# An examination of the identification problem arising from unit nonresponse in ILSA studies

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# A FAMILIAR EXAMPLE

# A familiar example

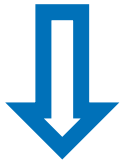
**Target inference:** Was it *very painful*, *somehow painful*, or *not painful?*

**Evidence:** The picture

**Missing information:** The context in which he lost the tooth

# A familiar example

$$truth = f\left(\underbrace{observable, unobservable}_{\text{information}}\right)$$



$$conclusion = f\left(\underbrace{evidence}_{\text{observable}}, \underbrace{assumption}_{\text{unobservable}}\right)$$

# A familiar example





1. Make no assumptions

2. Assume that my son cries when something is very painful

3. Assume the tooth fall naturally, it was loose for weeks, and the root was fully dissolved.

# GENERATING KNOWLEDGE WITH IEA STUDIES

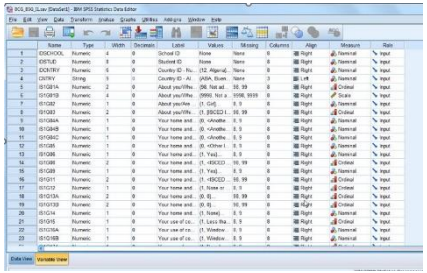
# A fundamental objective of an IEA study

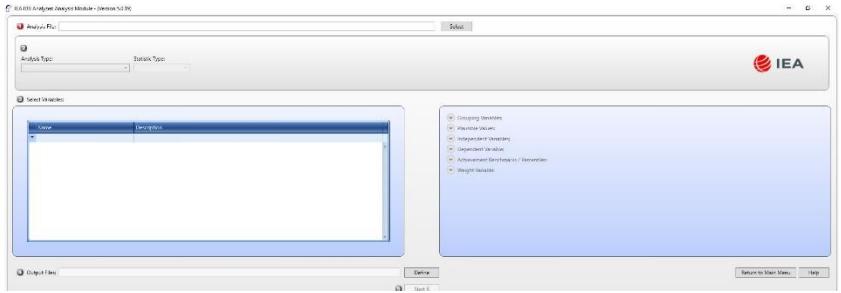
Generate knowledge about the distribution of student outcomes or charateristics in a given population

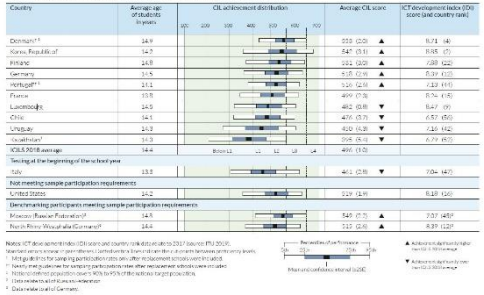
**PIRLS** **TIMSS** **ICILS** **ICCS**

# Generating knowledge



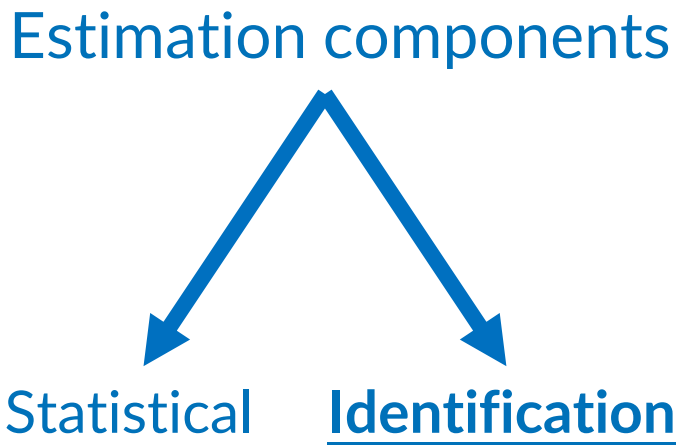




# Estimation



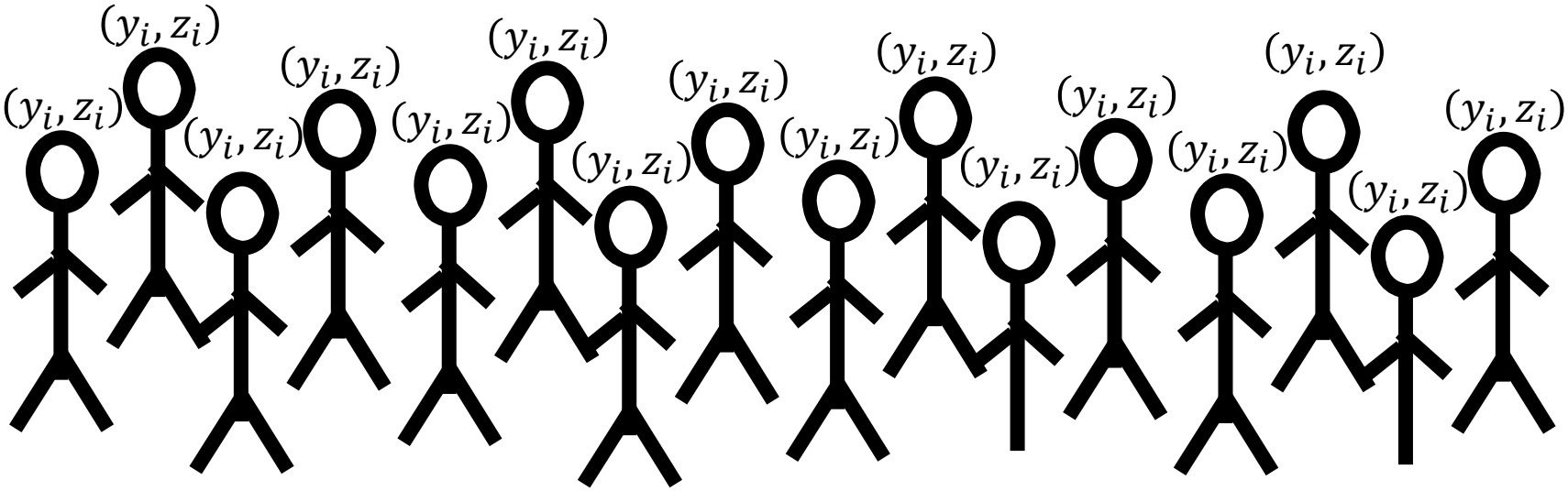


# THE IDENTIFICATION PROBLEM

## Unit nonresponse in IEA surveys

### Some insights

# The basic structure



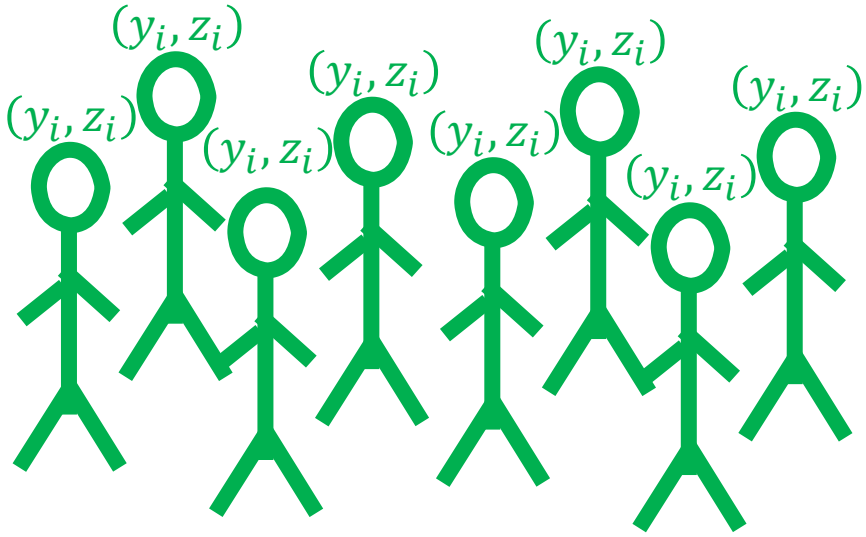

Each member of the population is characterized by:

- $y_i$ Student *i*'s CIL
- $z_i$ Student *i*'s indicator reflection participation **if sampled**

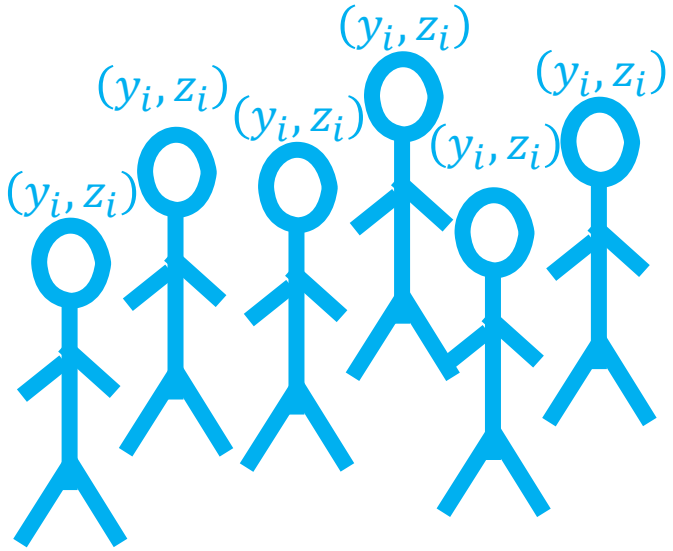
# The basic structure



## Respondents if sampled $(Z_i = 1)$

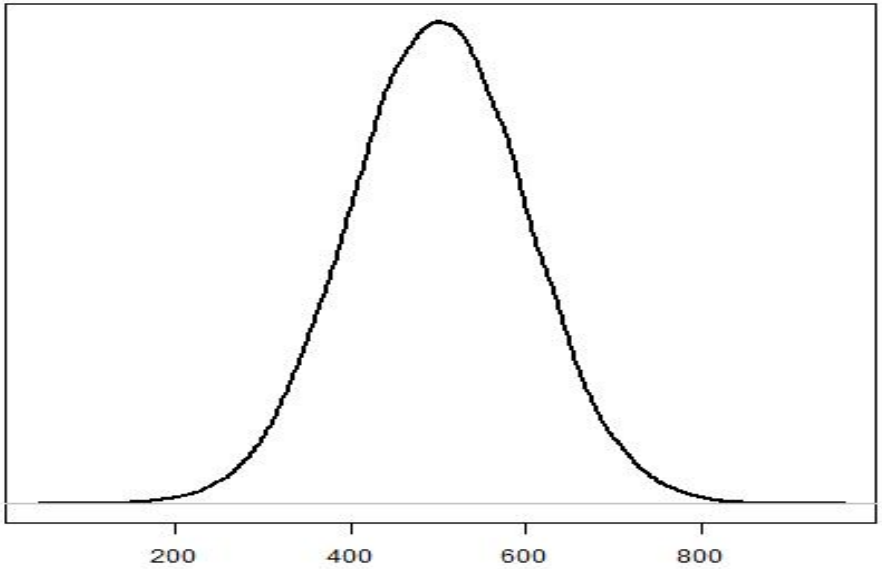



## Nonrespondents if sampled $(Z_i = 0)$



# Objective

To make conclusions about the mean of the CIL distribution in each population participating in ICILS 2018



# Identification question



What can be learned about the mean if all members of the population were to be sampled?

# Law of Iterated Expectations

$$E[y] = E[y|z = 1]P(z = 1) + \boldsymbol{E[y|z = 0]}P(z = 0)$$

Mean of $y$ among students that would participate if sampled

Proportion of students that would participate if sampled

Mean of $y$ among students that would not participate if sampled

Proportion of students that would not participate if sampled

Our conclusion really **depends on our choice for** $\boldsymbol{E[y|z=0]}$

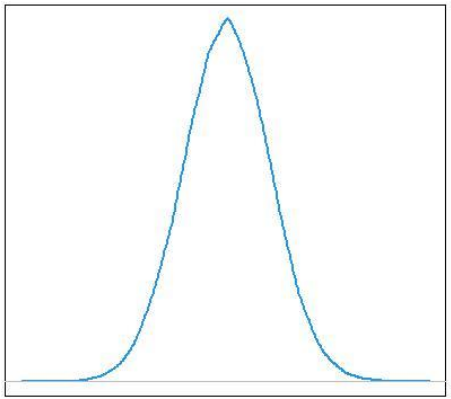
Credibility

Certitude

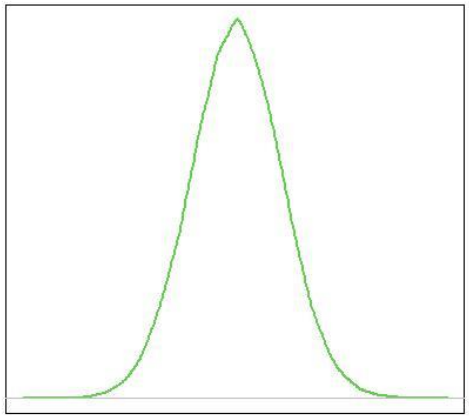
# Two extreme examples

- Get full certitude at the expense of credibility
- Get full credibility at the expense of certitude

# Get full certitude at the expense of credibility



$$E[y|z=0] = E[y|z=1]$$

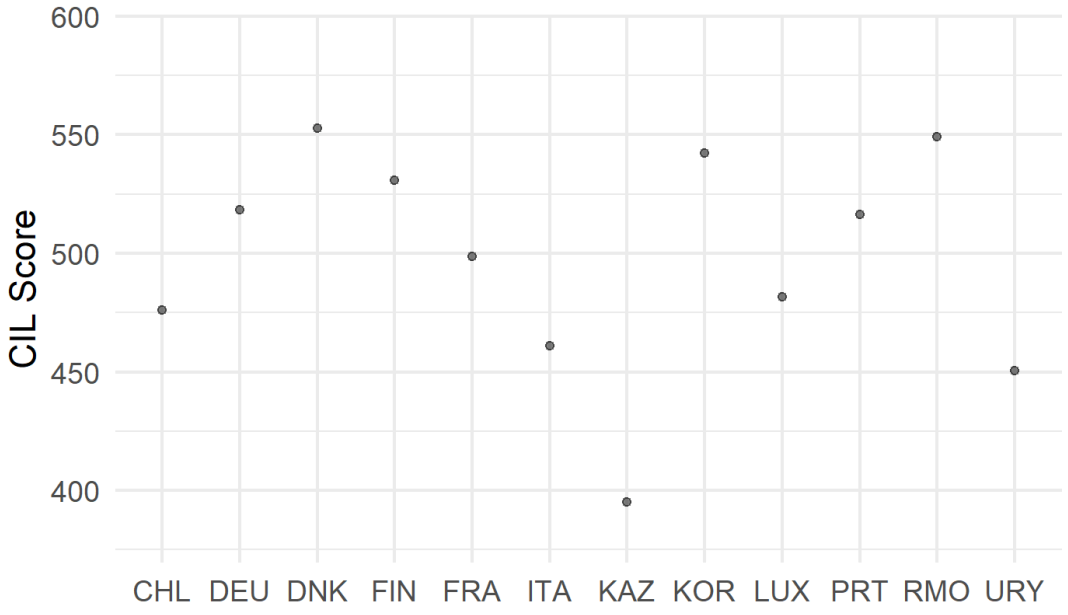


Nonrespondents if sampled

Respondents if sampled

$$E[y] = E[y|z=1]$$

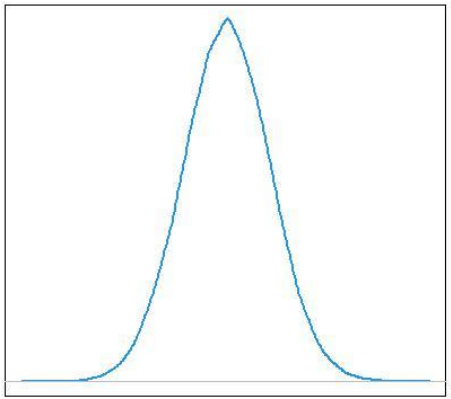
# Get full certitude at the expense of credibility



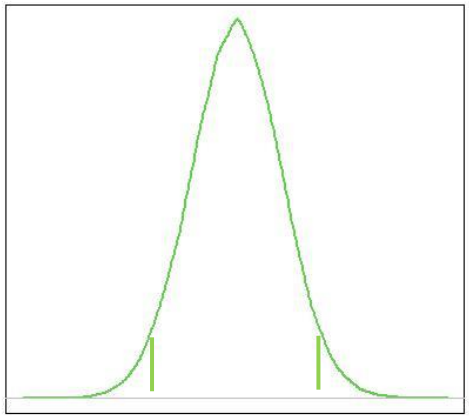

Assumption:

$$E[y|z=0] = E[y|z=1]$$

# Get full credibility at the expense of certitude



$E[y|z=0] \in [Q_5(y), Q_{95}(y)]$

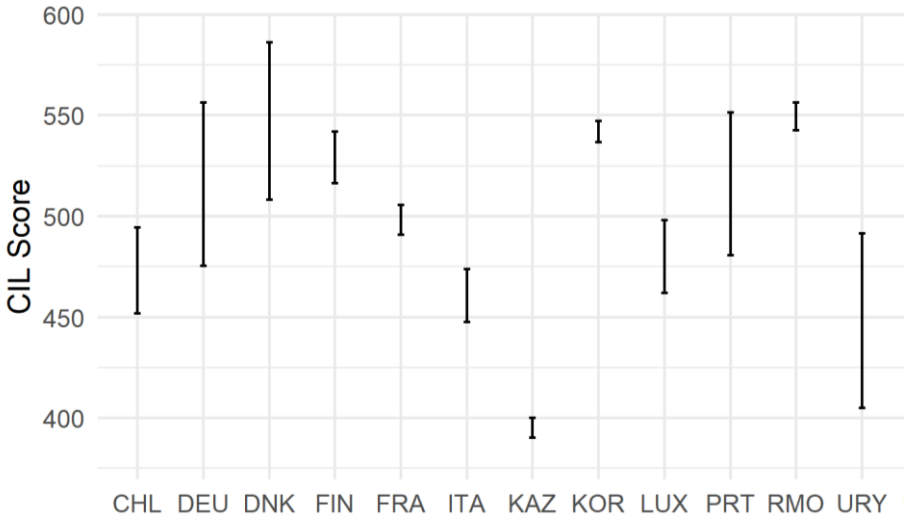


Nonrespondents if sampled

Respondents if sampled

$$E[y] = \begin{bmatrix} E[y|z=1]P(z=1) + Q_5(y)P(z=0), \\ E[y|z=1]P(z=1) + Q_{95}(y)P(z=0) \end{bmatrix}$$

# Get full credibility at the expense of certitude




Assumption:

$$Q_5(y) \leq E[y|z=0] \leq Q_{95}(y)$$

# Two extreme examples



Between these two extreme examples there is a continuum of options for $\boldsymbol{E[y|z=0]}$. Our nonresponse model lies within this continuum

# Take aways from the exercise

1. If $P(z = 0) > 0$ then we **must** make a **choice** about $E[y|z = 0]$
2. Our choice impacts where we stand in the balance between **certitude** and **credibility**
3. If $P(z = 0) > 0$, our **conclusion** about our paramater of interest is a **weighted average** of **evidence** and and **assumptions**

# Wrap up

- Estimation framework: Partial identification
  - Establishing the boundaries of what the data reveals
- Vocal about identification problems in ILSA context
  - Assumptions matter
- Unit nonresponse

# Thank you ☺

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