The Program on Governance and Local Development

Use of Tablet Computers to Implement the Local Governance Performance Index (LGPI) in Tunisia

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Abstract

This paper shares the advantages and challenges of using tablets to implement a complex survey on local governance and offers practical advice stemming from lessons learned during the successful implementation of the survey. It focuses on the experience of the Program on Governance and Local Development Using tablets offered several advantages. They allow for implementation of a long, complicated questionnaire and to implement survey experiments in which randomized subpopulations received different "treatments" (namely, versions of questions, framing questions, and list experiments). Tablets also make it possible for us to verify the location of respondents according to our sampling design. This geographical information is important at the data analysis stage by making it possible to account for clustering and "neighborhood effects" within small localities. Additionally, tablets allowed us to time the length of each interview precisely, which turned out to be important for catching data collection errors in the field. Using the tablets entailed some particular challenges as well. These included start-up costs of learning new software, programming the questionnaire, and the need to do pretesting and piloting to resolve coding bugs that can potentially introduce errors into the study. There are also important logistical considerations, including the availability of electricity and Internet connectivity. Finally, although tablets remove some sources of survey error, they may introduce others. It is important to recognize these potential problems in order to guard against them.

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Cover Photo

Picture taken by Kristen Kao (2015).

1. Introduction

While the use of Computer-Assisted Personal Interviewing (CAPI) using Internet-connected tablets has exploded over the past several years, methodological training and the literature on best practices have not kept pace. This article discusses the advantages and challenges of using tablets to implement a complex survey on local governance, the Local Governance Performance Index (LGPI), and offers practical advice stemming from lessons learned during the successful implementation of the 2015 survey in Tunisia.

Developed and implemented by the Program on Governance and Local Development (GLD) at Yale University, the LGPI is a statistical tool that helps countries assess and benchmark detailed statistics around issues of local and public sector performance and service delivery at the level of the municipality across five areas: education; health; security and dispute resolution; social assistance and welfare; citizen-state linkages, corruption, and trust. The survey is designed to provide information at the individual, municipal and national levels on citizens' experience, perception and satisfaction regarding governance and service provision. Results can be presented by sector (e.g., health, education, security) or governance component (e.g., transparency, accountability, participation). The goal is to use the data to help pinpoint, diagnose, and foster discussion regarding areas of need, help formulate policy recommendations, provide a benchmark for assessing policy implementation, and allow us to examine the factors driving good governance and quality service provision.

The survey questionnaire is extremely complex. It contains a significant number of questions with multiple forks. For instance, individuals are asked whether they were the victim of assault, theft, and a number of other crimes. Those who were victims are then asked whom they turned to for help, and, if they sought help, how satisfied they are with the outcome. As this example suggests, the questionnaire also contains a large number of questions on security, health, and other areas that tap into rare events, many of which have detailed follow-up questions. Further, the questionnaire includes many batteries of varying length. For instance, respondents were asked if they had children, and then for each one, answered series of questions about their child's experience in school. (In Tunisia, the respondents' number of children ranged from zero to nine.) Finally, the questionnaire contained survey experiments. In paper form, it is extensive and unwieldy.

The LGPI fielded in Tunisia was further complicated because we used this pilot study to test different versions of the questionnaire. The instrument is extremely long, and we wanted to determine how important a number of questions were for each battery. To do so, we created long and short versions of the five main batteries, and developed five questionnaires, each with a different 'long' section. This strategy allowed us to field long versions of each battery, allowing us to evaluate the value added of additional questions, while keeping each interview to a reasonable length. At the same time, however, the decision to include both long and short batteries, combined with the survey experiments, made the questionnaire even more complicated.

In this context, tablets had specific advantages. They allowed for a long, complicated questionnaire; the random assignment of detailed modules to subsets of the population, reducing total interviewing time; inclusion of randomized experiments; and, randomization of response choices to eliminate primacy and recency effects. They also allowed for daily uploading of data that was automatically coded via the CAPI software, making it easy for researchers to quickly identify and resolve problems in the questionnaire, implementation, sampling, and randomization.

There were drawbacks as well, many of which can be mitigated in the future, given lessons learned. There were start-up costs of learning new software, coding the questionnaire on the tablets, and the need to pretest and pilot the instrument in order to resolve coding bugs that can potentially introduce errors into the study. There are also important logistical considerations, including the availability of electricity and Internet connectivity. Finally, although tablets remove some sources of survey error, they may introduce others. It is therefore critical that these challenges be assessed and addressed.

This article presents all the details of the different steps of this survey and assesses how tablets affect implementation and may impact data quality. It presents the process we put in place in implementing the LGPI, assesses advantages and disadvantages of this kind of tool and process when implementing a face-to-face survey, and recommends steps that can be taken to alleviate problems in the future. It concludes by considering the environmental factors that may affect tablet use, the ethical issues arising from tablet administration, and the possibilities for future research.

2. Sampling

2a. The Process

The survey was fielded February-March 2015 in 6 of Tunisia's 24 governorates (Bizerte, Monastir, Mahdia, Sfax, Siliana, and Tunis), focusing on 3 municipalities in each governorate. Households within each governorate were randomly sampled using Probability Proportional to Size sampling (PPS). Points of light data was used as a proxy for local population density due to the fact that the last census was conducted in 2004 and there appeared to be considerable changes in population distribution in the last decade. Respondents within households were chosen randomly from among Tunisians the age of 18 using Kish tables. There were 3,659 complete interviews, approximately 200 in each municipality.

Within governorates, the seat of the governorate was purposively included (self-representing unit), and two other units (*delegations*) were selected at random following the principle of selection proportional to measure of size (PPMS). Below the level of the delegations, we used a spatial approach that selected tiles (half-arc square minutes) using the nightlight measure of each tile from the DMSP-OLS project as a proxy for population density. Each spatial tile was selected by PPS using this measure (see Figures 1. and 2.). Finally, a random cluster of starting points (latitude and longitude coordinates) were drawn as starting points from which the enumerators were instructed to reach the first dwelling through a random walk process. Once the enumerators reached the dwelling, they were instructed to use the GPS function of the table and save the geo-coordinates of their location (right before entering the dwelling). This procedure allowed the home office to verify that the teams correctly followed instructions and properly reached households actually located within the sampling unit where they were assigned to work. If the dwelling was inhabited and accepted to participate, the team proceeded to use the tablet to list all eligible respondents within the household and selected the final respondent though the Kish method that was programmed into the questionnaire interface.

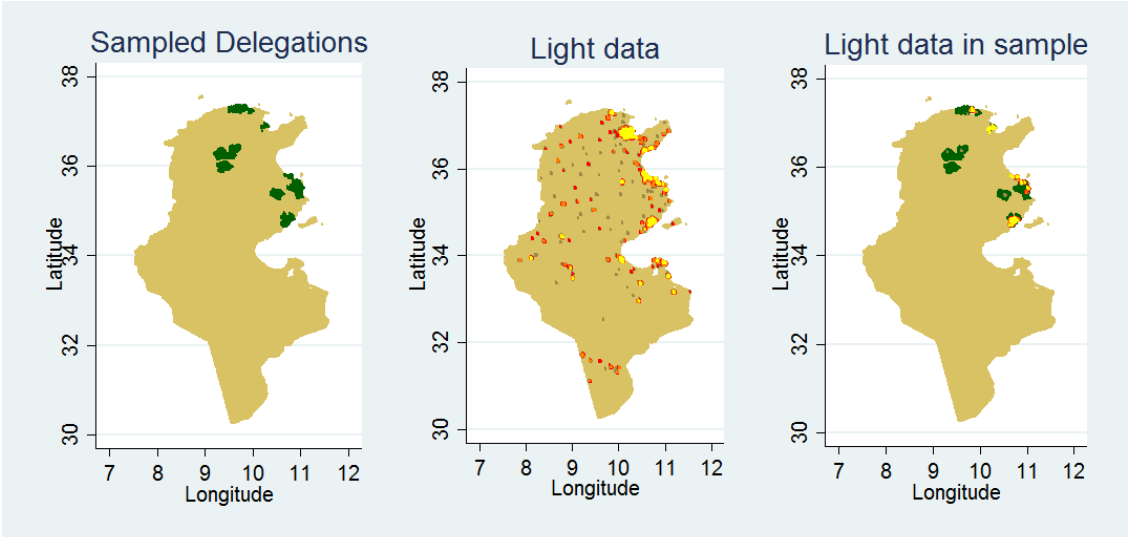

Figure 1a. Sampling Clustered Municipalities in Tunisia. Six governorates selected by PPS, 18 delegations (3 per governorate), with each seat of governorate self-representing and the other two randomly selected by PPS. Based on DMSP-OLS night light data, tiles scaled as half arc-minutes were selected by quasi-PPS technique based on the refraction of the tiles (0-63 scale). The Kish-grid method was used to select final respondents within households.

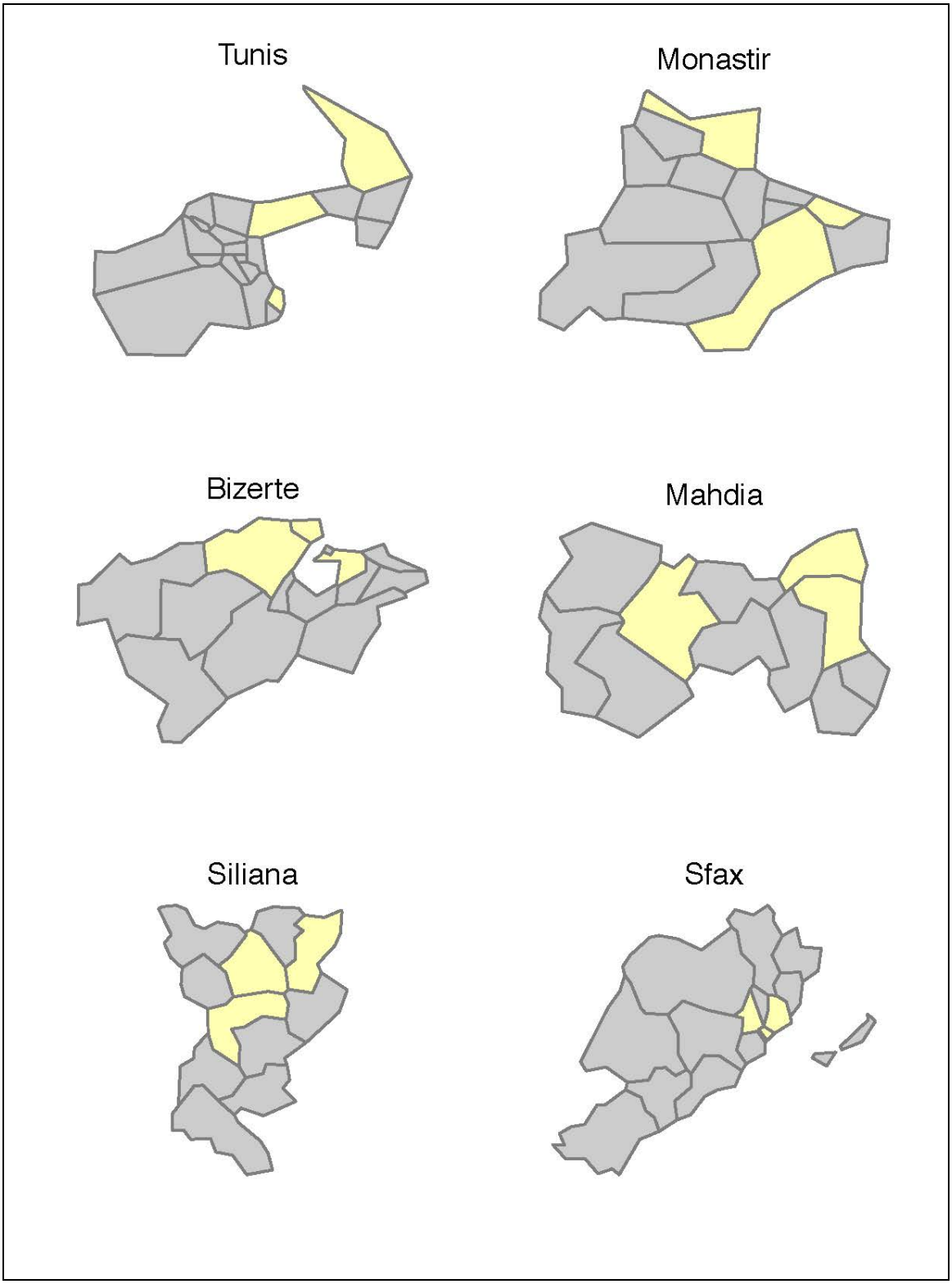

Figure 1b. Municipalities selected within each governorate.

2b. Opportunities

2b1. *The ability to program the random selection of the respondent (the "Kish grid") greatly facilitated the work of selecting the final respondents once the interviewers had entered the household.* The paper-and-pencil process can easily lead to errors, by forcing the enumerator to access a table of random numbers based of the total number of eligible respondents in the household that she has just listed or by using one of eight pre-supplied grids. Paper-based methods also make it very easy to cheat, since the interviewer can simply pick the random number corresponding to the persons who happens to be present in the household during the first visit. These discrepancies may be detectable once they return to the home office, or even during the data analysis stage by carefully evaluating the variables related to household composition. Tablets, on the other hand, remove all human intervention in the selection process once the listing of all eligible respondents is complete. The interviewer may attempt to manipulate the process by only listing members of the household who are physically present at the time or who appear as if they would be more cooperative respondents. However, the ability of the central office to monitor household composition within hours of each interview makes it much easier to ensure that such manipulation is detected early and stopped before it contaminates the research project. Thus, tablets tend to reduce sampling errors related to the selection of the respondent via the Kish grid.

2b2. *The use of tablets helps to verify if the interviewers have gone to the correct location.* The tablet records the geo-location of the interview. This allows supervisors and managers to match the location against destinations in the sample, providing a means of quickly catching mistakes.

2c. Challenges

A tablet interface does not fully solve the challenge of sampling manipulation by interviewers. Tablets remove human error from the implementation process of the Kish table, but a dishonest interviewer may still cheat. He or she may exit the survey and re-run the Kish table in order to redraw a respondent who is available, or, worse, simply interview the wrong person (e.g., interviewing the 35 year old female, while the data collected states it comes from a 35 year old male). He or she may also pretend that the person refused the interview, noting that she was not available, rather than trying to make an appointment to return. In this latter case, the interview is terminated and the interviewer can move to a different (presumably easier) household. Instances of the wrong

person being interviewed can be detected by comparing gender with indicators like pregnancy rates. As is also true of paper-and-pencil techniques, it is up to the research group and team leaders to recruit and train interviewers thoroughly so that they comply with all instruction related to the survey process. What tablets allow is very quick access to the data while the work teams are still in the field, which enables researchers to watch for oddities in the distributions of the variables related to the sampling process.

2d. Recommendations

2d1. *Time-stamps can and should be used to aid in data forensics.* The survey interface allows for the insertion of 'time-stamps' at any stage of the questionnaire. Among the lessons learned from Tunisia is the fact that performing "forensics" on anomalous data would have been easier had each answer been time stamped. (This can be done seamlessly in the background, without any human intervention.) Since we only recorded the beginning and the end of interview, we lack the ability to identify cases where the interviewer may have attempted to cheat by entering answers without asking questions, or may have asked the questions at such a fast tempo that the respondent does not have sufficient time to articulate a thoughtful answer. Systematic time-stamping is impossible with a paper questionnaire; it is not only possible but highly recommended to make it a norm when tablets are being used.

2d2. *The survey should be programmed to prevent interviewers from going backwards in the survey and redoing the Kish table.* The problem of interviewers redrawing the respondent can be easily resolved by programming the tablet so that it does not allow the interviewer to return to the Kish table.

2d3. *The survey should be programmed to stop the timer when interviews are suspended (e.g., when the interviewer makes an appointment to return) and to note when cases are closed and reopened.* This will allow the team to better use the timer to identify problematic interviews (e.g., those that were completed too quickly).

3. The Tablets, Software, and Team

Some time was spent researching and deciding upon the right mobile survey program for our purposes. Since the survey would be conducted in Arabic, it was essential to find a mobile survey program that can handle Arabic script. Fortunately, the SurveytoGo (STG) program has an interface that is UTF/Unicode compliant, and thus allows for the production of questionnaires in a variety of languages, including, if necessary, multilingual and multiscript instruments. At the time that we conducted the survey, the STG program charged according to the number of survey responses to be recorded and stored in their online database.

3a. The Tablets

STG must be downloaded onto a tablet that uses the Android platform. As a result, we did not consider using the Ipad. Among those with the Android platform, we looked for a model that was a good value. We selected the ASUS Memo Pad 8 with the Android 4.4 operating system (see Image 1). This tablet has an 8.00-inch, 1280x800 display and is powered by 1.86GHz processor with 1GB RAM. The tablet dimensions are 124.90 x 211.00 x 8.30 mm. At the time of the study, the purchase price was about $250 per tablet. While the cost of purchasing tablets is high, using them for multiple surveys allows these costs to be spread out across studies making the a worthwhile investment.

Image 1. ASUS Memo Pad 8

We purchased the tablets in the United States and made arrangements to have them temporarily imported into Tunisia through an international organization. Although we made arrangements to bring additional tablets by putting them in team members' checked baggage, and had prepared the necessary documents in advance, we were not successful. (Instead, we were forced to leave them at the airport until they could be taken back out of the country.) This presented some challenges and led us to believe that purchasing the tablets in country may be a better approach in the future. Other options are to work with survey providers that already own tablets, or to write the cost of tablets into the grant and offer them afterwards to the provider as part of the remuneration for the survey. If importing tablets, it is critical to know the procedures in advance and to develop contingency plans should logistical difficulties occur.

Another issue was the potential problem that interviewers may break or not return the tablet. This was one consideration that prompted us to select a less expensive model. To mitigate this concern, we employed a successful, two-pronged approach. First, we recruited interviewers through trusted personal and organizational networks (e.g., business and school networks) and, second, we included a statement in interviewer contracts about returning the tablet in good working order. Each interviewer had a tablet and each supervisor also had one additional tablet for use in case one of the other tablets failed. We did not provide a stylus.

3b. Programming tablets and coding the questionnaire using SurveyToGo

The questionnaire downloaded to the tablets was programmed using the application SurveyToGo (STG) (http://www.dooblo.net/stgi/surveytogo.aspx). This software is designed to conduct mobile field surveys; interviewers can work offline, uploading their work nightly to the server for review of interviewers' work. The data can be easily monitored, accessed, modified, and managed at any time. And, users and collaborators working from any location can be given special permissions to see, control, and manage the results (although edits to the survey cannot be done simultaneously,so communication between team members is crucial for ensuring only one person is editing the survey at a time).

STG allows many functions, including branching, skipping, looping, validation, piping, randomizing questions, answers and chapters, and many other options (see Images 2a and 2b). It also includes a desktop tablet emulator that allows you to fully test your mobile surveys from your desktop (although some features do not work in the emulator, like randomization patterns).

The GLD team designed the questionnaire and tested many of its functionalities using this emulator. Since the emulator is hosted online, the team can test it from any location by simply by going online and accessing the STG account. Once this step is ended, the final version of the questionnaire is uploaded on each tablet. Updating the questionnaire can also be done easily by connecting the tablets on Internet.

STG automatically captures the GPS location where interviews were conducted and can later be viewed on a map. However we faced some problems with the capture of geo-coordinates in the field and failed to record 30 percent of the dwellings. This happened for one of two reasons. First, some buildings blocked the GPS signal. Second, the memory cache on the tablet was sometimes too full to save GPS information. To resolve this, we recommend uploading the completed questionnaires to the database mainframe at least once a day and performing a purge of the memory cache by going into tablet settings and clearing the memory cache.

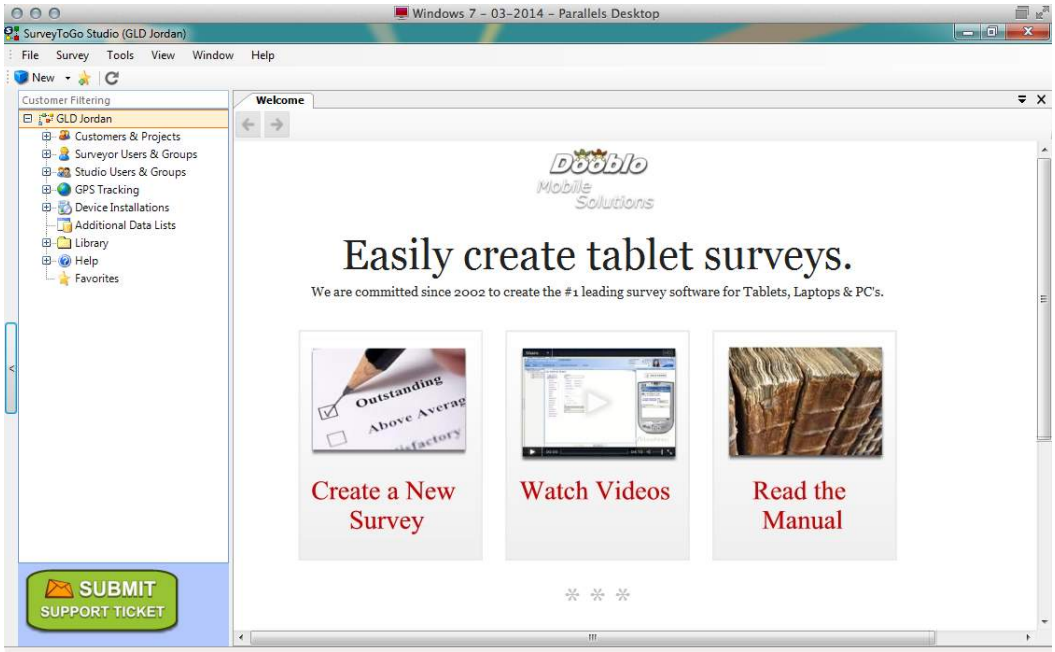

Image 2a. The interface of SurveyToGo on the computer to implement the questionnaire.

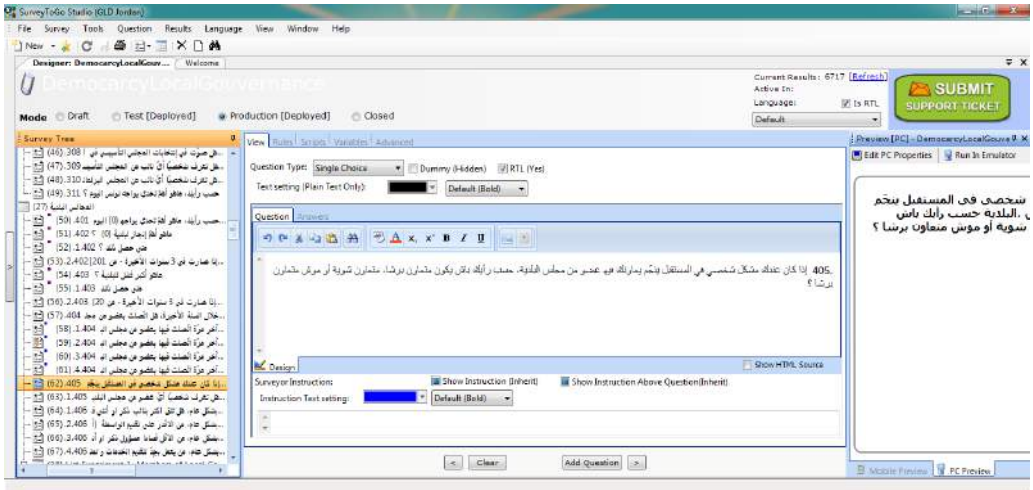

Image 2b. The questionnaire on SurveyToGo

3c. The Team

The LGPI was designed by a core group of scholars (Lindsay Benstead, Pierre Landry, Ellen Lust, and Dhafer Malouche) based on a similar survey, the Public Administration Performance Index (PAPI), conducted in Vietnam in collaboration (*inter alia*) with Prof. Landry. The team conducted interviewer training and the survey was implemented and overseen by Prof. Malouche. The survey team consisted of 60 interviewers, 18 supervisors (one per municipality), 6 controllers (one per governorate), and 2 data controllers. The interviewer team consisted of young students experienced in conducting surveys and active in civil society organizations (see Image 3).

The training took place at a private hotel over three days. During this training, interviewers received tablets with the downloaded questionnaire, learned about all aspects of the survey sampling and implementation, and practiced using the tablet to conduct a standardized interview. Each team was assigned to a municipality, including supervisors, who also learned about their role managing fieldwork and monitoring the quality the interviewers' work. Controllers were assigned to one governorate (i.e., three municipalities), monitoring progress and making unannounced visits to sampled homes to verify that interviews had indeed taken place. Controllers took special care to ensure that the household listing was done properly and verified that the person interviewed was truly the one selected through the Kish-grid process. Controllers

also performed daily statistical analyses on the uploaded data. They looked for outliers, such as high or low rates of non-participation or item non-response or suspiciously large proportion of a given demographic (e.g., females, younger respondents). The core team of researchers, led by Prof. Malouche, managed the overall process.

Image 3a. The Survey Team after Training

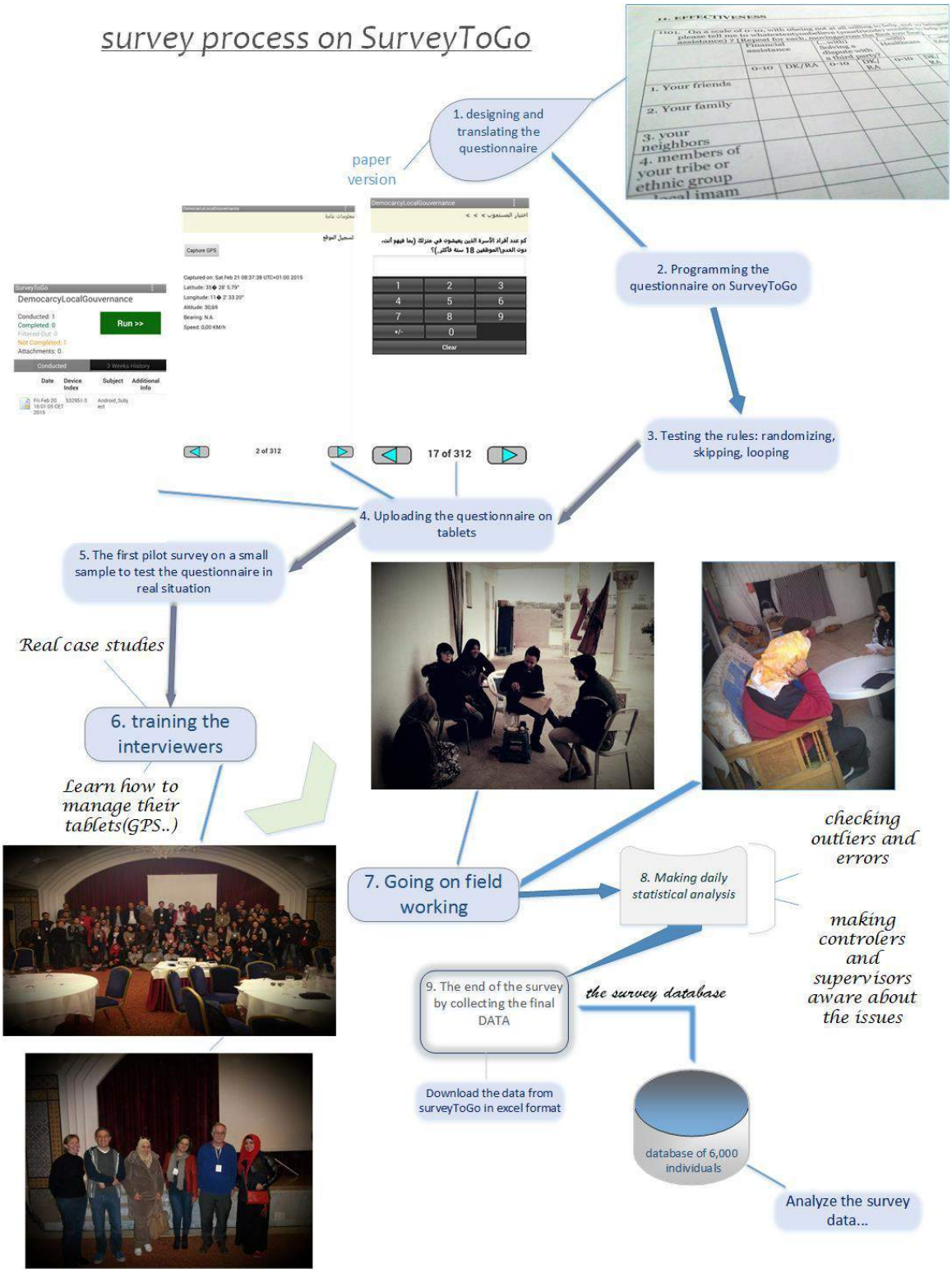

Image 3b. Survey Process on SurveyToGo

4. Questionnaire, Development and Programming

4a. Process of Questionnaire Construction

We began by writing the questionnaire through the same process followed when implementing a face-to-face survey with paper forms. The survey included a cover page, which lists the characteristics of the dwelling, as well as the disposition of the case. Batteries on each of the core LPGI areas were written, drawing from existing instruments when possible.

As discussed above, the survey instrument included complicated skip patterns and extensive batteries. Given its length, and the desire to test the usefulness of different questions for the development of the LGPI, we decided to create long and short versions of the five main batteries. This allowed us to assign randomly one long battery to each respondent, thus testing many types of questions while keeping the interview within reasonable length for any given respondent.

When the questionnaire was nearly finalized, we programmed it into STG and quickly realized that using tablets required reconfiguring several sections. We carefully considered module order in light of the need to randomize some long batteries as well as a survey experiment. The process of inputting the questionnaire led to decisions to reorganize and reword some of the questions in order to ease implementation. For instance, the standard cover sheet was reorganized to facilitate coding (see Appendix A for examples of the standard cover sheet and the one used in STG.)

4b. Opportunities

4b.1 *The use of tablets allows for the development and implementation of complex questionnaires.* As discussed above, the survey was extensive and complicated, with experimental questions and long batteries with multiple forks. Using paper versions, it would have required 25 versions and been over 50 pages long. By using the tablet, randomization was assured and skip patterns programmed, automatically leading interviewers to the correct questions. This makes complex questionnaires easier for the enumerator to navigate, reducing errors.

4b.2. *CAPI offers new capabilities for randomizing the questions that are shown and response item order within questions, both important elements of testing the effects of survey administration techniques.* For example, survey methodologists have found that respondents have tendencies to prefer the first or the last response item in a question. Computerized surveys allow for easy randomization of response order and a means for tracking which version was showed to which respondent in order to empirically test for primacy and recency effects due to the response order.

4b.3. *Tablets allow for the embedding of color photos and audio clips, creating new opportunities for administering surveys.* Tablets can allow more accurate implementation of survey experiments in which alternative photos (e.g., varying gender, dress) are used. Embedded videos and pictures can also aid in communication with less educated populations and, where appropriate, allow for video-assisted self-implementation of surveys.

4b.4. *CAPI makes it possible to embed QxQs and additional interviewer instructions more easily into the questionnaires.* For instance, the team can code certain response options to send enumerators specific instructions for specific situations (e.g., follow-up prompts for "don't know.") They can also embed standard definitions for interviewers to use when giving clarification.

4b.5. *The rules surrounding answers to the questions are easier to enforce through the use of CAPI.* For example, the tablet can be programmed to force the interviewer to input only one answer if that is desired and it can make sure that an answer is provided, even if that answer is simply "I don't know" or "I refuse to answer." Consequently, tablet based surveys can result in lower item nonresponse error.

4c. Challenges

4c.1. *Mistakes can be easily made in the programming of the survey, particularly when surveys are complex.* For example, coding becomes more difficult each time a question is to be randomized, especially if questions are embedded within one another. Skip patterns can become more difficult to trace within the program and mistakes are easily overlooked. This can lead to blocks of questions being inadvertently skipped in one or more forms of the questionnaire.

4c.2. *There is a learning curve in implementing surveys by tablet; it requires learning the coding language and becoming familiar with all of features of the mobile survey software interface.* For instance, SurveyToGo requires some knowledge of the C# programming language.

4c.3. *The preparation of the questions and coding of the survey can have important implications for the shape of the data as it is downloaded and should be taken into account when preparing the survey.* In STG, for example, answers are automatically ordered alphabetically or numerically. This can lead to confusing reordering of the answer categories. Numbering them ensures that they appear in the desired order in the dataset.

4d. Recommendations

4d.1. *It is advisable to budget plenty of time for learning about all of the capabilities and limitations of the mobile survey software early on in the process.* For example, SurveyToGo has a feature that allows saving response code templates so that they can be inserted into following questions (e.g., a "no" response is coded as 0 and a "yes response is coded as 1").

4d.2. *We recommend that research teams prepare the survey by programming the CAPI interface directly or, alternatively, begin the process of uploading the survey early and leave plenty of time for adjustments.* The more that the survey can be programmed directly, the lower the error rate is. This also saves valuable time carefully checking that the program code is correct helps ensure that the data output is easily understandable and loads seamlessly into data analysis package such as R, STATA, or SPSS.

4d.3. *Establish a standardized scheme for how different variations of a question as well as choice items will be coded and then implement it within the tablet survey program before the questionnaire is uploaded.* Question numbering can be confusing when multiple versions of the same question are asked to different sub-samples, given that most data analysis software require a unique ID for each question. It might be helpful to first upload all questions into the program and then to go through and number them according to the coding scheme. If a question needs to be inserted after most questions have already been numbered, the coding scheme for all subsequent questions may be affected and be time consuming to change.

4d.4. *For complex surveys, think about how earlier randomization procedures might affect later ones and map out the process before running the survey to ensure participants will be selected into the correct groups and questions are evenly randomized.* Double-check all coding, making sure that each branch is set to correctly filter to the proper question before fielding the survey.

5. Pretesting an Piloting

5a. Process

The LGPI went through two rounds of pretesting and one of piloting. The first round took place nearly one year before the implementation of the survey. This consisted of a focus group of Tunisian and US-based scholars as well as a meeting of development specialists held at Yale University, one-on-one input on the questionnaire from other scholars and development specialists, and feedback from survey managers and interviewers at a meeting in June 2014. The second round took place in spring 2015, after significant revisions to the initial questionnaire. This included pre-testing of the program by multiple members of the team and hired consultants, as well as input from interviewers at training prior to the implementation. The major focus in the later stages was on the correct programming of the questionnaire.

The LGPI implemented in Tunisia in 2015 was itself a pilot because it was conducted in only six of Tunisia's 24 governorates. However, a pilot of the questionnaire took place as part of interview training, with revisions to the questionnaire and program again implemented prior to fielding.

5b. Opportunities

5b.1. *Tablets allow maximum benefit to be derived from a field pilot because the data will be coded immediately upon downloading.* Pilots are particularly useful when the responses are analyzed for lack of variation or high levels of item nonresponse. Such analysis is much easier with tablets, which allow for immediate compilation of the data.

5b.2. *Tablets also offer easier and less conspicuous use of recording during focus groups, behavior coding, and cognitive interviewing that can be particularly useful during pre-testing and piloting.* It is important, of course, that respondents give informed consent to such recording. If they do, or if individuals who volunteer for initial pretesting are willing to be recorded, such recordings can be particularly useful.

5c. Challenges

5c.1. *Programs like SurveyToGo require programming that must be verified to avoid costly errors, particularly when implementing complex surveys.* For instance, even with the multiple rounds and extensive checks of the survey, we found problems with the skip patterns in the initial survey, which required that a day's worth of surveys be eliminated and redone.

5c.2. *Pre-testing and piloting is both about programming and question wording and should be done on tablets as much as possible.* Skip patterns are important in paper and pen surveys as well; however, tablets do not allow for the easy alteration of skip patterns. Even highly skilled interviewers will be made to skip questions that are not programmed in the correct sequence. Moreover, as noted above, question wording may need to be altered as questions are inserted into the tablet platforms. It is therefore critical that pretesting be undertaken with the actual tablet computer to ensure that what is being pretested is not only the questions themselves, but also the tablet platform.

5d. Recommendations

5d.1. *Run pre-tests multiple times during the development of the survey, and the pilot at least a few weeks before you want to field the survey.* This will allow sufficient time for revising the survey, addressing problems in programming, and analyzing the data. It is particularly important to examine potential problems with randomization, skip patterns, question wording, etc.

5d.2. *We recommend writing the costs of using these techniques into grants and contracts.* Pre-testing and piloting surveys are too often overlooked and yet essential steps in the process. Sufficient time and resources should be allocated to ensure the proper implementation of these steps. This is particularly apt when tablets are used, as the pre-testing is more complex and the gains from piloting easier to realize.

6. Field Material Preparation

6a. Process

To prepare the field material, we purchased tablets, plug converters, car chargers, electrical outlet strips, and the STG program. We downloaded the program and survey on the tablets and, as the survey was revised, refreshed the program on each tablet. We also had to be sure that the tablets were fully charged before we the training.

6b. Opportunities

Tablets allow for easy revisions to the survey, even as fielding approaches. In contrast to paper and pen surveys, wherein changes in the survey require re-copying questionnaires at significant cost and time, tablets allow for surveys to be revised and re-downloaded.

6c. Challenges

Tablets require additional considerations to ensure that researchers are not in the field without appropriate survey instruments. First, care must be taken to assure that researchers will have access to electricity. Tablets that run out of battery or memory space are useless in the field. Second, tablets allow for easy updating of questionnaires, but the failure to download new versions onto the tablets will leave interviewers implementing different instruments.

6d. Recommendations

Implementing surveys with tablets requires adjustments in field material preparation. Some steps are made easier or eliminated (e.g., updating instruments, copying questionnaires), but new issues must be taken into consideration. Additional time should be allocated in survey preparation, particularly in the early stages of implementing surveys by tablet.

7. Interviewer Recruitment and Training

7a. Process

Interviewers were introduced to the tablet and training took them through the full stages from finding and approaching selected housing units, to filling out the household listing and conducting a standardized interview. At each stage, practical examples were given about what to do in unforeseen circumstances (e.g., the house was demolished, a local official asks for authorization, etc.).

7b. Opportunities

Interviewers appeared to generally enjoy and prefer working with tablets.

7c. Challenges

7c.1. *Interviewers must learn standardized interviewing, as well as how to use the tablets, which requires a slightly longer training time, better preparation of field materials so that the tablet has the finalized and piloted survey on it, and attention to hiring interviewers with some knowledge of computers.* Older enumerators might be less well-acquainted with tablets and may need more training or be afraid to admit when they do not understand how to get the tablet to work again after a malfunction.

7c.2. *Due to the high costs of the tablets, extra attention must be paid to concerns that enumerators could be targets for theft.* As with all surveys, interviewers should never be sent to areas that are not secure. Additionally, tablets should only be considered when their use does not increase the risk to interviewers. Choosing the most inexpensive tablet possible for the needs of the survey can be a good practice. When the study was fielded in Tunisia, potential concerns did not materialize, in part because tablets are widely available on the Tunisian market. Purchasing simple covers for the tablets also masks what they are while on the street.

7d. Recommendations

7d.1. *Be sure to hire interviewers who are comfortable with technology, in order to ease use of tablets, and make a few modifications to training.*

7d.2. *Do not over disclose your methods for how you monitor and check for evidence of dishonest work.* While interviewers should know the correct procedures and that their work will be monitored, precise details of data forensics should not be shared, so as to facilitate interviewers to find ways to circumvent controls.

7d.3. *Allow extra time for training, particularly in early stages of implementing surveys with tablets.* Always good survey practice: hold a separate training for the supervisors to go over these issues. Take time during the training to explain how to care for and charge the tablets.

7d.4. *Change the settings of the tablets to require a code to download extra applications or games so that enumerators do not spend a lot of time playing on the tablets.* This provision will prevent the wasting of valuable tablet space and energy in the field.

7d.5. *Come up with a system for locking and storing tablets.* Make sure interviewers understand that they will should not take tablets home--instead, have supervisors keep tablets overnight--and that they are personally responsible for them while they are in their care. Consider buying protective cases for carrying the tablets around in. Warn enumerators and instruct supervisors not to leave tablets in plan view in cars.

8. Concluding Interviews

8a. Process

We assigned four interviewers to each supervisor so that they could fit into a single car. The supervisors made sure that each enumerator's tablet was fully charged at the start of the day. Each day, the survey manager gave each supervisor five to six GPS starting points from the sample. Supervisors then assigned interviewers to a starting point and gave them a random number to begin the random walk. Each evening, the team members were expected to connect their tablets up to Internet if possible and upload data. Some of the teams had to spend the night

out in a hotel out in the field because of long distances to some sampling areas. In these cases, Internet was not always available. Interviewers worked for three weeks and were not allowed to do more than four interviews per day in order to ensure high quality administration.

8b. Opportunities

8b.1. *CAPI cuts out much of the hassle associated with paper-based surveys.* Imagine an enumerator in the field attempting to keep track of five different forms of a survey, flipping through pages to follow complicated skip patterns, and having to lug around a stack of papers, which can be quite large and heavy for long surveys with a high number of respondents. Similarly, surveys that must be conducted in multiple languages are easier to manage with the use of tablets, as they no longer require interviewers to carry multiple versions of the survey.

8b.2. *Direct uploading of the data means that there is less risk of surveys being damaged or lost in transit.* This not only reduces the risk of lost surveys, but it can also reduce potential problems that researchers may face in difficult environments.

8b.3. *There is less potential for interviewer error in using showcards or other tools.* As noted above, color photos and audio clips can be programmed to be shown during the interview process. Programming these into the survey reduces problems that may arise when interviewers inadvertently show the wrong clips or showcards.

8b.4. *Using tablets to conduct surveys can help assure that additional data collected is correctly mapped to the appropriate interviews.* Paradata collection is a new feature offered by the use of tablets that allows the collection of additional data regarding the sampling unit. For example, one can take photos on the tablets of the surrounding neighborhoods to get a better idea of the type of area the house was situated in. The geo-location of this material can be mapped to the GPS coordinates in the survey data to assure that they are correctly matched.

8b.5. *Interviewers may be perceived being seen as more sophisticated by respondents, which eased the process of conducting the study.*

8c. Challenges

8c.1. *Interviewers need to be disciplined in charging tablets, uploading surveys, and keeping tablets free from extraneous programs (e.g., games.)* Some of the tablets lost power in the field if enumerators forget to charge them at night. A few tablets ran out of memory space to store the information due to surveys that were not yet uploaded and, possibly exacerbated by the downloading of programs for personal use such as games.

8c.2. *The survey process can be made harder if the interviewer is in areas where connectivity is poor.* Both uploading the data to the central database and refreshing new versions of surveys (if necessary) require that the tablet be connected to the Internet. In areas where connectivity is very bad, it may be hard for interviewers to upload the data limiting their ability to free up space on the tablets. GPS signals are also not strong enough everywhere – particularly in rural areas – to be counted on.

8c.3. *Researchers could inadvertently disrupt randomization patterns if they go back to change previous responses.* Sometimes, interviewers will recognize that they made a mistake in recording response and return to correct it. When the survey is complex, this may actually change the randomization of survey questions and disrupt balance in experimental questions.

8c.4. *Supervisors may have difficulties reviewing the survey and tracking quality, particularly if the interviewer uploads surveys without approval.* The immediate review of surveys is more difficult when they are conducted on tablets than it is when the researcher has paper surveys to submit.

8c.5. *While tablets offer impressions of sophistication, some interviewers also reported being accused of spying – that is, the tablets with their recording capabilities, invited suspicion.*

8d. Recommendations

8d.1. *Implement measures that help to assure the technology works.* For instance, we bought a portable car charger for each supervisor that allowed two tablets to charge at any one time. We also gave each supervisor one extra tablet in case an enumerator's tablet failed in the field. For those who would be staying the night in a hotel, electrical strips with multiple outlets were purchased so that multiple tablets could be charged from the same spot. Supervisors were instructed to always

make sure their own tablets were charged while the enumerators were in the field and to remind enumerators to charge their tablets every evening.

8d.2. *Find ways to help supervisors review the survey.* Supervisors should be trained to ensure that every attempted contact with a respondent is recorded. This is done when interviewers fill in the cover page variables, as instructed, before going to the door.

Programmers should also look for ways to instruct SurveyToGo. See if there are ways to tell the program to keep surveys on the tablets until the supervisors have approved them. This will help supervisors keep track of completed surveys. Supervisors could also be trained in, or be put in close contact with teams trained in, data verification. Communication between those reviewing the full data on a daily basis and supervisors can help to alert supervisors to problems quickly.

8d.3. *Be strategic about where it is possible for interviewers to go back in the survey.* Interviewers should be limited in their ability to return to change answers, and particularly not to do so at strategically important points (e.g., after implementation of the Kish table, over randomization points, etc.) Alternatively, one can eliminate any ability for interviewers to retrace questions and simply include moments, at critical questions, where the interview is asked to confirm that the inputted answer is correct. Interviewers can also be provided with a section where the enumerator can write that he or she made and mistake and then can correct it.

8d.4. *Provide enumerators with official identification badges and letters as well as a number people can call to verify their identities to encourage trust among respondents.*

9. Qaulity-control and Data Forensics

9a. Process

We employed several techniques to verify the data. The first layer of monitoring was the supervisors who were instructed to check the tablets of their enumerators often and to communicate with them about their experiences in the field, directing them should they run into challenges. Second, we checked for inconsistencies in the data. This required that we know

details of how the survey should run inside and out. Third, we used information on the duration of the interviews to determine surveys that were completed too quickly to be valid.

9b. Opportunities

9b.1. *By downloading surveys and reviewing data every evening, one can quickly identify inconsistencies in answers indicating a need for more training or reveal possible cheating.* Where we suspected cheating, we were able to find new interviewers and replace potentially corrupted data during the main process of data collection. This is superior to addressing missing or invalid data after the survey has been completed, given that events can alter opinions and it is best, as much as possible, to have interviews conducted at the same point in time.

9b.2. *Recording interviews may be a way to validate data.* On some mobile survey programs there is a feature to allow for recording the interviews. We did not actually put this into practice, and we would expect that informed consent would be required to implement this tool in an ethical way. (See discussion of ethical issues below.)

9b.3. *Immediate review of data allows for the detection of errors before the survey is complete.* In fielding the LGPI, we detected a problem in the programming of the tablets that led to the skipping of a large number of questions. Since we were able to find this error while the enumerators were still in the field, we could quickly fix the error and have the team download an improved survey instrument. We were then able to redo those surveys, which was much easier and less costly than if the mistake was caught after fielding of the survey had completed.

9b.4. *Tablets help reduce the chance that human error affects the data collection process.* When paper and pencils are used, a back-office team must code each questionnaire and manually edit a database, with double-entry as the method to guard against data-entry errors. This invites human error into the process – a simple slip of the finger or the loss of a page of the interview or smudging of a pen or pencil can cause responses to be lost. When the data is immediately uploaded, these issues do not occur.

9c. Challenges

9c.1. *Connectivity to the Internet in the field for data uploading was sometimes problematic.* There are often areas in the developing world where there is just poor or no internet access. Inevitably, some surveys will only be download once the tablet makes it back to urban areas, meaning that review of this data can only take place once the teams have returned.

9c.2. *Labeling and cleaning variables can be time consuming if survey programs do not directly download into statistical programs like SPSS, R, or Stata.* A major limitation of the program that we have used is that it does not allow for a direct output into these data analysis programs. In addition, downloads of the data are very large (comprising hundreds of columns) and thus exceed the capabilities of standard spreadsheets. This creates extra work in labeling variables and preparing the final dataset.

9d. Recommendations

9d.1. *Use tablet features in data forensics.* A simple technique for checking whether interviews are being carried out properly is to measure interview duration. Any interview that lasted less than half of the time expected for a survey and was marked as complete was deemed suspicious. It is possible to program also the mobile survey platform to time-stamp all questions for all interviews continuously. When applying this technique, remember to account for the time needed for supervisors to enter the coversheet information. We also noticed that very short interviews were clustered by enumerator. This suggests that once poor training or cheating is detected, it is likely to affect other interviews conducted by the same interviewer. Numbering each interviewer and keeping track of who carried out which interview, when, and where, were all key factors in identifying such irregularities.

9d.2. *Set the program so that the tablets require a supervisor to look surveys through and approve of them before they enter the database.* In the specific program we used, different colored dots appeared next to surveys that were either complete or incomplete. Work out a system for the supervisor to check the number of surveys completed for the day. Some mobile survey programs will mark both incomplete and complete surveys and will allow them to remain on the tablet until a supervisor approves their inclusion within the larger dataset. This is a wise feature to implement.

9d.3. *Upload survey data as soon as possible to the servers to help with monitoring and also to help protect the safety of interviewers and the data.* One way to increase Internet capacity would be to ensure that each supervisor has an internet capable phone equipped with hotspot capabilities. Training supervisors to collect the tablets and hook them up to the Internet as well as checking the surveys do upload would be wise.

9d.4. *If you are working with a survey firm to put enumerators into the field, make sure to check their background and have firm protocols in place should data falsification occur.* Reputable firms terminate unethical employees and will return to the field for data collection for free if they are responsible for data falsification.

9d.5. *Download all versions of data that are available.* Some programs offer spreadsheets of the coded responses by item number and a file labeled with the wording of the responses (text format). Both can be used later to help label variables and items when using statistical programs like R or STATA.

10. Additional Considerations

The use of tablets raises additional considerations: 1) general environmental factors should be considered when deciding whether or not to implement surveys with tablets; 2) ethical considerations; and 3) potential research and improvements in survey methodologies, particularly in understanding the impact of tablet implementation.

10a. General infrastructure

While tablets do not require a permanent connection to the Internet, it is strongly advisable to ensure that country or region where the study is conducted has a basic public service infrastructure. For quality-control and monitoring purposes, it is extremely important to ensure that field supervisors have the ability to upload data preferably daily, or at several intervals while the study is 'in the field'. Keep in mind that most ISPs offer different speeds between downloads and uploads, and that upload speed is

almost always the slower of the two. Crucially, in low-bandwidth environments, upload speeds and basic points where access to the internet is possible at the end of the workday should be identified and preferably tested in advance.[1] It is of course always possible to defer uploads until the tablets are returned to the central office, provided that they have sufficient memory to hold the data until they return. This is not a problem in most instances. The drawback is of course that monitoring of field operations is thus entirely delegated to field supervisors. Furthermore, if one operates in very remote environments, one must ensure that tablets are fully charged at the beginning of the workday (see Image 5).

Image 5. Interviewers using tablets

The technology does not *per se* require using tablets. The application can be downloaded to a 3G cellphone and works well provided that the screen is not too small. Data can also be transmitted with the cellular network, which may incur additional costs.

Finally, the research team must ensure that it is safe and legal to operate tablets equipped with basic GPS technology for use in the field. In countries that restrict or ban activities that may be construed as surveying, it may not be possible to geo-reference the locations of the interviews, even for simple quality-control purposes.

[1] A popular free service to verify upload and download speeds is **http://www.speedtest.net/**

10b. Ethical Considerations

Tablets streamline data collection, boost interviewer professionalism, and may offer respondents an increased sense of confidentiality, ultimately increasing participation and item response rates. Yet, the technology also presents new risks to potential participants. Tablets identify the geo-location of interviews, which raises concerns about confidentiality during data uploading or storing surveys or through inappropriate and inadvertent public release of variables that might make it possible to identify respondents. Because data must be uploaded to the Web, there is potential for data interception by governments or other parties. Researchers must address these risks in human subjects protocols, ensure that data are securely uploaded via https protocols and stored on encrypted and password-protect hardware or cloudware. It is essential to remove or downgrade identifiable GPS coordinates before publicly releasing the data.

Tablets also allow interviewers to photograph streets or dwellings for the purpose of quality-control or for coding socio-economic characteristics of a neighborhood, which increase concerns about confidentiality. Through their sound-recording capability, tablets are extremely useful for monitoring, training, and questionnaire development (e.g., cognitive interviewing). However, the current contexts of field surveys in much of the world are not appropriate for recording, due to their potential to create fear. Recording might, with consent, be used in more limited field or laboratory settings. Human subjects protocols must incorporate these techniques and properly reflect benefits and potential harm of tablet use.

Best practices might include ensuring that the sponsor of the research is clearly and accurately stated in the informed consent script, paying extra attention to and bolstering content about the respondent's rights (e.g., further emphasizing that participation is voluntary), and specifying in agreements with research firms that government agencies cannot access data, or cannot do so until after ensuring protocols for safeguarding confidentiality and preparing files for release are fully implemented.

10c. Future Research

Mode studies (e.g. face-to-face vs. tablet interviews) should be implemented to assess how the use of tablet computers affects participation rates, item response rates, and data quality, especially for sensitive questions.

There are two ways to conduct mode studies. First, the study can be conducted in a laboratory setting in which the respondent is randomly assigned to receive the questionnaire using one mode and the interviewer is always the same person. Second, the mode study can be implemented in a limited area or in the entire sample. When doing so, interviewers should be instructed to alternate between a standard face-to-face questionnaire with answers recorded by the interviewer on paper, and a tablet each time they approach a new housing listing.

Tablets also offer unprecedented opportunities for survey experiments, which can include audio or video recordings, photos, or standard text, offering different frames, question wordings, or visual stimuli. Researchers can test the impact of different public service health announcements, in terms of content or messenger, and even later return to test how these interventions affected attitudes, behavior, or health outcomes. The successful implementation of the LGPI in Tunisia, as well as the lessons learned when we encountered unexpected issues, demonstrate the untapped potential of the tablet to better assess and address the service needs and citizens and consider how the methods used to do so can be improved in the future.

Appendix

Appendix 1: Cover page variables

The following are the cover page variables as downloaded and reformatted from SurveyToGo in the order they appeared on the tablet. Interviewers should be trained to fill out the cover page before approaching the door. By doing so, a "case" is opened, which can be reopened if necessary. If the interview is refused or the unit is closed, there will then be a record, allowing for accurate response rates to be recorded. The interviewer can also reopen the case when he or she tries again to knock at the same door for a second time. And, characteristics of the home, informant, and respondent are collected, even for refusals. This allows researchers to examine the process of respondent recruitment—that is, how socioeconomic status of the area or the gender or religiously of the respondent affects whether he or she participates.

Interviewer: Please fill out the cover page before approaching the door

COVER PAGE

		q00. Household id	|_____|
q05. Governorate |_____|	q06. Municipality |_____|	q02. Interviewer gender Male / Female	q01. Interviewer number |_____|
q03.Interview Date	|__| |__| / |__| |__| / |__| |__| M D Y		
Interview Start Time	|__| |__| : |__| |__|	Interview End Time	|__| |__| : |__| |__|

Q. The neighborhood / Sampling block |_____|

Q. The randomized survey form (A-E) - Embedded in three questions to randomize properly

Q. Knock on the door please. Is the house:
1. Demolished/missing [Stop]
2. Not a housing unit (e.g., an office) [Stop]
2. Closed or empty [Go to I7 and I8]
3. They opened the door

If the door is answered, the interviewer fills out:

q09. Gender of the person who opened the door:
1. Male
2. Female

q. I12d. Religious clothing/appearance of the respondent.
1. Very religious 2. Religious 3. Not religious at all 96. Unknown

Q. Introduction given – May we proceed with the interview?

Q. Did they agree to speak with you?
1. Yes
2. No
96. I don't know
97. Refuse to answer

Q. Kish Grid randomization procedure

q11. Total number of Adults Living in Household

Names and ages of up to 10 people living in the household

Q. Person selected for the interview

Q. Can I speak with (name of the selected person)
1. Yes
2. No, refused entrance

Q. With the person selected: Are you willing to participate in this survey? We would like your opinion with the knowledge that there are no right or wrong answers to these questions.

Interviewer fills out I7 and I8 if all contacts:

I7. Is this household in a:
1. 1 room
2. Two rooms or more
3. Apartment
4. An entire building
5. Country home
6. Villa

I8. What is the socioeconomic status of the housing based upon the external appearance of the house and neighborhood?
1. Lower class
2. Lower middle class
3. Middle class
4. Upper middle class

5. Upper class

If I11 is Refused: Information on refusals:

I12d. Religious clothing/appearance of the respondent.
1. Very religious 2. Religious 3. Not religious at all 96. Unknown

I12e. Religious clothing/appearance of others in the home.
1. Very religious 2. Religious 3. Not religious at all 96. Unknown

Any reason given for refusal? (if reason guessed or known):

_____

Appendix 2: Post-interview section to be filled out by interviewer

[To be filled by the interviewer after interview, but not in the presence of the respondent]

1401. Was there electricity in the house?		
1. Yes	2. No	96. Don't know

1402. Was the road closest to their house…			
1. Paved	2. Concrete	3. Gravel	4. Dirt

1403. Respondent's level of cooperation:			
1. Excellent	2. Good	3. Average	4. Poor
5. Very poor			

1403.1 If poor, please explain briefly: _____98. Doesn't apply

1403.1 Respondent's level of cooperation:		
1. Very high	2. Above average	3. Average
4. Below average		

5. Very low	

1404. Respondent's level of comprehension:		
1. Very high	2. Above average	Average
3. Below average		
4. Very low		

1405. If below average or low, please explain: _____98. Doesn't apply

1406. Were there other people present during the interview?	
1. Yes	2. No

1406.1 Who was present? _____98. Doesn't apply

1407. Did others present affect the quality of the interview?		
1. Yes	2. No	97. Doesn't apply

1408. How many people do you know in the area where this respondent lives?			
1. Most of the people	2. Some of the people	3. Few of the people	4. None of the people

1409. Did you know the interviewee?	
3. Yes	4. No

1409.1 If so, how:_____ [Check all that apply]			
1. Friend	2. Member of family or tribe	3. Other: _____	98. Doesn't apply

1410. Respondent lives in:			
1. Rural or agricultural	2. S	3. Large city	4. Subu

area	mall town		rb of a large city

1411. Based on your impression of the respondent's household, estimate the financial standing of households in that locality:			
1. Low income	2. Middle income	3. Upper-middle income	4. High income

1412. Respondent's level of anxiety about the survey before the survey began:		
1. No anxiety	2. Some anxiety	3. Lots of anxiety

1413.If lots of anxiety, please explain: _____98. Doesn't apply

1414. Level of reliability in respondent's responses:		
1. Completely reliable	2. Somewhat reliable	3. Not reliable

1415. If not reliable, please explain: _____98. Doesn't apply

1416.Respondent's level of interest in the interview in general:				
1. Very high	2. Above average	3. Average	4. Below average	5. Very low

1417. Was the interview conducted at respondent's home?	
1. Yes	2. No

1418. Type of home:		
1.One room	2.Two rooms	3.Apartment
4.Entire building	5.Rural house	6.Villa

1419. Religious appearance (respondent):		
1.Very religious	2.Religious	3.Not religious at all

1420.Religious appearance (others in the home):		
1.Very religious	2.Religious	3.Not religious at all

1421. Other points that need to be reported:….....
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