highly likely that these positive effects could further cascade into other dimensions of women’s lives, underscoring the vital contribution of literacy that goes beyond the three Rs..

Tables

Table 1: Treatment assignment and participation in adult education

	Participation in TA			
	No	Yes	A few classes	Total
Assignment				
Control	183	6	2	191
Treatment	64	153	23	240
Total	247	159	25	431

Table 2: Baseline balance table

Variables	Full sample	Control	Treatment	Conditional difference
	(s.d)	(s.d.)	(s.d.)	(s.e)
<i>Control variables regressions</i>				
Age of respondent (years)	35.912 (8.479)	35.670 (7.917)	36.104 (8.913)	-0.434 (.812)
Whether respondent is married (No=0, Yes=1)	0.903 (0.297)	0.901 (0.300)	0.904 (0.295)	-0.004 (0.029)
Scheduled Tribe/Scheduled Caste (ST/SC)	0.480 (0.500)	0.534 (0.500)	0.438 (0.497)	0.097** (0.048)
Other Backward Caste (OBC)	0.483 (0.500)	0.440 (0.498)	0.517 (0.501)	-0.077 (0.048)
Number of household members	10.724 (7.038)	10.720 (7.151)	10.727 (6.962)	-0.007 (0.701)
Number of children under 18 years in the household	5.303 (3.391)	5.396 (3.70)	5.229 (3.413)	0.166 (0.336)
Number of infants (under 5 years) in the household	2.375 (1.530)	2.504 (1.449)	2.273 (1.588)	0.231 (0.186)
Whether the household owns land (No=0, Yes=1)	0.979 (0.143)	0.969 (0.175)	0.988 (0.007)	-0.019 (0.015)
Whether respondent's main occupation is housework (No=0, Yes=1)	0.724 (0.448)	0.749 (0.435)	0.704 (0.457)	0.044 (0.043)

Table 3: Descriptive statistics of the outcome variables

	Obs	Mean	St. Dev	Min	Max
Knowledge score (out of 12)	431	5.17	2.86	0	12
Respondents' estimate of knowledge score (out of 12)	419	6.03	3.32	0	12
Self-awareness score (out of 12)	419	2.38	2.14	0	12
Confidence score (out of 36)	398	26.85	5.13	13	36
<p><i>Note: Knowledge score refers to the number of correct answers out of the 12 questions asked, which have been detailed in Appendix I. Respondents' estimate of the knowledge score refers to the number of their answers which the respondents expected to be correct after the game. Self-awareness score refers to the absolute value of the difference between the respondents' estimate and the actual knowledge score. A self-awareness score of 0 would imply that the respondent's estimate exactly matched the actual knowledge score. Confidence score is the summation of scores on the level of confidence reported by respondents while dealing with nine persons of authority like shopkeepers, doctors etc.</i></p>					

Table 4: Degree of precision of estimation of knowledge score

	Respondents (%)		
	Control	Treatment	Total
Accurate	15.96	17.32	16.71
Over-confident	52.66	46.75	49.40
Under-confident	31.38	35.93	33.89
<p><i>Note: Accurate refers to those respondents whose estimation of the number of correct answers exactly matched with the actual number of correct answers for the 12 questions detailed in Appendix I, over-confident refers to those whose estimation was more than the actual number of correct answers and under-confident refers to those whose estimation was lower than the actual number of correct answers (both also for the questions detailed in Appendix I)</i></p>			

Table 5: The effect of adult education on the knowledge score

	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Treatment (1=treatment, 0=control)	1.841***	1.870***		
	(0.263)	(0.260)		
Participated (1=yes, 0=no)			2.904***	2.940***
			(0.380)	(0.371)
Controls included	No	Yes	No	Yes
Observations	431	431	431	431
R-squared	0.161	0.191	0.294	0.322
F-statistic for First Stage Regression			4.59	3.92
<p><i>Note: The dependent variable, knowledge score is the summation of the scores across all 12 questions of the knowledge game. These twelve questions have been presented in Appendix I. Column (1) and (2) present the results of an OLS regression with robust standard errors. Columns (3) and (4) present the results of an instrumental variable strategy with instrument: invited to the</i></p>				

Table 6: The effect of adult education on the self-awareness score

	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Treatment (1=treatment, 0=control)	0.014	0.043		
	(0.216)	(0.214)		
Participated (1=yes, 0=no)			0.022	0.068
			(0.331)	(0.325)
Controls included	No	Yes	No	Yes
Observations	419	419	419	419
R-squared	0.027	0.045	0.027	0.046
F-statistic for First Stage Regression			0.68	0.73
<p><i>Note: The dependent variable self-awareness score is defined as the absolute value of the difference between the respondent's estimate and the actual score. Column (1) and (2) present the results of an OLS regression with robust standard errors. Columns (3) and (4) present the results of an instrumental variable</i></p>				

Table 7: The effect of adult education on the self-awareness - multinomial logit analysis

	Exact		Bandwidth=2	
	(1)	(2)	(3)	(4)
Accurate estimate (1=yes, 0=no)	1.027	0.918	0.535	0.415***
	(0.336)	(0.283)	(0.251)	(0.208)
Over-estimate (1=yes, 0=no)	0.707	0.657	0.355***	0.270**
	(0.258)	(0.230)	(0.204)	(0.169)
Controls included	No	Yes	No	Yes
Observations	419	419	419	419
Pseudo R-squared	0.054	0.075	0.081	0.126

Note: The difference between the respondent's estimate of the score after the knowledge exercise and the actual score is categorised into three in the dependent variable namely over-estimate, accurate and under-estimate. A multinomial logit analysis is conducted on the dependent variable with under-estimate as the base category (hence not reported). Odds ratios have been reported with robust standard errors in

Table 8: The effect of adult education on the confidence score

	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Treatment (1=treatment, 0=control)	1.239** (0.494)	1.020** (0.489)		
Participated (1=yes, 0=no)			1.951*** (0.748)	1.615** (0.736)
Controls included	No	Yes	No	Yes
Observations	398	398	398	398
R-squared	0.136	0.189	0.154	0.206
F-statistic for First Stage Regression			3.67	3.74
<p><i>Note: The dependent variable, confidence score is the summation of scores on the level of confidence reported by respondents while dealing with nine persons of authority like shopkeepers, doctors etc. Column (1) and (2) present the results of an OLS regression with robust standard errors. Columns (3) and (4) present the results of an instrumental variable strategy with instrument: invited to the treatment and endogenous variable: participated in TA, with robust standard errors. Controls include age of the respondent, whether the respondent's main occupation is housework, marital status of the respondent, indicators for scheduled status and being categorized as OBC (other backward caste), number of household members, number of children under 18 years, number of infants under 5 years and whether the household owns any land. Stratification (sub-village) fixed effects included in all specifications. ***, **, * denote statistical significance at the 1, 5, 10 percent levels, respectively.</i></p>				

References

- Aguero, J., & Bharadwaj, P. (2014). Do the more educated know more about health? Evidence from schooling and HIV knowledge in Zimbabwe. *Economic Development and Cultural Change* 62(3), 489–517.
- Andalón, M., Williams, J., & Grossman, M. (2014). *Empowering Women: The Effect of Schooling on Young Women's Knowledge and Use of Contraception*. National Bureau of Economic Research, Working Paper Series, No. 19961.
- Andrabi, T., Das, J., & Khwaja, A. I. (2012). What did you do all day? Maternal education and child outcomes. *Journal of Human Resources*, 47(4), 873–912.
- Aslam, M., & Kingdon, G. G. (2012). Parental Education and Child Health—Understanding the Pathways of Impact in Pakistan. *World Development* 40(10), 2014-2032.
- Banerji R., Berry J., Shotland M. (2017). The Impact of Maternal Literacy and Participation Programs: Evidence from a Randomized Evaluation in India. *American Economic Journal: Applied Economics*, 9(4):303-337
- Block, S. A. (2004). Maternal Nutrition Knowledge and the Demand for Micronutrient-Rich Foods: Evidence from Indonesia. *The Journal of Development Studies*, 40(6), 82–105.
- Blunch, N. H. (2013). Staying Alive: Adult Literacy Programs and Child Mortality in Rural Ghana. *World Development*, 42, 114–126.
- Brody, C., De Hoop, T., Vojtkova, M., Warnock, R., Dunbar, M., Murthy, P., Dworkin, S.L. (2015). Economic Self-Help group Programs for Improving Women's Empowerment: A Systematic Review. *Campbell Systematic Reviews*, 2015:19, 1-182.
- Clark, J., & Friesen, L. (2009). Overconfidence in Forecasts of Own Performance: An Experimental Study. *Economic Journal*, 119(534), 229–251.
- De Bondt, W. F., & Thaler, R. H. (1995). Financial decision-making in markets and firms: A behavioral perspective. In J. R. Birge, V. Linetsky, & ed, *Handbooks in Operations Research and*

Management Science, 9 385-410.

Deshpande, A., Desrochers, A., Ksoll, C. & Shonchoy, A. S. (2017). The Impact of a Computer-based Adult Literacy Program on Literacy and Numeracy: Evidence from India, *World Development*, 96, 461-473

Duflo, E., Glennerster, R., & Kremer, M. (2008). Using Randomization in Development Economics Research: A Toolkit. In T. Schultz, & J. Strauss (Ed.), *Handbook of Development Economics*, 4 (p. chpt. 15). Amsterdam: Elsevier Sci. Ltd. North Holl.

Gakidou, E., Cowling, K., Lozano, R., & Murray, C. J. (2010). Increased educational attainment and its effect on child mortality in 175 countries between 1970 and 2009: a systematic analysis. *The Lancet*, 376(9745), 959–974.

Glewwe, P. (1999). Why Does Mother's Schooling Raise Child Health in Developing Countries? Evidence from Morocco. *The Journal of Human Resources*, 34(1), 124-159.

Handa, S. (1996). Maternal education and child attainment in Jamaica: Testing the bargaining power hypothesis. *Oxford Bulletin of Economics and Statistics*, 58(1), 119–137.

Kapur, S., & Murthi, M. (2010). Literacy in India. In K. Basu (Ed.), *The Concise Oxford Companion to Economics in India*. Oxford, UK: Oxford University Press.

Kassouf, A. L., & Senauer, B. (1996). Direct and Indirect Effects of Parental Education on Malnutrition among Children in Brazil: A Full Income Approach. *Economic Development and Cultural Change*, 44(4), 817-838.

Maertens, A. (2013) "Social norms and aspirations: age of marriage and education in rural India." *World Development*, 47, 1-15

Masset, E., & White, H. (2003). *Infant and Child Mortality in Andhra Pradesh: Analysing changes over time and between states*. Munich Personal RePEc Archive.

Moore, D. A., & Healy, P. J. (2008). The Trouble With Overconfidence. *Psychological Review*,

115(2), 502–517.

Ortoleva, P., & Snowberg, E. (2015). Overconfidence in Political Behavior. *American Economic Review*, 105(2), 504–535.

Steen, E. V. (2011). Overconfidence by Bayesian-Rational Agents. *Management Science*, 57(5), 884–896.

Sticht, T. G., & McDonald, B. A. (1990). Teach the Mother and Reach the Child: Literacy across Generations. Literacy Lessons. Geneva: International Bureau of Education.

Udry, C. (1996). Gender, Agricultural Production, and the Theory of the Household. *Journal of Political Economy*, 104(5), 1010-1046.

Appendix I

Knowledge and Self-awareness Protocol

Now we will ask you 12 questions, some related to your village, some to India, and some related to health and education. We shall give you pencils at the end of this activity depending on your answers. So, please think carefully before answering.

Instructions to the enumerator: After reading out each question, record the answer of the respondent. If she says that she doesn't know, prompt her to make a guess and if that also fails, then you can write "D.K ." Please record the score as '1' if the answer is correct and '0' if it is not or if it is a "D.K". You may prompt each question for a maximum of three times. Once you have got an answer, do not repeat the question. Even if it is a wrong answer, do not prompt them to give the correct answer.

Questions:

1. What's the name of your state? (Right answer: Uttar Pradesh/U.P)
2. You have got Rs.25 to buy onions and tomatoes. You have bought onions for Rs.13. How much money is left with you to buy tomatoes? (Right answer: Rs.12)
3. Who is the Prime Minister of India? (Right answer: Narendra Modi/Modi)
4. If 20 mangoes have to be equally divided among 5 children, how many will each one get? (Right answer: 4)
5. Manoj's dad has four sons. If the three sons are named Ram, Laxman and Shatrughana, what is the name of the fourth son? (Right answer: Manoj)
6. When is the next Panchayat election in your village scheduled? (Right answer: 1 year from now)
7. Imagine I walk to store, and I first walk 2 miles East, then 2 miles North, then 2 miles West and then 1 Mile South. How far am I from my original starting position? (Right answer: 1 mile)
(In this question, you may show gestures with your hands to make the respondent understand the four directions)
8. What is the main cause for Diarrhea? a) Mosquito Bite b) Drinking dirty water c) Drinking excess water d) Not eating green vegetables (Right answer: b)
9. For how many months should a child receive only breastfeeding? (Right answer: 6 months)
10. What is the capital of India? (Right answer: Delhi)
11. What is the minimum marriageable age for girls by law? (Right answer: 18)

12. Which disease is caused due to iodine (which is found in salt) deficiency? a) Polio b) Malaria c) Goitre d) TB (Right answer: c)

Instructions to the enumerator: Sum up the scores and note down.

We have asked you 12 questions. How many you think do you have answered right? You will get two notebooks if what you think you have answered right and what you have actually answered right are the same. If what you say is above or below the number of correct answers you have told by one, then you will get one notebook.

Instructions to the enumerator: Record the response.

In case the respondent is to get a notebook or two, please give it/them right away.

Appendix II

Appendix Table 1: Percentage of correct responses to each question in the knowledge exercise (N=431)

	Question content	Respondents
1	Name of home state	39.9%
2	Subtract 13 Rupees in purchase from 25	55.0%
3	Who is the Prime Minister	54.5%
4	Divide 20 mangoes by 5	43.6%
5	Manoj's dad	7.9%
6	Year next Panchayat election	49.0%
7	Where end up after three turns	11.1%
8	What is main cause of diarrhoea	58.9%
9	Ideal duration of exclusive breastfeeding	60.6%
10	Capital of India	22.7%
11	Minimum marriage age	60.6%
12	What is disease due to iodine deficiency	53.6%
<p><i>Note: The complete text of each of the questions, as they were asked in the exercise and the correct responses are presented in Appendix I</i></p>		

Appendix Table 2 : Percentage of respondents who expressed varied degree of confidence in dealing with persons of authority during endline survey (N=398)

S.No.	Persons of authority	Cannot imagine dealing with	Will never deal with	Not confident dealing with	Somewhat confident dealing with	Very confident in dealing with
1	Male shopkeeper	1.01	10.8	26.38	43.47	18.34
2	Female shopkeeper	0	6.28	11.31	37.19	45.23
3	Contractor	0.5	14.07	34.17	44.22	7.04
4	ASHA*	0.25	0.5	15.83	38.44	44.97
5	Angawadi worker**	0	1.51	14.32	33.92	50.25
6	Village head	0.25	19.35	27.89	44.47	8.04
7	Bank employee	0	6.79	27.68	55.61	9.92
8	Male doctor/nurse	0	6.03	27.89	55.78	10.3
9	Female doctor/nurse	0	0	2.26	29.4	68.34

**ASHA (Accredited Social Health Activists) are community health workers in most villages of India who create awareness on health and its social determinants and mobilize the community towards local health planning and on increased utilization and accountability of existing health services.*

***Anganwadi worker is the frontline worker of an anganwadi which is a centre within most villages in India which provides supplementary nutrition, non-formal pre-school education, nutrition and health education, immunization, health check-ups and referral services to pregnant and lactating women and to children aged 6-35 months*

Appendix Table 3: Probit and IV Probit estimates of the effects of adult education on knowledge, question by question

		OLS		IV	
Dependent variable: Correct answer for question		Coeff.	SE	Coeff.	SE
1	Name of home state	0.810***	0.136	1.282***	0.207
2	Subtract 13 Rupees in purchase from 25	0.357***	0.127	0.576***	0.202
3	Who is the Prime Minister	0.640***	0.130	1.064***	0.202
4	Divide 20 mangoes by 5	0.366***	0.132	0.568***	0.214
5	Manoj's dad	0.377*	0.208	0.543*	0.325
6	Year next Panchayat election	0.375***	0.136	0.596***	0.214
7	Where end up after three turns	0.045	0.171	0.070	0.277
8	What is main cause of diarrhoea	0.431***	0.129	0.696***	0.202
9	Ideal duration of exclusive breastfeeding	0.680***	0.133	1.189***	0.219
10	Capital of India	0.631***	0.147	0.945***	0.225
11	Minimum marriage age	0.410***	0.131	0.699***	0.214
12	What is disease due to iodine deficiency	0.416***	0.129	0.704***	0.217
<p><i>Note: This table presents the probit regression results of an indicator of the correct answer for each question of the knowledge game on the treatment assignment (OLS) and on the participation instrument (IV), with robust standard errors. Stratification (sub-village) fixed effects included in all specifications. ***, **, * denote statistical significance at the 1, 5, 10 percent levels, respectively. The complete text of each of the questions, as they were asked in the game and the correct responses are presented in Appendix I</i></p>					

Appendix Table 4: The effect of adult education on the difference between estimated and actual knowledge score

	OLS	OLS	IV	IV
	(1)	(2)	(3)	(4)
Treatment (1=treatment, 0=control)	-0.496	-0.568*		
	(0.311)	(0.310)		
Participated (1=yes, 0=no)			-0.783*	-0.894*
			(0.474)	(0.465)
Controls included	No	Yes	No	Yes
Observations	419	419	419	419
R-squared	0.066	0.094	0.078	0.104
F-statistic for First Stage Regression			1.57	1.85

Note: The dependent variable is the difference between respondents's estimate of the score and the actual knowledge score. Note that a positive difference refers to over-estimation, while a negative difference refers to under-estimation. Column (1) and (3) present the results of an OLS regression with robust standard errors. Columns (2) and (4) present the results of an instrumental variable strategy with instrument: invited to the treatment and endogenous variable: participated in TA, with robust standard errors. Controls include age of the respondent, whether the respondent's main occupation is housework, marital status of the respondent, indicators for