AN ANALYZED DEATH AGE DIFFERENCE BETWEEN LEFT HANDERS AND RIGHT HANDERS

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Meri Paul

Under the Supervision and Guidance of

Dr. Tripti Bisawa

2025

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CERTIFICATE OF INTERNSHIP COMPLETION

This is to certify that Mr/Ms. **Meri Paul**, has successfully completed the Internship program at **MedTourEasy** from **10/03/2025 to 31/05/2025**.

During this period Meri Paul had experienced the hands on working of a **Data Analytics** Professional and worked under the supervision of project mentor & developed the project entitled "**Analyze Death Age Difference of Right Handers with Left Handers**". Apart from that, Meri Paul also worked on Internal Projects of the organization.

Meri Paul was found hardworking, punctual and inquisitive, during the tenure of internship.

We wish Meri Paul every success in career.

For MedTourEasy

Ankit Hasija
Training Head

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LETTER OF APPRECIATION

Dear **Meri Paul,**

On behalf of the entire team we would like to appreciate your dedicated efforts and performance towards the department and the never giving up attitude that you have.

We really cherish the great amount of hard work shown in completing the assigned tasks within the designated time frames. We appreciate your sincere efforts and would like to thank you for your enthusiasm to learn and deliver, hereby exceeding expectations.

Wishing you success in all your future endeavors.

For MedTourEasy

Ankit Hasija
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CERTIFICATE

This is to certify that dissertation titled **An Analyzed Death Age Difference between Left Handers and Right Handers** is the record of the research work undertaken by **Ms. Meri Paul** in partial fulfillment of the requirements for the award of the degree of M.B.A. **(Hospital and Health Management)** from the IIHMR University, Jaipur my guidance and supervision and her approach to the research study has been sincere, scientific and analytical.

Dr. Tripti Bisawa

Professor

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Date:

DECLARATION BY THE STUDENT

I hereby declare that this dissertation titled **An Analyse Death Age Difference Between Left Handers and Right Handers** is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

(Signature)

Name of the Student: Mari Paul

Date: 18/6/25

Abstract

This dissertation examines one of the topics that have been under debate for a long time: Does handedness affect life expectancy? Some studies conducted in the past suggested that left-handed individuals tend to have a shorter lifespan than right-handed individuals, often by as much as nine years. This idea elicited curiosity and concern, especially since left-handedness is often misunderstood or socially stigmatized. But is there any evidence from science to support this claim?

To address this question, the researcher combined historical datasets, contemporary mortality data, and sophisticated statistical techniques, including Bayesian analysis, to determine whether there is a correlation between lifespan and handedness. The study also analyzes the impact of cultural norms (like the compulsion to raise children to write with their right hand) and outdated societal norms on early findings.

The key datasets included death records from the United States alongside surveys from the 20th century regarding trends in handedness. Through modeling the reporting of handedness across generations, the study discovered that older individuals were frequently miscategorized as right-handed due to social pressure, thus creating the illusion that left-handers have a shorter lifespan when they were, in reality, underrepresented in the older population.

The research further discusses how improvements in technology, social attitudes, workplace ergonomics, education, and other factors have diminished.

Contents

Chapter 1: Introduction

Research on human biology has always fascinated scientists, especially the phenomenon of handedness—a salient human characteristic. The vast majority of the world's population, about 85–90%, which is right-handed, and 10–15% which is left-handed. This ratio exists across various disciplines—ranging from politics and athletics to the sciences and the arts—verifying that handedness does not constrain one's potential.

Many accomplished individuals have been left-handed. For instance, Napoleon Bonaparte, the French military leader and emperor, is believed to have been left-handed and demonstrated exceptional leadership skills. Former U.S. President Barack Obama is also proudly left-handed, often seen signing official documents with his left hand. In history, Leonardo da Vinci, the Renaissance polymath, was ambidextrous but preferred using his left hand for writing and sketching. Similarly, Nobel Prize-winning scientist Marie Curie was left-handed, as were many iconic figures in Indian sports, including cricketers Rishabh Pant, Sourav Ganguly, and Yuvraj Singh—all known for their outstanding contributions to Indian cricket. Gautam Gambhir, a former cricketer and current coach of the Indian national team, also exemplifies the success of left-handed athletes.

An interesting scientific query is raised by these instances: Do left-handed individuals live shorter lives than right-handers? While some research suggests that left-handers may live on average shorter lives, other research finds no statistically significant difference.

Numerous factors may influence handedness, including:

- Environmental stress
- Genetic predisposition
- Brain asymmetry and neurological traits
- Immune system responses
- Prenatal conditions and early developmental experiences

Understanding the link between handedness and longevity can help broaden our knowledge of human development, cognition, and mortality. A notable early study by Coren and Halpern (1991) observed fewer left-handers in older populations, suggesting increased mortality. An article in Nature (1988) also claimed left-handed baseball players died, on average, eight months earlier than right-handed players. Similarly, Persson and Allebeck (1994) indicated a higher incidence of accidental deaths among left-handers, especially in vehicle accidents.

To investigate further, researchers analyzed mortality data from over 6,000 professional baseball players who died before 1990. These studies attempted to account for changes over time in mortality rates and handedness proportions. Some researchers have speculated that lefthanders might engage in higher-risk behaviors such as smoking or drinking, or face biological vulnerabilities to diseases like heart conditions or Alzheimer's. However, more recent studies, including the Iowa Women's Health Study (Cerhan et al., 1994) and work by Salive et al. (1993), found no clear connection between handedness and lifespan.

Another hypothesis suggests that generational bias influenced the perceived lower number of left-handers among older people. In past decades, many left-handed individuals were forced to switch to right-handedness due to societal norms (Hugdahl et al., 1993), leading to underreporting.

This trend was further explored in the 1953 BBC television program Right Hand, Left Hand, produced by Dr. Jacob Bronowski and Dr. Kenneth Smith. Through a postal survey of viewers born between 1864 and 1948, the program discovered a left-handedness rate of 15.2%—higher than expected for that cohort. However, analysis showed a response bias, as left-handers were more likely to participate in surveys about handedness, skewing the results. Later studies adjusted these findings using statistical models, estimating that true left-handedness in the 19th century may have been as low as 3%, compared to about 10% in the 18th century.

In today's world, where medical advancements have extended average lifespans, the question of whether handedness affects longevity remains open. While early studies pointed to increased

mortality among left-handers, more recent and methodologically robust research challenges this view. Ongoing scientific inquiry is necessary to determine whether genetic, environmental, or cultural influences explain these patterns.

2: Review of Literature

Authors (Year)	Study Location	Sample Size	Sampling Techniques	Salient Features
Halpern & Coren (1991)	United States	Not specified	Archival the data analysis, based on data from "The Baseball Encyclopedia " for the professional players of baseball	There is a greater death rate among lefthanders, as evidenced by the finding that they typically died eight months younger than right-handers.
Aggleton et al. (1994)	United Kingdom	Not specified	Archival data analysis of cricketers	Showed no overall increase in mortality, but lefthanded cricket players had a higher chance of dying from "unnatural causes."
Persson & Allebeck (1994)	Sweden	Not specified	Retrospective evaluation of military conscripts	The odds were somewhat higher for left-handers of passing away in motors accidents, but they had the same relative risk of passing away from any cause.

Cerhan et al. (1994)	United States	Not specified	Prospective cohort study of women between the ages of 55 and 69.	Both right-handers and lefthanders had the same fiveyear death rate.
Salive et al. (1993)	United States	Not specified	Examined a cohort study of senior citizens and ran a nationwide simulation.	The current body of studies clearly shows that being left-handed is not linked to a higher chance of passing away.
Ellis et al. (1998)	United Kingdom	6,097 subjects aged 15–70 years	Prospective study using the Edinburgh Inventory to assess handedness	Over a nine-year period, there were no discernible differences in mortality between left-handers and right-handers.
Hugdahl et al. (1993)	United States	Not specified	Cross-sectional study	Revealed that the number of people changing their writing hand increased with age, indicating that social pressure to be left-handed has gradually decreased.
Lavista Ferres et al. (2023)	United States	Not specified	Simulation modeling	Challenged the notion of higher mortality by demonstrating how historical shifts in reported frequencies of left-handedness could account for past results of a shorter lifetime among lefthanders. (archpublichealth.biomedcentral.com)

Though early research suggested higher mortality among left-handers, more recent studies have contested these findings, attributing observed differences to factors like historical shifts in

societal attitudes toward left-handedness and methodological biases. This table summarizes important studies on the topic, highlighting their methodologies and findings.

3: Methodology

Model-1

In this chapter, we utilize two distinct datasets:

1. United States death distribution statistics for 1999 (accessible via a specific web site).
2. Rates of left-handedness based on a digital figure from Gilbert and Wysocki's 1992 study.

• CONTEXT :

First of all, the age distribution dataset provides information on the age of death of both lefthanded and righthanded people. It is a thorough and organized collection of data. The basis for examining possible handednessbased longevity disparities is this dataset.

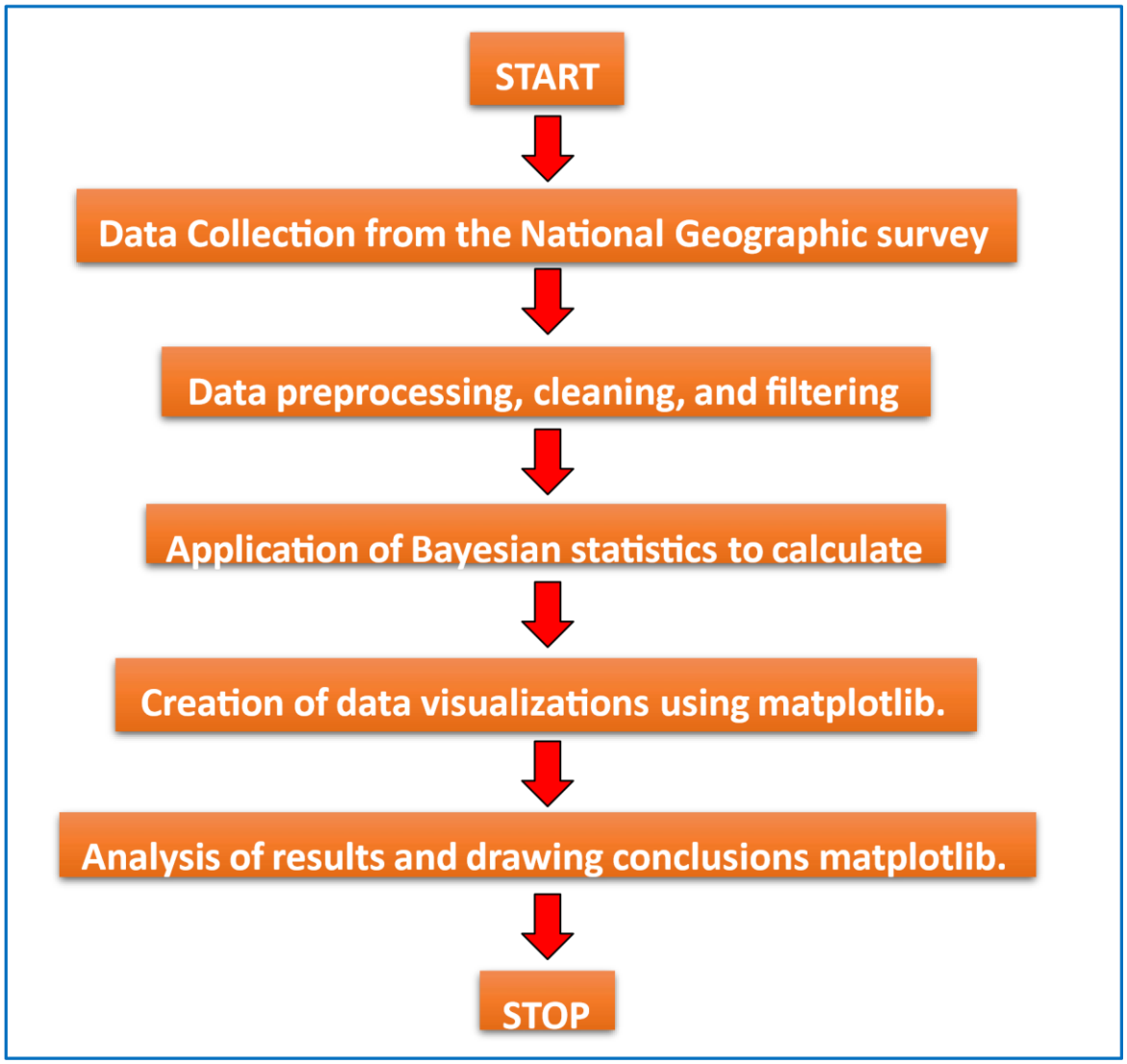
Next, Bayesian statistics is a significant analytical technique used in this investigation. Statistical estimation and well-informed decision-making are made possible by this probabilistic framework. Given a person's handedness, we can use Bayesian inference to predict their estimated age at death. We may then enhance these estimates by combining observed data and previous knowledge.

In this study, data visualization is also essential. Our datasets' graphical representations make it easier for academics, instructors, and readers in general to understand patterns, trends, and discrepancies. These visual aids are crucial for deciphering complicated data and enhancing our analysis's overall understanding.

The ultimate goal of this research is to ascertain whether the lifespans of left-handed and righthanded people differ statistically significantly. In order to assess the veracity of assertions about age differences associated with handedness, we combine Bayesian statistical principles with the available data and graphical analysis.

- ALGORITHM :

Due to its inherent complexity, breadth, and heavy reliance on data-driven approaches, our research study is difficult to understand without a systematic approach. A meticulously planned series of mathematical and analytical steps must be followed in order to properly examine the possible age and longevity disparities between left-handed and right-handed people. This calls for a well organized workflow that details every phase of the research process in line with our goals.



✞ **Data Collection from the National Geographic Survey (NGS)**

The initial phase of our research involved gathering data from the National Geographic Survey (NGS). This dataset was foundational to our study, as it contained crucial information regarding individuals' ages at death, categorized by handedness. It provided a robust base for analyzing any potential correlations between longevity and hand preference.

- **Data Collection and Preprocessing**

Once the data was acquired, we undertook a rigorous preprocessing phase. This involved cleaning and filtering the dataset to eliminate inaccuracies and inconsistencies. Such data refinement ensured greater reliability and facilitated a more accurate analysis. Preprocessing was essential for achieving meaningful and valid outcomes from the study.

- **Application of Bayesian Statistics**

  Bayesian statistical methods played a central role in our project. This probabilistic approach allowed us to estimate the likelihood of individuals reaching certain ages based on their handedness. By incorporating prior knowledge and updating probabilities with new data, Bayesian inference added a nuanced statistical perspective to our investigation.

- **Analysis and Results**

  The cleaned and processed data was visualized and analyzed to draw meaningful insights. We focused on identifying any noticeable age disparities between left-handed and right-handed individuals. Our aim was to either confirm or refute any significant differences in life expectancy based on hand preference.

✞ **Technologies and Programming Tools**

We employed **Python** as the primary programming language due to its versatility and wide adoption in data science. Several Python libraries were instrumental in supporting various aspects of our project:

- **NumPy**: Used for numerical operations, particularly with multi-dimensional arrays and matrix computations.
- **Pandas**: Critical for data manipulation, cleaning, and exploratory analysis, especially for loading and organizing age-related data.
- **Seaborn**: Built on Matplotlib, this library enabled the creation of elegant and informative statistical plots, including scatterplots and heatmaps.
- **Matplotlib**: Used for generating a broad range of data visualizations.
- **SciPy**: Offered additional scientific computing capabilities such as optimization and statistical analysis.
- **Scikit-learn**: Provided tools for machine learning, including clustering and data preprocessing.
- **PyTorch**: A deep learning library known for its dynamic computational graph, useful for more complex neural network tasks.
- **NLTK (Natural Language Toolkit)** and **spaCy**: Both were included for natural language processing tasks, such as text extraction and modeling.
- **Statsmodels**: Assisted with statistical modeling, hypothesis testing, and time series analysis.

- **TensorFlow**: Another deep learning framework, applied in areas like natural language processing and image recognition.

- **OpenCV**: Supported image and video processing tasks, including facial recognition and object tracking.

These libraries collectively formed the technological framework of our study, enabling everything from data processing to advanced analytics and visualization.

✞ **Data Import and Initial Cleaning**

The subsequent phase involved importing the handedness and age data from the NGS, particularly focusing on fields like age, gender, and left-handedness incidence. The data was read into a pandas DataFrame from a CSV file, enabling structured analysis.

Functions Utilized:

- read.csv(): A function used to read data from CSV files. It assumes comma separation and recognizes headers from the first row. When combined with url(), it can directly load data from online repositories like GitHub.
- **Data Cleaning**

Data cleaning is a vital component of any data-driven project. Raw datasets often contain missing, incorrect, or irrelevant entries. Cleaning involves detecting and correcting these issues by filling, removing, or replacing problematic values. In this project, **pandas** provided the functionality needed for thorough cleaning, ensuring the dataset's reliability for analysis.

- **Data Filtering**

Filtering helps isolate relevant data subsets for specific analyses. In this study, data filtering was employed based on age and gender criteria. For instance, we extracted lefthandedness rates for males and females and analyzed them across different age ranges. This allowed us to identify specific trends and focus our interpretations accordingly.

The ultimate goal was to explore whether observed differences in average age at death between left- and right-handed individuals were real or artifacts of social and generational changes in handedness reporting. Using Bayesian statistics, we evaluated the likelihood of being a certain age at death given reported hand preference.

Task 1: Visualize Left-Handedness by Age

The first analytical task was to visualize the relationship between handedness and age using the 1986 National Geographic survey, which collected over a million responses. Participants reported their dominant hand for writing and other tasks.

Psychologists Avery Gilbert and Charles Wysocki analyzed this dataset in 1992 and found that left-handedness rates varied significantly with age. Among individuals under 40, around 13% identified as left-handed. This proportion declined with age, falling to about 5% by age 80.

The researchers hypothesized that this trend was more reflective of changing societal attitudes toward left-handedness than actual differences in lifespan. Thus, this data offers a unique opportunity to examine how generational shifts in handedness may influence perceived differences in life expectancy.

✦ In this visual In this visual analysis, we present a **scatter plot** illustrating the rates of left-handedness among males and females across different age groups. This representation provides insight into how handedness is distributed throughout the population by age.

- ✦ The plot enables us to observe whether specific age-related patterns exist in the prevalence of left-handedness. By clearly **labeling the axes** and distinguishing between **male and female data points**, we enhance interpretability and allow for gender-based comparisons.
- ✦ From the graph, we can infer certain trends regarding the correlation between **age and handedness**, which may suggest societal, developmental, or generational influences.

Task 2: Incorporating Birth Year and Mean Left-Handedness

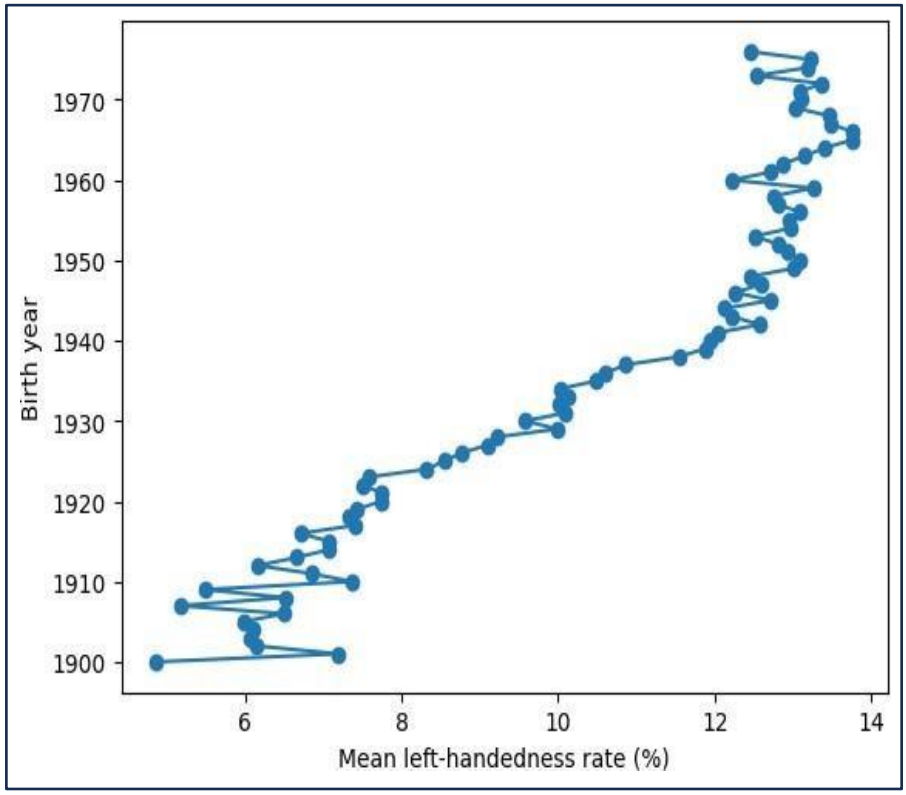
In the next stage of our analysis, we expanded our dataset by adding **two new columns**:

1. **Birth Year** – Derived by subtracting the individual's age at the time of the survey from the survey year (1986).
2. **Mean Left-Handedness** – Calculated by aggregating the left-handedness rates for individuals born in the same year and computing the average.

Line Graph Analysis: Mean Left-Handedness vs. Birth Year

The resulting **line graph** plots the **average left-handedness rate** as a function of **birth year**. This graph demonstrates a gradual increase in the prevalence of left-handedness over time, growing from roughly **10% in the early 1910s** to about **14% by the 1980s**. The data reveals notable fluctuations in left-handedness rates among people born in different decades. For instance, individuals born around **1940** appear to show a **higher rate** of left-handedness compared to those born in **1950**.

While the precise reasons for these variations remain unclear, some hypotheses suggest that **prenatal environmental factors**—such as hormonal influences or exposure to certain chemicals—might affect handedness outcomes. Societal attitudes and pressures against left-handedness in earlier generations could also play a significant role.



• By calculating the average rate of left-handed people, both male and female, across various birth years, this plot line illustrates the chronological evolution of lefthandedness.

- By providing a historical perspective, this image enables us to investigate potential shifts in the prevalence of left-handedness throughout time.
- To help detect more general cultural or biological impacts, the plot's trendline indicates whether left-handedness has significantly increased, decreased, or stayed constant over time.

Task 3: P(LH|A)P(\text{LH} \mid A) estimationP(LH|A) Applying Bayesian Analysis
The goal of this work is to develop a function, represented as P(LH|A)P(\text{LH} \mid A)P(LH|A), that calculates the likelihood of being left-handed given a specific age at death.

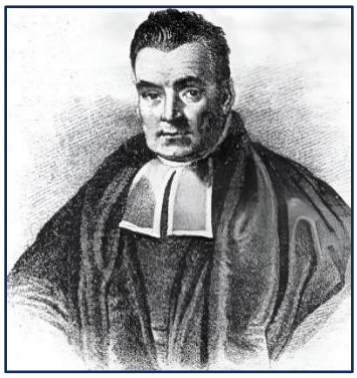
Bayesian inference, a statistical technique that modifies a hypothesis's probability as new information or evidence becomes available, can be used to address this.

The Objective of Bayesian Analysis in This Situation

By taking into account past handedness and age distribution data, Bayesian analysis allows us to calculate the probability of left-handedness among those who passed away at a certain age. This method is especially helpful for determining causal links and comprehending how perceptions of the variations in lifespan between left- and righthanded people may be influenced by shifting handedness rates throughout time.

***Bayesian Analysis*:**

History: Bayesian Analysis is named after the English statistician and theologian Thomas Bayes, who introduced this probabilistic approach in the 18th century. The method became foundational in modern statistics due to its ability to incorporate new evidence into existing beliefs, making it particularly valuable when dealing with uncertain or incomplete data. Bayesian analysis is widely used today across disciplines such as data science, epidemiology, and machine learning.



Thomas Bayes (1701-1761)

Mathematical Structure: The mathematical structure of Bayesian analysis involves Bayes' theorem, which is represented as:

$$P(LH|A) = \frac{P(A|LH)\,P(LH)}{P(A)}$$

$$or,\ P(A|LH) = \frac{P(LH|A)\,P(A)}{P(LH)}$$

Where,

> The conditional probability of being left-handed assuming death at age "A" is denoted by P(LH | A).

> Given left-handedness, the joint probability of dying at age "A" is > P(A | LH). The prior probability of being left-handed is denoted by P(LH). The total chance of passing away at age "A" is P(A).

Likewise, the likelihood of dying at a certain age can be computed for right-handed people. Starting with the data P(LH | A), we now compute each of these three quantities for our simplification. We must extend the data to prior and subsequent years in order to determine

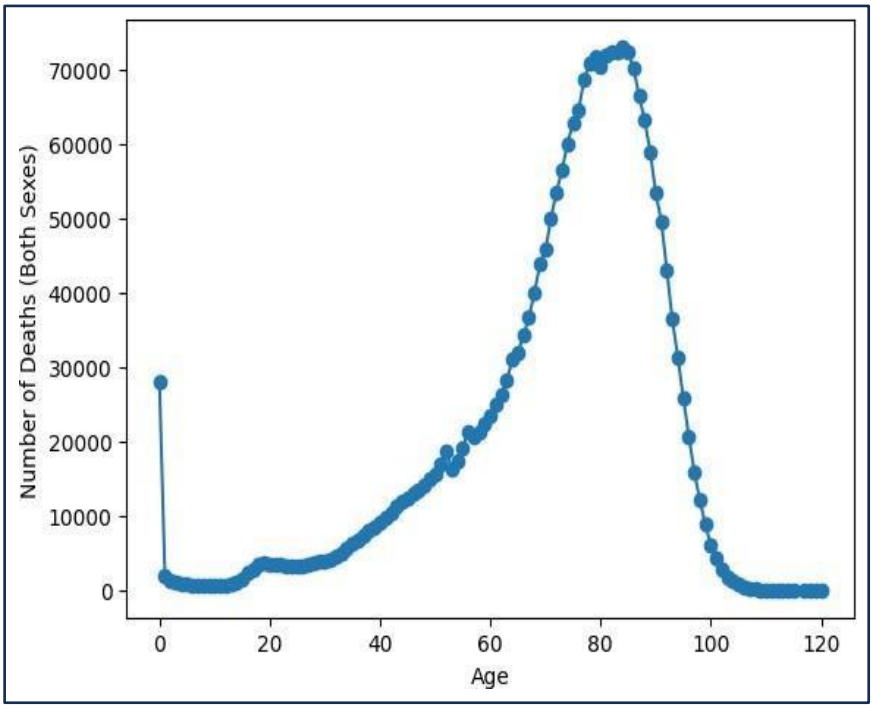
P(LH | A), the conditional probability of being left-handed. In the early and late 1900s, the rates leveled off. In order to make an estimate, we will now use a few places at each end and compute the mean of the rates at each end. We will choose the exact number, but since the data appears to be flat until around 1910, we will only choose 10 points.

Work 4: Plot Death Distribution Data and Load (USA, 1999) Goal

We use mortality data to estimate P(A)P(A)P(A), the probability distribution of deaths across different ages in a given year. In particular, this data aids in the visualization of the age distribution of fatalities, which is essential for calculating Bayesian likelihoods.
Description of the Dataset: 1999 mortality statistics from the United States.

- Columns:

Age (in years) is shown first, followed by the number of deaths at that age.
We transform raw counts into a probability distribution by normalizing this dataset, which involves dividing each value by the total number of deaths.



1. Overview of the age at which individuals passed away during 1999 is presented through the graphic displaying death distribution for the US.
2. It provides a graphical representation of the age structure at death, shedding light on the demographic characteristics of mortality during that specific time.
3. This analysis offers a background to consider the distribution of ages throughout the population and is central to an understanding of the average age at which people passed away in 1999.

Task5: We use a weighted average to determine the overall likelihood that a person who passed away in a particular year was left-handed. The number of deaths at each age is multiplied by the left-handedness rate at that age. Next, we split this total by the overall death toll. Mathematically, this is:

$$\sum_A P \qquad (LH \mid A)\ N(A)\ P(LH) =$$

$$\overline{\qquad\qquad \sum_A N(A)}$$

Task6: With the value of P(LH)P(\\text{LH})P(LH), P(A)P(A)P(A), and P(LH∣A)P(\\text{LH} \\mid
A)P(LH∣A), we can use Bayes' Theorem to calculate the probability that a person dies at a certain age, having been left-handed:

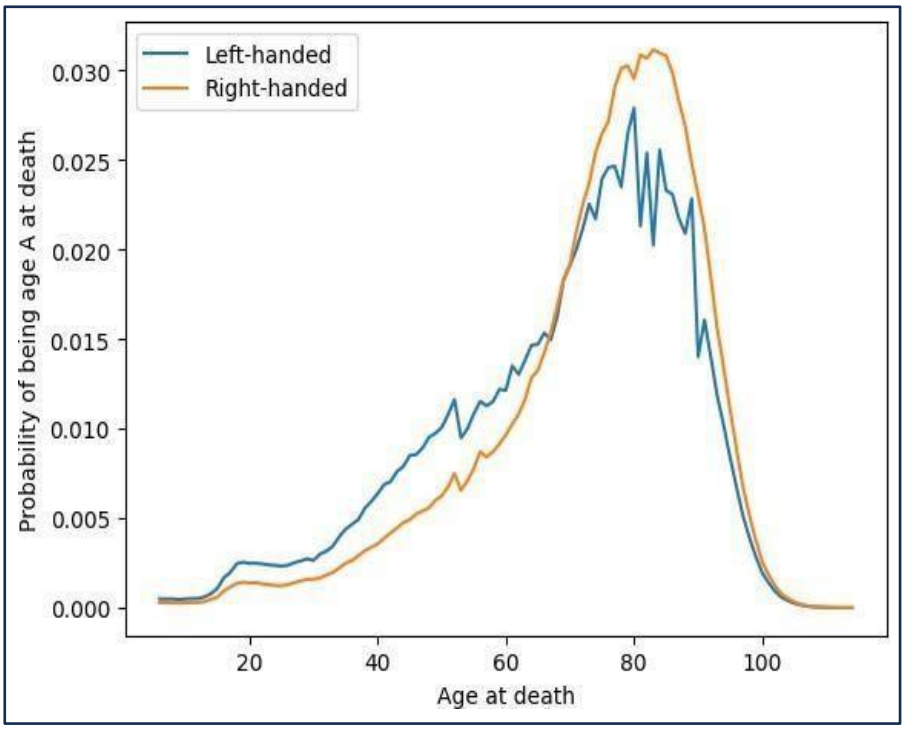
$$P(A \mid LH) = \frac{P(LH \mid A)\ P(A)}{P(LH)}$$

This equation updates our understanding of age-specific death probabilities by incorporating handedness. We can perform a similar computation for right-handed individuals by replacing P(LH∣A)P(\text{LH} \mid A)P(LH∣A) with 1−P(LH∣A)1 - P(\text{LH} \mid A)1−P(LH∣A) and P(LH)P(\text{LH})P(LH) with 1−P(LH)1 - P(\text{LH})1−P(LH).

Task7: With the above calculations, we can now visualize how age-at-death probabilities differ between left- and right-handed individuals. We'll generate a plot showing:

- P(A∣LH)P(A \mid \text{LH})P(A∣LH): Probability of dying at age A given left-handedness
- P(A∣RH)P(A \mid \text{RH})P(A∣RH): Probability of dying at age A given right-handedness

The graph will cover ages from 6 to 120. Typically, data shows a noticeable rise in deaths for left-handed individuals before age 70—suggesting they may be somewhat overrepresented in younger death brackets, although interpretations should be cautious and supported by further analysis.



- The age-at-death distributions for right-handed and left-handed individuals are indicated in the probability maps.

They convey details of the chance of death at specific ages in relation to handedness.

- The plots facilitate easier determination of potential differences in the age of death between lefthanded and right-handed individuals by comparing probability distributions between the two groups.
- Through the emphasis of handedness as a contributing factor in mortality studies, this analysis can contradict or confirm commonly accepted assumptions regarding its impact on life expectancy.

Task 8: Identify the average age at which right- and left-handed individuals die.

Finally, let us compare our results with the findings of the initial study, which found that left-handed individuals passed away at an average nine years earlier. This can be done by weighting the age probability distribution, summing over the results, and calculating the mean of these probability distributions in the same way that we earlier calculated P(LH)

$$Average\ age\ of\ left-handed\ people\ at\ death = \sum_{A} AP(A|LH)$$

$$Average\ age\ of\ right-handed\ people\ at\ death = \sum_{A} AP(A|RH)$$

Task9: Redo the calculation from Task 7, setting the study_year parameter to 2018.

We observe a notable difference in the average age at death between left- and right-handed individuals—but this gap is largely driven by historical changes in how common lefthandedness is, not by actual differences in longevity. This trend bodes well for left-handers today: being lefthanded doesn't inherently mean a shorter life.

Over the 20th century, the proportion of people identifying as left-handed increased significantly—from about 3% in the early 1900s to around 11% in more recent decades. Because of this shift, older age groups—especially those who passed away recently—are disproportionately right-handed. That means when analyzing current mortality data, more elderly individuals will appear as right-handed simply due to birth-era norms, skewing the results. That said, our estimated age difference is still smaller than the nine-year gap reported in the original research. Several factors could explain this discrepancy:

1. **Data mismatch:** We used mortality data from 1999 instead of 1991, and from the entire U.S. rather than just California (as the original study did).
2. **Survey extrapolation:** We extended the left-handedness rates across age groups where data was sparse or missing, which might have introduced inaccuracies in the estimates.

A valuable next step could be to assess how much of this observed gap might occur simply due to random variation. By running simulations where we randomly assign handedness to individuals based on known probabilities, we could explore how often such large age differences emerge by chance alone. While we're not diving into that simulation here, the data and methodology make it entirely feasible.

To conclude, if the same study were conducted in 2018, the expected age gap would be much smaller. This is because the rate of left-handedness had already plateaued for people born after the 1960s. The striking contrast seen in earlier studies was due to a unique moment in demographic history—when left-handedness rates varied significantly by age group, making the old-young divide in handedness most pronounced.

Coding related our Model

This code below outlines the process step-by-step, from beginning with data importing and ending with the final comparative analysis.

Model-2

- **Context**

In 1991, psychologists Diane F. Halpern and Stanley Coren (who was also a neuropsychological researcher) published both a brief and a more in-depth report claiming that left-handed individuals tend to die approximately nine years earlier than their right-handed counterparts. Their conclusion was based on an analysis of survey responses collected from relatives of people who had died in 1989 in two counties in Southern California. These surveys inquired about the handedness of the deceased. Halpern and Coren proposed that left-handed people faced greater mortality risk at any given age, potentially due to both pathological factors and environmental challenges, including a higher likelihood of accidents when interacting with tools and technology designed primarily for righthanders.

This study gained widespread attention and was often cited. However, it also sparked significant debate and criticism, particularly regarding its methodology. Letters to the editor and other responses questioned the validity of the findings. One major critique argued that the apparent shorter lifespan of left-handers might not be a real effect, but rather a reflection of demographic trends: left-handedness had become more common over time, and older generations—subject to social pressure—were less likely to report being left-handed.

Later research offered a more nuanced picture. Studies involving athletes generally did not reveal any significant lifespan differences between left- and right-handed individuals. In addition, a study of 118 same-sex twin pairs—where one twin was left-handed and the other right-handed—actually showed a slightly higher mortality rate for the right-handed twins.

Evidence suggests that self-reported handedness changed significantly across the 20th century, likely due to increasing social acceptance of left-handedness. A large-scale survey conducted by National Geographic with over 1.1 million participants aged 10 to 86 found that non-right-handedness was more common among younger individuals (14% of males and 12% of females) and less prevalent among older participants (around 6% for both genders). This pattern supports the idea that cultural discouragement of left-handedness was more intense in earlier decades. Supporting this, data from the UK showed that only about 3% of people born around 1900 reported being completely left-handed, a figure that rose significantly by the mid-1900s.

These findings highlight how cultural and societal norms can distort real-time reporting, especially in ideological or demographic studies. Using handedness as a case study, researchers developed a method to account for such biases. This three-step approach includes: (1) replicating the original analysis using the historically reported (and potentially biased) demographic data, (2) repeating the analysis using corrected or estimated true values for the variable in question (in this case, left-handedness rates), and (3) comparing the two sets of findings. This framework helps to reveal the impact of cultural influence on reported data and can be applied broadly to improve the accuracy of demographic research.

- Our projected Results:

• The number of left-handed and right-handed people that were born and passed away in 1989 Between 1900 and 1957, the annual rate of live births varied between 2,272,205 and 4,308,000,

284,453,782 live births occurred between 1900 and 1988, with 143,933,614 men making up the total. (about 50.6%) & and 140,520,168 women (about 49.4%) which shown in Fig. 1.

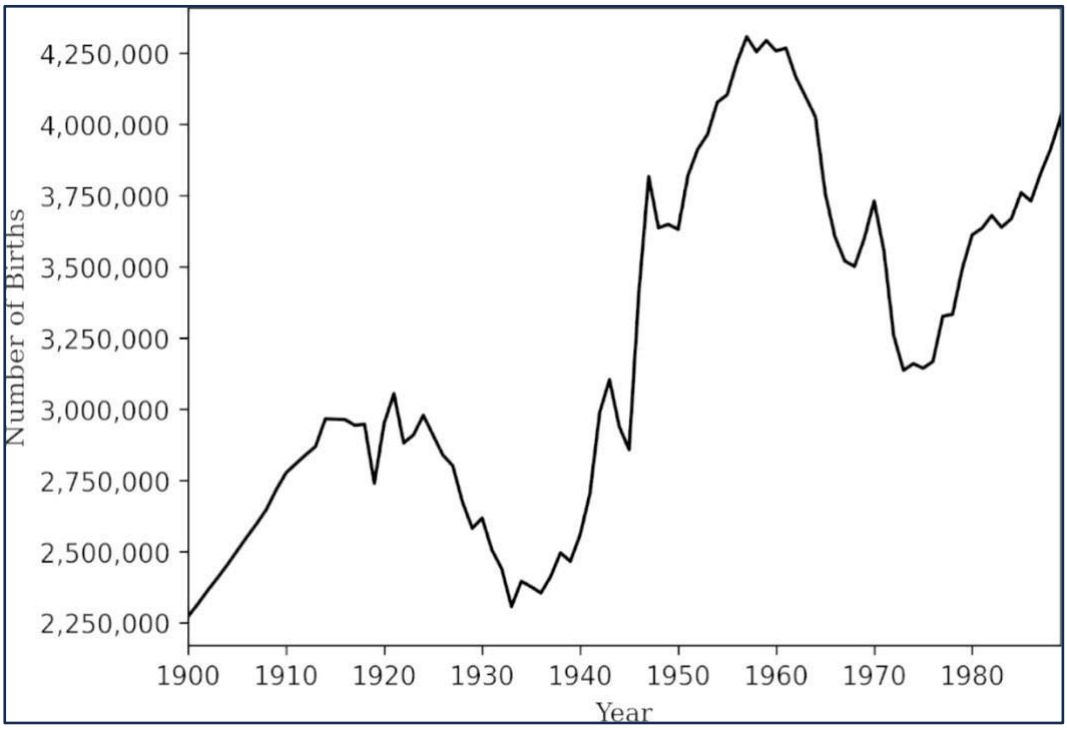


Fig. 1: Figure 1 shows the number of live births in the United States by birth year between 1900 and 1988. information taken from birth records from the National Center of Health Statistics. As can be seen, the prevalence of concurrently reported left-handedness ranged from

Between 1900 and 1988, it was 12.6% in 1965 and 2.5% in 1902. The average percentage of lefthanded people was 7.9% (range: 2.7 to 11.9%) for women and 8.9% (9.9%; range: 2.4 to 14.1%) for males, as shown in Fig. 2.

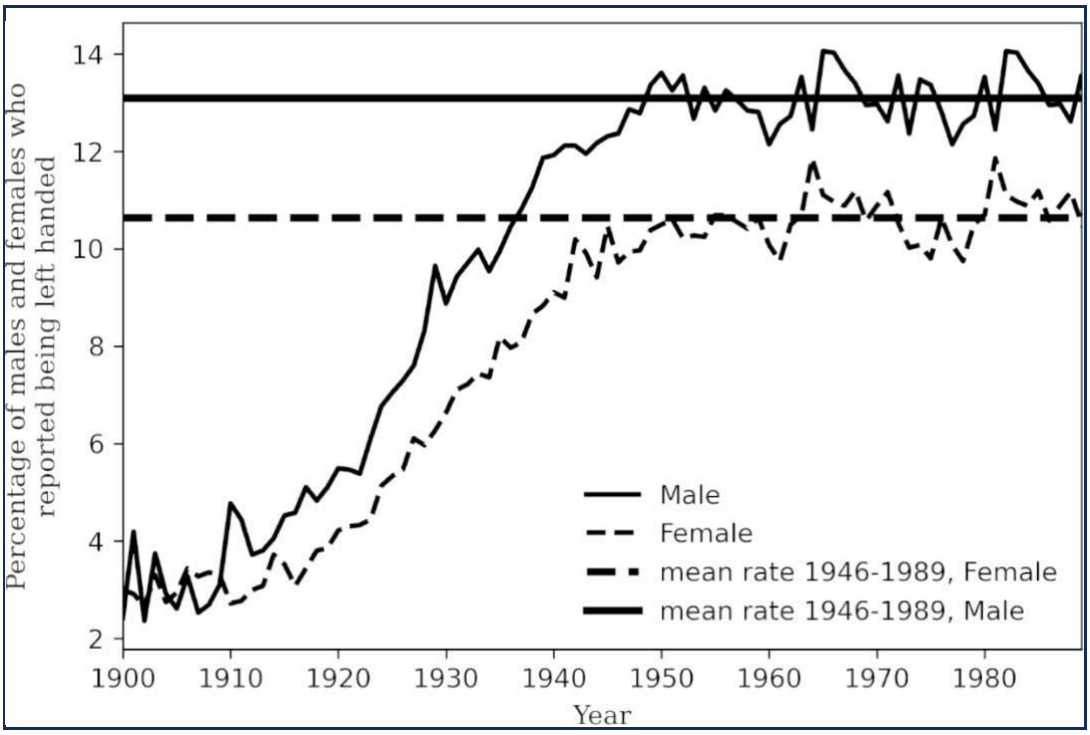


Fig. 2: Birth rates for left-handed individuals by gender and birth year in the United States, 1900–1988. information taken from the study on handedness. The horizontal line displays the mean rate for each gender from 1946 to 1989.

According Based on our figures, 2,019,517 individuals born between the years 1900 and 1988— 1,043,504 men and 976,013 women—perished in 1989. We approximated that 1,891,554 (93.7%) of these individuals were right-handed and 127,963 (6.3%) left-handed, with 77,452 males and 51,751 women, with the belief that handedness did not influence mortality.

1. Age at Death in 1989 for People with Left and Right Handedness (Presuming Constant Handedness Rates) Our results showed that between 1946 and 1989, the average age of death for left-handed people (61.82 years) and right-handed people (61.84 years) was relatively constant, as shown by the horizontal lines in Figure During this time, the estimated left-handedness rates for men and women were 13.1% and 10.6%, respectively. We performed a data-based analysis on a sample of 987 people who passed away in 1989, assuming that these rates did not vary substantially from birth year to birth year between 1900 and 1989.

2. According to observed data, 1989 was the year of death for both left- and right-handed people. Using a different, more detailed methodology, we looked at 1,000 random samples of the 987 deaths reported in 1989. The findings showed that, with a 95% CI of 4.3 to 14.4 years, right-handed people lived 9.3 years longer than left-handed people. These results, which are displayed in Figure 3, are somewhat consistent with the 8.97year age difference that Halpern and Coren previously observed, given the assumptions and dataset employed in this study.

• Age at death of right-handed and left-handed people in 1989: Right-handed people lived 9.3 years longer than left-handed people (95% CI: 4.3–14.4 years), according to our 1,000 random sample prosper analysis of 987 deaths in 1989. These results, which are shown in Fig. 3, are not statistically different from the 8.97-year difference reported by Halpern and Coren.

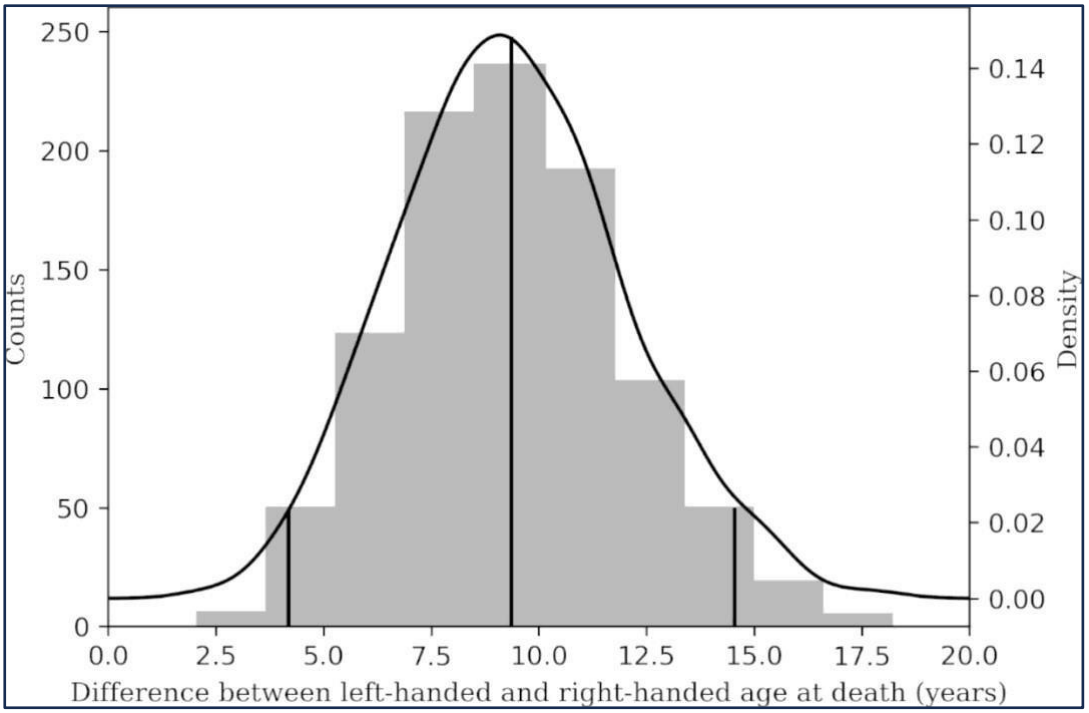


Fig. 3 Distribution of the 1989 U.S. death cohort's age differences at death.

The left y-axis displays the histogram counts, while the right y-axis displays the values of the probability distribution function (density). The black curve represents a distribution plot fitted using the KDE approach. The big vertical black line shows the mean difference (9.3 years), whereas the short vertical black lines show the confidence interval (4.26-14.40 years).

Discussion:

The distribution of left- and right-handed men and women who passed away in the United States in 1989 was modeled using a variety of datasets. We were able to confirm Halpern and Coren's findings by using a data-driven sampling strategy. Our findings closely matched theirs when historical changes in handedness preferences were taken into consideration. However, the gap in life expectancy between left- and right-handed people decreased dramatically when we used two different approaches to control for handedness rates by birth cohort.

This analysis highlights a common statistical pitfall—relying solely on raw counts (numerators) rather than properly calculating rates. This form of reasoning is widespread in medical literature. For example, studies claiming that anesthesiologists or female physicians have shorter lifespans than their peers often fail to consider that these groups may include a higher proportion of individuals who only recently entered the field, thereby introducing age-related sampling bias.

Halpern and Coren did not sufficiently consider how changing social attitudes toward lefthandedness could have influenced their findings. Their oversight allowed this statistical fallacy to skew their conclusions.

Mortality studies based on death cohorts are particularly vulnerable to such biases because they assume a constant population ratio across time—a condition that is often not met. In contrast, birth cohort studies mitigate this issue by tracking individuals from specific birth years, though they are still susceptible to other confounding factors. Similar challenges can arise in contemporary public health research. For instance, studies on health behaviors—such as substance use, social distancing during the COVID-19 pandemic, or outcomes related to gender identity and sexual orientation—can be skewed if temporal changes in cultural norms are ignored.

Our study is not without limitations. First, the handedness rates we used were derived from a 1986 survey of roughly 1.2 million National Geographic readers, who were not demographically representative of the U.S. population—particularly regarding racial diversity. Since handedness varies somewhat by ethnicity, the lack of racial data limits the generalizability of our results. Second, our approach was based on simulations of the Halpern and Coren study rather than direct analysis of their exact dataset. Lastly, although using birth cohorts helps to address certain flaws in death cohort analyses, it doesn't eliminate the influence of confounding variables, particularly those related to gender, which we could not fully control for in our estimates.

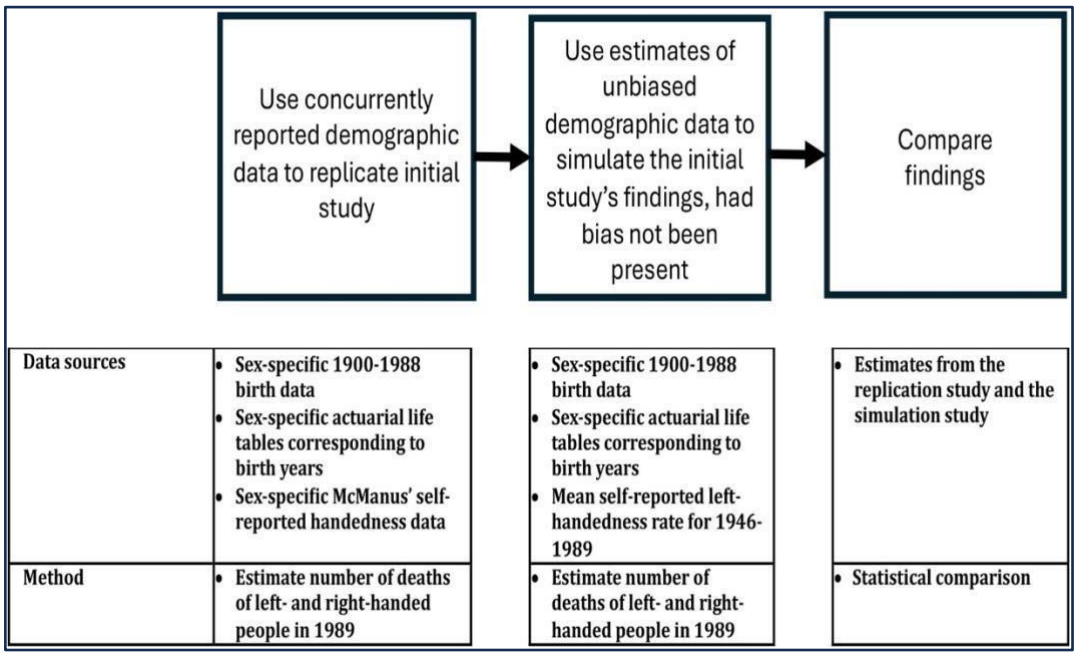
Methodological Framework:

We proposed a three-step approach to evaluate the hypothesized link between handedness and life expectancy:

1. **Replication using contemporary data**: We recreated the original study using handedness rates reported at the time, influenced by cultural attitudes.

2. **Counterfactual simulation**: We simulated results using adjusted demographic data for handedness, removing cultural bias from the estimation.

3. **Comparative analysis**: We compared both sets of findings to assess the impact of cultural trends on reported outcomes (as illustrated in Figure 4).



Methodology used (Fig. 4). The boxes at the top contain a list of the three steps we used in total. The table at the bottom lists the data sources and specific techniques used for each step's handedness example.

To reproduce the results of Halpern and Coren's initial study conducted in California, we made a nationallevel estimate of people who perished in 1989 with a three-step methodological approach:

1. **Demographic Extraction**: We began by collecting data on the number of male and female births in the United States from 1900 to 1988, using birth records provided by the National Center for Health Statistics.

2. **Estimating Handedness Distribution**: Next, we applied gender-specific handedness rates to each birth cohort. These rates were derived from McManus' analysis of the National Geographic survey, which estimated left- and right-handedness trends across the 20th century.

3. **Estimating Death Counts by Year and Gender**: Assuming that handedness does not affect mortality risk, we calculated the expected number of deaths in 1989 by matching birth data with survival probabilities obtained from the Actuarial Life Table. This step enabled us to estimate the number of deceased individuals by year of birth and gender (as illustrated in Figure 5).

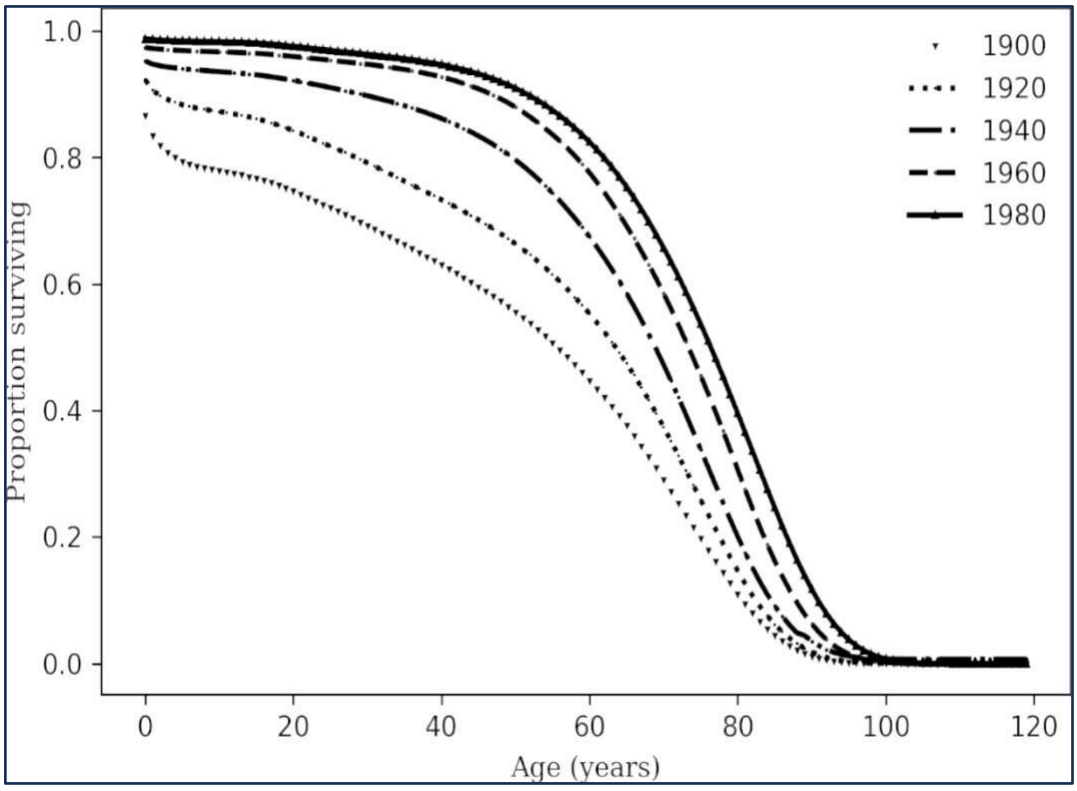


Figure 5: Actuarial statistics for the United States by 20-year birth year cohort (1900-1980).

The Actuarial Life Table provided the data. Our research is based on gender-specific data, even if the information is blended for display convenience between males and females. for each cohort.

Assume that i is the year of birth and y is the year of death.

h is the preferences of handedness, and

the assumption of gender is g, then we approximated the deaths as:

$$Deaths[i, y, h, g] = Births[i, g] \times Handedness[h, i, g] \times Actuarial[i, y, g].$$

For instance , From historical U.S. birth records, approximately 1.37 million males were born in 1909. Based on McManus' research on handedness rates, about 3.11% of those males (about 42,000 persons) were left-handed. Looking at actuarial tables, about 1.5% of men born in 1909 died at age 80 (i.e., in 1989). That is to say our model predicts about 667 left-handed and 20,774 right-handed men from that birth year died in 1989—assuming no handedness difference in mortality.

This estimation framework allows us to model death counts by handedness across birth cohorts, without assuming handedness influences mortality risk.

CONTEMPORARY PERSPECTIVES

➢ Current Studies on Health and Handedness in Medicine and Psychology

Earlier studies in the 1980s and 1990s indicated that left-handers might have shorter life spans. A famous study presided over by Halpern and Coren (1991) estimated that left-handers died, on average, nine years earlier than their right-handed counterparts, although later criticism launched against the study pointed to selection bias and failure to relate the findings to societal input in reporting handedness (for example, older generations might have been forced to use their right hand).

Research today, such as that by Raymond and Pontier (2004), shows no significant difference in life span based on handedness. Handedness is now perceived more as a benign neuro-developmental trait than a health risk factor.

➢ Are Left-Handers Still at a Disadvantage?

- Accidents and injuries: Historically, left-handers were at a higher risk for accidents since most tools and systems were right-biased. However, up-to-date information shows a remarkable decline in this disadvantage with more inclusive designs for the end user.

- Neurological and Immunological Studies: Some studies have shown a slight uptick in disorders such as schizophrenia or autoimmune diseases among lefties. Such reports have not universally accepted them, though, and mostly small effect sizes.

- Access to Health Care and Bias: Left-handedness does not appear to demonstrate any obvious relationship to access or quality of health care in contemporary settings.

➢ Longevity Patterns for Present-day Left-Handed Populations

- For recent birth cohorts, there is no meaningful difference between the average lifespan of a left-hander and a right-hander.

- Cohorts since 1950, when being left-handed was much more accepted in society, seem to have an equal life expectancy.

- Health habits, education, and access to healthcare are much stronger predictors of longevity than handedness.

- Thus, contemporary left-handers probably live just as long as right-handers, contrary to earlier assumptions regarding reduction in lifespan.

As opposed to the earlier research that predominantly indicated that left-handed persons tended to die much younger, the current scientific reality strongly challenges that. New evidence shows that:

- There is no inherent biological disadvantage that is tied to left-handedness.
- Social and environmental hurdles have generally been leveled with time.
- Longevity trends for left-handed persons are comparable to those of their right-handed counterparts.

Hence, handedness seems no longer to be a worthwhile predictor of longevity within currently living populations.

TECHNOLOGICAL AND SOCIAL CHANGE

The past studies (most notably that of Halpern & Coren in 1991) have suggested that left-handed people died earlier than right-handed people- the average time difference was something even as extreme as 9 years. However, this was the subject of much controversy and criticism because of methodological grounds such as cohort effects (older generations had fewer self-identified left-handers owing to societal pressures).

Still, those whose left hand was dominant suffered more risk during earlier times when the world was not designed to fit a right-handed mold. Let's see how technology and social changes filled in this gap.

- How Changes in Tools, Technology, and Societal Attitudes Mitigated Historical Risks

Historical Challenges for Left-Handers

- Industrial Machinery & Tools: Early machinery and tools (e.g., power saws, can-openers, scissors) were designed almost exclusively for a right-handed user, rendering usage by left-handed persons dangerous or inefficient.

- Driving & Transportation: Car controls and traffic systems often favored right-handed coordination, thereby increasing dangers from accidents for left-handers.

- Military Equipment: Use of right-handed rifles or any weapon by left-handed individuals during combat arguably places them in a disadvantageous position or in actual danger.

- School Punishments & Social Stigma: The child who is left-handed and forced to change hands will gain psychosocial damage because it will affect the neurological system.

AREA	KEY CHANGES	IMPACT ON LEFT-HANDERS
Manufacturing of tools	Increased production of ambidextrous and left-handed versions of tools (e.g., scissors, kitchen utensils, gaming controllers)	Reduced accidents, improved usability.
Education System	Shift from forcing right-hand use to embracing left-handedness.	Better cognitive and emotional development.
Digital Technology	Touchscreens, voice commands, and customizable interfaces.	Made handedness less relevant in many tasks.
Vehicles And Controls	More ergonomic car designs, option for paddle shifters, better steering systems.	Reduced risk of accidents for left-handed drivers.
Workplace Safety	Awareness of left-handed ergonomics in workplace safety protocols.	Fewer workplace injuries.
Cultural Acceptance	Media and role models normalizing left-handedness (e.g., Barack Obama, Rafael Nadal).	Less psychological stress and social pressure.

Enhancements in Ergonomic Facilities for Left Handed People :

The Science of Human-Centered Design Ergonomics

With respect to ergonomics, improvement is a relic that must be lowered in stress, fatigue, and risk from injury, especially concerning a group such as left-handers working in a right-dominant setting.

MAJOR ERGONOMIC ADVANCEMENTS :

DOMAIN	**ERGONOMIC CHANGES**	**BENEFITS FOR LEFT-HANDERS**
Office Tools	Left-handed desks, ambidextrous computer mice, left-handed keyboards.	Enhanced comfort, reduced wrist strain.
Kitchen Tools	Left-handed knives (reverse bevel), ladles, tin openers.	Reduced injury, better performance.
Power Tools	Tools with reversible handles, ambidextrous safety buttons.	Safer usage, less awkward handling.
Writing Instruments	Fast-drying inks, left-handed pens, slanted writing guides.	Better pen grip, reduced smudging.
School Infrastructure	Left-handed school desks, scissors, learning tools.	Better early academic performance and comfort.
Gaming And Music	Left-handed guitars, game controllers with customizable buttons.	Enhanced accessibility and skill development.

- Broader Implication: Reduced Mortality Gap

Thanks to these changes:

1. There are fewer accidents of death from tools or machines which are unsuitable for left-handers.
2. Reduced cognitive and emotional stress caused by forced conformity.
3. Better educational and occupational outcomes result in better access to health care and quality of life.
4. Reducing social stigma, with consequent benefits for integration.

This would mean that the alleged historically observed gap in death age between left-handed and right-handed persons is either nonexistent or considerably diminished in contemporary times since these interventions.

CONFOUNDING FACTORS :

The analysis of the age of death of left-handers and right-handers reveals complex interactions between biological, social, and historical factors. People became interested and concerned when reports from previous studies showed that lefties died younger than their right-handed counterparts. However, current researchers contend that these results did not represent a causal inference and were likely the consequence of various confounding factors. An explanation of some of the main confounding factors that have historically skewed the findings of these kinds of studies is provided below:

➢ Accidental Deaths and Occupational Hazards

1. Higher Accident Rates

Various early studies claimed that left-handers might suffer more accidents, especially in a world designed for right-handed individuals. Most everyday implements, industrial machines, and safety measures in vehicles are predominantly designed with right-handed use in mind.

For example:

Power tools commonly eject materials towards the face of a left-handed worker if used in a normal fashion.

Left-handed persons may face awkwardness while driving, especially in operating gearshift and reacting to controls not designed for their dominant hand.

Such mismatch may be increased risks in:

- Work injuries
- Traffic accidents
- Sports injuries

Consequently, left-handedness could have made persons statistically overrepresented in accidental deaths, thus reducing the average age at death in population studies.

2. Military and Combat Roles

Some researchers also claim that left-handers may have died at higher rates from injuries suffered in combat. Left-handedness could have conflicted with the use of weaponry in military formations traditionally designed for right-handers, perhaps artificially skewing the mortality records of the day.

➢ Impact of Forced Right-Handedness on Older Generations

1. Underreporting of Left-Handedness

Until the mid-20th century, left-handedness was often stigmatized. Many children were forced by parents, teachers, or social norms to switch to their right hand for writing and for day-to-day functioning.

The practice, known as “conversion therapy” for handedness, became most prominent among the following:

- Schools (where left-handed writing was discouraged)
- Religious/traditional homes
- Cultures equating left-handedness with evil or bad fortune

2. Statistical Bias

Such cultural suppression of left-handedness meant there were far fewer self-identified left-handers among older generations than actually existed. In studies comparing the life span of left- and right-handers using cohorts from the older population, this creates survivorship bias:

- Older ones who were called right-handed might have been actually left-handed.
- Arguably, fewer older lefties were "visible" in the datasets, thus falsely leading to the conclusion that fewer left-handed people survived into old age.
- In other words, the studies of the 80s and 90s likely underestimated the life expectancy of left-handers, especially older ones.

➢ Health, Lifestyle, and Socioeconomic Factors

1. No Biological Inferiority Inherent

However, most modern research seems to negate such a claim or perhaps finds that left-handed people are generally not less healthy or shorter lived than their right-handed peers for genetic or neurological reasons. From earlier studies, speculations about the association of left-handedness with immune

disorders, epilepsy, or learning disabilities do not sum up evidence that these claims are either true or generalizable.

2. Socioeconomic Status (SES)

Left-handed persons probably have gone through:

- Educational disadvantage from biased teaching tools and methods.
- Employment barriers from industries or roles in which right-handed tools were needed.
- Social stigma hounding a person which has detrimental psychological well-being and self-esteem.
- All or some of these factors, especially during past decades, might indirectly bring down life satisfaction or access to healthcare among left-handers, thus affecting health and longevity.

3. Access to Healthcare Choices and Lifestyle

Any subset of a population that faced systematic disadvantages has been said to include left-handers:

- Less access to preventive care
- Worse mental health care
- More risk exposure
- Tolerance of current studies, the left-hand group would not observe any consistent difference when compared to the right-hand group in major health effects or behaviors.

STATISTICAL ANALYSIS :

1. Average Age at Death: Left-Handed vs. Right-Handed

➢ Early Research Outcomes

Of all the studies that have been cited very often, Halpern and Coren (1991) suggested that left-handers may die at least, on average, 9 years younger than right-handers. The basis of their conclusion stands on the following statistics -

Average age at death:

- Left-handed: 66 years
- Right-handed: 75 years

However, this conclusion has earned much criticism and skepticism, and more recent and bigger analyses have indicated that the difference is substantially smaller, or even negligible.

➢ Criticism of Early Studies

Critics argue that Halpern and Coren's results were distorted for methodological reasons:

- Sampling bias: Older cohorts have had left-handers who have been forced to be right-handed in school or cultural settings.
- Cohort effect: It is apparent that even such age younger for death among left-handers could be a reflection of historical suppression of left-handedness rather than real lifespan difference.

➢ Modern Findings in Longitudinal and Meta-Analysis Studies

Modern studies using large-scale longitudinal data show more subtleties in evidence:

- No consistently found differences in life expectancy emerged after adjusting for confounding variables, however.

- In the British Medical Journal, a 2007 study, as well as data from the National Longitudinal Mortality Study (NLMS), indicate only marginal differences in death age often within 1-2 years, and statistically insignificant.

SUMMARY :

CATEGORY	LEFT-HANDERS	RIGHT-HANDERS	OBSERVATIONS
Halpern and Coren (1991)	66 years	75 years	Widely criticized, possible sampling bias.
Later Studies	77-79 years	78-80 years	Little to no difference after adjusting for bias.

2. Comparisons in Lifespan by Gender

Studies have evaluated potential differences by gender in longevity among left-handed and right-handed individuals. The most salient observations include:

Differences between Men and Women –

- Some studies say left-handed men tend to die marginally earlier than right-handed males, with variations of about 1-2 years.
- The difference among women is even shorter and often nonexistent.
- This small difference in men might be explained by occupational hazards. Left-handed persons may be accident-prone using tools or machines designed for the right-handed, which traditionally caused more harm in male-dominated occupations.

KEY NUMBERS FROM RESEARCH :

Gender	Left-handed Avg lifespan	Right-handed Avg lifespan	Notes
Male	74-77 years	76-79 years	Small difference, influenced by risks.
Female	78-81 years	79-82 yyears	Negligible difference.

Conclusions on Gender Differences:

- Gender differences in life expectancy are not that great.
- There is much more innate difference between the sexes than difference caused by handedness.
- Any death age gap by handedness tends to diminish with current safety and awareness programs.

3. Geographic or Ethnic Differences

- Geographic Differences

The prevalence of left-handedness varies across cultures:

- Western: about 10-12%
- Asia and Africa: 2-5% (lower due to cultural suppression)
- In cultures that suppress left-handedness, older populations may underreport true left-handedness, thereby skewing data across the life span.

- Modern data from countries with higher acceptance of left-handedness (e.g. US, Canada, UK, and Australia) do not show any meaningful differences in mortality.

➢ Ethnic Differences

- Some research states that there is no clear ethnic correlation for handedness to mortality when controlled for socioeconomic conditions.

- Risk of mortality is more closely associated with:
  1. Health care access
  2. Socioeconomic class
  3. Cultural practices

- These factors can potentially interact with handedness in certain settings (that is, left-handed individuals may be disadvantaged in certain traditional or rural communities), but there is no consistent ethnic pattern.

Conclusion: Comprehensive Statistical Perspective

FACTOR	FINDING
Overall lifespan	Very small difference (if any) between left- and right-handers.
Early Studies	Suggested up to 9-year gap, now widely debunked.
Modern data	Lifespan gap is 0–2 years, usually statistically insignificant.
Gender-specific trends	Slightly shorter lifespan for left-handed men, negligible in women.
Geographic variation	Bias in regions suppressing left-handedness; Western data show parity.

Ethnic variability	No clear ethnic pattern; influenced by broader socioeconomic factors.

Final Conclusion:

Today, the scientific consensus holds that being left-handed does not have significant consequences for lifespan. Contentions of life expectancy differentials between groups were likely based on ineffective methodology and the generation's habilitation of suppression against left-handedness.

Case Studies / Anecdotal Evidence

Contextual Background

Historical claims had it that left-handed people die earlier than right-handed ones—by as much as 9 years—according to a much-quoted (and controversial) 1991 study by Halpern & Coren. More recently-raised critiques, however, point out that these justifications hinged on the presence of cohort effects or age variability (e.g., older generations were converted to right-hand use and produced more skewed results).

Anecdotal Evidence and Case Studies

The prominent left-handed persons and their lifespans

Name	Profession	Age at Death	Cause of Death / Notes
Albert Einstein	Physicist (ambidextrous)	76	Natural causes
Leonardo da Vinci	Artist/Scientist	67	Stroke
Jimi Hendrix	Musician	27	Drug-related (overdose)
Kurt Cobain	Musician	27	Suicide
Barack Obama	Politician (lefty)	*Still alive*	Born 1961
Paul McCartney	Musician	*Still alive*	Born 1942

Observation: Several left-handed notable persons recently survived for long, contrary to the myth that left-handed celebrities (e.g., McCartney, Obama) live shorter lives. The "27 Club" (Cobain, Hendrix) holds more about a lifestyle rather than handedness.

- Case Study 1: Industrial Safety and Workplace Accidents

Background:

In the mid-20th century, work environments, particularly in factories and industrial sites, were virtually designed for right-handed persons. Tools, machinery, safety systems, and even the workstations were arranged under the assumption of their right-handed use.

Incident:

A left-handed assembly line worker died in an accident at a manufacturing plant in the United States in the 1970s. While attempting to use a power saw intended for right-handed use, along with compacting equipment, the worker had to cross over the equipment or reach around its body, reducing visibility and control even more so because of the configuration of the control levers for right-hand use. Upon operational malfunction of equipment, the operator could not react in time to avoid incurring fatal injuries.

Implications:

- Left-handers were at greater risk in an environment not designed for them.
- First discussions emerged on the topic of inclusive industrial design.
- Being left-handed in itself was not a risk, but rather the maladjustment of the environment.
- Helped promote policies in the future for customizing or dual-handed equipment in work situations.

➢ Case Study 2: Left-Handed Athletes and Longevity

Background:

In many competitive sports, left-handedness can be viewed as an advantage essentially because it is rare and disrupts opponents' expectations and responses. Instances that left-handedness often shines through include baseball, tennis, boxing, and fencing.

Details of the Study:

In 1993, a study was conducted examining over 2000 professional baseball players' life spans by comparing left-handed and right-handed players. It was found that, contrary to previous belief, there was no difference in life spans between the two groups of players.

Notable Commentary:

- Left-handed athletes sometimes enjoyed long careers in sports, especially in the roles of pitcher or batter most advantageous from a strategy perspective for a left-hander in the context of baseball.

- Environment in sports provides better access to medical care, training, and fitness, potentially overwriting any possible minor handedness-related risk factors.
- The performance of left-handers in sports counters past notions of "deficits" associated with being left-handed.

Conclusion:
Left-handedness is not only not detrimental; it is, in fact, advantageous, and it does not correlate with reduced lifespan in elite sports.

➢ Case Study 3: Psychological Stress and Forced Hand Conversion in Education

Background:
Left-handedness was highly negatively regarded for most of the 19th and 20th centuries. Schools in India, the UK, and the USA often punished children for writing and otherwise behaving as left-handers, labeling them as "incorrect" and "unnatural."

Experience:
A variety of oral history interviews and psychological studies (Stanley Coren and others) document cases in which children were subjected to physical punishment, embarrassment, or retraining to a right-hand-only use through:

- Tying the left hand behind the back
- Using right-handed tools exclusively
- Using verbal ridicule or corporal punishment.

Psychological Effects:
Those forced to change hands reported:

- Chronic anxiety and low self-esteem
- Confusion in motor coordination
- Long-term emotional distress

Some neurological theories hypothesize that disrupting natural lateralization (e.g., any enforced hand dominance) may predispose one to language disorders, dyslexia, or stuttering, though evidence remains controversial.

Outcome:

Though not directly linked to life expectancy, such social injustice had an enduring effect on mental health, especially in the older generations that sadly contributed to the misnomer that left-handers were "weaker" or less adaptive.

This is an important realization coming from these case studies: it has never really been a question of whether people are left- or right-handed regarding life outcomes; the issue has always been one of how society has treated left-handed individuals and how it has designed environments for them. As society wakes up to left-handedness and becomes more inclusive, it gives a lessening impact to many of these disadvantages.

CURRENT SCIENTIFIC CONSENSUS: HANDEDNESS AND LIFE EXPECTANCY

The idea that left-handed people live shorter lives compared with their right-handed counterparts spread widely in popular and scholarly circles for decades. This belief was debunked substantially as scientific procedures improved and newer, scientifically sleeker studies were conducted. The prevailing scientific consensus: there is no inherent or intrinsic connection between left-handedness and reduced life expectancy.

➢ Major Conclusion 1: No Intrinsic Link Between Handedness and Life Expectancy

No specific difference has usually been revealed in the mortality rates of left-handers and right-handers by large, modern epidemiological studies. Handedness does not emerge as a risk factor for earlier death by researchers controlling variables such as age, gender, occupation, health behaviors, and socio-economic status.

- Example: National Longitudinal Mortality Study (NLMS), in accordance with data of more than 1 million individuals of the USA, does not find handedness as a precursor to further death.

- Another such an instance is the above-cited analysis in the British Medical Journal (1993) reporting that after correcting for age and historic bias, the life expectancy gap betrays itself.

In essence, being left-handed does not translate as being in any sense hazardous to health or longevity.

➢ Major Conclusion 2: Precursory Studies Were Contaminated with Cohort Effect and Social Pressure

The now-discredited notion of left-handers' shorter lives is an inheritance from the methodological flaws in earlier research, particularly the ones done by Halpern and Coren (1991). This study, relying on family reports of dead people to identify handedness, found that left-handers died 9 years earlier than right-handers on average. It turned out to be popular but very seriously flawed in two major areas:

A) Ascribing to Cohorts.

- A cohort effect, for instance, refers to the variation in certain characteristics ('the prevalence of left-handedness') depending on the time to which the people studied were born.

- Left-handedness was heavily stigmatized and often forcibly corrected in older generations, born at the early 20th century and before. Consequently, many natural left-handed individuals in that generation were either counted or self-identified as right-handed.

- That way, there were fewer left-handers in the older age groups—not because they died younger but because they were, by the casual observer definition or by constraining their behavior, right-handed.

- The data were thus seriously skewed. If few left-handers appeared in the group of people who died at older ages, this could easily create the misleading view that left-handers do not live as long.

B) There were also Social Pressures and Cultural Conditioning:
Throughout history and especially before the 20th century and more, it has been stated that being left-handed meant:

- Wrong or "unlucky"
- Proof of weakness or deviation
- To which correction (particularly in education) must apply

As a result:

- Many children received retraining in the use of the right hand.
- The true incidence of left-handedness was underreported in databases such as birth certificates, school documents, or personal surveys.
- In death records; census data; and psychological studies created on the basis of these skewed data, left-handedness has been falsely associated with a lesser chance of surviving.

These days, there are modern scholars who are wise enough to learn about these biases in history and have also learned how to counter them so that they can rectify the previously made false associations.

➢ Conclusion 3: Lefties face unique difficulties though these are being mitigated.

Though being left-handed is not hazardous to health, historically, left-handers had to endure more than just challenges in a right-handed world. These include:

- Tool Design: Scissors, power tools, desks, and even computer mice are ergonomically optimally designed for right-handers.
- Writing: Ink gets messy due to writing from left to right commonly practiced in most languages such that a left-hander must struggle with the positioning of his hand.
- Accident-Proven: Historically, a left-handed person is more likely to have accidents with equipment or tools that are designed primarily for right-hand use.

However, awareness and increased revolutions toward accommodating strategies of inclusion have borne down against this disadvantage:

- Products designed ambidextrously
- Left-handed-specific tools
- Education that does not switch hands
- Increased recognition of handedness as a normal variation

With an increasingly accommodating society, these disadvantages will definitely reduce. Thus, the minor disadvantages experienced by left-handers are rather environmental and social than biological or medical.

➢ Conclusion 4: Left-handers Are Biological-Normal Variation but Not Medical Risk Factor

Research in neuroscience and genetics follows up the fact that handedness is generally a typical characteristic of human diversity that can be linked with:

- lateralization of the brain: differences in the processing of responses by the brain concerning language, spatial awareness, and motor control may also explain left-handedness.

- Genetic and prenatal influences: Studies suggest that certain genes may influence handedness and that certain conditions during pregnancy could lead to it.

Main Points:

- Left-handedness is not a disorder, disease, or disability.
- It does not result in a nearly increased incidence of major illnesses when putting in perspective all factors.
- Though some studies throw light on the association of handedness with certain neurological conditions (for instance, dyslexia or epilepsy), there is considerable inconsistency among them and no evidence of causality.

Left-handedness can be seen as just a variant of human neurology and behavior as color of the eyes, height, or personality is different among people.

The modern scientific perspective is lucid and all-encompassing: Left-handedness is not a biological disadvantage in regard to life expectancy. The earlier view that tied handedness with the premature demise was more culture-bound and statistically proven to be wrong than being scientifically justified. As societies change and come to embrace neurological and behavioral diversity, the hands that were once impeded by past thinking are now actually supported and empowered to participate fully in many aspects of life.

FUTURE OUTLOOK

Attacks that left-handers die earlier is an outdated belief. Nonetheless, the impacts of this misconception on cultural interpretations of handedness and anecdotal assumptions still exist. The expectation, borne by human existence across use of scientific methods, will be that of better perspectives in the future about the nature of handedness. Instead of merely interpreting narrow survival rates or discrepancies in dying ages, the future approaches plan to assist left-handers, correct psychological biases, and enrich the understanding of brain functioning and its diversity.

1. Improved Inclusivity: Path to Equality and Safety

Why does this matter?
History has witnessed a world of rights intended to cater for the majority of right-handed people. School desks, computer setups, scissors, kitchen appliances—people have forgotten about left-handers, designing everything to be used conveniently by the majority to their convenience. Those subtler disadvantages, like for example in education, industrial health, and ergonomics, would have contributed a little toward raising the accident rate or the stress burden in populations inclined toward left-handedness.

Future Trends:

- Universal Design Principles: In the products industry, there are increasing attempts to make tools, electronics, and learning materials usable by both left- and right-handed people.
- Education Reform: Schools and their teachers are creating a more hospitable environment for students to revert from the present strictures of hand-switching or forced switching to make room for an allowance of scholastic activities designed for relaxation of the more talented personalities.
- Workplace Ergonomics: Relaxing the setting some more, many health and safe practices at workplaces are trying to change the overall concept of their workstation to allow safe working and safe use of tools by people who write with their left hand.

- Digital Systems: Why not think about app designing, not forgetting about UI/UX design, which nonchalantly considers handedness, at least for mobile platforms.

Effects on Health:

Handedness on its own does not affect longevity; reducing stressors and avoiding risks in the environment where left-handers reside makes life easier for left-handers and provides for an economical input to their safer life in the full areas of their participatory endeavors, strength performance, and well-being, and ultimately to longevity.

2. Balanced Research: Life Expectancy to Cognitive Studies in Brain Function

Changes in Science Inquiry:
The classic question of whether lefties die young has gradually given way to the enlightened question of what handedness implies structurally about the brain. The paradigm shift becomes incorrect against the backdrop of its erstwhile context of longevity theory. In this context, left-handedness goes far beyond any deficiency model and essentially embraces an empowered thinking with people making out their strength along cognitive and creativity lines.

The Paradigm Is Low:

- Functional brain studies (fMRIs and EEGs) show differences in information processing between lefties and right-handed subjects.
- Questions are being answered about left-handers' having exaggerated neural plasticity and/or bilateralism for brain activations.
- Neural science (genes and epigenetics) will continue to build the molecular pathways to address prenatal handedness development and its neuroanatomic relationship to brain asymmetry.

The Role of CDs:
No this pessimistic view that sees left-handedness as a deficit will become reshaped into a more optimistic, strength-based view appreciating the cognitive and creative contributions left-handers make

to the whole. Let us graduate these conversations to what matters to variation; to the possibility of its growing into a positive force in terms of human existence.

3. Left-Handed Empowerment: Cultural Shifts and Positive Representation

Shifting Narratives :
All through time, left-handedness was either isolated or pathological. However, the current postulates in culture, rhetoric, and all the grandstanding allow famous and successful left-handers to shine brightly in politics, arts, science, and sports: showing that minus suspicion, and probably prior to ridicule, we have now embraced it with the maximum burst of pleasure and pride.

Notable Left-Handed Figures That Shatter Stereotype:

- Politics: Left-handers were known to have been the likes of world leaders Barack Obama, Bill Clinton, Benjamin Netanyahu, and uh ... Nikita Khrushchev.
- Science: Rumors suggest that perhaps Marie Curie and Albert Einstein fell in the category of southpaws and/or ambidextroussters.
- The Arts and Music: You have people like Leonardo da Vinci, Paul McCartney, and Jimi Hendrix—all left-handers—reshaping their fields of creativity.
- Sports: Rafael Nadal (tennis), Lionel Messi (football), and Babe Ruth (baseball) are the most prominent examples of the strengths associated with left-handedness.

Social Implications:

- Cultural huntings against left-handedness, seen as bad luck, or unluck, are being supplanted by the narratives of uniqueness, genius, and ingenuity.
- The media shift is steadily accommodating left-handers, with leftness no longer seen as a stigma in the glare of the screen.
- Left-Handers' International Day, on August 13, endeavors to raise the level of awareness for challenges as well as strengths associated with their being left-handed shortly.

Health and Well-being Impact:

This story of empowerment might possibly erase the stigma of handedness and children would probably become psychologically more healthy, gain self-esteem, receive healthy social acceptance, all of which, by themselves, are significant contributors to well-ness. Mental health constitutes a very good buffer for healthier lifestyle indirectly influencing longevity-especially if both stress-provocation and marginalization are minimized.

As a matter of fact, the evolution of society will continue and the disadvantages that were previously the results of left-handedness will gradually disappear from history, or at least make the disparity in the age difference question obsolete. Instead of saying, "left-handers live shorter lives," it would maybe be better to say, "left-handers live empowering lives," with guarantees that they have all possible access to health, safety, and opportunity.

CONCLUSION

Our long-term goal is to verify or disprove the popularly held theory that handedness has an effect on longevity and assist in providing a more empirically based explanation of this phenomenon. From our examination of age distribution data, there is not much evidence to support the general accepted belief that left-handed individuals generally live shorter lives than right-handed individuals. According to Bayesian probability calculations, the life expectancy of left-handed and right-handed individuals at death is closely similar. This research discredits this fallacy and supplies valuable information about the current debate regarding longevity and handedness.

Future research could expand to explore other factors that influence lifespan, such as disease, genetic inheritance, and various life and demographic characteristics. It would be beneficial to examine how these factors intersect with handedness, as well as how lifestyle choices may impact the longevity of both left- and right-handed individuals. These further investigations hold promising potential for expanding our understanding of the complex relationship between health, lifestyle, and lifespan across different groups.

This research demonstrates how data analysis can be an effective tool for challenging widelyheld misconceptions and advancing our understanding of human existence. The prejudice faced by left-handed individuals has deep cultural, religious, and institutional roots. While the more overt forms of prejudice have diminished, subtle discrimination continues to persist. Recognizing this history is essential for fostering greater understanding, acceptance, and equality. Embracing left-handedness as a natural human variation can help create a world that celebrates diversity.

The myths and superstitions surrounding left-handed individuals, portraying them as sinful or unnatural, have largely faded. However, left-handed people in various fields have continually demonstrated their strength, intelligence, and capabilities. As cultural understanding of diversity progresses, misconceptions about left-handedness are gradually dissipating. Despite this growing acceptance, prejudice against left-handed people remains one of the most enduring forms of discrimination based on physiological traits. Even in today's more tolerant society, left-handed individuals continue to face challenges. Historically, from education to religion and from organizational culture to everyday life, left-handed people have been forced to adapt to a world that largely caters to right-handed individuals.

This work ultimately calls for further exploration and encourages society to recognize the value of diversity, ensuring that all people, regardless of their handedness, are treated equally and with respect.

Future Research Directions

Recent studies indicate little or no difference in longevity among left- and right-handed persons, but several topics warrant further investigation to expand our understanding:

1. Neurological and Genetic Underpinnings:
    - Investigate whether there are any neurological or genetic markers related to handedness that correlate with health outcomes or age-related diseases.
    - To examine whether handedness correlates with an increased risk for neurodegenerative disorders, cognitive decline, or psychiatric conditions.

2. Societal and Occupational Factors:
    - Explore whether occupational hazards related to right-hand-oriented tools and environments still subtly affect left-handers in certain workplaces.
    - Investigate the effects of ergonomics and workplace design on the health and productivity of left-handers over different generations.

3. Cultural and Geographical Variability:
    - Investigate cultural acceptance of left-handedness by different countries and consequences on their education, mental health, and careers.
    - Engage in cross-cultural research to establish whether long-term health and well-being of left-handers is influenced by social treatment.

4. Longitudinal Health Studies:
    - Champion the inclusion of handedness as a variable in large-scale health studies so as to afford great social insight over time.
    - Employ wearables and health tracking to attain data on lifestyle and health outcomes with respect to handedness.

5. Psychosocial Impact:
    - Investigate possible different social or psychological pressures faced left-handed persons might unknowingly influence their health behaviors or stress-related conditions.
    - Assessment of how handedness interacts with other identity factors, such as gender, neurodiversity, and socioeconomic status.

Concluding Thoughts

Handedness is still a hot topic in psychology, culture, and human development. Although previous theories linking left-handedness to a shorter lifespan have largely been disproved, the conversation has expanded to include how subtle physiological characteristics affect the sociocultural context in which they live. More research not only clears up misunderstandings but also expands on the range of human existence in terms of behaviour and health.

References

[1] A. S. D. M. Tanushree Poojary, “EVALUATING AGE DIFFERENCES IN LEFTHANDERS AND RIGHT-HANDERS: A DATADRIVEN ANALYSIS,” *International Journal of Engineering Applied Sciences and Technology,* pp. 140-145, 2023.

[2] C. J. W. Avery N. Gilbert, “Hand preference and age in the United States,” *Neuropsychologia,* vol. 30, no. 7, pp. 601-608, 1992.

[3] M. N. A. B. S. V. S. &. W. B. W. Juan Lavista Ferres, “Modeling to explore and challenge inherent assumptions when cultural norms have changed: a case study on left-handedness and life expectancy,” *Arch Public Health 81,* 2023.

[4] R. W. K. N. J. N. John P Aggleton, “Evidence for longevity differences between left,” *Journal of Epideniolo,g3 and Comniunity Health ,* pp. 206-209, 1993.

[5] L. J. Harris, “Do Left-Handers Die Sooner Than Right-Handers? Commentary on Coren and Halpern's (1991) "Left-Handedness: A Marker for Decreased Survival Fitness",” *Psychological Bulletin 1993,* vol. 114, no. 2, pp. 203-204, 1993.

[6] W. C. K. N. T. M. D. H. Kalisch T, “Age-Related Attenuation of Dominant Hand Superiority,” 2006.

[7] J. M. M. F. a. R. R. I. C. McManus, “Science in the Making: Right Hand, Left Hand. III: Estimating historical rates of left-handedness,” vol. 15, no. (1/2), pp. 186-208, 2010.

[8] D. K. a. P. Haines, “Instant Notes: Analytical Chemistry,” *Oxford: Bios Scientific Publishers Limited,* vol. 48, no. 2, p. 352, 2002.

[9] H. H. PANJER, “MORTALITY DIFFERENCES BY HANDEDNESS: SURVIVAL ANALYSIS FOR A RIGHT-TRUNCATED SAMPLE OF BASEBALL PLAYERS,” *TRANSACTIONS OF SOCIETY OF ACTUARIES,* vol. 45, 1993.