RANDOMIZED CONTROL TRIALS ARE CHANGING HOW WE HELP THE POOR

Visualizing **Abhijeet Banerjee, Esther Duflo, and Michael Kremer's** experimental approach to alleviating global poverty using Randomized control trials.

Ankit Anand
216330007
M.Des IxD

Guided by
Prof. Venkatesh Rajamanickam

Development of Western science is based on two great achievements: the invention of the formal logical system (in Euclidean geometry) by the Greek philosophers, and the discovery of the possibility to find out causal relationships by systematic experiment (during the Renaissance). - Albert Einstein

Poverty is not just a lack of money; it is not having the capability to realise one's full potential as a human being. - Amartya Sen

TABLE OF CONTENTS

05 DEVELOPMENT AND FINAL DESIGN

Development

Final Design

Scrollytelling

Web technologies & Libraries

Project Scope

Approach and Methods

Expected outcome and significance

Stage deliverables

06 EVALUATION

07 REFERENCES

08 CONCLUSION

INTRODUCTION

Data visualization plays a crucial role in communicating economic insights to a general audience. The standard tools of the trade, like Bar charts and Line charts, have been used for decades by economists to convey study results. Even though economists use these tools, their papers are often challenging for a layperson to understand as they are written for a specific academic audience familiar with the field's terminology. These papers are also quite dense with mathematical analysis, which requires a significant time investment to understand the study results. There are books written on these subjects, but only a few people would be willing to go through a 300-page book to know about a topic they are only curious about. This project will use data visualization to communicate the study results in a way that is easy to understand and engaging to read. By visualizing the study results, the audience can see the data come alive, and hopefully, they will be much more interested in learning about the topic.

THE SIGNIFICANCE OF BANERJEE, DUFLO, AND KREMER'S WORK

Data visualization plays a crucial role in communicating economic insights to a general audience. The standard tools of the trade, like Bar charts and Line charts, have been used for decades by economists to convey study results. Even though economists use these tools, their papers are often challenging for a layperson to understand as they are written for a specific academic audience familiar with the field's terminology. These papers are also quite dense with mathematical analysis, which requires a significant time investment to understand the study results. There are books written on these subjects, but only a few people would be willing to go through a 300-page book to know about a topic they are only curious about. This project will use data visualization to communicate the study results in a way that is easy to understand and engaging to read. By visualizing the study results, the audience can see the data come alive, and hopefully, they will be much more interested in learning about the topic.

AIMS AND OBJECTIVES

- To use creative data visualization methods for communicating economic insights.
- To explain how Randomized Control Trials (RCTs) work using narrative and visualizations.
- To summarize the work of Banerjee, Duflo, and Kremer, who pioneered the use of Randomized Control Trials (RCTs) in designing welfare policies.
- To visualize the study results of Banerjee, Duflo, and Kremer's experiments.
- To provide a comprehensive overview of RCTs, including criticism of its methods and ethical/moral questions involved in RCT experiments

SCOPE

- The study will summarise and visualize the work of Abhijit Banerjee, Esther Duflo, and Michael Kremer, who won the Nobel prize in Economics “for their experimental approach to alleviating global poverty” using Randomized control trials.
- The project will rely on data and analysis provided by the authors and will not involve any statistical analysis or data collection.
- The project will not examine flaws in the study design.
- The focus will be solely on the study results of Banerjee, Duflo, and Kremer and not include any other RCT experiments or the broader context of Developmental economics.
- The data visualizations will be a mix of static and interactive depending on the context.

APPROACH AND METHODS

1. Review of literature: A comprehensive review of the literature related to the work of Banerjee, Duflo, and Kremer on Randomized Control Trials will be done. This review will provide background information and help to identify the key study results.
2. Data Collection: Data related to the study results of Banerjee, Duflo, and Kremer will be collected from the sources provided by the authors. No additional data collection will be carried out for this project.
3. Data Preparation: The raw data will be cleaned and processed to prepare for visualization.
4. Narrative Development: A written narrative that explains the work of Banerjee, Duflo, and Kremer, the methodology used in their studies and the results of the studies will be developed. Background information on Randomized control trials will also be included. The visualizations will be interspersed throughout the written narrative to tell a story.
5. Data Visualization: Visualizations will be created for the selected data sets with code. The focus will be on creating visualizations that are easy to understand and engaging.
6. Criticism and Ethical Considerations: A critical analysis of RCTs and the ethical/moral considerations involved in RCT experiments will be included in the narrative.

EXPECTED OUTCOME AND SIGNIFICANCE

EXPECTED OUTCOME:

- An interactive data visualization narrative to explain the work of Banerjee, Duflo, and Kremer, Nobel Prize winners in economics, in a way that is easy to understand and engaging for a general audience.
- Engaging and easy-to-understand visualizations of study results. A narrative that explains the methodology and results of RCT experiments.
- Critical analysis of RCTs and ethical/moral considerations involved in RCT experiments.

SIGNIFICANCE:

- Bridge the gap between economic research and the general public, make complex economic concepts easier to understand and increase public engagement with the topic.
- Demonstrate the usefulness of data visualization in communicating complex economic concepts, and contribute to the academic discourse on the use of RCTs in development economics.
- Increase understanding of Randomized Control Trials (RCTs) and their use in designing welfare policies.

RESEARCH

INTRODUCTION

REVIEW OF PAPERS PUBLISHED BY BANERJEE, DUFLO, AND KREMER

I reviewed the work of Banerjee, Duflo, and Kremer and focused on their research that utilized Randomized Controlled Trial (RCT) methods. From the results, I selected their top ten most significant studies based on citation count. In the pages that follow, I have summarized the studies. For the final story, I selected three papers to visualize:

1. IMPROVING IMMUNISATION COVERAGE IN RURAL INDIA: CLUSTERED RANDOMISED CONTROLLED EVALUATION OF IMMUNISATION CAMPAIGNS WITH AND WITHOUT INCENTIVES.

2. A MULTIFACETED PROGRAM CAUSES LASTING PROGRESS FOR THE VERY POOR: EVIDENCE FROM SIX COUNTRIES.

3. DEBUNKING THE STEREOTYPE OF THE LAZY WELFARE RECIPIENT: EVIDENCE FROM CASH TRANSFER PROGRAMS WORLDWIDE.

1 THE MIRACLE OF MICROFINANCE? EVIDENCE FROM A RANDOMIZED EVALUATION

by Esther Duflo, Abhijit Banerjee ,Rachel Glennerster, Cynthia G. Kinnan

SUMMARY

- This study was a randomized evaluation of the impact of introducing the standard microcredit group-based lending product in a new market
- Half of 104 slums in Hyderabad, India, were randomly selected for opening a branch of a particular microfinance institution (Spandana) while the remainder were not, although other MFIs were free to enter those slums.

METRIC BEING MEASURED

- Microcredit loan uptake.
- Likelihood of starting a new business.
- Increased investments in their existing business.
- Average monthly expenditure per capita.
- Spending on durable goods and "temptation goods."
- Borrowing behaviour from MFIs
- Business profitability
- Development outcomes (health, education, women's empowerment)

SUMMARY

- Households were 8.8 percentage points more likely to have a microcredit loan 15 to 18 months after the MFI started lending in the area.
- Participants were no more likely to start a new business, although they were more likely to start several at once, and they invested more in their existing businesses.
- No effect on average monthly expenditure per capita.
- Expenditure on durable goods increased in treated areas, while expenditures on "temptation goods" declined.
- Three to four years after the initial expansion, the probability of borrowing from an MFI in treatment and comparison slums was the same. However, on average, households in treatment slums had been borrowing for longer and in larger amounts.

2 REMEDYING EDUCATION: EVIDENCE FROM TWO RANDOMIZED EXPERIMENTS IN INDIA

by Abhijit Banerjee, Shawn Cole, Esther Duflo, Leigh Linden

SUMMARY

- The study evaluated methods to improve the quality of education in urban slums in India.
- Two experiments were conducted: a remedial education program and a computer-assisted learning program.
- The remedial education program hired young women from the community to teach basic literacy and numeracy skills to children lagging behind in government schools.

METRIC BEING MEASURED

- Average test scores of children.
- Math scores of children in fourth grade.

SUMMARY

- The remedial education program increased average test scores by 0.14 standard deviations in the first year and 0.28 in the second year.
- The computer-assisted learning program increased math scores by 0.35 standard deviations in the first year and 0.47 the second year.
- The results persisted for at least one year after leaving the program.
- Instrumental variable strategies suggest that while the remedial education program benefited the children who attended the classes, their classmates did not post gains, suggesting that resources alone may not be sufficient to improve outcomes.

3 PITFALLS OF PARTICIPATORY PROGRAMS: EVIDENCE FROM A RANDOMIZED EVALUATION IN EDUCATION IN INDIA

by Abhijit Banerjee, Rukmini Banerji, Esther Duflo, Rachel Glennerster, Stuti Khemani

SUMMARY

- This study evaluates three different interventions to encourage beneficiaries' participation through these committees: providing information, training community members in a new testing tool, and training and organizing volunteers to hold remedial reading camps for illiterate children.

METRIC BEING MEASURED

- Community involvement in public schools
- Teacher effort in schools
- Learning outcomes in schools

SUMMARY

- No impact on community involvement in public schools or teacher effort/learning outcomes
- Large impact on activity outside public schools, volunteers trained to teach and children who attended camps improved their reading skills.
- Citizens face substantial constraints in participating to improve the public education system, even when they care about education and are willing to do something to improve it.

4 A MULTIFACETED PROGRAM CAUSES LASTING PROGRESS FOR THE VERY POOR: EVIDENCE FROM SIX COUNTRIES

by Abhijit Banerjee, Esther Duflo, Nathanael Goldberg, Dean Karlan,* Robert Osei, William Parienté, Jeremy Shapiro, Bram Thuysbaert, Christopher Udry

SUMMARY

- The study investigated whether a multifaceted Graduation program can help the extreme poor establish sustainable self-employment activities and generate lasting improvements in their well-being.
- The program targets the poorest members in a village and provides a productive asset grant, training and support, life skills coaching, temporary cash consumption support, and typically access to savings accounts and health information or services.
- Baseline and endline surveys were conducted to measure the impact of the program on various outcomes, including consumption, food security, productive and household assets, financial inclusion, time use, income, physical and mental health, political involvement, and women's empowerment.

METRIC BEING MEASURED

- Participants income. Improvements in well-being
- Other metrices being measure include impacts on consumption, food security, productive and household assets, financial inclusion, time use, income and revenues, physical health, mental health, political involvement, and women's empowerment.

SUMMARY

- At the end of the intervention, statistically significant impacts were found on all 10 key outcomes.
- 1 year after the end of the intervention, 8 out of 10 indices still showed statistically significant gains, with little or no decline in the impact of the program on key variables (consumption, household assets, and food security).
- Income and revenues were significantly higher in the treatment group in every country.
- House-hold consumption was significantly higher in every country except Honduras.

5 DEBUNKING THE STEREOTYPE OF THE LAZY WELFARE RECIPIENT: EVIDENCE FROM CASH TRANSFER PROGRAMS WORLDWIDE

by Abhijit Banerjee, Rema Hanna, Gabriel Kreindler, Benjamin A. Olken

SUMMARY

- The study is about the effect of targeted transfer programs (directed towards the poor citizens in developing countries) on attitudes towards work.
- The study re-analyzes the results of seven randomized controlled trials of government-run cash transfer programs from six countries.

METRIC BEING MEASURED

- The metric being measured is the labor supply, i.e., the propensity to work and the overall number of hours worked.

SUMMARY

- The study finds no observable impacts of the cash transfer programs on the propensity to work or the overall number of hours worked for either men or women.
- The study finds a small, significant negative effect on work inside the household, but no observable effect on work outside the household.
- The results do not support the rhetoric that cash transfer programs lead to a massive exodus from the labor market.

6 WOMEN AS POLICY MAKERS: EVIDENCE FROM A INDIA-WIDE RANDOMIZED POLICY EXPERIMENT

by Raghabendra Chattopadhyay, Esther Duflo

SUMMARY

- The study uses the political reservation for women in India to examine the impact of women's leadership on policy decisions.
- It compares the type of public goods provided in reserved and unreserved Village Councils.

METRIC BEING MEASURED

- The type of public goods provided by the Village Councils.

SUMMARY

- Women leaders invest more in infrastructure directly relevant to the needs of rural women (water, fuel, and roads).
- Men invest more in education.
- Women are more likely to participate in the policy-making process if the leader of their village council is a woman. No changes in consumption between the control and target group.
- No increases in profitability for the average business, although there is a slight increase in profits at the top end.
- No changes in any of the development outcomes including health, education, and women's empowerment.

7 IMPROVING IMMUNISATION COVERAGE IN RURAL INDIA: CLUSTERED RANDOMISED CONTROLLED EVALUATION OF IMMUNISATION CAMPAIGNS WITH AND WITHOUT INCENTIVES

Abhijit Banerjee, Esther Duflo, Rachel Glennerster, Dhruva Kothari.

SUMMARY

- A clustered randomised controlled study was conducted to assess the efficacy of modest non-financial incentives on immunisation rates in children aged 1-3 and compare it with the effect of only improving the reliability of the supply of services
- Participants: 1640 children aged 1-3 from 134 villages in rural Rajasthan, India.
- 134 villages were randomly assigned to one of three groups: reliable monthly immunisation camps (without incentives), reliable monthly immunisation camps with small incentives (raw lentils and metal plates), or control (no intervention).
- Surveys were undertaken in randomnly selected households at baseline and about 18 months after the interventions started (end point).

METRIC BEING MEASURED

- The metric being measured is the labor supply, i.e., the propensity to work and the overall number of hours worked.

SUMMARY

- 39% of children from villages with reliable immunisation camps and small incentives were fully immunised compared to 18% from reliable immunisation camps without incentives and 6% from control villages.
- The relative risk of complete immunisation for intervention B (eliable immunisation with incentives) versus control was 6.7 (4.5 to 8.8) and for intervention B versus intervention A (reliable immunisation without incentives was 2.2 (1.5 to 2.8).
- Children in areas neighbouring intervention B villages were also more likely to be fully immunised than those from areas neighbouring intervention A villages.
- The average cost per immunisation was higher for intervention B ($56) compared to intervention A ($28).
- Improving reliability of services improves immunisation rates, but the effect remains modest.
- Small incentives have large positive impacts on the uptake of immunisation services in resource poor areas and are more cost effective than purely improving supply.

8 FEMALE LEADERSHIP RAISES ASPIRATIONS AND EDUCATIONAL ATTAINMENT FOR GIRLS:A POLICY EXPERIMENT IN INDIA

Lori Beaman, Esther Duflo, Rohini Pande, Petia Topalova

SUMMARY

- The study focused on the impact of female leadership on adolescent girls' career aspirations and education attainment in India.
- Authors exploited a randomized natural experiment in India (A 1993 law reserved leadership positions for women in randomly selected village councils) to carry out this study.
- 8453 adolescents aged 11 to 15 and their parents in 495 villages were surveyed for this study.

METRIC BEING MEASURED

- Career aspirations and educational attainment of adolescent girls.

SUMMARY

- Female leadership influences adolescent girls' career aspirations and educational attainment
- The gender gap in aspirations reduced by 20% in parents and 32% in adolescents in villages assigned a female leader for two election cycles.
- The gender gap in adolescent educational attainment was erased.
- Girls spent less time on household chores.
- No evidence of changes in young women's labor market opportunities.
- The impact of women leaders primarily reflects a role model effect. No changes in consumption between the control and target group.
- No increases in profitability for the average business, although there is a slight increase in profits at the top end.
- No changes in any of the development outcomes including health, education, and women's empowerment.

9 NUDGING FARMERS TO USE FERTILIZER: THEORY AND EXPERIMENTAL EVIDENCE FROM KENYA

by Esther Duflo, Michael Kremer, Jonathan Robinson

SUMMARY

- This study analyses when an individual (farmer) is biased towards prioritizing short-term rewards (immediate purchases, leisure spending, etc.) or outcomes over long-term benefits (Higher yields). It also looks at what might nudge them to think about the future benefits over present comforts.

METRIC BEING MEASURED

- Farmers fertilizer purchase decisions

SUMMARY

- Small, time-limited discounts on the cost of acquiring fertilizer (e.g. free delivery) just after harvest can increase fertilizer investments.
- Later discounts have a smaller impact.
- Small, time-limited discounts yield higher welfare than either laissez faire or heavy subsidies. No changes in consumption between the control and target group.
- No increases in profitability for the average business, although there is a slight increase in profits at the top end.
- No changes in any of the development outcomes including health, education, and women's empowerment.

10 GRANDMOTHERS AND GRANDDAUGHTERS: OLD AGE PENSION AND INTRA-HOUSEHOLD ALLOCATION IN SOUTH AFRICA

by Esther Duflo

SUMMARY

- This paper studies whether the impact of a cash transfer on child nutritional status is affected by the gender of its recipient.

METRIC BEING MEASURED

- Impact of the cash transfer on the anthropometric status (weight and height) of children under 5 years old.

SUMMARY

- Pensions received by women had a significant positive impact on the anthropometric status of girls, improving their weight given height by 1.19 standard deviations and height given age by 1.16 standard deviations.
- Little effect on the anthoropometric status of boys.
- Pensions received by men had no effect on the anthropometric status of children.
- The study suggests that households do not function as a unitary entity and that the efficiency of public transfer programs may depend on the gender of the recipient.

DRAFTING THE STORY

DRAFTING THE STORY

Before starting with any ideation on the visualization, I wrote down the basic narrative that I wanted to use to engage the readers and tell a story. This also helped me to understand what kind of visualizations would be best suited for the story.

SLIDE 1

- A paragraph about the fact that world and especially developing nations has a lot of people who are struggling and rely on government help to get by. Improving the quality of life, particularly for the poor, is considered to be one of the main objectives of modern societies.
- Data viz to show how many people throughout the world rely on government welfare to get by.

SLIDE 2

- Quote: “Poverty is not just a lack of money; it is not having the capability to realise one’s full potential as a human being” - Amartya Sen

SLIDE 3

- A paragraph about the fact that world and especially developing nations has a lot of people who are struggling and rely on government help to get by. Improving the quality of life, particularly for the poor, is considered to be one of the main objectives of modern societies.
- Data viz to show how many people throughout the world rely on government welfare to get by.

SLIDE 4

- A paragraph about the fact that world and especially developing nations has a lot of people who are struggling and rely on government help to get by. Improving the quality of life, particularly for the poor, is considered to be one of the main objectives of modern societies.
- Data viz to show how many people throughout the world rely on government welfare to get by.

SLIDE 5

- Observational studies show that many of the social welfare policies implemented by the government do result in improved life quality for the poor.
- Data viz to show results of social welfare policies across the world.

SLIDE 6

- However, it is extermely hard to say that the effect was because of the interventions, as there can be many other factors which could have impacted the results. as a result, these policies become hard to defend and a negative image is created that these are a waste of hard earned tax payers money.
- Quote by John Hills on the myths of welfare.

SLIDE 7

- To understand this, let's take an example:
- It is a common misconception that people who receive assistance like food stamps or direct cash transfer are lazy and use hard earned tax payer's money.
- Observational studies have shown that workers productivity do not decline who receive welfare but due to the limitations of an observational study the governments find it hard to defend such policies.
- So we can't prove that the effect was because of the cause and we can not prove causation. Which ultimately makes it harder to defend policies for any government.

SLIDE 8

- Decades ago, this was the same problems in medicine. Researchers were not sure if the effects were because of the treatment or because of some other variable of factor.
- Example - If you give a pill to patients, and there is a positive effect of the pill on the patients, how can you be really sure that the effect was because of the pill and not some other factors, like placebo effect or enviromental and social factors.

SLIDE 9

- This search for cause and effect is hundred of years old. Philosophers, scientists have been pondering this question for hundreds of years. How can we be really sure that the cause is what produced the effect.
- There are two important ideas in proving causality beyond a reasonable doubt: Randomization and Control.

SLIDE 10

- "Randomization is a process of assigning subjects or participants in a study to different treatment groups or experimental conditions in a random manner, meaning that chance determines which group each participant is assigned to.
  The purpose of randomization in a study is to reduce the influence of potential confounding variables and to ensure that the groups being compared are as similar as possible at the start of the study. By randomly assigning participants to groups, the researchers can be more confident that any differences observed between the groups are due to the treatment or intervention being studied, rather than other factors like age, gender, or other characteristics."

SLIDE 9

- "Thus, we arrive at the generally accepted first surviving mention of randomized assignment, due to Flemish chemist and physician Jan Baptist van Helmont. Everyone at the time, including van Helmont, believed that bloodletting was a fantastic cure for most ailments. However, he believed that evacuation (i.e. inducing vomiting and defecation) was an even better approach, and he proposed a simple way

SLIDE 9 (cont.)

to settle the argument once and for all: Let us take out of the Hospitals, out of the Camps, or from elsewhere, 200 or 500 poor People, that have Fevers, Pleurisies, etc. Let us divide them in halfes, let us cast lots, that one half of them may fall to my share, and the other to yours; I will cure them without bloodletting... we shall see how many Funerals both of us shall have. For better or worse, there is no evidence that this test was ever put into practice, but the idea is up to modern standards."

SLIDE 10

- "The idea behind having a control group in the context of a study is to provide a basis of comparison for the treatment or intervention being tested. A control group is a group of participants who do not receive the treatment or intervention being studied, but are otherwise similar to the group that does receive the treatment."

SLIDE 11

- The adoption of RCT by social researchers.
- These concerns about methods and policies provided a fertile ground for randomised experiments in development economics. The surge of interest in experimental approaches in economics began in the early 1990s.
- But it really gathered momentum in the 2000s, with researchers such as the Nobel awardees designing and implementing experiments to study a wide range of microeconomic questions.

SLIDE 12

- Proponents of these methods argued that a focus on "small" problems was more likely to succeed. They also argued that randomized experiments would bring credibility to economic analysis by providing a simple solution to causal questions. These experiments randomly allocate a treatment to some members of a group and compare the outcomes against the other members who did not receive treatment.

SLIDE 12 (cont.)

- Randomized control trials in economics are now mostly used to evaluate the impact of social policy interventions in poor and middle-income countries.

SLIDE 13

- Some micro economic question that these authors want to answer:
- Does providing free bed nets decrease cases of malaria?
- Does providing small incentives increase immunization rates?
- Does providing a range of benefits result in lasting improvements for the poor?

SLIDE 14

- Chapter 1: Can providing free lentils increase immunization rates?

SLIDE 15

- Another case study on an important RCT study.

SLIDE 16

- Let's come back to the lazy welfare question. it was indeed proven using RCTs that giving assistance does not lead to a less productive workforce.

SLIDE 17

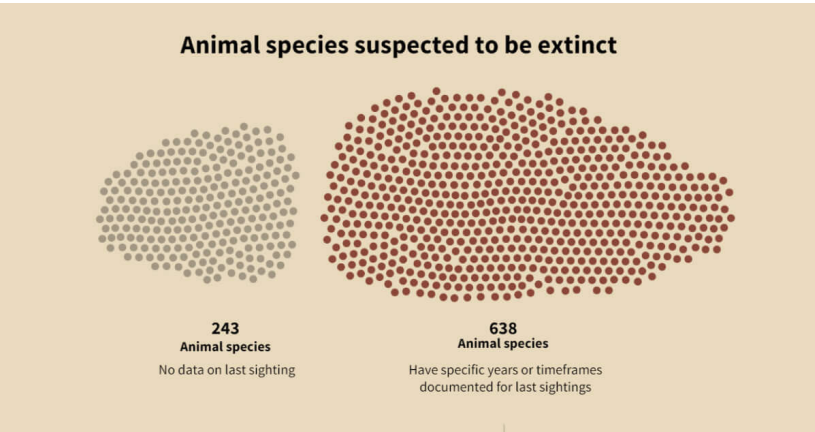
- Conclusion, Criticisms and Concerns

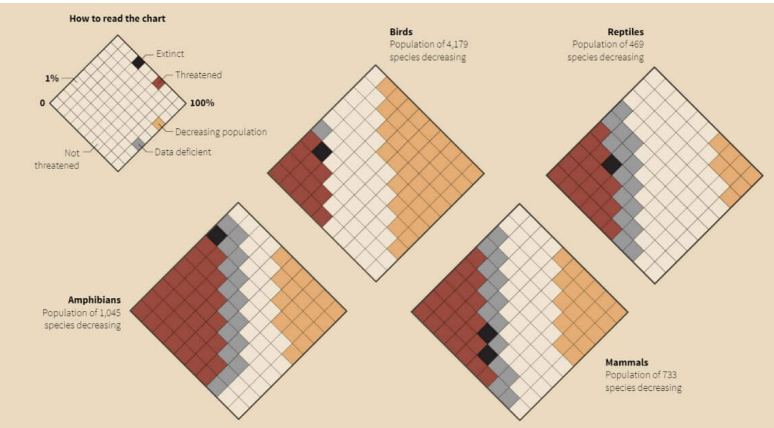
IDEATION

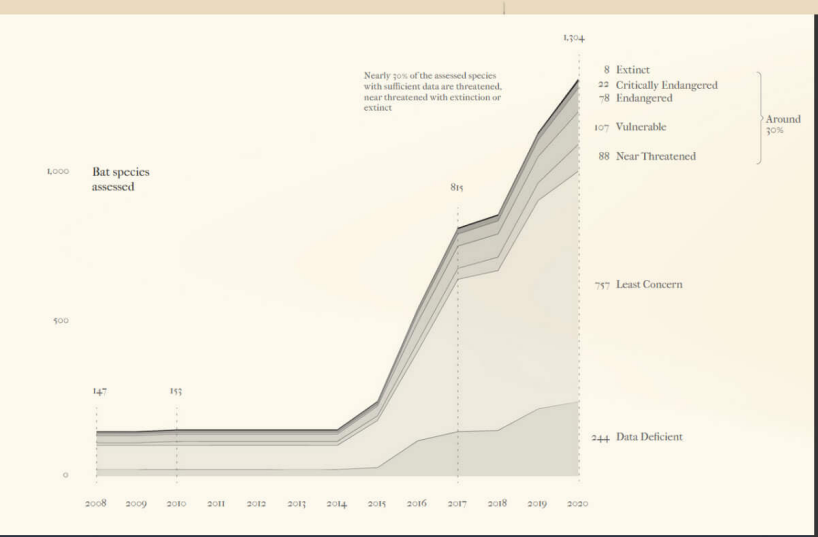
INSPIRATION

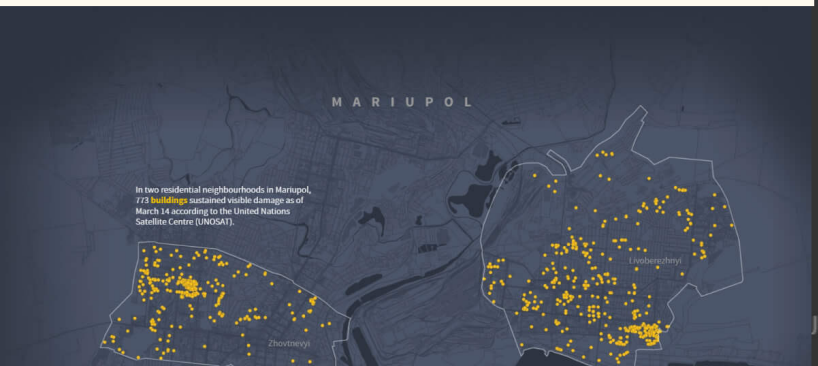
For the visualizations, I took a lot of inspiration from the work of designers at places like Reuters, The New York Times, The Pudding, South China Morning Post, and Financial Times. The visualizations they use are a mix of scientific and illustrative style, depending on the context. Since, I was making a long-form data visualization article, I felt that having illustrative style visualizations would help the article feel more engaging and memorable to the readers.

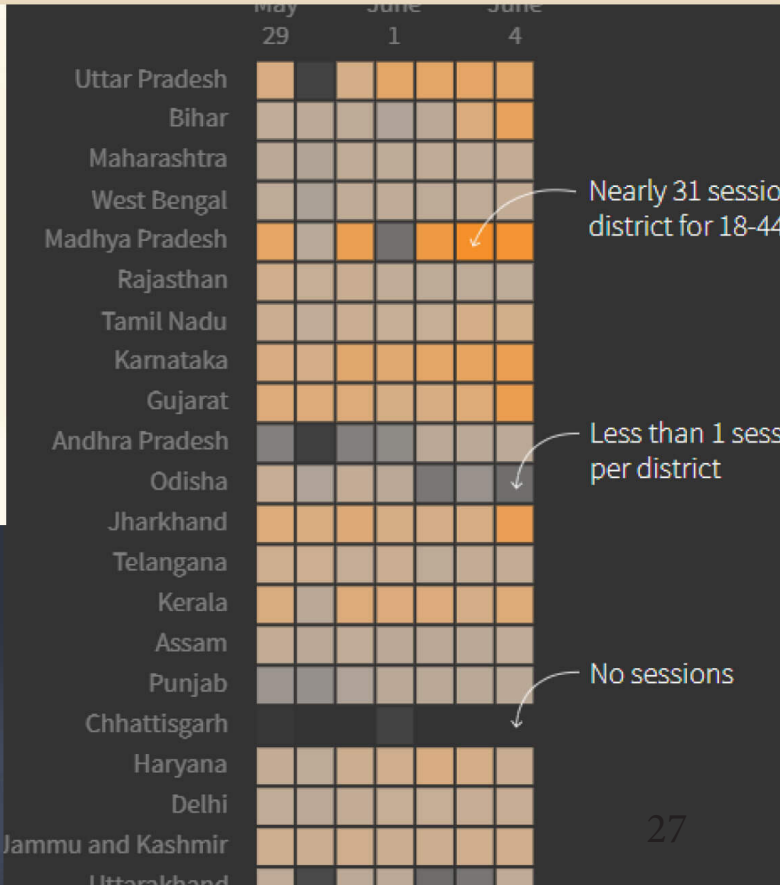
Screenshots from various stories published by the Reuters Graphics team.

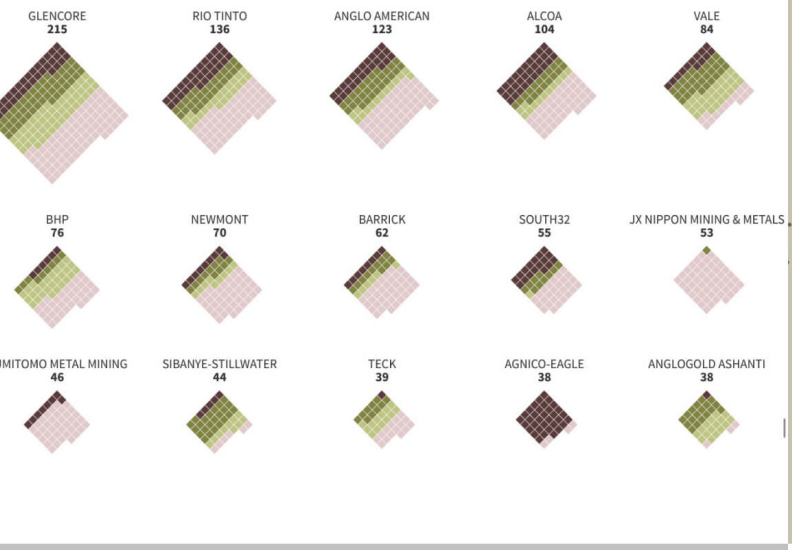


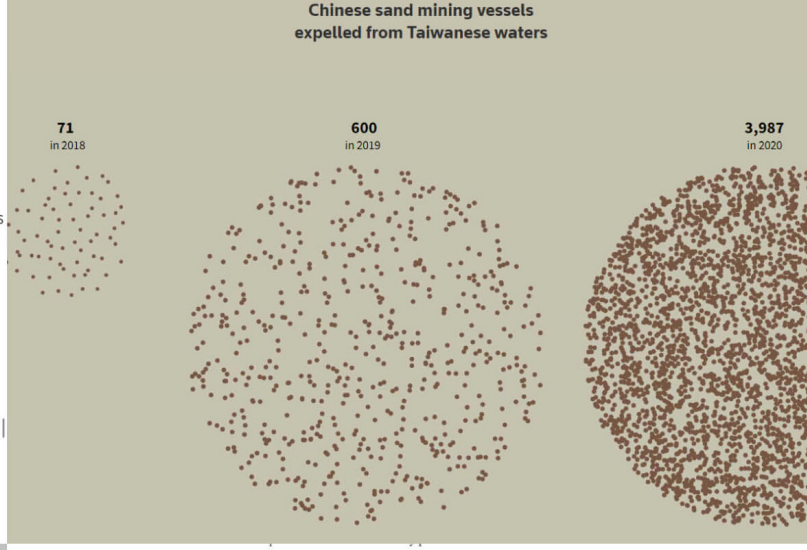








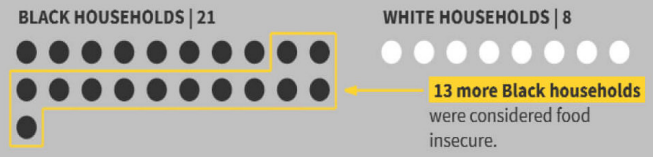




FOOD INSECURITY

USDA food insecurity survey

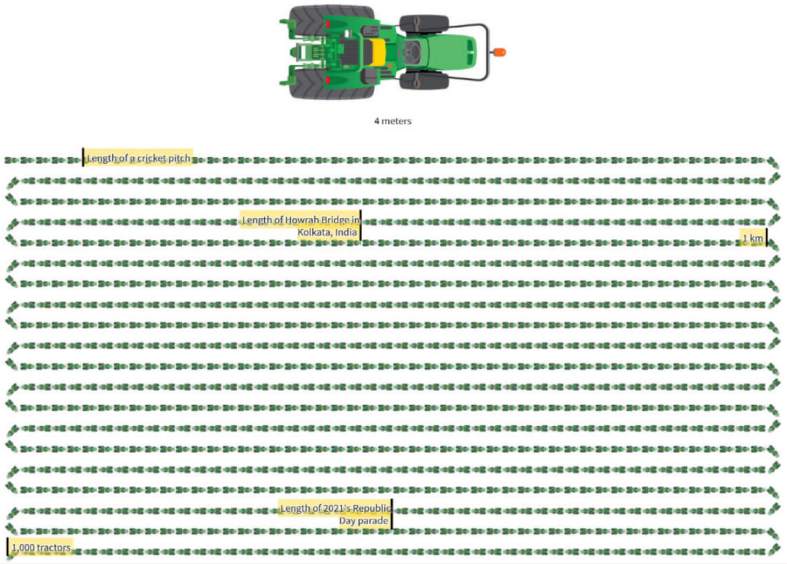
Out of every 100 Black households, 21 sometimes have difficulty providing enough food

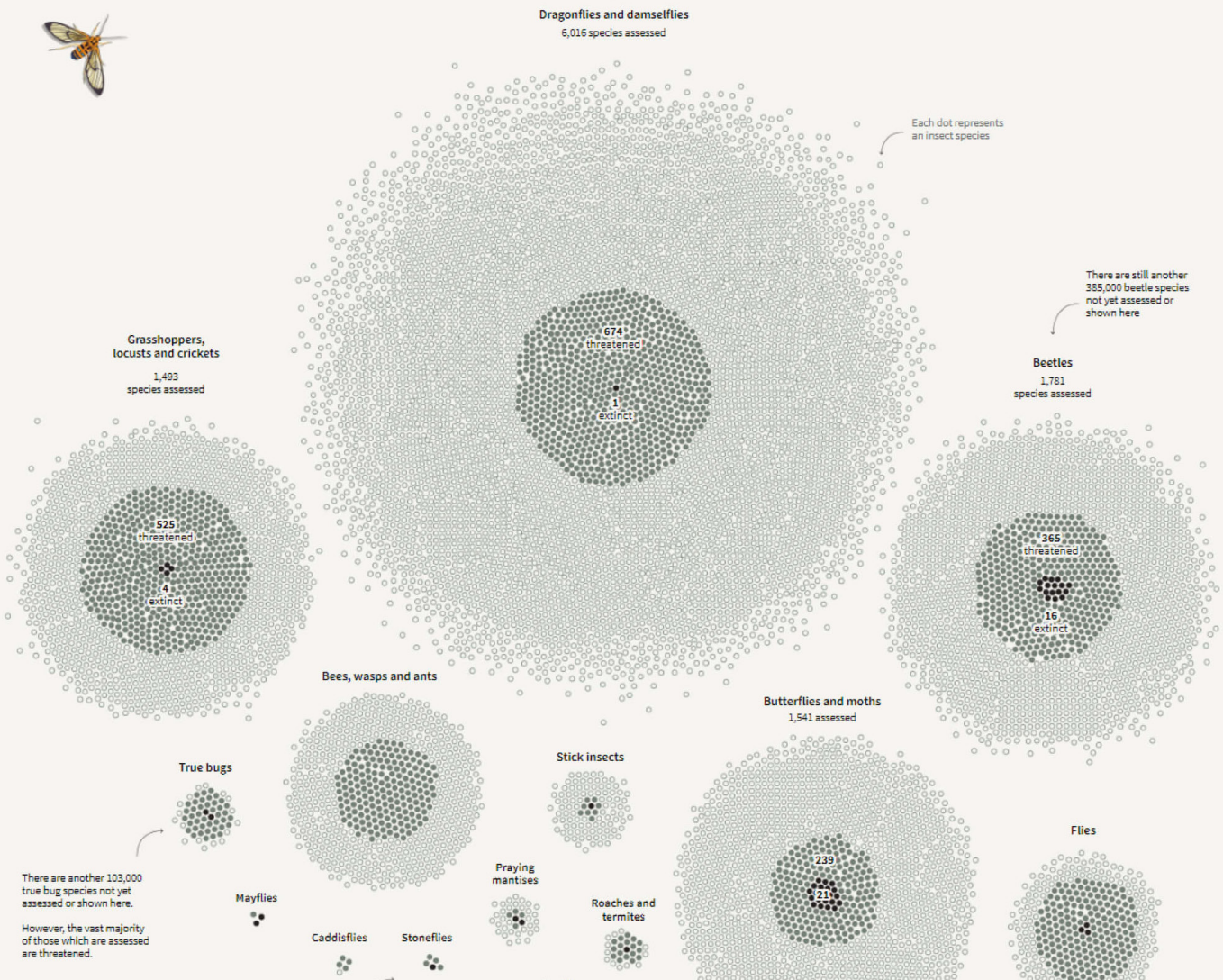


13 more Black households were considered food insecure.

Note: Data from 2018

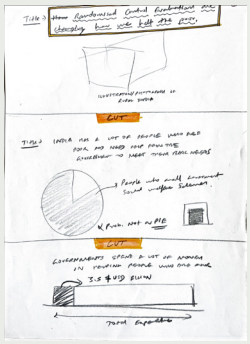
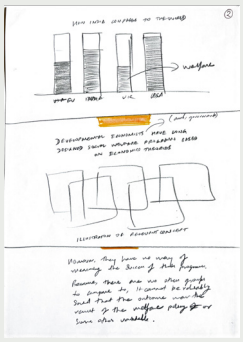
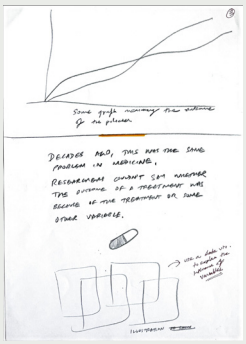
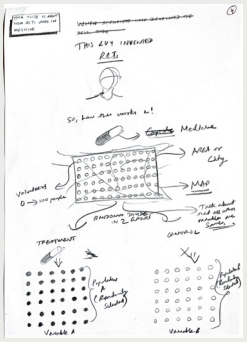
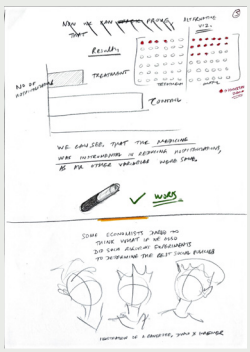
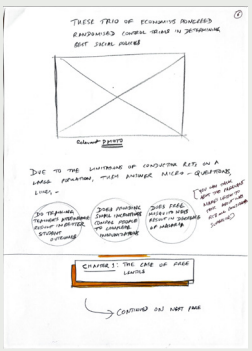
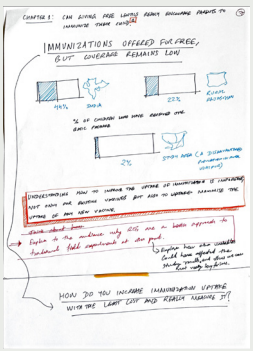
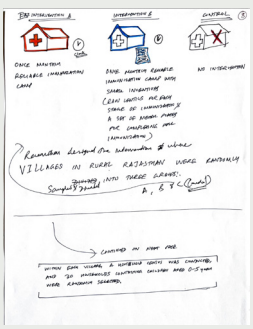
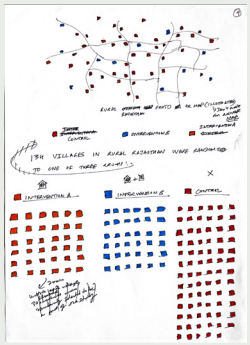
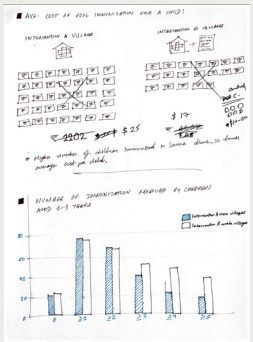
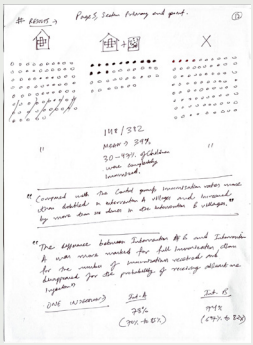
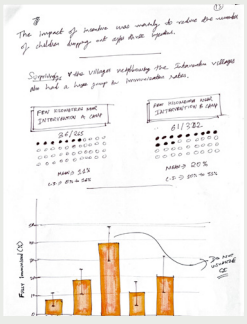
Source: USDA



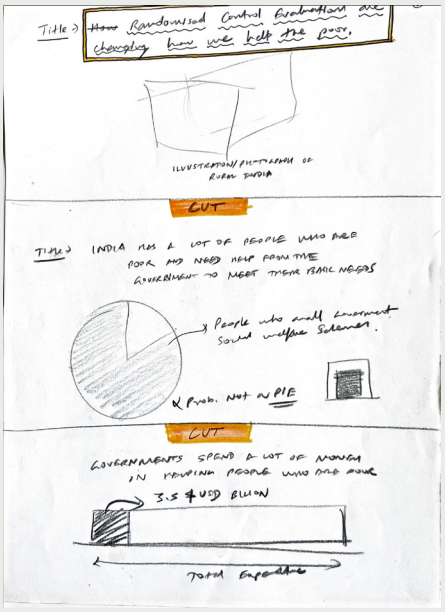


IDEATING VISUALISATIONS

After writing the draft for the article, I identified which data would be best presented through visualizations. I collected the data and made rough sketches to ideate how the visualizations should be designed. These sketches helped me to sense if the visualizations are appropriate for the data that I had. I also used the sketches to get a sense of how the visualizations would flow with the overall article.

1



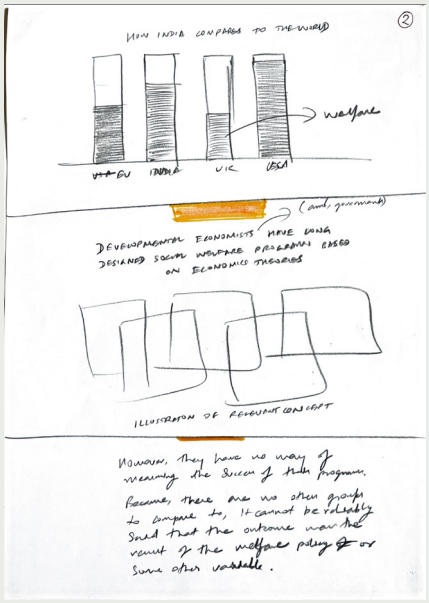
2

3

1. The title for the story with an illustration as a background. This section is supposed to be full-size to give an immersive feeling.
2. Visualization to show how many people rely on various kinds of welfare from the government.
3. A bar graph to show the amount of money that the government spends on welfare out of the total expenditure of the government.

4. Next would be a visualization to show how many Indians rely on welfare compared to the rest of the world.
5. This section gives context on how social welfare policies are designed by economists.
6. The idea that it is very hard to prove beyond reasonable doubt the effectiveness of these policies at solving the problems. How can we be sure that the policies were what impacted the outcome or was the outcome result of some other variable?

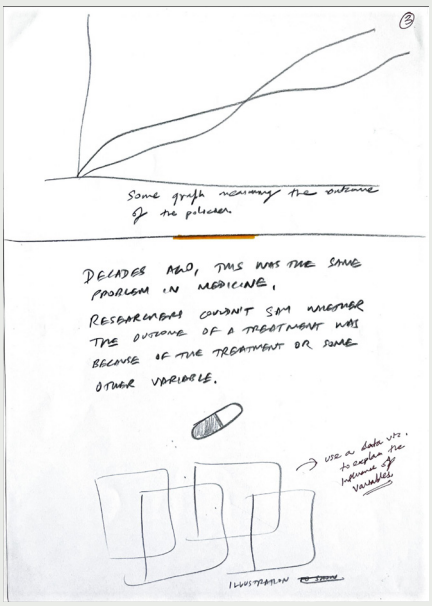
4



5

6

7

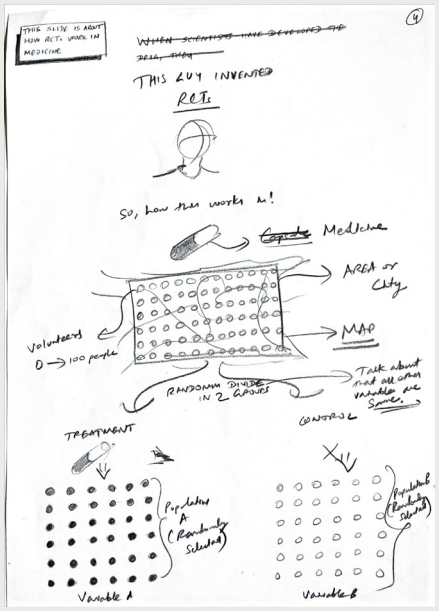


8

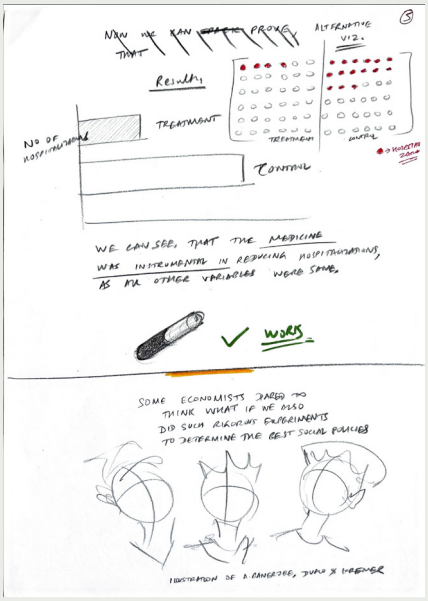
7. With this graph, I want to show the outcomes achieved by some of these policies.
8. Here there will be break for Chapter 2. Chapter will be a detour from welfare to the world of medicine. This chapter will explain to the readers that the problem of cause and effect (being certain that the cause is what produced the effect) is centuries old and was one of the most important pieces in scientists abilities to develop better treatments.

9. This section will talk about the person who first used Randomized Control Trials to determine the efficacy of a treatment. This section, using visualizations, will explain how the concept of Randomization, Control and will show the readers (using a real historical example) how a Randomized Control Trial would have been carried out.

9



10

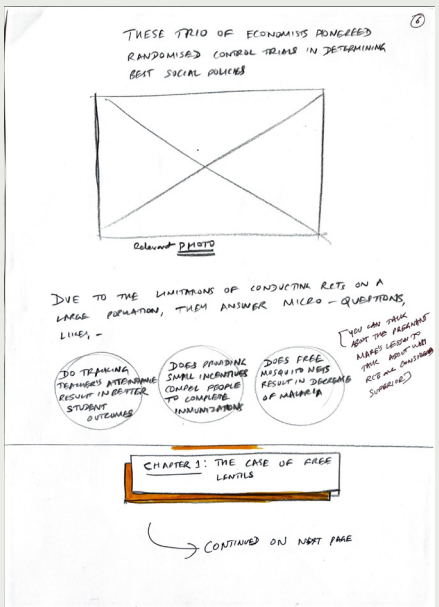


11

10. The next section would visualize the result of one such experiment and show that having a control group and randomizing the population allowed the scientists to prove beyond a reasonable doubt that a treatment is more effective over another treatment.
11. Now here we will break into Chapter 3. In Chapter 3, we will talk about how some economists began to take the idea of a RCT and applied it the world of welfare economics to design better policies.

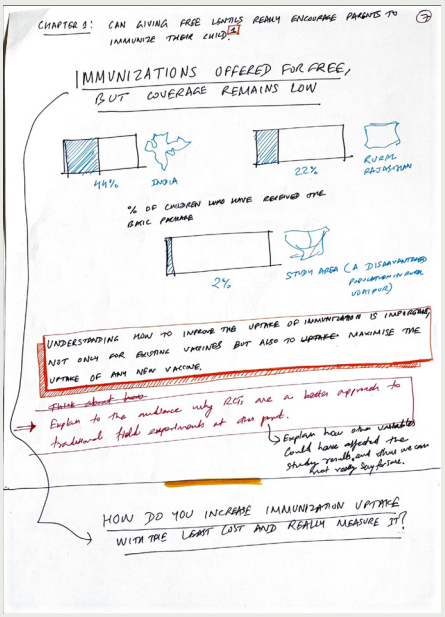
12. Further in this section we will talk about how a trio of economists (Abhijeet Banerjee, Esther Duflo, and Michael Kremer) pioneered the idea of doing a RCT study to design the most effective social welfare policies aimed at fighting poverty.
13. Within this chapter, we will be looking at one of such study in detail. The study that I chose is “Improving immunization coverage in rural India: clustered randomized controlled evaluation of immunization campaigns with and without incentives”. (Banerjee, Duflo, et al.)

12



13

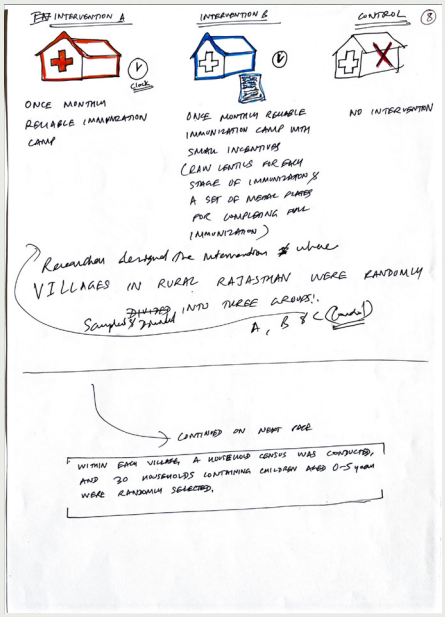
14



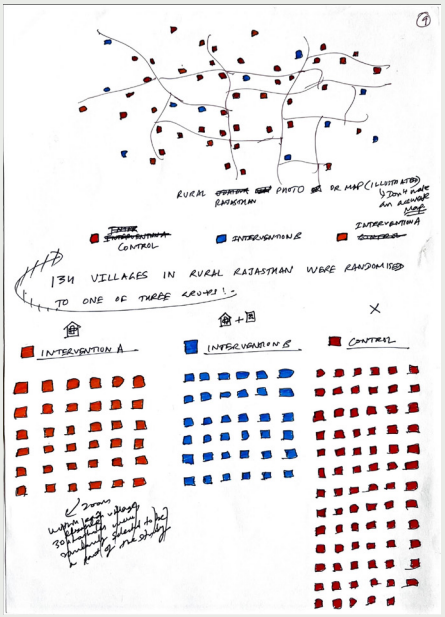
14. We will begin with an introduction to the study, why was the study needed and some contextual information about the study. We will also talk about how an RCT study was a better choice for determining the effectiveness of incentives on increasing immunization among children.

15. These next set of visualizations would visualizations would show the design of the study: Villages were divided into three groups: Intervention A (reliable camps to encourage immunization as nurses were absent from government clinics), Intervention B (reliable camps as well as providing a small incentive of 1kg lentils to act as a nudge), and Control (no intervention)

15



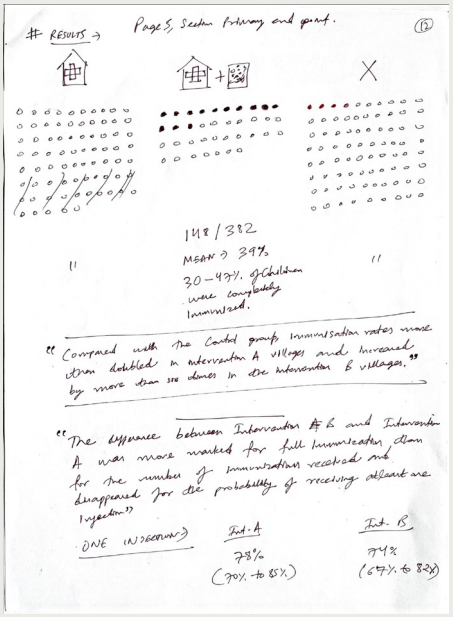
16



16. This visualization would show the readers how randomization works in a study like this. Over a map of the area in which the study was conducted, icons representing villages would be placed and they will be animated to show that the villages were truly selected at random to be a part of one of the three groups.

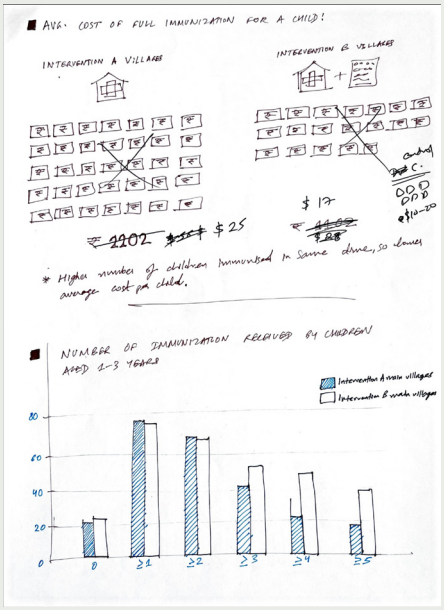
17. Now we will be showing the results of the study. Here, I am using circles to represent one child. A filled circle is child who got immunized and an unfilled child is one who did not. Showing the results in a visual way like this would hopefully make the results much more interesting to read. The results conclusively show that incentives increased the immunization rate in children in the study area.

17



18

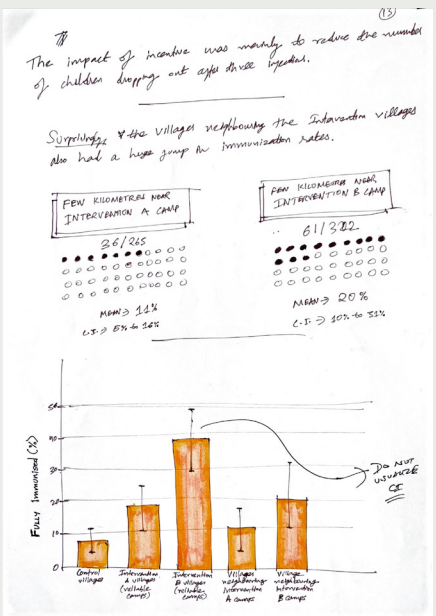
19



18. This section will visualize the cost of providing incentives versus just having reliable camps and how that compares to the standard cost of immunization.
19. We will also be looking at an interesting insight that came out of the study: Incentives do not play a huge role in increasing immunization rates initially but have an outsize role in making the parents come back for the full set of immunizations.

20. These visualizations are to show the spillover effect: villages neighboring Intervention A and Intervention B villages had a surprising jump in the immunization rates.

20



PROTOTYPE

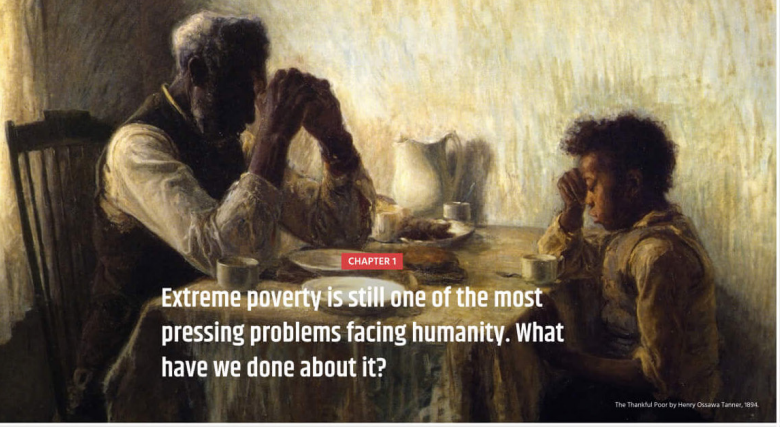
PROTOTYPE

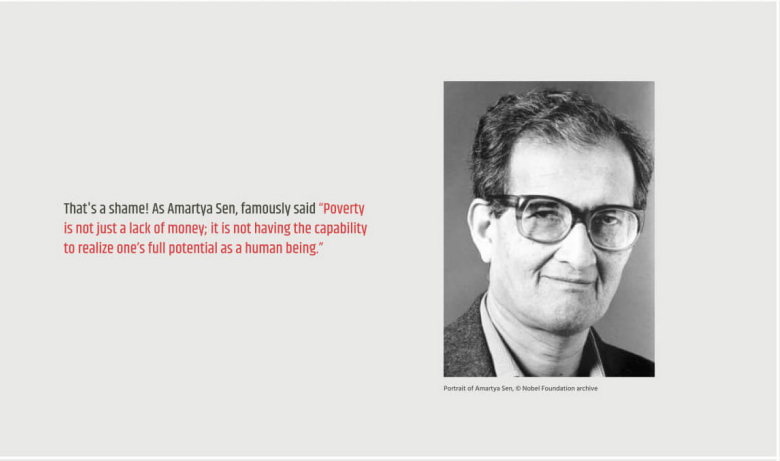
After I had written the first draft of the story and sketched out the accompanying visualizations, I designed a high-fidelity prototype of the story. Working in Figma, I rapidly iterated through multiple design choices for the visualizations and the narrative. For the final design, I wanted to design a scrollytelling experience that is quite popular among newsrooms like The New York Times and Reuters. But due to the limit of prototyping options in Figma, I created a click through prototype that simulate the experience and allowed me to get quality feedback on the final design.

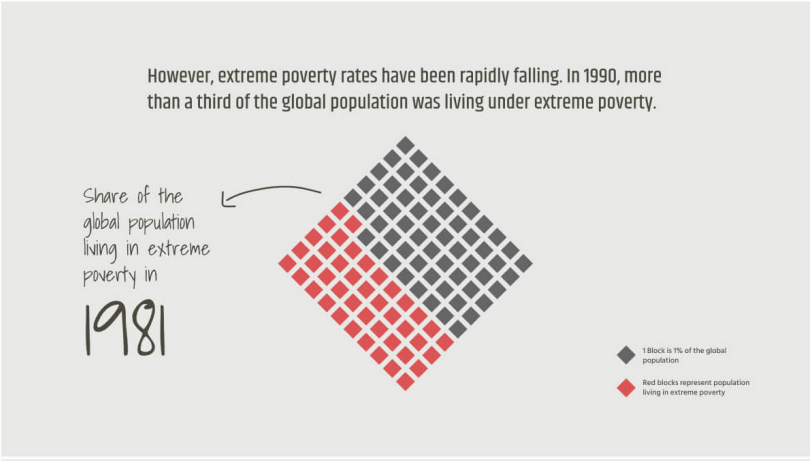
PROTOTYPE LINK

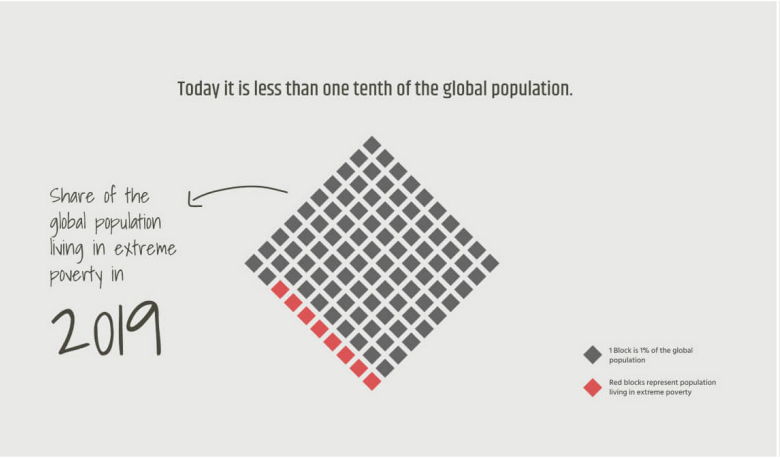
COPY & PASTE IN BROWSER

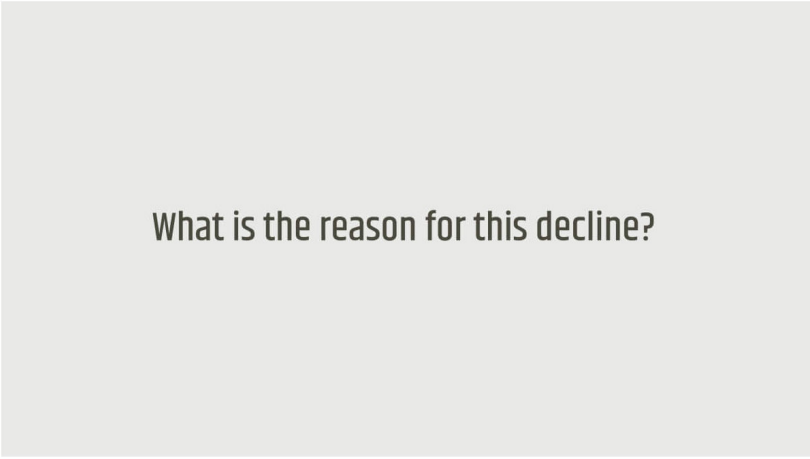
bit.ly/3WiFmgm







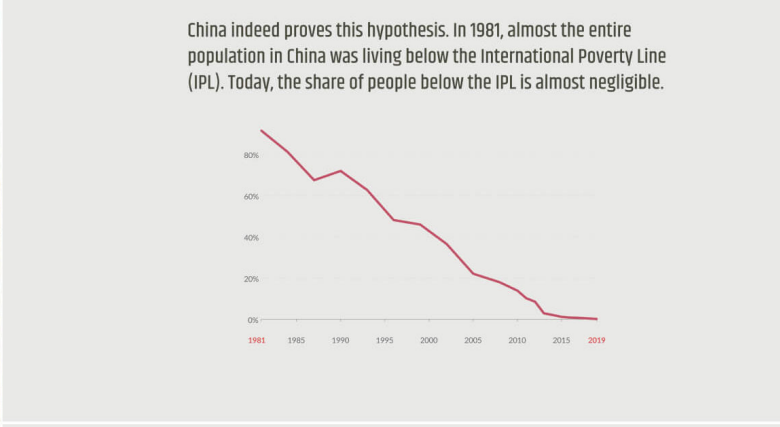


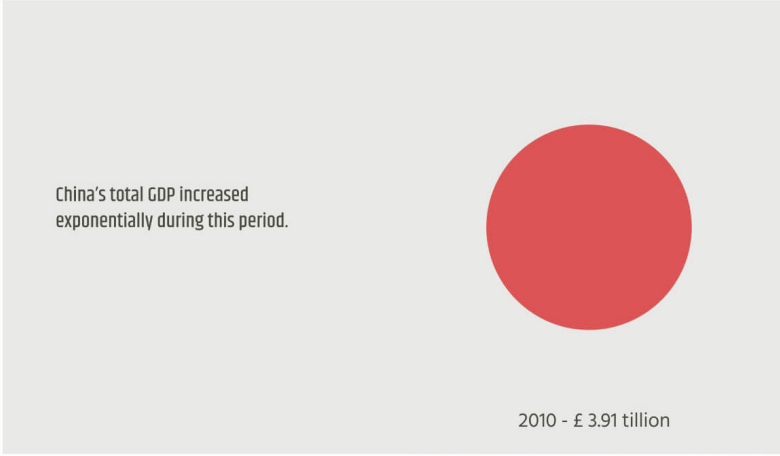


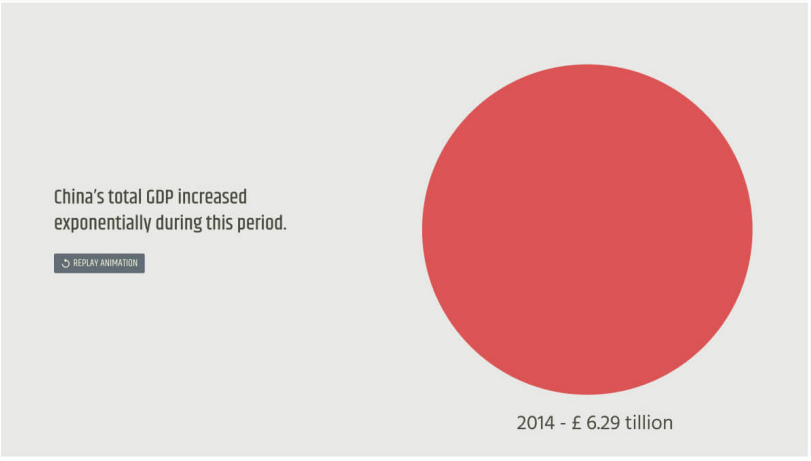
CHAPTER 1: SLIDES 1 TO 6

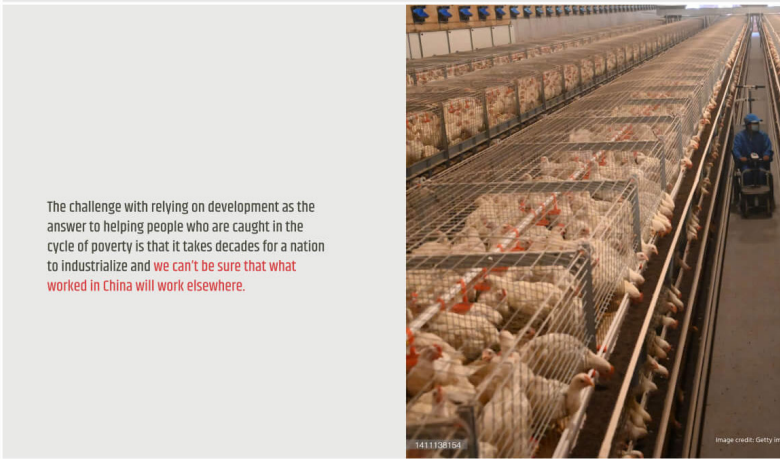
The article starts with Chapter 1: "Extreme poverty is still one of the most pressing problems facing humanity. What have we done about it?". This chapter gives background on the crisis of global poverty and how that is one of the most urgent problems facing humanity.

In Ideation, I had decided to start the article with the premise that a lot of people rely on welfare and that welfare is a huge chunk of government expenditure. The idea was to build the narrative that since welfare is such a important part of government spending, we need to get it right and not just rely on economic theories to design welfare policies. But after getting some feedback and on revisiting the article from a reader's point of view, I realized that building the argument from this perspective was not strong enough to hook the readers. So I pivoted the focus away from talking about the flaws of the design of welfare policies to shifting the argument to a moral one. Extreme poverty is a case where we need to do everything to eradicate it once and for all. And I believe, Randomized Control Trails are the best weapon we have to lead the fight on poverty.







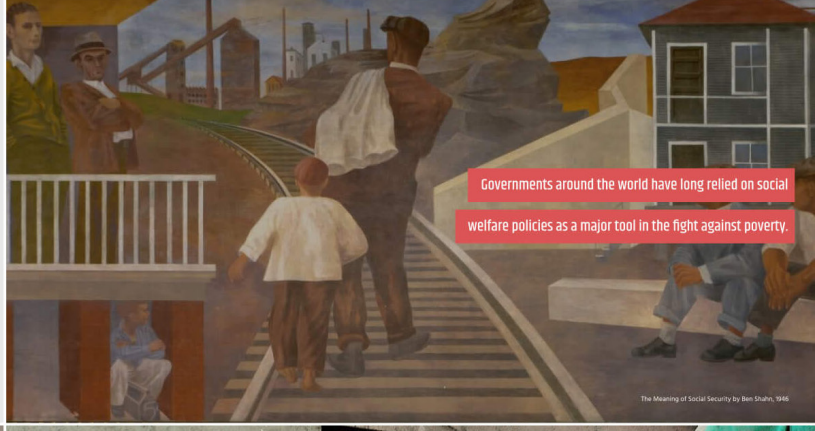


CHAPTER 1: SLIDES 7 TO 12

This section explains the idea propagated by many Developmental Economists today, that the problem of extreme poverty will solve itself as nations industrialize. Taking the example of China, I showed how as the country industrialized, poverty rates started to plummet.

Slides 9-11 visualized the growth of China's economy using animating circles (the size of the circles representing the size of the economy). However, upon reviewing with users, I found that this visualization was unnecessary distrating and a simpler line chart visualization would have conveyed the idea much better.

The more urgent question is: what can be done in the present?



However, some economists and policy-makers argue that social welfare programs create a culture of dependency and discourage work.

A more fundamental criticism is that there is no direct evidence that these programs are effective at solving the problems they are designed for.

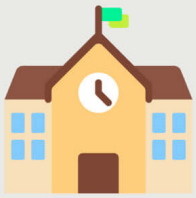
CHAPTER 1: SLIDES 13 TO 18

After establishing the idea that extreme poverty is one of the worst problems facing humanity, I move on to talking about what is being in the present. Governments around the world have pledge to eradicate extreme poverty and to that effect, many goverments run social welfare policies like MNREGA (guarantee to atleast 100 days of paid labour in India), Food Stamps in the US, Mid-Day meals scheme where children going to government run schools in India are given lunch, etc. I also present criticisms of the welfare policies made by some economists and policy makers: 1. That welfare programs create a culture of dependancy and discourage work, and 2. That there is not conclusive evidence that these programs are effective at reducing poverty. Later in this article, I will show that both of these claims are not true and that welfare programs do indeed help the poor and that they do not reduce the propensity of work among the people.W

While observational studies have shown that these programs do indeed have positive impact, they are often criticized for their inability to establish causality.

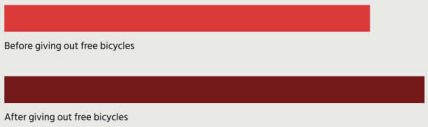
Let's understand with a hypothetical example

A government wanted to increase school attendance rates of children.



Many kids were not going to school because the schools were far away and the kids didn't have bicycles.
To increase the school attendance rates, the government gave free bicycles to students.

A study conducted a year later found that the attendance rates did increase in the area.



However, it was later found that incomes of parents had also risen in that area by a significant amount.

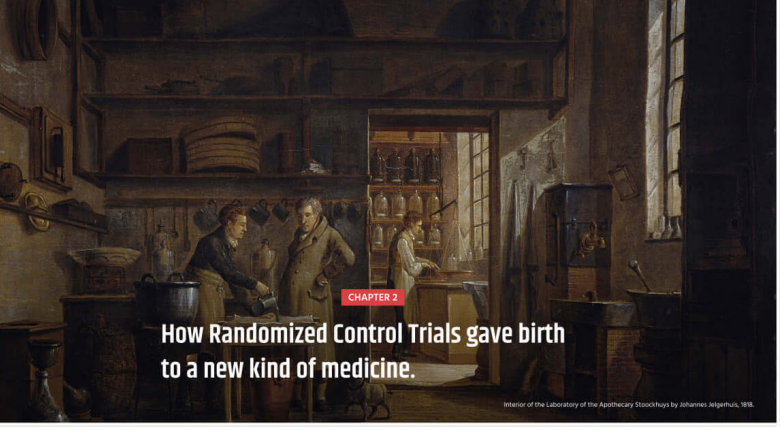
Can free bicycles alone be proven to increase school attendance, or could the income jump might have allowed more parents to afford public transport or to pull the kids out from labor and instead send them to school ?

In an observational study, we cannot control for all possible confounding factors, and the observed associations may have been influenced by unmeasured or unobserved variables. That is, it is impossible to accurately calculate the impact of bicycles alone in increasing school attendance.

Decades ago, this was the same problem facing the medical community. Researches couldn't conclusively say whether the outcome of a treatment was the result of the treatment itself or some other unmeasured or unobserved variable.

CHAPTER 1: SLIDES 19 TO 26

This section was meant to show using a fictional example the fundamental problems with observational studies. That we cannot be sure that the cause is what produced the effect. But on reviewing this with users, I found that most of them thought it was a real study and were confused when I explained to them later that it was not. As the idea of cause and effect was already explained many also found this section to be unnecessary. So In the final design, I removed this section entirely.



CHAPTER 2

How Randomized Control Trials gave birth to a new kind of medicine.

Interior of the Laboratory of the Apothecary Stoockhuys by Johannes Jelgerhuis, 1818.

This search for cause and effect is hundred of years old. Philosophers, scientists have been pondering this question for milennia. How can we be really sure that the cause is what produced the effect?

Till the nineteenth century, bloodletting was (drawing out a person's blood using surgical methods) thought of as a fantastic cure for most ailments.

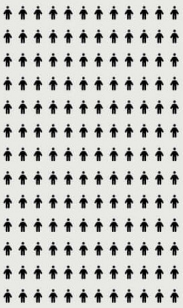
Breathing a Vein, a caricature of bloodletting by venesection by James Gillray, 1804

Life of George Washington: The Christian by Junius Brutus, 1853.

When George Washington developed a swollen sore throat in 1799, he asked his overseer to bleed him. Doctors then drained nearly half his blood. He died within a day.

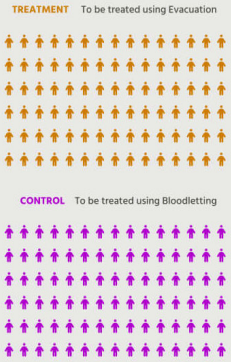
Life of George Washington: The Christian by Junius Brutus, 1853.

When George Washington developed a swollen sore throat in 1799, he asked his overseer to bleed him. Doctors then drained nearly half his blood. He died within a day.



Van helmont suggested taking 200 patients with similar symptoms and dividing them into two group by randomly allocating them to either one of the group (so as to remove any bias in selection).

Half of the patients would be treated by Van Helmont using evacuation and the other half by the more widely used method of bloodletting.



The success of the treatment can be determined by finding out the number of people who die in each group (Since the groups are fairly similar, any differences in the death rate would be because of the treatment and not some other factor). He says as much: "I will cure them without bloodletting... [and] we shall see how many Funerals both of us shall have."

Van Helmont never got to carry out his randomized experiment.

CHAPTER 2: SLIDES 1 TO 8

In chapter 2, we take a detour and talk about where the idea of a Randomzied Control Trial came from. Slides 1-1 visualize the earliest example of an RCT. Though the Flemish Chemist Jon Baptist Van Helmont never got to carry out his study, the idea was a breakthrough and one which introduced the idea of Randomization.

But the idea was still not fully developed. For example, there was no untreated control group to compare the effects of our treatment to. What would have happened if there was no intervention (Bloodletting or Evacuation) ?

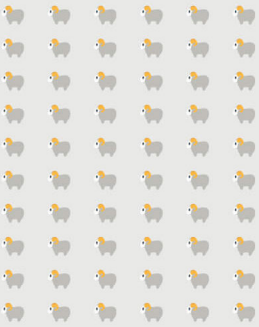
The results were stark: all of the exposed but untreated sheep died, while all of the vaccinated sheep survived healthily.

Portrait of Louis Pasteur, artist unknown

That idea of an untreated control group came later, with the famous experiment of microbiologist Louis Pasteur who was trying to prove that he had developed an animal anthrax vaccine.

So how can Randomized Control Trials help us fight poverty?

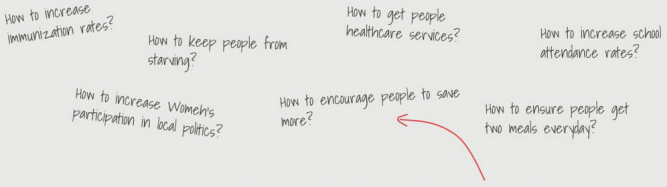
To test the efficacy of his vaccine, he asked for 60 sheep and split them into three groups:



CHAPTER 2: SLIDES 9 TO 14

This section in chapter 2 builds on the background behind RCTs and we see the results of the first study that incorporated both the ideas of Randomization and a Control group. The famous experiment carried out by Louis Pasteur cemented RCTs as the best method in determining causality.

Economists are concerned about the reliability of previously used methods for identifying causal relationships and grand theories of development.



Many economists today say that focus on "small" problems is more likely to succeed rather than the grand theories of Development which excluding some outliers have failed to solve the problem of poverty.

They argue that randomized experiments are a simple solution to causal questions and bring credibility to economic analysis.

Let's see for ourselves what this experimental approach looks like.

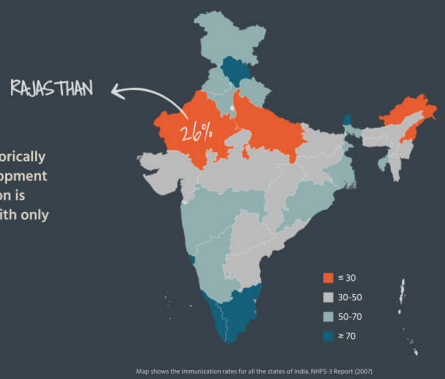
CHAPTER 3: SLIDES 1 TO 8

Chapter 3 talks about how some economists believe that just relying on development is not enough to change the lives of the poor and that focusing on smaller problems is a better approach.

EXPERIMENT 1

CAN GIVING OUT FREE LENTILS INCENTIVIZE PARENTS TO GET THEIR KIDS IMMUNIZED IN RURAL RAJASTHAN?

In Rajasthan, a state which has historically lagged behind in key human development indicators, the rates of immunization is among the lowest in the country with only 26% of children fully immunized.



Map shows the immunization rates for all the states of India. NHFS-3 Report (2007)

Understanding how to increase the immunization rates is **important not only for existing vaccines but also to maximize the uptake of any new vaccine.** The economists Abhijeet Banerjee, Esther Duflo, and Rachel Glennerster set out to find what could be done about it.

The researchers found that parents were not immunizing their kids because the public health centers where the vaccine doses were being administered were often closed, or the nurses were absent. Additionally, the parents were not entirely sold on the benefits of immunization and taking their kids to the immunization centers (which were not guaranteed to be open) meant forgoing a day's wage.

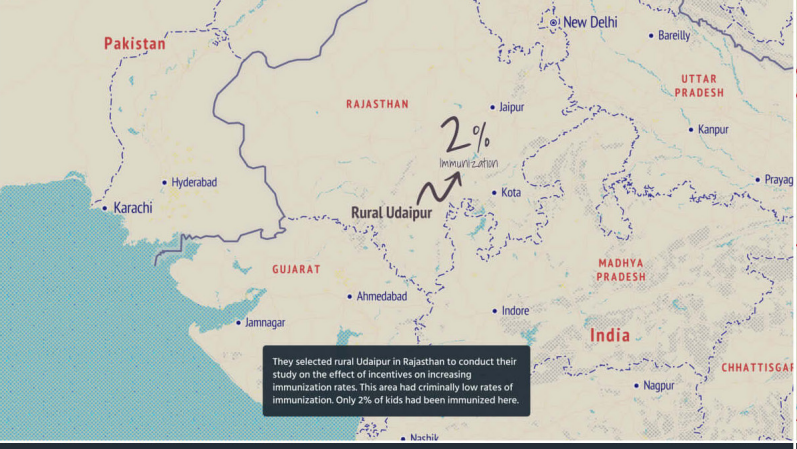
The researchers believed that having **reliable supply** of free immunization services and **incentives to improve the demand** for these services could **improve immunization rates.**

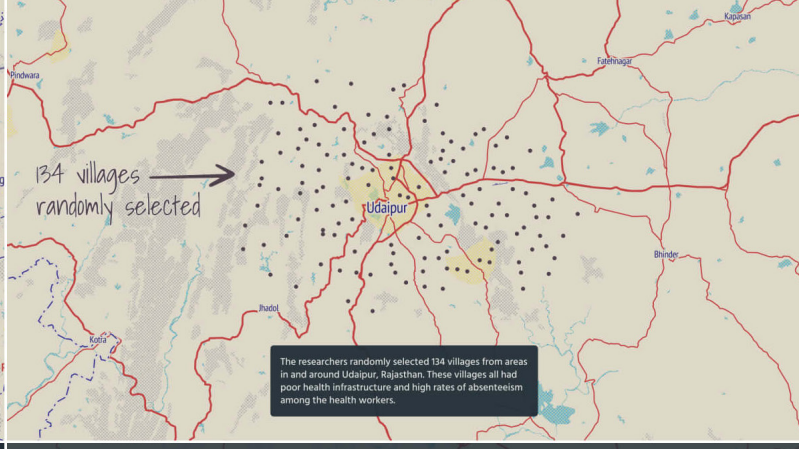
Abhijeet Banerjee, Esther Duflo, and Rachel Glennerster designed a Randomized Controlled Trial (RCT) study to **assess the efficacy of modest non-financial incentives on immunization rates** in children aged 1-3.

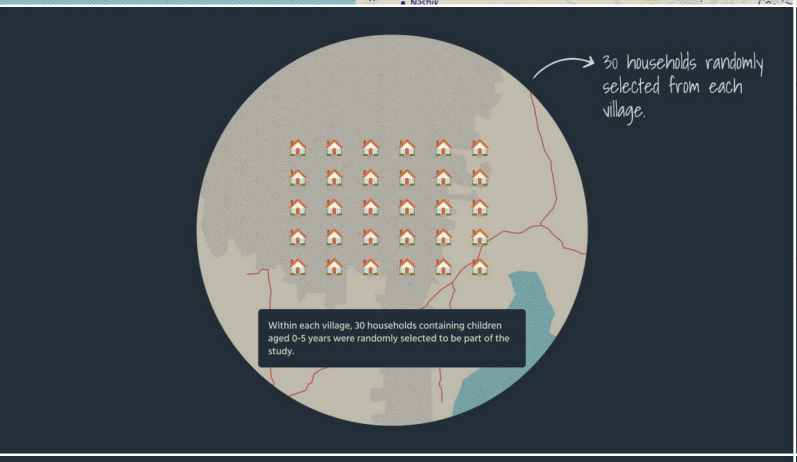
The Randomized Control Trial (RCT) design is important because **by randomly assigning participants to receive the intervention or not, the researchers can control for other factors that may influence the outcome**, such as socioeconomic status or access to healthcare. RCT allows the researchers to more confidently attribute any changes in immunization rates to the interventions.

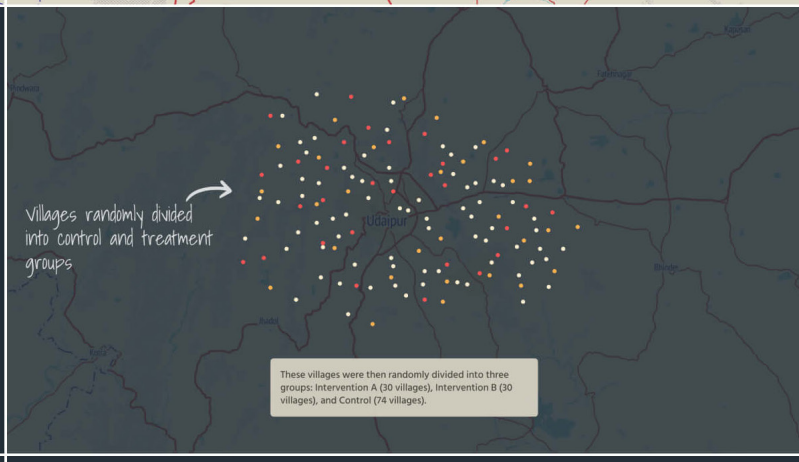
CHAPTER 3: SLIDES 9 TO 16

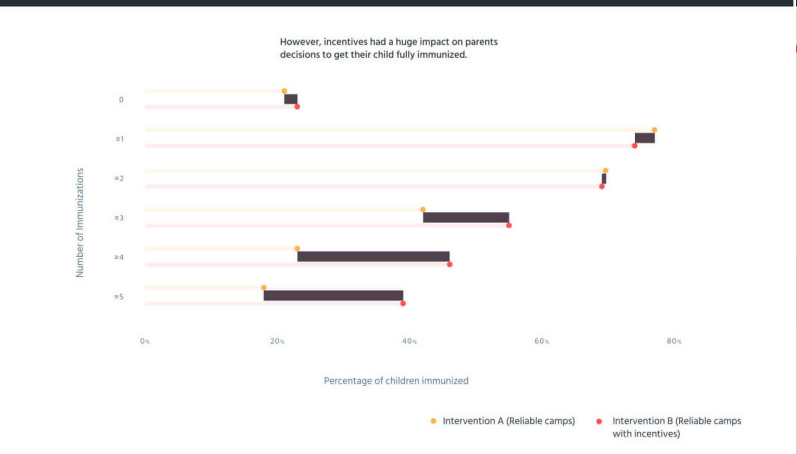
These slides set the background for one of the RCT study that I will be visualizing in the next few slides. Abhijeet Banerjee, Esther Duflo, and Rachel Glennerster designed a study to see if giving small incentives to parents in rural areas results in higher immunization rates.

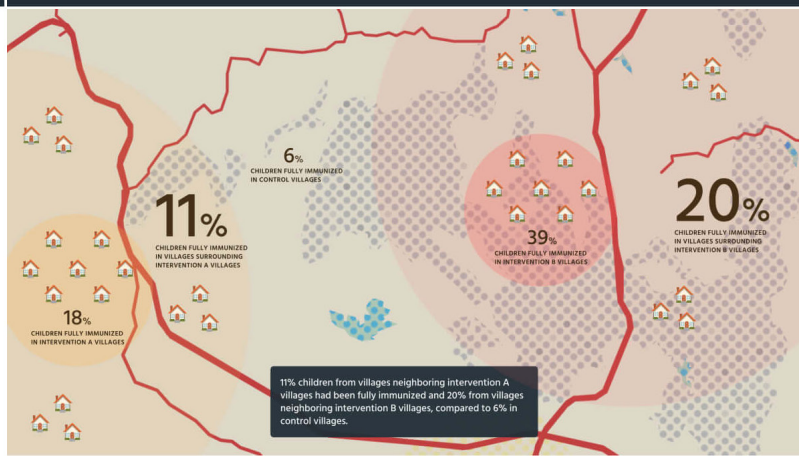






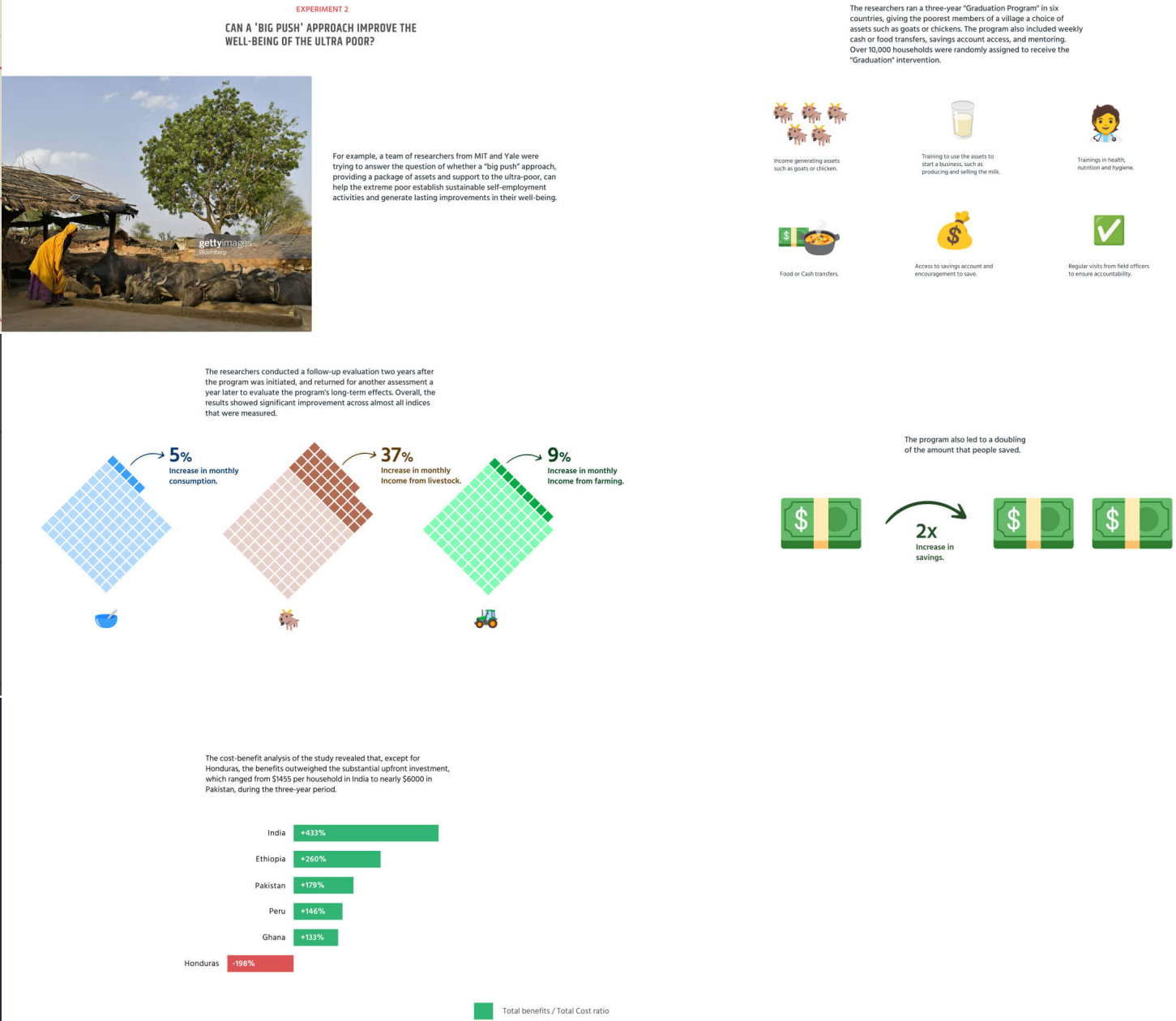






CHAPTER 3: SLIDES 17 TO 24

Slides 17-21 visualize the study design and slides 22-24 visualize the study results.

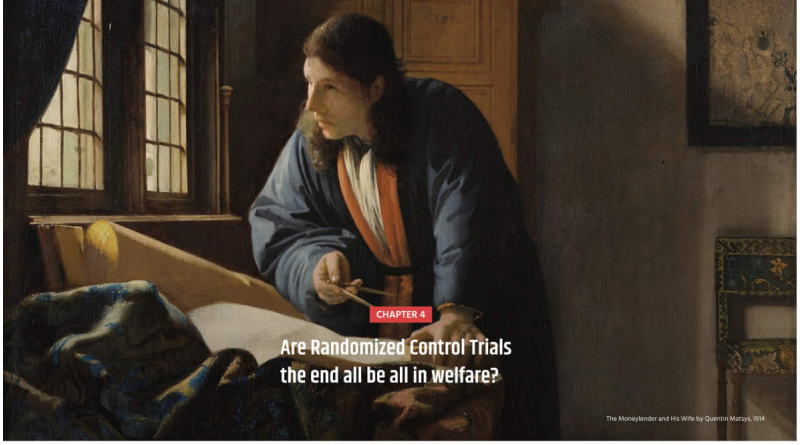


CHAPTER 3: SLIDES 25 TO 29

To give the readers a fuller picture about how the economists are using RCT studies to deisgn better welfare policies, I included two more experiments. The first study (Slides 25 to 29) looks at the impact of a program that aims to increase people's living standards through a wide range of intervention.

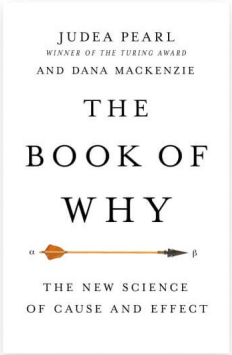
CHAPTER 3: SLIDES 30 T0 33

Slides 30 to 33 looks at another RCT experiment where the reaserchers wanted to study if people who receive welfare tend to work less. Their findings concluded that the propensity to work does not decrease for people on welfare.
Though this is an important study that tackles an important misconception about welfare, the story's focus is on showing how researchers are designing better policies to tackle the problem of poverty. So during the editing process, I decided to remove this section to make the story concise and more focused on the core argument.



RCTs, **employing the most rigorous statistical methods, challenges the criticism** of some policy makers and economists who say that **social welfare programs are not effective at solving the problems and are a waste of tax-payers money.**

As Judea Pearl writes in his book "The Art and Science of Cause and Effect" : [Randomized experiments are]... **"the only scientifically proven method of testing causal relations from data, and to this day, the one and only causal concept permitted in mainstream statistics."**



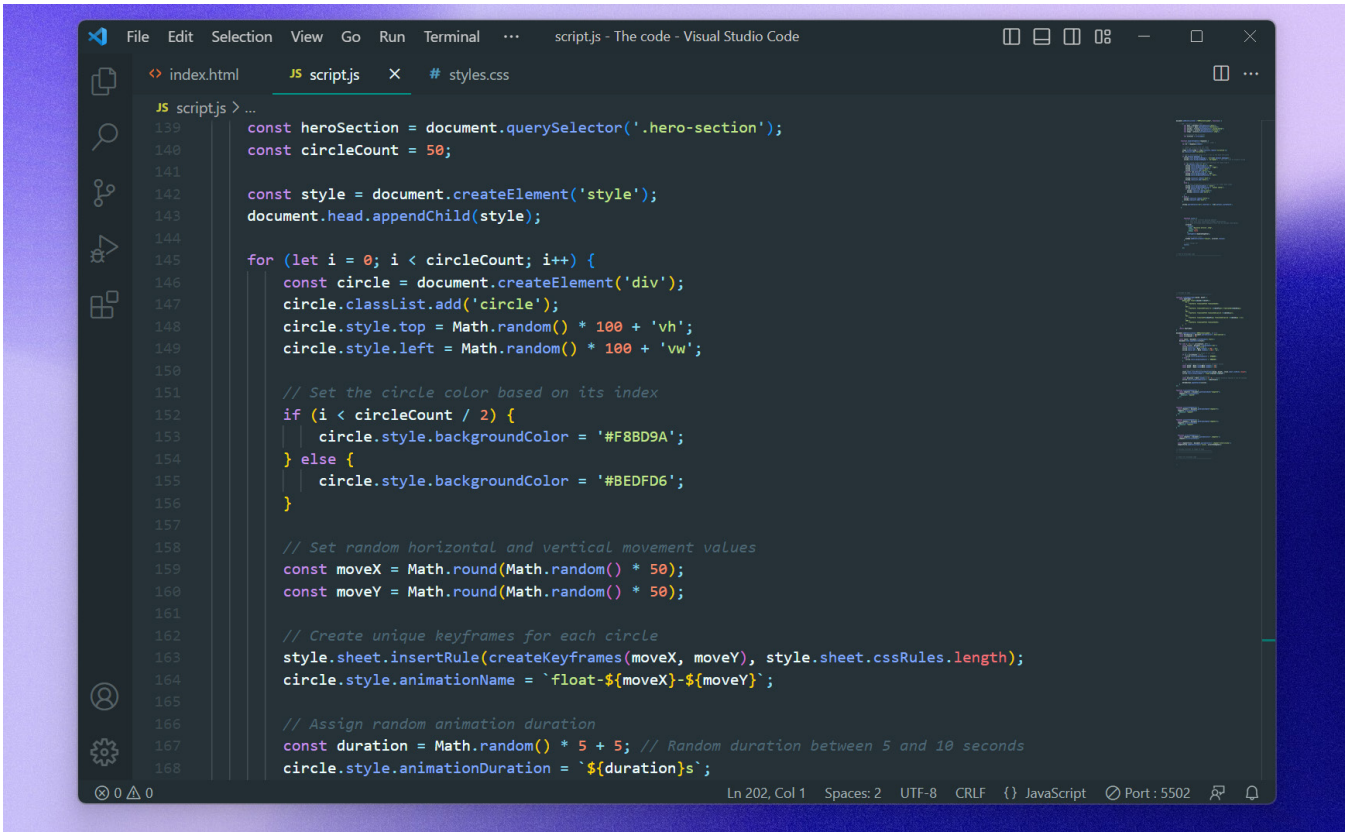
CHAPTER 4: SLIDES 34 T0 36

This chapter concludes the story by summarising the argument presented till now. And I had also intended to present the critical arguments against the use of RCT in relying to fight poverty. However, during discussions with faculty members, I was suggested the story doesn't have to present both sides of the story and communicating just the core argument would make this stronger.

DEVELOPMENT AND FINAL DESIGN

DEVELOPMENT

Once I was done with the final design, I started coding the designs. Coding the design allowed to me make scroll based animations and incorporatate elements of scrollytelling throught the article. I used a lot of web technologies like HTML, CSS, JS, SVG, D3.js, and GSAP.
Coding the design was incredibly challenging for me as I do not have prior experience in programming. But following along with tutorials I was able to figure out the code for the visualizations and the article. I hosted the site using Netlify and used Github to host the code.



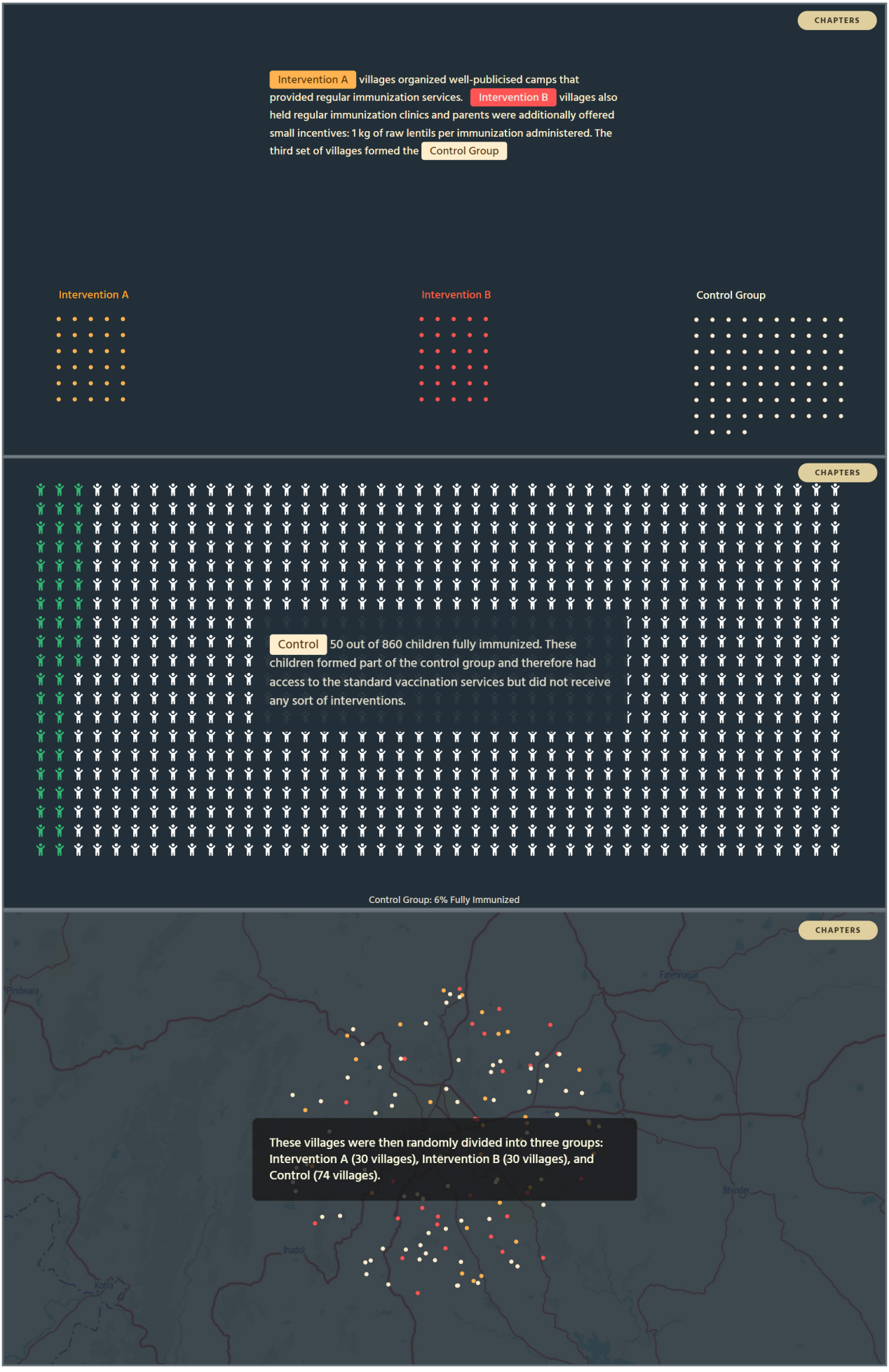
Screenshot of the code editor

FINAL DESIGN

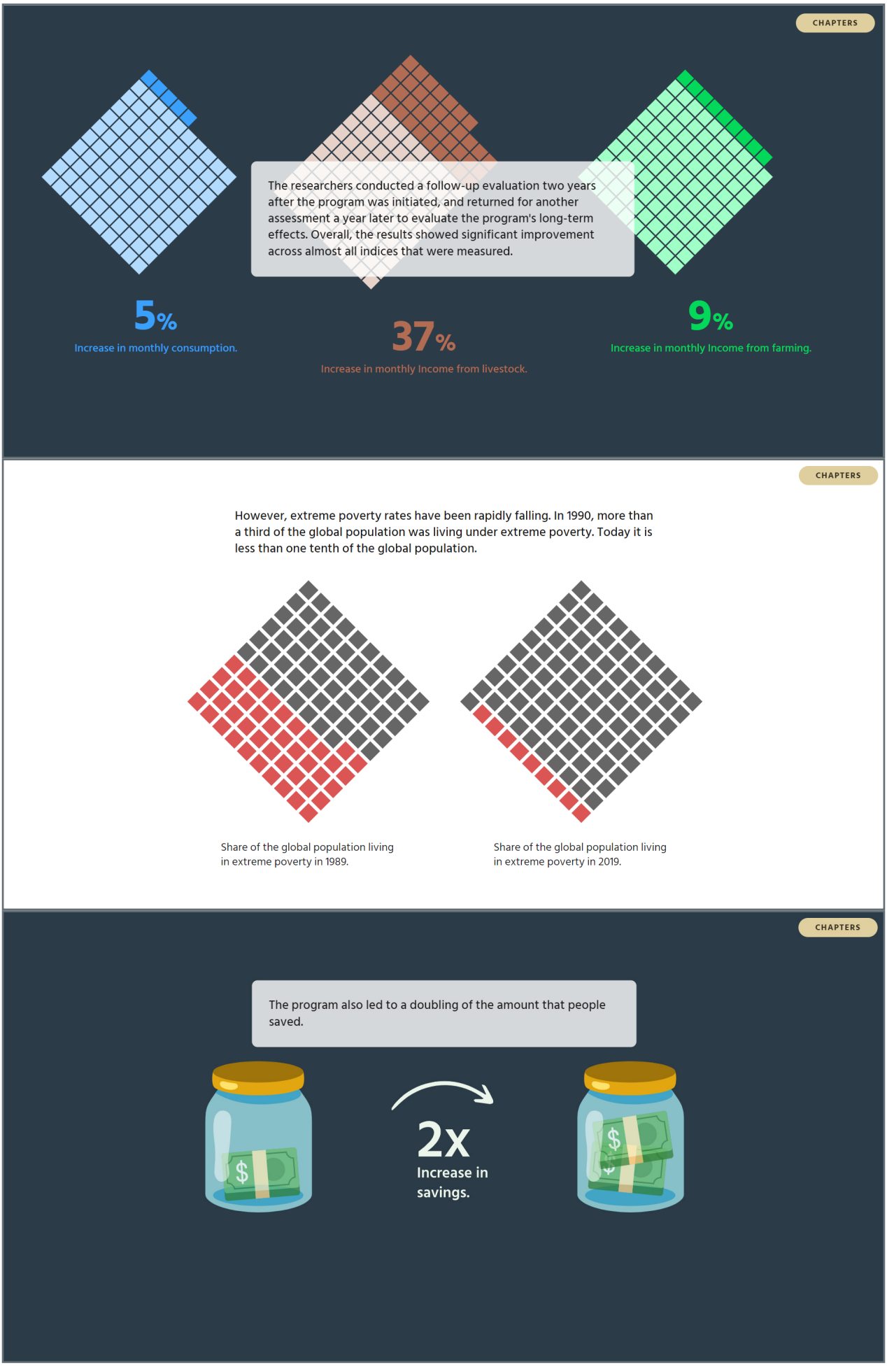
https://www.ankit-anand.com/rct

Please view the website only on a laptop or desktop as it has not been optimized for viewing on a mobile or tablet.

Screenshots from the final design



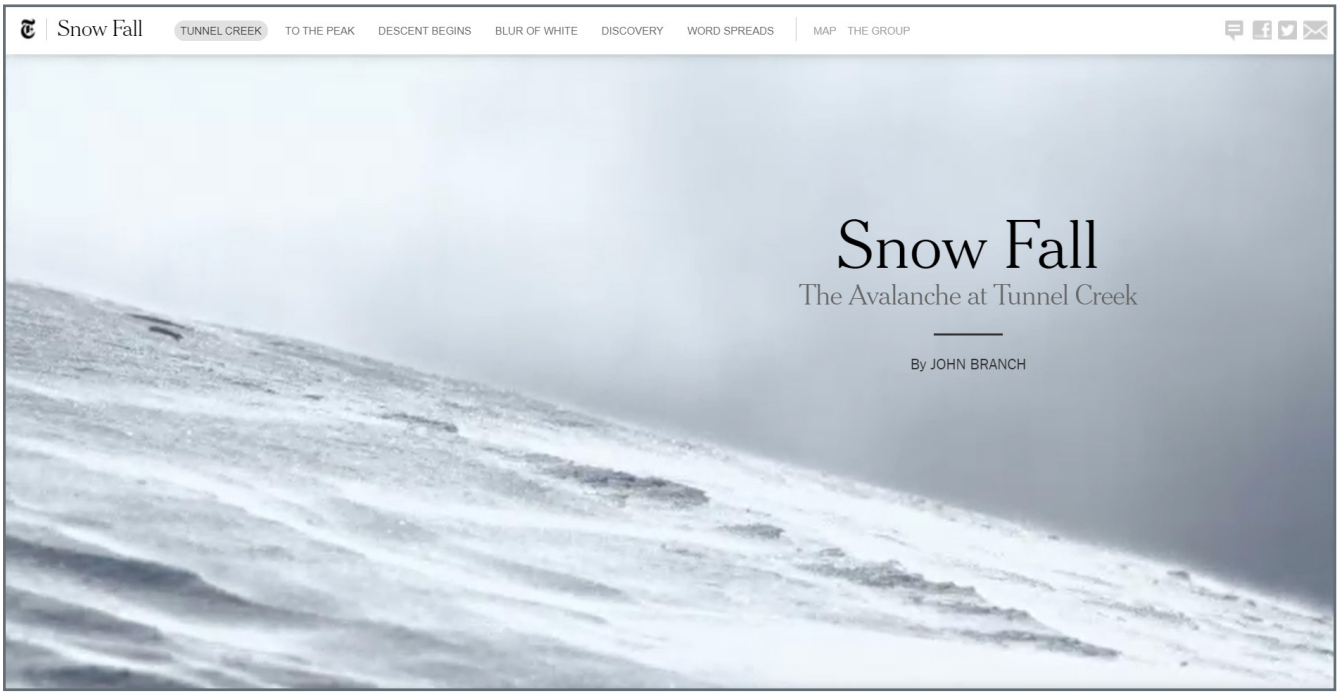
Screenshots from the final design



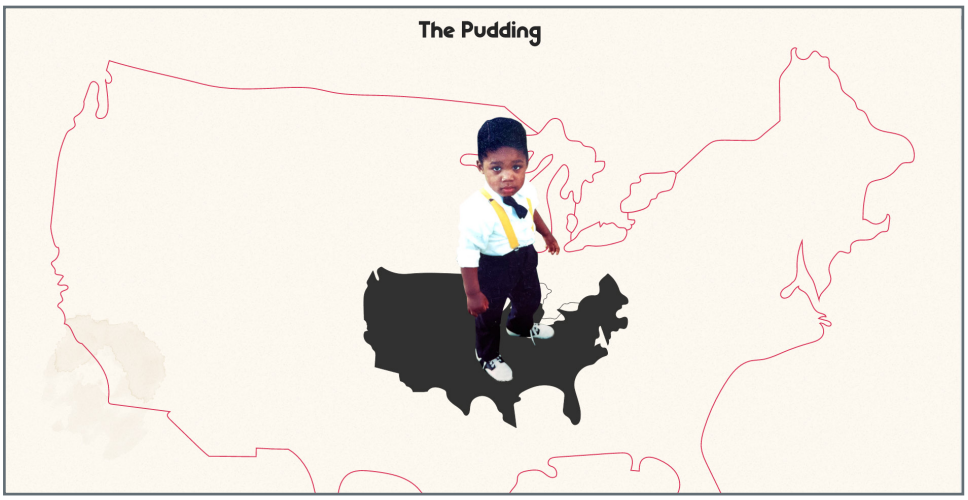
Screenshots from the final design

SCROLLYTELLLING

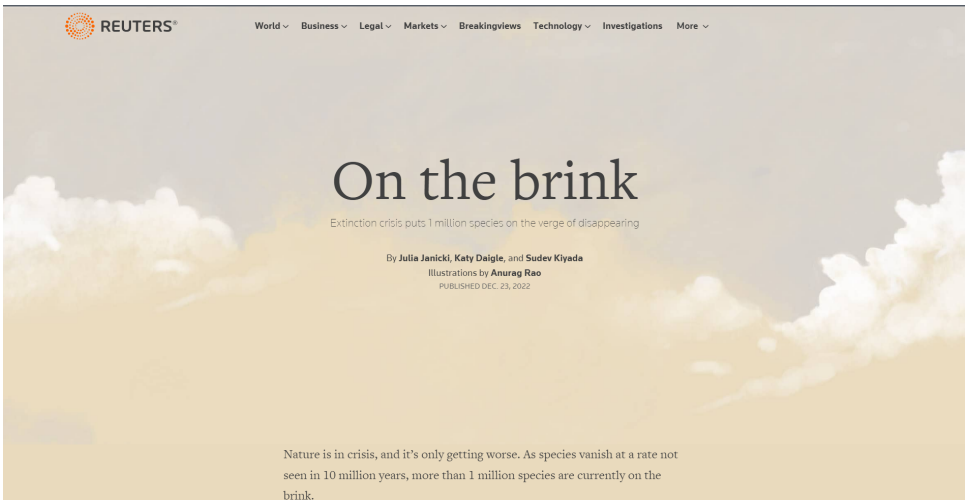
Scrollytelling is a term that describes online longform stories that reveal or change content as the user scrolls through the website. It was first popularized by The New York Times when they published the Pulitzer Prize-winning multimedia feature called “Snow Fall”. Since then, it has completely changed the way newsrooms approach long-form visual stories. I used Scrollytelling extensively throughout the story to reveal content and the data visualizations as the users scrolls through the page. I used GSAP (a JavaScript library) to implement Scrollytelling on the website.



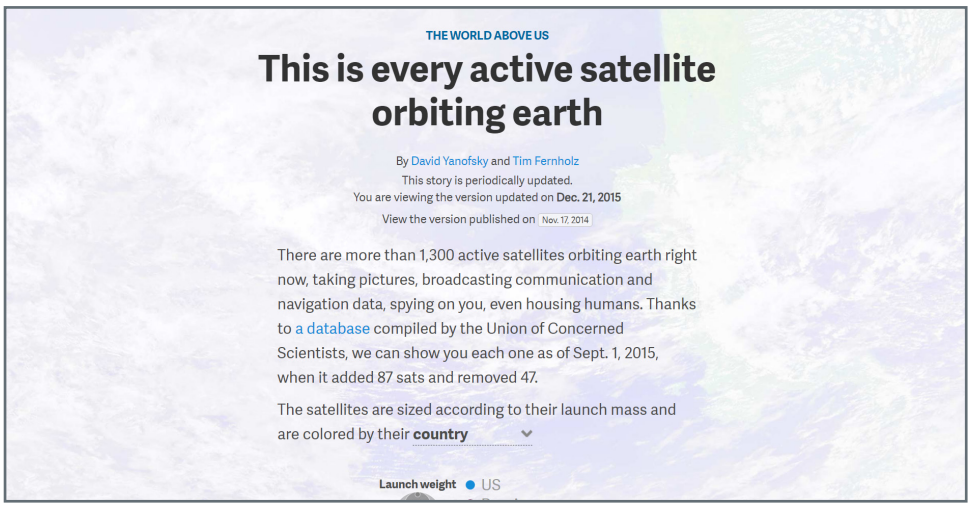
Today most of the newsrooms publishing online data visualization stories rely on Scrollytelling techniques to engage the readers.



The Pudding is one of new age digital only media outlets that uses Scrollytelling to create data-driven stories.



Reuters Graphics is Reuter's division which creates online interactive news stories and often uses Scrollytelling to engage the audience.



Quartz is an online news portal that uses Scrollytelling to create interactive online stories.

WEB TECHNOLOGIES & LIBRARIES

I coded the final website using some of the basic web technologies like HTML, CSS, and JavaScript. Since I was coding and animating the data visualizations, libraries that were geared towards this purpose such as D3.js and GSAP also came in handy.

"The HyperText Markup Language or HTML is the standard markup language for documents designed to be displayed in a web browser." HTML is the skeleton which allows us to display any kind of content on a website. I wrote the content using HTML which then rendered on the web page.

"Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation of a document written in a markup language such as HTML." With CSS, I styled the content I had included in the web page including all text, images, icons, etc.

"Scalable Vector Graphics (SVG) is an XML-based vector image format for defining two-dimensional graphics, having support for interactivity and animation." While CSS allows to style all kinds of content, it doesn't helps us to draw vector elements on screen. That's where SVG comes in. Using SVG we can draw any imaginable shape on screen. SVGs can also be very easily animated using CSS and Javascript.

"JavaScript is a high-level programming language that follows the ECMAScript standard." Essentially, Javascript allows us to make our webpages interactive. I used Javascript extensively throughout the website including animations, designing elements and manipulating SVGs.

"D3.js (also known as D3, short for Data-Driven Documents) is a JavaScript library for producing dynamic, interactive data visualizations in web browsers." Most of the visualizations that I created use D3 to some extent or other. D3 is a really powerful JavaScript library that allows to create visualizations usings SVGs.

GSAP is a JavaScript library that is tailored just for creating animations on the web. GSAP hugely simplifies creating animations and scrollable experiences as this library was created specifically for this purpose.

EVALUATION PLAN

EVALUATION PLAN

Evaluation Plan for "Randomized Control Trials are revolutionizing the fight against poverty"

A. Participant Selection

Objective: Recruit 5-7 participants who represent the target audience.

Procedure:
- Identify potential participants among students, professionals across various industries, and individuals of diverse ages.
- The criteria for selecting a participant is that they have a high school education and are able to read and comprehend articles published in newspapers.

B. Pre-Reading Assessment

Objective: Understand the participants' prior knowledge of key concepts related to the article.

Procedure: Administer a brief questionnaire assessing participants' understanding of concepts like "control group" and "Randomized Control Trials".

C. Article Interaction

Objective: Observe the interaction between participants and the article, including navigation and engagement with visualizations.

Procedure:
- Provide participants access to the article.
- Observe participant engagement with the article.
- Make notes about navigation behavior, areas of focus, and any visualizations that cause them to pause or revisit.

D. Post-Reading Assessment

Objective: Measure the change in participants' understanding and

comprehension after reading the article.

Procedure:

- Re-assess participants' understanding of the key concepts through a post-reading questionnaire.
- Ask participants to explain a visualization from the article in their own words.
- Note improvements in understanding and identify areas that may need more clarity.

E. Feedback Collection

Objective: Obtain qualitative feedback on the article, the effectiveness of visualizations, and the reader experience.

Procedure:

- Conduct a post-reading interview or survey with each participant.Gather thoughts on the design, visualizations, ease of understanding, and overall reader experience.
- Encourage honest feedback to help refine and improve the article for future readers.

REFLECTION

REFLECTION

- **Scroll-based animations:** While it is possible to create scrollytelling effects using vanilla Javascript, using a library specifically tailored for animations saves more time and is also efficient for example GSAP, Intersection observer or Scrollama.
- **Scrollytelling Implementation:** Scrollytelling can significantly enhance the engagement and comprehension of a data visualization article. A key learning here is the importance of planning clear 'waypoints' in the text where visualizations are triggered and ensuring a smooth narrative flow.
- **Data Visualization Design:** Developing effective visualizations to convey complex concepts can be a challenge, especially for beginners. Always be ready to test and refine your visualizations with your target users - their feedback can guide your design choices.
- **Inspiration from Experts:** When you're starting out with data visualization, take time to study the work of leading experts. Resources like The New York Times and Reuters Graphics are rich sources of inspiration, showcasing how scrollytelling and data visualizations can be effectively implemented.
- **Learning to Code:** If you're new to coding, start with the basics (HTML, CSS) before diving into more complex scripting languages (JavaScript). Be patient with yourself, and remember that troubleshooting is a major part of learning to code. Online resources, forums, and coding communities can be great places to find help and advice.
- **Narrative Structure:** Paying attention to the interplay between the narrative text and the visual elements is key to creating a compelling data visualization article. The narrative should be effectively segmented to align with the visualizations, enhancing reader engagement and comprehension.

REFERENCES

REFERENCES

Dizikes, Peter. "A "big push" to lift people out of poverty." MIT News, 22 December 2021, https://news.mit.edu/2021/tup-people-poverty-decade-1222. Accessed 18 May 2023.

Engen, John. "Money is the solution to global development issues." Quartz, https://qz.com/we-already-know-what-would-solve-most-global-developmen-1849555475. Accessed 18 May 2023.

"Improving Immunization Rates Through Regular Camps and Incentives in India | The Abdul Latif Jameel Poverty Action Lab." Poverty Action Lab, https://www.povertyactionlab.org/evaluation/improving-immunization-rates-through-regular-camps-and-incentives-india. Accessed 18 May 2023.

Muller, Seán Mfundza, and Nimi Hoffmann. "How randomised trials became big in development economics." The Conversation, 9 December 2019, https://theconversation.com/amp/how-randomised-trials-became-big-in-development-economics-128398. Accessed 18 May 2023.

Piper, Kelsey. "Esther Duflo, Abhijit Banerjee, and Michael Kremer and the rise of randomized control trials." Vox, 11 December 2019, https://www.vox.com/future-perfect/2019/12/11/20938915/nobel-prize-economics-banerjee-duflo-kremer-rcts. Accessed 18 May 2023.

Aizenman, Nurith. "How The 3 Nobel Winners For Economics Upended The Fight Against Poverty." NPR, 15 October 2019, https://www.npr.org/sections/goatsandsoda/2019/10/15/770346240/how-the-3-nobel-winners-for-economics-upended-the-fight-against-poverty. Accessed 18 May 2023.

Miguel, Edward. "This year's Nobel prizes prompt soul-searching among economists." The Economist, 23 November 2019, https://www.economist.com/finance-and-economics/2019/11/23/this-years-nobel-prizes-prompt-soul-searching-among-economists. Accessed 18 May 2023.

Blinderman, Ilia. "Making Internet Things, Part 1: Working with Data." The Pudding, https://pudding.cool/process/how-to-make-dope-shit-part-1/. Accessed 18 May 2023.

"Incentives Work: Getting Teachers to Come to School." American Economic Association, https://www.aeaweb.org/articles?id=10.1257/aer.102.4.1241. Accessed 18 May 2023.

"Making Internet Things, Part 2: Design." The Pudding, https://pudding.cool/process/how-to-make-dope-shit-part-2/. Accessed 18 May 2023.

"Making Internet Things, part 3: Storytelling." The Pudding, https://pudding.cool/process/how-to-make-dope-shit-part-3/. Accessed 18 May 2023.

"Many Children Left Behind? Textbooks and Test Scores in Kenya." American Economic Association, https://www.aeaweb.org/articles?id=10.1257/app.1.1.112. Accessed 18 May 2023.

"Six Randomized Evaluations of Microcredit: Introduction and Further Steps." American Economic Association, https://www.aeaweb.org/articles?id=10.1257/app.20140287. Accessed 18 May 2023.