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"Touching Beliefs: Using Touchscreen Technology to Elicit Beliefs and Subjective Expectations in Survey Research"

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Extended abstract

Topic

Individuals, especially in developing countries, face many sources of uncertainty. While taking decisions, individuals may form subjective expectations about probabilities of events relevant for their choice. Even though more challenging in developing countries because of lower-literacy settings, it is becoming critical to collect individual subjective beliefs and expectations data. In fact, eliciting probabilistic expectations improve our understanding of individuals' decision-process and population behavior. Hence, the development of proper measurement methods is fundamental to collect high-quality data and use those beliefs and expectations in empirical analyses, as predictors of economic and future individual choices. Recently, more and more researchers are incorporating this information into their surveys, but very few have compared methods for eliciting subjective expectations to identify best practices in the field. Improvements of these methods are then necessary.

In this paper we describe a new touchscreen-based slider method designed to elicit subjective expectations and test the validity of this method in rural Kenya. There are two main innovations compared to methods traditionally used in eliciting subjective expectations in survey research. First, we elicit subjective expectations with the use of visual aids by means of dynamic images shown on a touch-screen device rather than using common objects such as beans, sticks, and balls. Second, through the use of a slider on the interactive digital touchscreen interface, we enable the respondent to indicate the probability that an event will occur (from 0% to 100%) and capture the continuous distribution of probabilities, rather than collecting discrete points as with traditional methods (Delavande et al, 2011b).

Our validation study is implemented in the context of a larger ongoing research project in Bungoma East Subcounty in western Kenya that examines households' decision making for purchasing anti-malarial drugs. We build on a growing literature about the feasibility of collecting subjective expectations data, especially in developing countries, focusing on the methodology adopted to gather high-quality data (Delavande, 2014; Delavande et al. 2011a and b; Delavande and Zafar, 2013; Attanasio, 2009a). The data collection for our validation study is scheduled to commence in December 2014 and it will last less than one month.

The slider method that we developed consists of eliciting the continuous distribution of expectations with the help of an interactive slider application on an Android touchscreen device. As shown in the figures in Appendix, the respondent moves the slider using the touch screen to indicate the probability that she thinks an event will happen, from 0% at the extreme left, to 100% at the extreme right. In addition, the application includes dynamic images that change relative sizes based on the probability indicated by the respondent. This visual aid helps the respondent to better understand and consider the answer she is selecting. For example, at 50% probability, the size of images on both extremes is identical. This approach allows the respondent to be as precise as she would like to be in indicating her beliefs.

The objective of our validation study is to test our innovative method of eliciting subjective expectations compared to a more traditional method of using visual aids, such as the use of a discrete number of beans. In particular, following Delavande et al (2011b), we will be using 20 beans as the alternative method to collect probabilities. The paper will present the results from the comparison of the two methods with the aim of showing that our new approach can also be successfully implemented in developing countries, while at the same time providing important advantages. Given the higher precision of the collected data (mainly due to the elicitation of a continuous probability distribution) and the lower implementation costs (the elicitation of beliefs is part of the main digital household survey), we believe this new method should be given serious consideration when deciding to collect subjective expectations' data.

Previous Measurement Methods

A variety of methods have traditionally been used to elicit subjective expectations in contexts such as health, education, agricultural production, income and wealth (Delavande, 2014).

First, the Likert Scale[1] has been used in surveys to collect data about perceptions of the distribution of future events occurring. However, the main concern with the Likert Scale is that it is very difficult to make interpersonal comparisons, as different respondents may interpret the scale differently.

A second approach consists of asking about probabilities without the use of visual aids, for instance by asking individuals directly about the percent chance that a certain event will happen. However, this method assumes that respondents are educated and understand concepts of probability well enough to articulate their responses in 'percent chance'. In developing countries, where many respondents have a low level of education or are illiterate, and the notion of probability is not very common, visual aids were shown to be important in explaining this abstract concept (Delavande et al. 2011a; examples of the use of visual aids in developing countries are found in Luseno et al, 2003; Lybbert et al.,2007; Hill, 2007; Delavande and Kohler, 2009b).

A third method that is now commonly employed involves asking respondents to allocate a given set of stones, balls, beans, or sticks into a number of bins to indicate the probability that a certain event happens. A recent study (Delavande et al. 2011b) tested three facets of this elicitation methodology: the number of beans, the design of the support (predetermined with many intervals or self-anchored with few intervals[2]) and, in the case of self-anchored with few intervals, the ordering of questions about the asked minimum and maximum values. Even though both variations in the design have advantages and disadvantages[3], the data collected are shown to be robust to different measurement variations, and the researchers conclude that the use of 20 beans together with a predetermined support with many intervals is the method that provides more accuracy. Indeed, respondents seem to be more precise in their responses thanks to the possibility of using more beans and more intervals.

We compare our slider approach to the latter method, the results of which are used as motivation for our proposed methodology. Indeed, our method gives the respondent the possibility to be as accurate as possible, since she can indicate any probability point in the full distribution.

Experimental Design

We collect subjective expectations data using two different approaches: our "slider" method implemented on a touchscreen Android tablet device and the most recent method used and validated in the literature, i.e. visual aids using 20 beans and predetermined support (Delavande et al. 2011b). We interview in total 552 individuals in Bungoma East Subcounty in western Kenya. First, we randomly assign the 552 subjects into two equal groups. One group receives the subjective expectations questions using our "slider" approach, while other half of the sample is asked the same questions using the traditional "beans" approach. However, this comparison does not alleviate the concern about balance: even if we confirm that our sample is balanced on observable characteristics, we cannot rule out unobserved heterogeneity across the two samples in their understanding and ability to answer subjective probability questions. In order to address this concern, we also ask another set of questions, but this time we use the two different methods to elicit expectations from the same individual. In this second strategy, there remains a concern about "learning": even if the order of the methods used within our sample were randomized (so as to avoid one method influencing the other), it is difficult to rule out whether observed differences are due to individuals learning about the method used, or learning about the probability question.
Given the challenges of overcoming both of these concerns, we use a combination of the two options described above. Figure 1 describes our experimental design.

We select a total of 552 individuals that will be interviewed using the two different approaches.

[1] Usually the Likert Scale consists of five levels of likelihood of a certain event happening: extremely likely, likely, neutral, unlikely, extremely unlikely.
[2] In Delavande et al. (2011b) the respondents are asked about the probability of getting a certain number of fish catches. In the predetermined support, the researcher decides the range of the catches to ask respondents about, while in the self-anchored support the respondents are asked about which are the values most relevant to them, defining their personal range giving a minimum and a maximum value of possible catches. Then, she is asked about the probability that her catches will be in that range.
[3] The disadvantage of self-anchored method is that it requires real-time calculations by the interviewer, which can be time-consuming, and subject to interviewer calculation error; then, in practice the feasible number of intervals is limited. In contrast, a predetermined support can accommodate more intervals, but if the support is very heterogeneous across respondents then intervals will be wide to encompass everyone's relevant range.

In Step 1 half of them will be interviewed using the "beans" method (Group 1), while the other half will be interviewed with the "slider" method (Group 2). Both randomly selected groups will be asked to answer the same first set questions (Question Set #1) in the survey.

In Step 2, within each sub-sample of respondents, we will randomly select half of the respondents to be asked another small set of questions (Question Set #2) with the two methods, but the order of the two approaches will be randomized. Group 1A and Group 2A will be asked questions from Question Set # 2, first with "beans", and then with "slider". On the other hand, Group 1B and Group 2B will be administered these questions first with "slider", and second with "beans".

Figure 1: Experimental Design

Total number of respondents (N=552)				
Step 1	**Half sample (N=276)**		**Half sample (N=276)**	
Questions Set #1	Beans (Group1)		Slider (Group2)	
Step 2	**Half sample (N=138)**	**Half sample (N=138)**	**Half sample (N=138)**	**Half sample (N=138)**
Questions Set #2	Beans Slider (Group1A)	Slider Beans (Group1B)	Beans Slider (Group2A)	Slider Beans (Group2B)

Data Collection

The subjective expectations questions asked will be selected from the beliefs and expectations questions implemented in our main household survey. The questions in our primary household survey consist of four types of expectations: current illness that individuals may have (e.g. fever or "malaria-like" symptoms), general beliefs about malaria, expectations on ACT compared to other drugs effectiveness, and expectations about the RDT test results. We confirm that respondents understand the concept of probability, nested probability and extreme values in the distribution using a set of 5 questions[4].

During data collection for our validation study, we will be also be collecting additional information on the respondent and household characteristics for two main reasons: first, we want to check that the random samples are balanced (at least for socio-demographic characteristics) and, second, we would like to look at possible heterogeneity in the probability distributions (e.g. by age, gender, wealth and education level). We can additionally check if the probability distributions are comparable for specific sub-sample of respondents[5].

Hypothesis Testing and Expected Findings

Given the experimental design in Figure 1, Step 1 and Step 2 allow us to conduct several tests. However, given the novelty of our method, we do not have any strong prior about the expected results.

TEST 1

[4] We ask the following 5 questions: 1) Imagine I have 5 beans, one of which is white and four of which are green. Imagine you pick one of these beans without looking. How likely is that you will pick the white bean? 2) How likely are you to go to the market sometime in the next two days? 3) How likely are you to go to the market sometime in the next two weeks? 4) How likely is that River Nzoia will dry up by next week? (0%) 5) How likely is that 12th of December is a public holiday? (100%)

[5] In Delavande et al. (2011b) the sample the authors investigate was homogenous, because consisting of only fishermen in Tamil Nadu, India. However, we can exploit potential heterogeneity in our sample to draw more detailed comparison among distributions, by socio-demographic characteristics.

In Step 1, we ask the same set of questions to both Group 1 and Group 2. The first test then compares the probability distributions elicited using the "slider" approach on Group 1 to the one elicited using the "beans" approach on Group 2.

TEST 2 a) and b)

In Step 2, we want to test the following:

a) The order of the methods (beans and slider) through which respondents were asked in Step 2 does not matter.

In each group (1 or 2) we compare the distributions of the responses given using the beans first, to the distributions of responses given using beans as second approach: we compare the distributions of responses under beans approach in Group1A with the distribution of responses under beans approach in Group1B. We will do the same for Group2: we want to compare the distributions of the responses given using the beans first in Group2A to the distributions of responses given using the beans as second approach in Group2B.
Similarly we compare the distributions of responses given using the slider first with responses given using the slider as second approach. We compare the distributions of responses under slider approach, used first, in Group1B with the distribution of responses under slider approach, used as second approach, in Group1A. We will do the same for Group2: we want to compare the distributions of the responses given using the slider first in Group2B to the distributions of responses given using the slider as second approach in Group2A.

b) The method used more often to elicit subjective expectations and beliefs data does not affect individual responses elicited trough a different method in Step 2, i.e. "learning" does not exist.

In details, by "learning" we mean that individuals responding several questions (Questions Set#1 and #2) using the same method twice consecutively, such as Group1A (beans) and Group2B (slider), will have more chances to learn how to answer probability questions in Step 2 with a different approach used as second. Then, we expect that these respondents [who answer a different set of questions (Questions Set #1 and Set #2) using the same method twice (in Step 1 and, first, in Step 2), and asked the same questions once again with a different approach (second, in Step 2)] will be the ones who provide similar probability distributions in Step 2 through the two different approaches. We expect the probability distributions provided through beans and slider in Step 2 to be closer for Group 1A and Group 2B compared to the probability distributions provided through beans and slider for Group 1B and 2A. In fact respondents in Group 1B and Group 2A will possibly experience less "learning," due to the "confusion" of being asked different questions with different approaches through Step 1 and Step 2. We expect "learning" in these latter groups to be more limited.

In each Group (1 and 2) we construct differences among distributions of responses elicited with beans and slider in Step 2. In each Group (1 and 2) we will compare the difference between distributions elicited through beans and slider approach, between individuals with high "learning" and individuals with low "learning". In Group 1, we compare the difference between distributions elicited through beans and slider in Group1A (people with "high" learning) to the difference between distributions elicited through beans and slider in Group1B (people with "low" learning). We do the same in Group 2 for Group2B (people with "high" learning) and 2A (people with "low" learning).

We compare probability distributions or differences in probability distributions, elicited from different[6] respondents using the two different methods, as described in details above in the empirical tests listed. In particular, we perform Komogorov-Sminorv test and the Mann-Whitney test, two leading non-parametric tests of equality that do not require any specific distributional assumption. Moreover, we test the equality of moments (mean, median, mode, standard deviation, and percentiles) of the two probability distributions as well.

The results presented in the paper will provide information on the quality of the data collected through the new touchscreen-based slider method, compared to a more traditional one. We believe that this novel method should be taken into consideration by researchers collecting subjective expectations' data in developing countries. We do not exclude that this method could be used in developed countries as well.

[6] We also check that the two samples are balanced in the main socio-demographic characteristics.

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APPENDIX: The tool

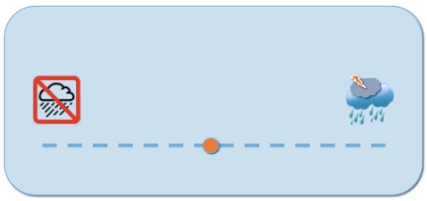
Example:

[The following example will help the respondent to understand the concept of probability and how to answer during the survey using the touch-screen tablet. The interviewer reads out the text and then shows the figures on the tablet; the interviewer let's the respondent play with the screen to get a sense of the probability]

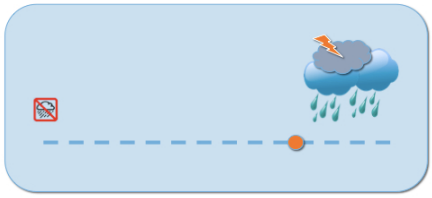
I would like to ask you about the chance or likelihood that certain events are going to happen. As you know, there are many events in our lives that are uncertain. For example, we can guess about the chance it will rain tomorrow, but cannot say for sure it will rain on any given day. Also, the chance it might rain will also depend on the season. For example, in this rainy season (April – June), you might expect that there is a high chance that it will rain tomorrow. But there is no guarantee that it will rain for sure.

On the other hand, if I had asked you this question about a day in the dry season (January – March), you might have expected that the chance of rain is very low. But again, completely unexpected rains can arrive even in March!

Using this screen, you can express how certain you think these uncertain events might occur (like whether it will rain tomorrow). When the ball is in the middle of the line, it shows you think it is equally likely that it will rain or not rain. As you move the ball towards the RAIN, you indicate that you are more and more certain it will rain. If you slide it all the way to the right, you are 100% absolutely certain it will rain.



(Example of equal likelihood of rain and no rain)



(Example of 7 out of 10 chance of rain tomorrow)

Note that in this last example, the ball is not all the way at the end, indicating a very high likelihood it could rain, but there is a small chance it might not rain. This is an example of a 99% chance.