

Left-Handed Texts

Dr. Moshik Miller

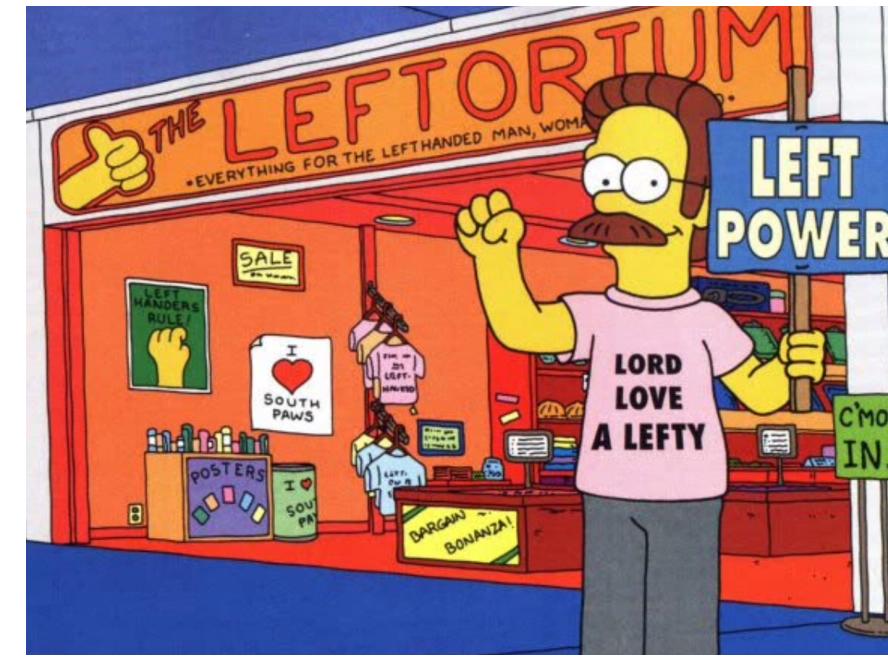
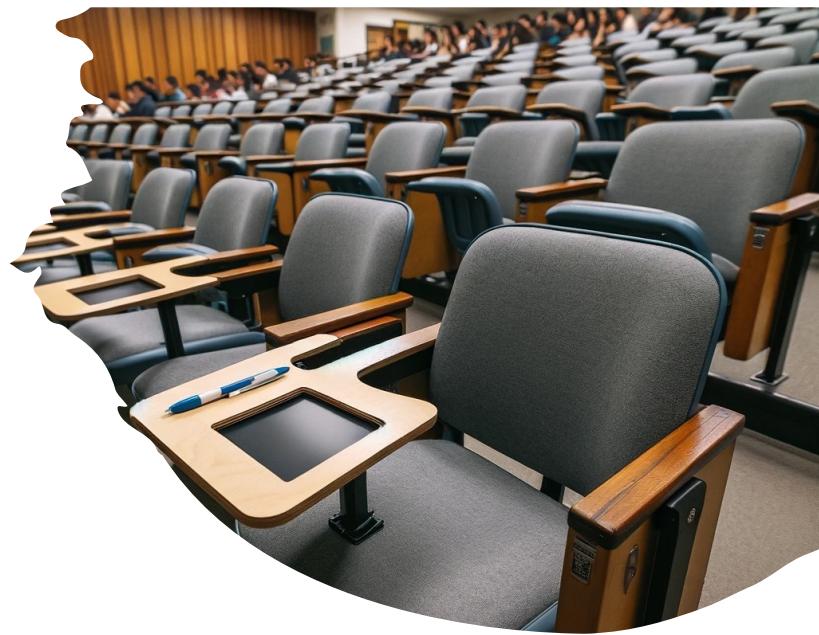
Orr Zwebner



Motivation

Motivation

- Our world is designed for right-handed individuals
- Left-handed individuals are ~10% of the global population
- What if we can identify them?
 - Target marketing



Research Question

Is it possible to predict left-handedness based on text analysis?

 Amazon Customer

★★★★★ It works great!

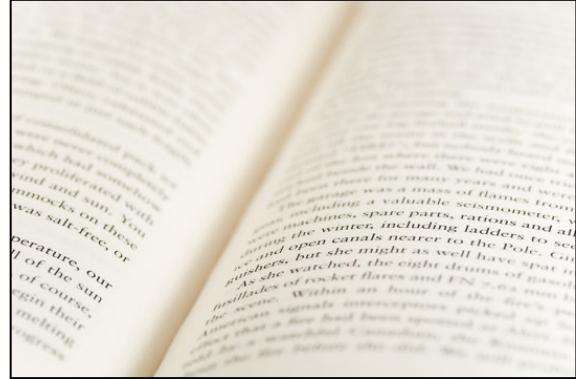
Reviewed in the United States on November 3, 2018

Verified Purchase

We love the lamp! We use it as a night light. It works great. We keep it on red since it slowed me to see the baby and is not bright at all. The white light makes my room too bright and I can't sleep. It has different colors available and it can rotate while you sleep. It doesn't make much noise at all it will let you sleep. (Only makes minimal noise while rotating). It's a great gift. The material does feel cheap but we get what we pay for. I would so buy it again if anything was to happen to this one. Yes the material may be cheap but it works great. Like I said before, we love it!

65 people found this helpful

[Helpful](#) | [Comment](#) | [Report abuse](#)



 Melyssa Griffin •
April 13 at 3:08 PM • 6 comments

If there's one thing I've learned over the past couple years of self-exploration + radical risk-taking, it's this: We have all been shoved into boxes that define who we're allowed to be in the world. The fear, overwhelm, & disconnection we feel are simply indicators that we're walking around in containers that are too small to hold our true essence and power.

If only you saw how limitless you actually are -- how comically small the box is compared to your fullest self -- you'd find the courage to make brave decisions, take meaningful risks, & create the kind of life you actually desire.

Soooo...that's why I'm bringing my podcast back. 😊

I'm changing its name to Limitless Life because this renewed show will help you finally let go of your boxed-in self so that you can live an approval-free existence -- full of courageous choices + your fullest expression as a human being + entrepreneur. And guess what? It's launching tomorrow!!!!

Here's what you can expect...

💡 Interviews with global leaders, entrepreneurs, authors, and risk-takers who aren't afraid to drop-kick the status quo to create meaningful change in the world.

💡 Episodes that will bring you inside private coaching calls, where I'll be coaching digital business owners of all levels on how their mindset is getting in the way of their success or joy. I have a feeling you'll gain relatable pearls of wisdom about how your fears may be running the show, too.

💡 Solo episodes with me to dive even deeper into concepts that will reprogram your mindset for abundance instead of scarcity (and so much more). Plus, plenty of behind-the-scenes personal stories.

There will be two episodes per week, on Tuesdays and Thursdays. I truly can't wait for you to listen. ❤️ I know that this work is the path I'm meant to be on, and in many ways, the path you're meant to be on, too. When we let go of who we *have* to be and become who we *could* be, that's when we truly become limitless. (BTW you can follow my new Instagram podcast account @limitlesslifepodcast for updates on new episodes, and more!)

Leave a comment below and let me know which episodes you're most looking forward to (interviews, coaching calls, or solo shows)! 🙌😊

A22 N THE NEW YORK TIMES EDITORIALS/LETTERS TUESDAY, AUGUST 18, 2009

The New York Times

ARTHUR OCHS SULZBERGER JR., Publisher

Founded in 1851

ADOLPHS. OCHS
Publisher 1856-1896

ARTHUR OCHS SULZBERGER
Publisher 1933-1961

GILVIL D. STUYVESANT
Publisher 1961-1963

ARTHUR OCHS SULZBERGER
Publisher 1963-1992

DEAN RAGAZZI
Editorial Page Editor

RICHARD L. BRINKE
Editorial Page Editor

TOM BROOKS
Editorial Page Editor

SUSAN EDGERLEY
Editorial Page Editor

ANDREW ROSENTHAL
Editorial Page Editor

CARLA ANNE ROSSINI, Deputy Editorial Page Editor

DAVID SHIPLEY, Deputy Editorial Page Editor

The News Sections

BILL VELLEKOOP, Executive Editor
JILL ABRAHAMSON, Managing Editor
JOHN M. CEDERSON, Managing Editor
JONATHAN LANDMAN, Deputy Managing Editor
WILLIAM E. SCHMITT, Deputy Managing Editor

ANDREW ROSENTHAL, Executive Managing Editor

DEAN RAGAZZI, GLEN KIRKHAM
RICHARD L. BRINKE, GERALD MARSHAK
TOM BROOKS, MICHAEL MORNATSKY
SUSAN EDGERLEY, CRAIG R. WHITNEY

The Opinion Pages

ROBERT K. BRADLEY, Executive Editor
ROBERT K. BRADLEY, Senior V.P., General Manager
DENNIS J. STEAN, Senior V.P., Deputy General Manager
DENNIS J. STEAN, Senior V.P., Chief Advertising Officer
DENNIS P. WARREN, Senior V.P., Chief Advertising Officer
GORDON MCKEEON, Senior V.P., Marketing
ALEXANDER H. SCHAFFNER, Senior V.P., Advertising
ROLAND A. CAUTIO, Senior V.P., Financial Officer
THOMAS C. CARLEY, Senior V.P., Planning
TERRY L. HAYES, Senior V.P., Operations and Labor
YANNIS K. KARLIS, Senior V.P., Marketing and Circulation
MICHAEL VALENTINE, V.P., Human Resources

MARTIN GOTTLIEB, Editor, Global Editions

The Climate and National Security

One would think that by now most people would have figured out that climate change represents a grave threat to the planet. One would also have expected from Congress a plausible strategy for reducing the greenhouse gas emissions that lie at the root of the problem.

That has not happened. The House has passed a climate bill that is not as strong as needed, but is a start. There is still time for the Senate to act. The Senate could pass a bill, given the reflexive opposition of most Republicans and profound fears among many Democrats that rising energy costs will cripple local industries.

The problem, when it comes to motivating politicians, is that the dangers from global warming — drought, famine, rising seas — appear to be decades off. But the only way to prevent them is with sacrifices in the

jobs, about keeping America competitive in the quest for new technologies, and about one generation's moral obligation to the next. Those are all sound arguments. They have not been enough to fully engage the public, or overcome the lobbying efforts of the fossil fuel industry.

Proponents of climate change legislation have now settled on a new strategy: warning that global warming poses a serious threat to national security. Sea-level-induced flooding, like drought, starvation, disease and mass migration, they argue, could unleash regional conflicts and draw in America's armed forces, either to help keep the peace or to defend allies or supply routes.

This is increasingly the accepted wisdom among the national security establishment. A 2007 report published by the CNA Corporation, a Pentagon-funded think tank,

 Chopt Salad •@Chopt

Follow

Great question! Instead of us telling you what we think, let's put it to Twitter.
Tweet us with your answer - best reply gets a free salad!

jenny labovitz @jennyy_labovo
@chopt what's the taste difference between mexican goddess and california goddess dressing?

4:33 PM - 21 Aug 2017

1 Retweet 4 Likes

We suggest that by using ML tools we can predict who is left-handed by using their reviews.

innocent 19 July at 06:24

Good morning to everyone who's just woken up for the 47th time because it's too hot to sleep.

Jennifer.Gunter @Djengunter 11 Oct 2021

The measles vaccine is beneficial for the immune system. Measles damages the immune system.

JYSK UK 11 Oct 2021

For the first time ever in JYSK Ireland & UK history we gathered all our Senior Leaders and Store Managers together in person to look back on the last year and of course celebrate in style with our incredible JYSK Awards Evening.

1,613 Retweets 4.9K Likes

Star Wars (1977) User Reviews

1 of 98

hemes and themes" t

oung to be on the ap

it I turn 13 before I

it that says you get way more if you change your birthday to make

Chopt Salad @Chopt

Great question! Instead of us telling you what we think, let's put it to Twitter. Tweet us with your answer - best reply gets a free salad!

Artful Film @ArtfulFilm

Author: Chris Ashworth from artful.film

I couldn't have asked for anything more. Star Wars: A New Hope had it all. If I had to sum it up in one word, superlative would be my answer. I saw the film for the first time three years ago and I still can't stop raving about it. It was the best Star Wars movie. I was disappointed with the prequels (Attack of the Clones was my least favorite), but this, Return of the Jedi and Empire Strikes Back were perfect.

I have to say that the film looks absolutely amazing even after thirty plus years, with highly imaginative sets and dazzling special effects. And the action sequences were superbly choreographed and directed. The performances were outstanding, led by John Williams is absolutely outstanding, by far one of his most exciting and rousing scores. The story is fast-paced, intelligent and has an essence of sophistication, and the

45 out of 54 found this helpful. Was this review helpful? Yes No Report this Permalink

HubSpot @HubSpot

Okay, marketers. Y'all ready for this one?

In your own words, define "campaign".

product (What's this?)

d the importance of comfortable clothing shorts for your pregnancy, the QGGQDD

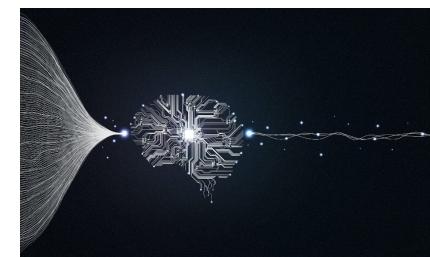
Maternity Shorts Over Belly with Pockets might be a great option for you.

One of the best things about these shorts is their premium fabric blend. Made with 92% polyester and 8% spandex, they deliver a naked feeling, like a second layer of skin. The opaque double-layered design ... able, secure fit that stretches to accommodate a growing bump

Faire January 29

Over the past six months, we've been talking a lot about virtual trade shows. If you haven't yet registered for one of our events, here's your chance to learn more about what online trade shows are all about. Check out The Storefront to see why the digital format is the future of the wholesale industry.

answer, we might share it



innocent 19 July at 06:24

Good morning to everyone who's just woken up for the 47th time because it's too hot to sleep.

Jennifer.Gunter @Djengunter 11 Oct 2021

The measles vaccine is beneficial for the immune system. Measles damages the immune system.

JYSK UK 11 Oct 2021

We know the last few years have been a challenge for everyone but with the ambition, attitude and corporate spirit we saw this week, we are sure our teams are ready to take on the busy months ahead.

Would you like to be a part of our growing success? Check out our current positions here <https://jy.sk/fri>

Star Wars (1977) User Reviews

1 of 98

hemes and themes" t

oung to be on the ap

it I turn 13 before I

it that says you get way more if you change your birthday to make

Chopt Salad @Chopt

Great question! Instead of us telling you what we think, let's put it to Twitter. Tweet us with your answer - best reply gets a free salad!

Artful Film @ArtfulFilm

Author: Chris Ashworth from artful.film

I couldn't have asked for anything more. Star Wars: A New Hope had it all. If I had to sum it up in one word, superlative would be my answer. I saw the film for the first time three years ago and I still can't stop raving about it. It was the best Star Wars movie. I was disappointed with the prequels (Attack of the Clones was my least favorite), but this, Return of the Jedi and Empire Strikes Back were perfect.

I have to say that the film looks absolutely amazing even after thirty plus years, with highly imaginative sets and dazzling special effects. And the action sequences were superbly choreographed and directed. The performances were outstanding, led by John Williams is absolutely outstanding, by far one of his most exciting and rousing scores. The story is fast-paced, intelligent and has an essence of sophistication, and the

45 out of 54 found this helpful. Was this review helpful? Yes No Report this Permalink

HubSpot @HubSpot

Okay, marketers. Y'all ready for this one?

In your own words, define "campaign".

product (What's this?)

d the importance of comfortable clothing shorts for your pregnancy, the QGGQDD

Maternity Shorts Over Belly with Pockets might be a great option for you.

One of the best things about these shorts is their premium fabric blend. Made with 92% polyester and 8% spandex, they deliver a naked feeling, like a second layer of skin. The opaque double-layered design ... able, secure fit that stretches to accommodate a growing bump

Faire January 29

Over the past six months, we've been talking a lot about virtual trade shows. If you haven't yet registered for one of our events, here's your chance to learn more about what online trade shows are all about. Check out The Storefront to see why the digital format is the future of the wholesale industry.

answer, we might share it

Theory



Downloaded from https://royalsocietypublishing.org/ on 13 January 2024

Review

Why are some people left-handed? An evolutionary perspective

V. Llaurens^{1,*}, M. Raymond¹ and C. Faurie^{1,2}

¹Institut des Sciences de l'Evolution de Montpellier (UMR CNRS 5554), Université de Montpellier II,
C.065, 34095 Montpellier Cedex 5, France

²Department of Animal and Plant Sciences, University of Sheffield, Sheffield S10 2TN, UK

Since prehistoric times, left-handed individuals have been ubiquitous in human populations, exhibiting geographical frequency variations. Evolutionary explanations have been proposed for the persistence of the handedness polymorphism. Left-handedness could be favoured by negative frequency-dependent selection. Data have suggested that left-handedness, as the rare hand preference, could represent an important strategic advantage in fighting interactions. However, the fact that left-handedness occurs at a low frequency indicates that some evolutionary costs could be associated with left-handedness. Overall, the evolutionary dynamics of this polymorphism are not fully understood. Here, we review the abundant literature available regarding the possible mechanisms and consequences of left-handedness. We point out that hand preference is heritable, and report how hand preference is influenced by genetic, hormonal, developmental and cultural factors. We review the available information on potential fitness costs and benefits acting as selective forces on the proportion of left-handers. Thus, evolutionary perspectives on the persistence of this polymorphism in humans are gathered for the first time, highlighting the necessity for an assessment of fitness differences between right- and left-handers.

Keywords: handedness; polymorphism; human

1. INTRODUCTION

The aim of this review is to identify the evolutionary forces involved in human handedness. Two main questions are critical to improve our understanding of the evolution of human handedness: (i) why is hand use asymmetric (i.e. why do individuals show a preference for one hand in most manual tasks)? and (ii) why is hand use asymmetry polymorphic (i.e. why do some individuals prefer the left hand and some the right for a similar task)? Most research on handedness has focused on the intersection of these two questions, namely, why are humans right-handed? As a consequence, the debate on the origin and understanding of handedness has been partially obscured, as left-handedness was historically considered as an anomalous or pathological case, thus ignoring the relatively high proportion of left-handers within human populations.

Previously, asymmetric hand use has been studied extensively. Corballis (2003) suggested that the evolution of human speech implied an association between speech and gesture, and thus brain lateralization for speech may be responsible for asymmetric hand use. This evolutionary explanation was further elaborated by Vallortigara & Rogers (2005) who evaluated

the costs and benefits of brain asymmetry. The aim of the present review is to clarify the question of the asymmetric hand use polymorphism in humans.

Many diverse studies on left-handedness have been conducted by researchers from various fields such as medicine, neurology and psychology. Although some data remain controversial, several hormonal, cultural and developmental factors have been found to be associated with handedness. Here, we attempt to review the information available on both proximal and ultimate aspects of handedness in humans to identify the evolutionary mechanism of the persistence of left-handers.

2. RIGHT AND LEFT HAND USE IN HUMAN POPULATIONS

To understand the evolutionary processes implied in handedness, it is first necessary to have a clear idea of the historical and geographical variation of this trait.

(a) Hand preference assessment

Handedness measures are based on hand use preference or hand performance (McManus 1996). However, there are no two clear categories such as left- and right-handers. For a given manual action, each individual shows a preference for the use of one hand, and it is not always the same hand for two different actions (Salmaso & Longoni 1985). This suggests that right- or left-handers are not general

* Author for correspondence (violaine.llaurens@univ-montp2.fr).

One contribution of 14 to a Theme Issue 'Mechanisms and functions of brain and behavioural asymmetries'.

Handedness and its genetic influences are associated with structural asymmetries of the cerebral cortex in 31,864 individuals

Zhiqiang Sha^a, Antonietta Pepe^{b,c,d}, Dick Schijven^b, Amaia Carrion-Castillo^{a,b}, James M. Roe^b, René Westerhausen^a, Marc Joliot^{b,c,d}, Simon E. Fisher^{a,b}, Fabrice Crivello^{b,c,d}, and Clyde Francks^{a,b,1}

^aLanguage and Genetics Department, Max Planck Institute for Psycholinguistics 6525 XD Nijmegen, The Netherlands; ^bGroupe d'Imagerie Neurofonctionnelle, Université de Bordeaux, Institut de Médecine et de Santé, UMR-S 5592, Institut d'Imageries Biomédicales, 33077 Bordeaux Cedex 33077, France; ^cCentre National de la Recherche Scientifique, Bordeaux F-33000, France; ^dNeuroSpin Center on Cognition, Brain and Language, San Sebastian 20009, Spain; ¹Center for Lifespan Changes in Brain and Cognition, Department of Psychology, University of Oslo, Oslo 0315, Norway; ²Section for Cognitive and Clinical Neuroscience, Department of Psychology, University of Oslo, Oslo 0315, Norway; ³Center for Lifespan Changes in Brain and Cognition, Department of Psychology, University of Oslo, Oslo 0315, Norway; ⁴Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen 6525 EN, The Netherlands

Edited by Michael C. Corballis, School of Psychology, University of Auckland, Auckland, New Zealand, and accepted by the Editorial Board October 12, 2021
(received for review July 16, 2021)

Roughly 10% of the human population is left-handed, and this rate is increased in some brain-related disorders. The neuro-anatomical correlates of hand preference have remained equivocal. We resampled structural brain image data from 28,802 right-handers and 3,062 left-handers (UK Biobank population dataset) to a symmetrical surface template, and mapped asymmetries for each of 8,681 vertices across the cerebral cortex in each individual. Left-handers compared to right-handers showed average differences of surface area asymmetry within the fusiform cortex, the anterior insula, the anterior middle cingulate cortex, and the precentral cortex. Meta-analyzed functional imaging data implicated these regions in executive functions and language. Polygenic disposition to left-handedness was associated with two of these regional asymmetries, and 18 loci previously linked with left-handedness by genome-wide association analysis were within one or more of these asymmetries. Implicated genes included six encoding microtubule-related proteins: *TUBB*, *TUBA1B*, *TUBB3*, *TUBB4A*, *MAP2*, and *NME7*—mutations in the latter cause left-to-right reversal of the visceral organs. There were also two cortical regions where average thickness asymmetry was altered in left-handers: on the postcentral gyrus and the inferior occipital cortex, functionally annotated with hand sensorimotor and visual roles. These cortical thickness asymmetries were not heritable. Heritable surface area asymmetries of language-related regions may link the etiologies of hand preference and language, whereas nonheritable asymmetries of sensorimotor cortex may manifest as consequences of hand preference.

brain asymmetry | left-handedness | cerebral cortex | gene-brain-behavior | polygenic scores

Roughly 90% of the human population is right-handed and 10% left-handed, and this strong bias is broadly consistent across cultures, ethnicities, and history (1–3). Hand motor control is performed primarily by the contralateral brain hemisphere, such that right-handedness reflects left-hemisphere dominance for hand articulation, and vice versa (6). Behavioral precursors of hand preference are established in the developing human fetus (7, 8), probably through a genetically regulated program of asymmetrical brain development (9–12). Left-handedness occurs at increased frequencies in neurodevelopmental and psychiatric conditions, including intellectual disability (13), autism (14), and schizophrenia (15). This suggests overlapping genetic and developmental contributions to altered brain asymmetry and psychiatric conditions. However, it is important to stress that the large majority of left-handed people do not have these conditions.

Despite decades of research, the brain anatomical correlates of hand preference have remained uncertain. Some MRI studies have reported slightly altered laterality of the sensorimotor cortex

around the central sulcus as well as temporal auditory cortex in left-handed people—while other studies found no effects at all (16–22). Most of these studies focused on hypothesis-driven regions of interest rather than mapping across the entire cerebral cortex, and they used different methods of analysis and measurement. The results were conflicting, not replicated or negative, possibly due to small sample sizes, the largest number of left-handers in any of these studies was 198 (16). Cortex-wide screening using atlas-defined regions has also not shown robust associations with hand preference (23, 24), even in as many as 608 left-handers versus 7,243 right-handers. One possibility is that brain anatomical correlates of handedness may be too focal to be captured by common atlas-defined parcellations. To this end, atlas-free mapping in a large population sample may provide new insights into how hand preference relates to cerebral cortical structural asymmetry.

Significance

Left-handedness occurs in roughly 10% of people, but whether it involves altered brain anatomy has remained unclear. We measured left to right asymmetry of the cerebral cortex in 28,802 right-handers and 3,062 left-handers. There were small average differences between the two handedness groups in brain regions important for hand control, language, vision, and working memory. Genetic influences on handedness were associated with some of these brain asymmetries, especially of language-related regions. This suggests links between handedness and language during human development and evolution. One implicated gene is *NME7*, which also affects placement of the visceral organs (heart, liver, etc.) on the left to right body axis—a possible connection between brain and body asymmetries in embryonic development.

Author contributions: Z.S., A.P., A.C.-C., J.M.R., R.W., M.J., S.E.F., F.C., and C.F. designed the research; Z.S., A.P., and D.S. analyzed data; Z.S., A.P., D.S., A.C.-C., J.M.R., R.W., M.J., S.E.F., F.C., and C.F. wrote the paper; Z.S. performed visualization; M.J., S.E.F., F.C., and C.F. acquired funding; and F.C. provided direction and supervision.

The authors declare no competing interest.
This open-access article is distributed under Creative Commons Attribution-NonCommercial-NoDerivatives License 4.0 (CC BY-NC-ND). See online for related content such as Commentaries.
¹To whom correspondence may be addressed. Email: Clyde.Francks@mpg.de.

This article contains supporting information online at <http://www.pnas.org/lookup/suppl/doi:10.1073/pnas.2113095118>. Published November 16, 2021.

Data

Amazon review dataset
~233 M reviews



Amazon Fashion	reviews (883,036 reviews)	metadata (186,637 products)
All Beauty	reviews (371,345 reviews)	metadata (32,992 products)
Appliances	reviews (602,777 reviews)	metadata (36,459 products)
Art, Crafts and Sewing	reviews (1,000,000 reviews)	metadata (1,000,000 products)
Automotive	reviews (7,900,166 reviews)	metadata (932,019 products)
Books	reviews (51,311,621 reviews)	metadata (2,935,525 products)
CDs and Vinyl	reviews (4,543,369 reviews)	metadata (2,544,442 products)
Cell Phones and Accessories	reviews (10,063,255 reviews)	metadata (590,269 products)
Clothing, Shoes and Jewelry	reviews (32,295,000 reviews)	metadata (2,686,000 products)
Digital Music	reviews (1,000,000 reviews)	metadata (1,000,000 products)
Electronics	reviews (20,894,365 reviews)	metadata (786,868 products)
Gift Cards	reviews (147,194 reviews)	metadata (1,548 products)
Grocery and Gourmet Food	reviews (5,074,160 reviews)	metadata (287,209 products)
Home and Kitchen	reviews (21,928,568 reviews)	metadata (1,301,225 products)
Industrial and Scientific	reviews (1,758,333 reviews)	metadata (187,524 products)
Kids and Baby	reviews (1,000,000 reviews)	metadata (1,000,000 products)
Luxury Beauty	reviews (574,628 reviews)	metadata (12,308 products)
Magazine Subscriptions	reviews (85,688 reviews)	metadata (3,493 products)
Movies and TV	reviews (8,765,568 reviews)	metadata (203,970 products)
Musical Instruments	reviews (1,512,000 reviews)	metadata (1,512,000 products)
Office Products	reviews (1,311,313 reviews)	metadata (313,644 products)
Patio, Lawn and Garden	reviews (5,236,058 reviews)	metadata (279,697 products)
Pet Supplies	reviews (6,542,483 reviews)	metadata (206,141 products)
Prime Pantry	reviews (477,614 reviews)	metadata (10,815 products)
Software	reviews (459,436 reviews)	metadata (26,815 products)
Sports & Outdoors	reviews (1,000,000 reviews)	metadata (1,000,000 products)
Toys and Home Improvement	reviews (9,015,203 reviews)	metadata (571,982 products)
Toys and Games	reviews (8,201,231 reviews)	metadata (834,414 products)
Video Games	reviews (2,565,349 reviews)	metadata (84,893 products)



phrases = ['im left handed', 'i am left handed']



Balanced dataset (0:1)



11,603 "Lefties" reviews



category	Category_index	left_matching	reviewText	label	rank	overall	n_words
Office_Products	7479	4373629	I bought these to include thank you cards in t...	0	1.0	h	81.0
Office_Products	10670	10631	DOWNTON ABBEY has won the hearts of countless ...	0	1.0	h	259.0
Office_Products	11998	12011	One of the very best all around ferret books a...	0	1.0	h	62.0
Office_Products	14974	14897	good quality	0	1.0	h	2.0
Office_Products	18364	18367	I wanted to love these! While I do like them, ...	0	1.0	m	212.0
...
Tools_and_Home_Improvement	8960818	8960818	Needed some light to maneuver around in the AM...	1	0.0	h	44.0
Tools_and_Home_Improvement	8965606	8965606	I should start by saying that I received this ...	1	0.0	h	272.0
Tools_and_Home_Improvement	8971765	8971765	Nice well made wire wheel but not sized proper...	1	0.0	m	26.0
Tools_and_Home_Improvement	8976956	8976956	I do a fair amount of residential light switch...	1	0.0	h	53.0
Tools_and_Home_Improvement	9006904	9006904	Need some solder to repair some small diameter...	1	0.0	h	16.0

2008 Users: "Lefties"

ML - Embeddings + Classification

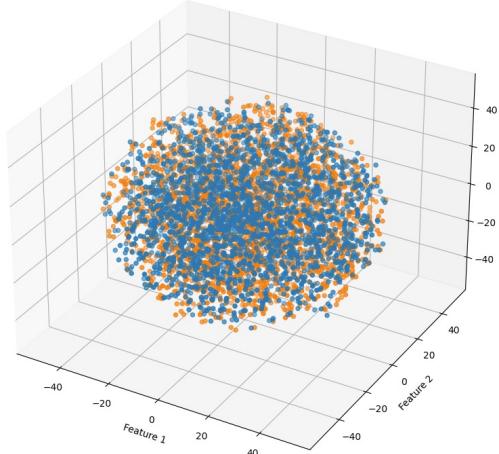
Balanced dataset (0:1)

category	Category_index	left_matching	reviewText	label	rank	overall	n_words
Office_Products	7479	4373629	I bought these to include thank you cards in t...	0	1.0	h	81.0
Office_Products	10670	10631	DOWNTON ABBEY has won the hearts of countless ...	0	1.0	h	259.0
Office_Products	11998	12011	One of the very best all around ferret books a...	0	1.0	h	62.0
Office_Products	14974	14897	good quality	0	1.0	h	2.0
Office_Products	18364	18367	I wanted to love these! While I do like them, ...	0	1.0	m	212.0
...
Tools_and_Home_Improvement	8960818	8960818	Needed some light to maneuver around in the AM...	1	0.0	h	44.0
Tools_and_Home_Improvement	8965606	8965606	I should start by saying that I received this ...	1	0.0	h	272.0
Tools_and_Home_Improvement	8971765	8971765	Nice well made wire wheel but not sized proper...	1	0.0	m	26.0
Tools_and_Home_Improvement	8976956	8976956	I do a fair amount of residential light switch...	1	0.0	h	53.0
Tools_and_Home_Improvement	9006904	9006904	Need some solder to repair some small diameter...	1	0.0	h	16.0

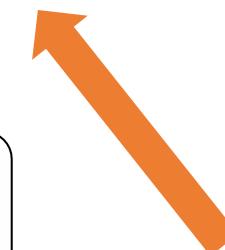
Doc2Vec



```
[[0.04654552, -0.12952729, -0.14820385, 0.0636...  
[[0.0381407, -0.16156931, -0.11644878, 0.04711...  
[[0.05128969, 0.06779332, 0.1340215, 0.0183997...  
[[0.07730825, -0.0900512, -0.02022021, 0.20481...  
[[0.17915358, -0.07627708, -0.15042198, 0.1412...  
...  
[[0.16125943, 0.10676357, 0.14965369, 0.197790...  
[[0.18460453, 0.01375406, -0.13325493, 0.10458...  
[[0.14225666, 0.12170646, 0.26246628, 0.269648...  
[[0.17865594, 0.09707598, -0.07001592, 0.06419...  
[[0.21670435, 0.0075497, 0.20974098, 0.1461632...  
...
```



1



0



6 Classification models:

Pytorch
Neural
Network #1

Pytorch
Neural
Network #2

Logistic
Regression

SVM

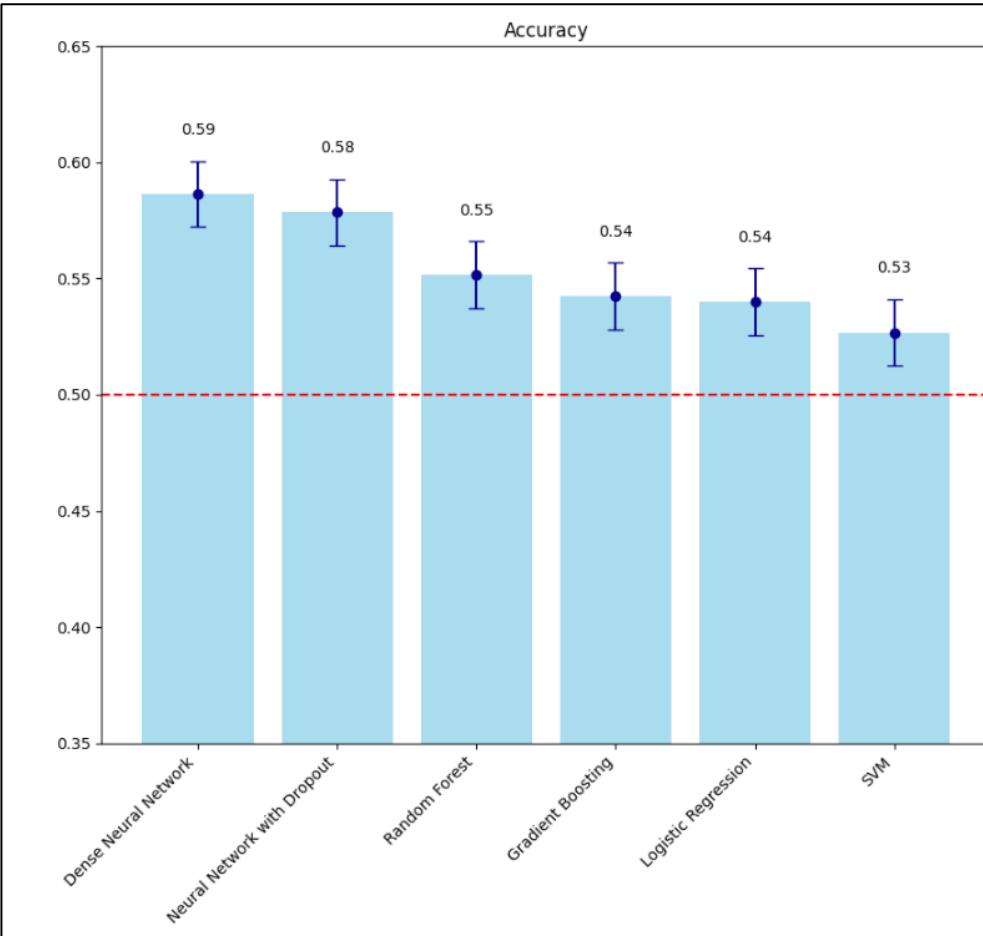
Random
Forest

Gradient
Boosting

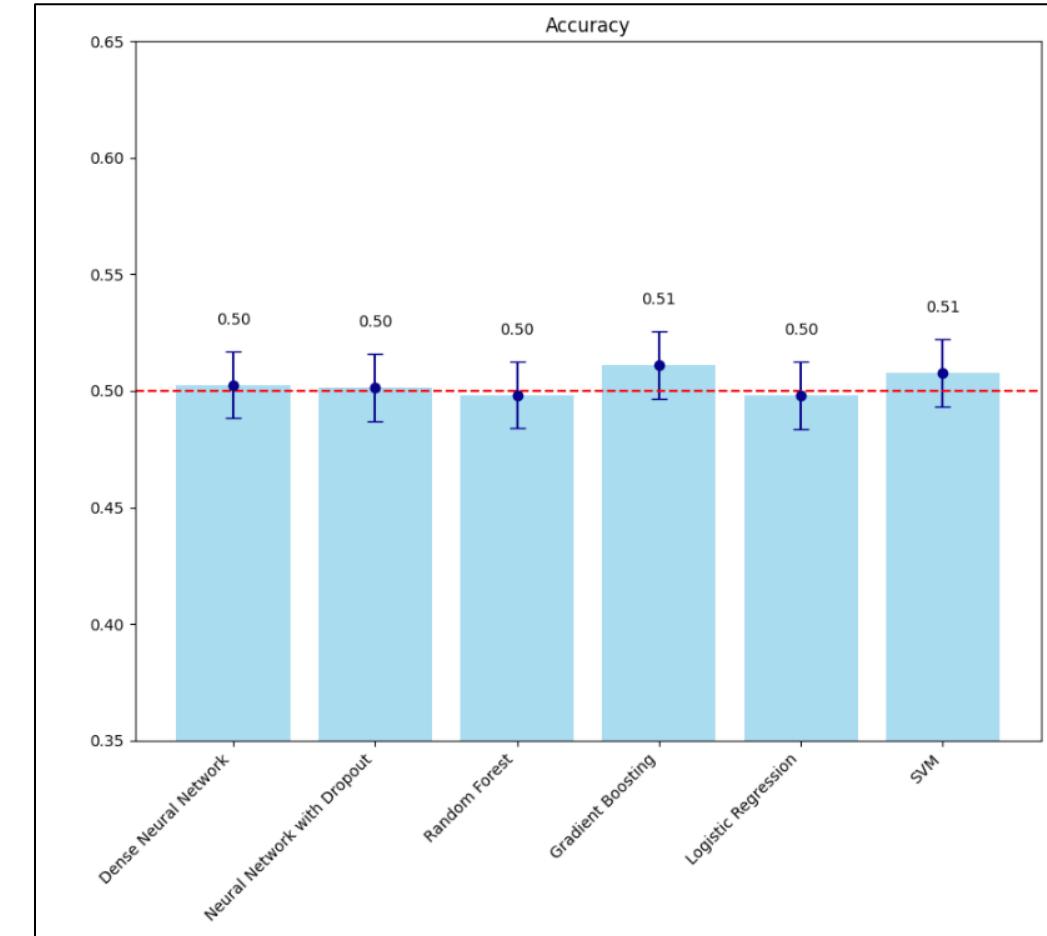
Results

Accuracy

Balanced dataset:



Shuffled labels:

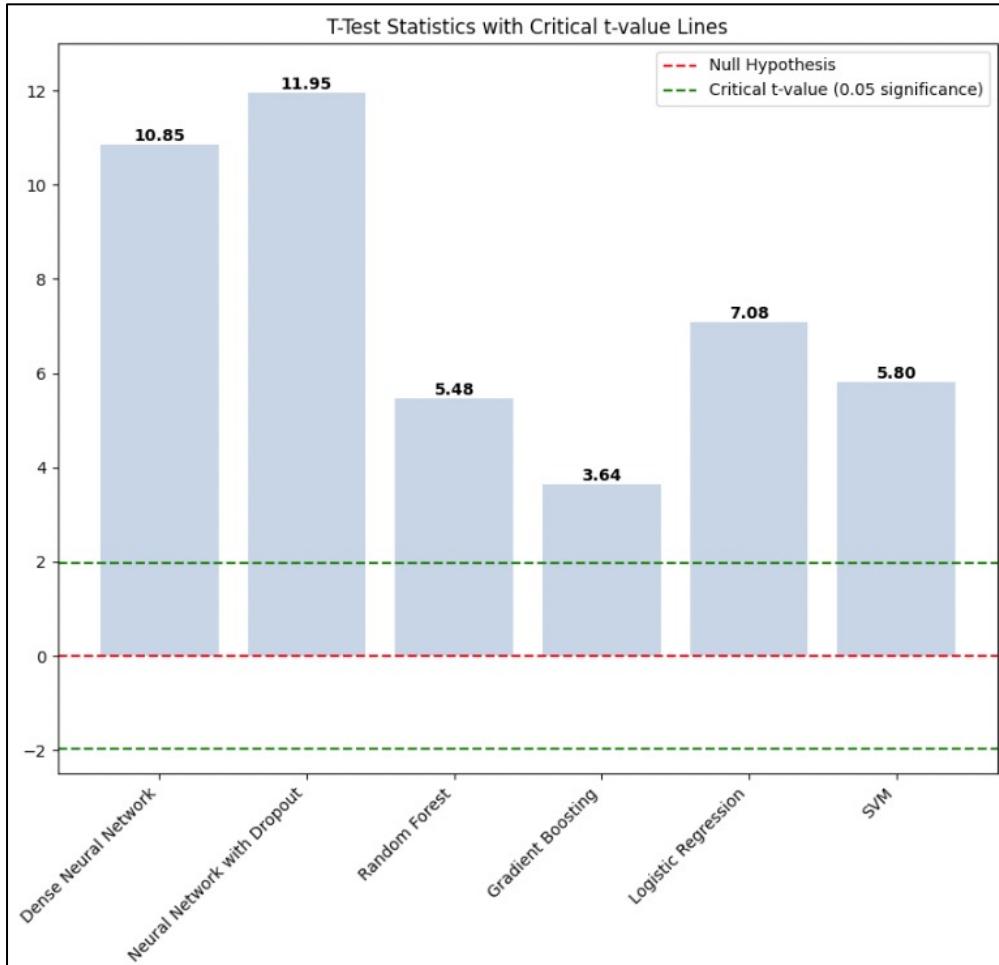


category	Category_index	left_matching	reviewText	label	rank	overall	n_words
Office_Products	7479	4373629	I bought these to include thank you cards in t...	0	1.0	h	81.0
Office_Products	10670	10631	DOWNTON ABBEY has won the hearts of countless ...	0	1.0	h	259.0
Office_Products	11998	12011	One of the very best all around ferret books a...	0	1.0	h	62.0
Office_Products	14974	14897	good quality	0	1.0	h	2.0
Office_Products	18364	18367	I wanted to love these! While I do like them, ...	0	1.0	m	212.0
...
Tools_and_Home_Improvement	8960818	8960818	Needed some light to maneuver around in the AM...	1	0.0	h	44.0
Tools_and_Home_Improvement	8965606	8965606	I should start by saying that I received this ...	1	0.0	h	272.0
Tools_and_Home_Improvement	8971765	8971765	Nice well made wire wheel but not sized proper...	0	0.0	m	26.0
Tools_and_Home_Improvement	8976956	8976956	I do a fair amount of residential light switch...	0	0.0	h	53.0
Tools_and_Home_Improvement	9006904	9006904	Need some solder to repair some small diameter...	1	0.0	h	16.0

Results

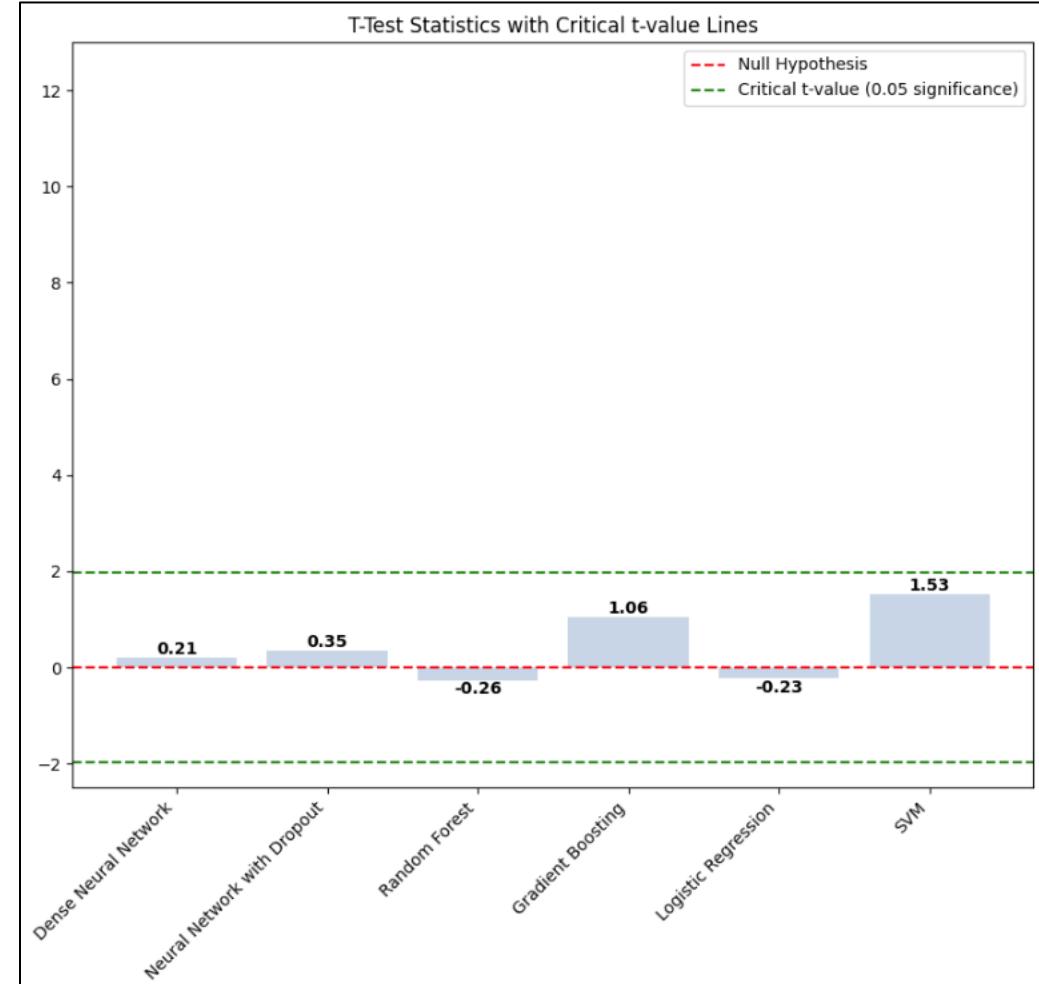
T-Test (one-sample)

Balanced dataset:



category	Category_index	left_matching	reviewText	label	rank	overall	n_words
Office_Products	7479	4373629	I bought these to include thank you cards in t...	0	1.0	h	81.0
Office_Products	10670	10631	DOWNTON ABBEY has won the hearts of countless ...	0	1.0	h	259.0
Office_Products	11998	12011	One of the very best all around ferret books a...	0	1.0	h	62.0
Office_Products	14974	14897	good quality	0	1.0	h	2.0
Office_Products	18364	18367	I wanted to love these! While I do like them, ...	0	1.0	m	212.0
...
Tools_and_Home_Improvement	8960818	8960818	Needed some light to maneuver around in the AM...	1	0.0	h	44.0
Tools_and_Home_Improvement	8965606	8965606	I should start by saying that I received this ...	1	0.0	h	272.0
Tools_and_Home_Improvement	8971765	8971765	Nice well made wire wheel but not sized proper...	1	0.0	m	26.0
Tools_and_Home_Improvement	8976956	8976956	I do a fair amount of residential light switch...	1	0.0	h	53.0
Tools_and_Home_Improvement	9006904	9006904	Need some solder to repair some small diameter...	1	0.0	h	16.0

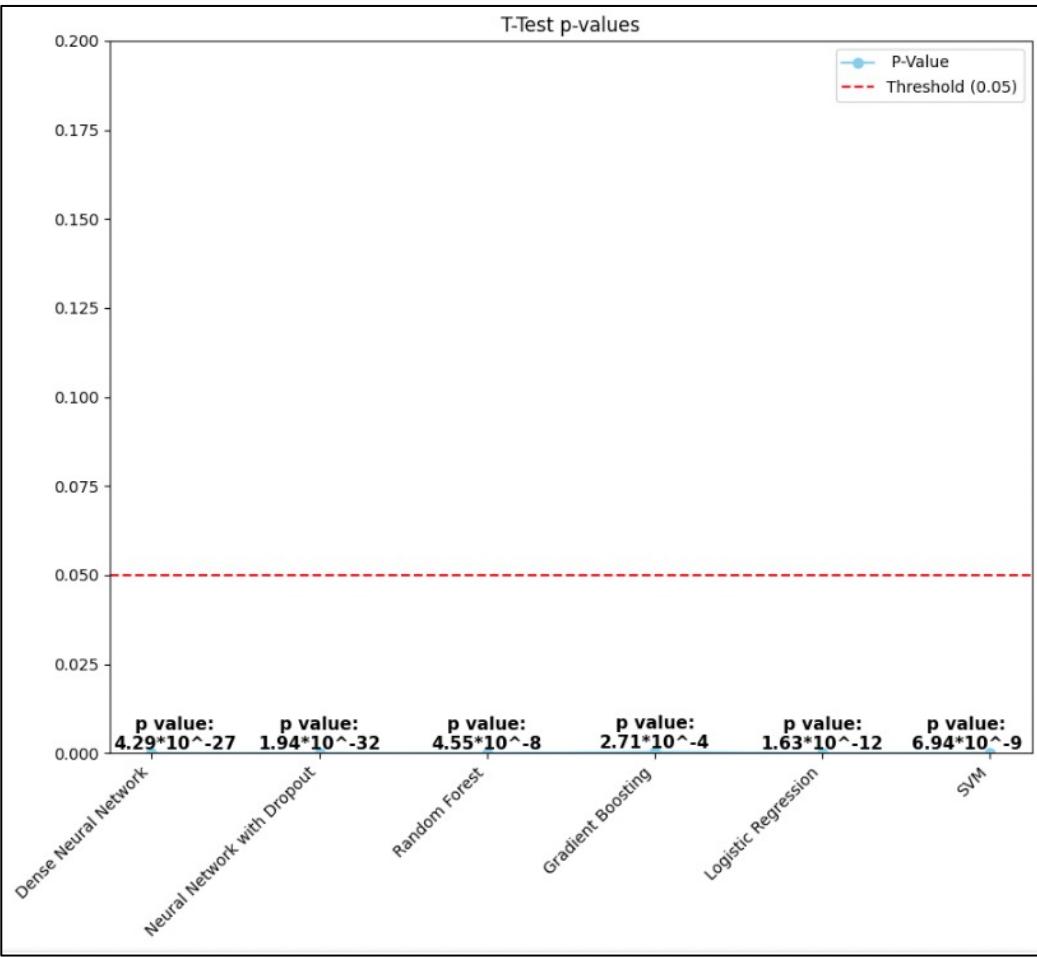
Shuffled labels:



Results

T-Test p-value

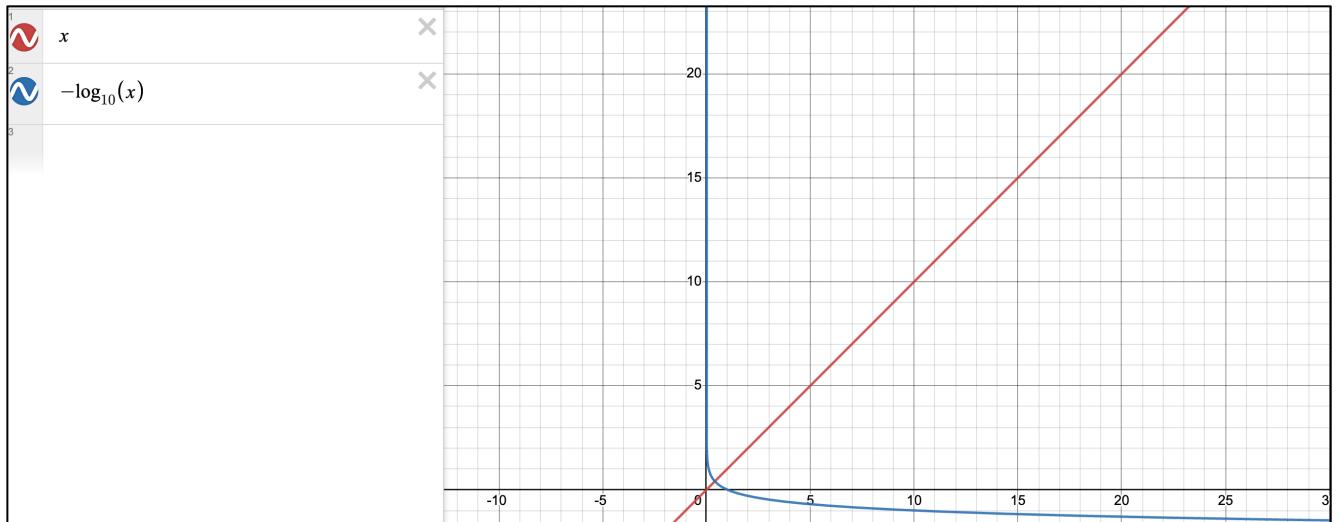
Balanced dataset:



category	Category_index	left_matching	reviewText	label	rank	overall	n_words
Office_Products	7479	4373629	I bought these to include thank you cards in t...	0	1.0	h	81.0
Office_Products	10670	10631	DOWNTON ABBEY has won the hearts of countless ...	0	1.0	h	259.0
Office_Products	11998	12011	One of the very best all around ferret books a...	0	1.0	h	62.0
Office_Products	14974	14897	good quality	0	1.0	h	2.0
Office_Products	18364	18367	I wanted to love these! While I do like them, ...	0	1.0	m	212.0
...
Tools_and_Home_Improvement	8960818	8960818	Needed some light to maneuver around in the AM...	1	0.0	h	44.0
Tools_and_Home_Improvement	8965606	8965606	I should start by saying that I received this ...	1	0.0	h	272.0
Tools_and_Home_Improvement	8971765	8971765	Nice well made wire wheel but not sized proper...	1	0.0	m	26.0
Tools_and_Home_Improvement	8976956	8976956	I do a fair amount of residential light switch...	1	0.0	h	53.0
Tools_and_Home_Improvement	9006904	9006904	Need some solder to repair some small diameter...	1	0.0	h	16.0

Solution – Negative log!

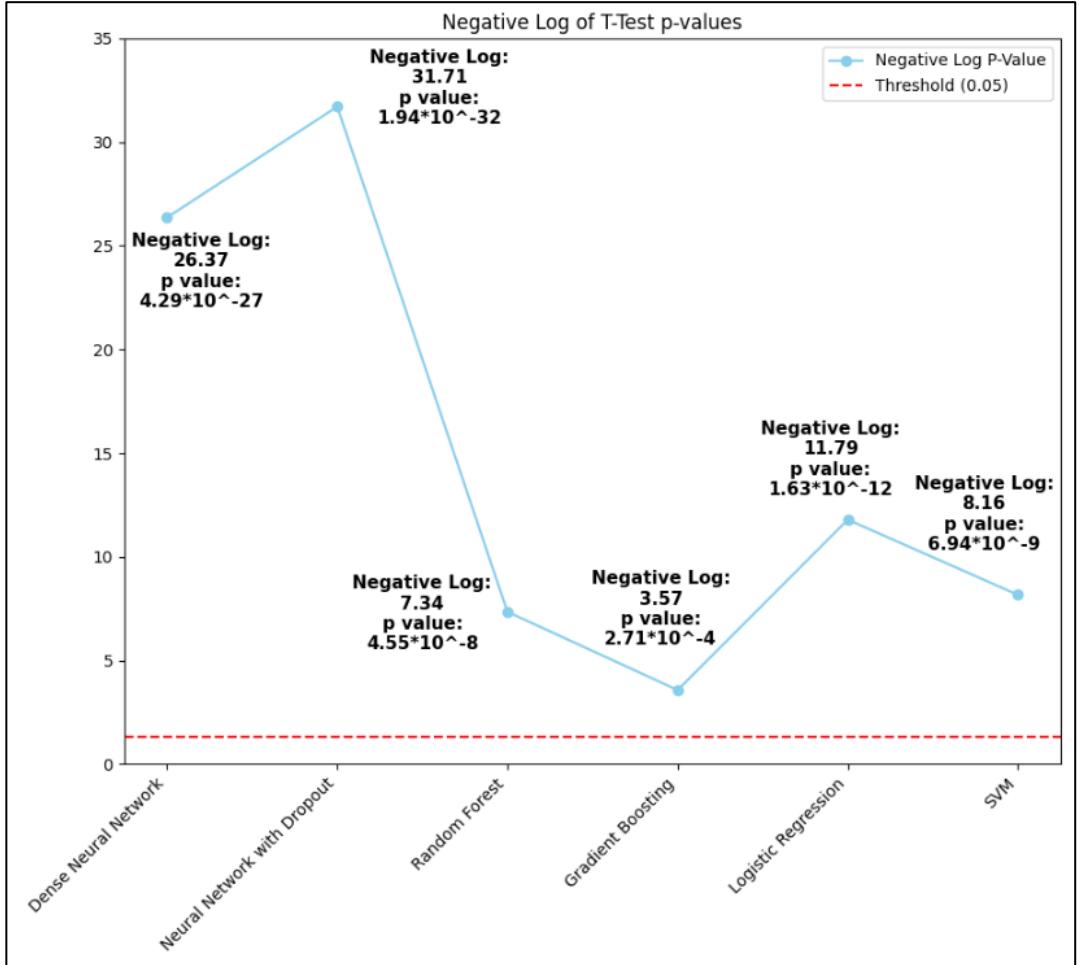
$$f(x) = -\log_{10}(x)$$



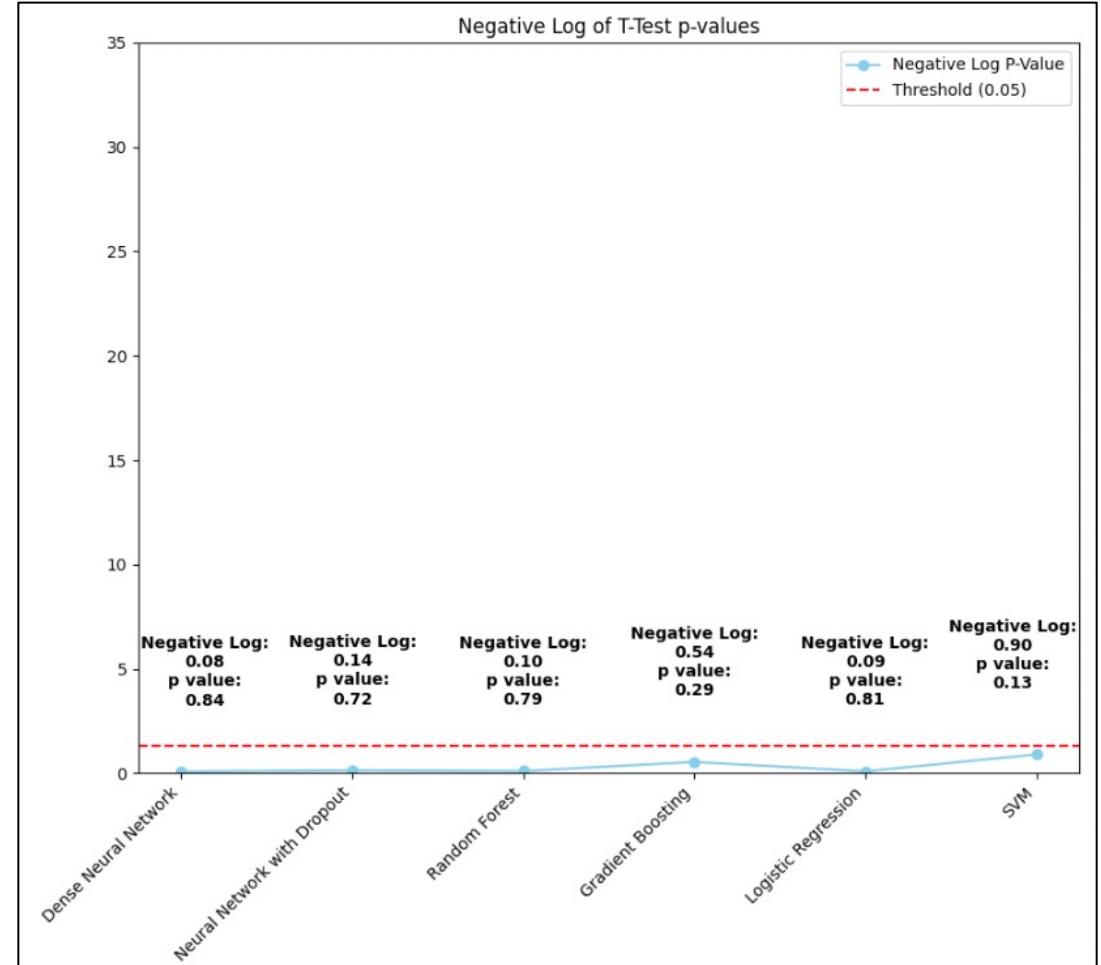
Results

T-Test p-value

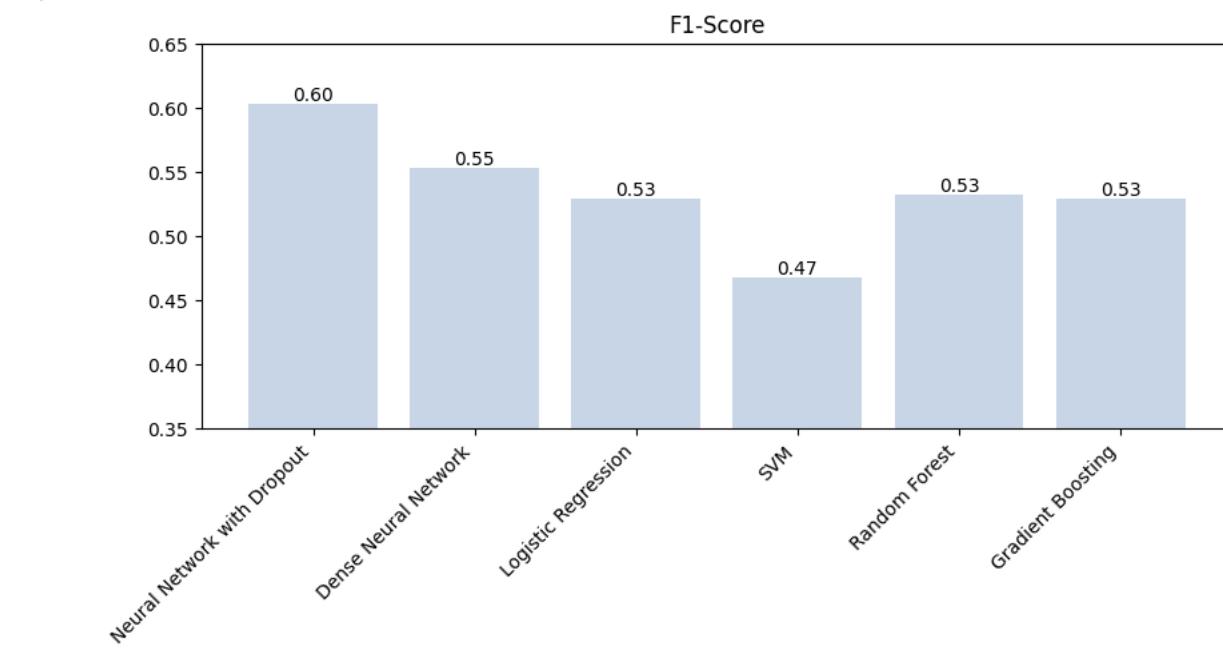
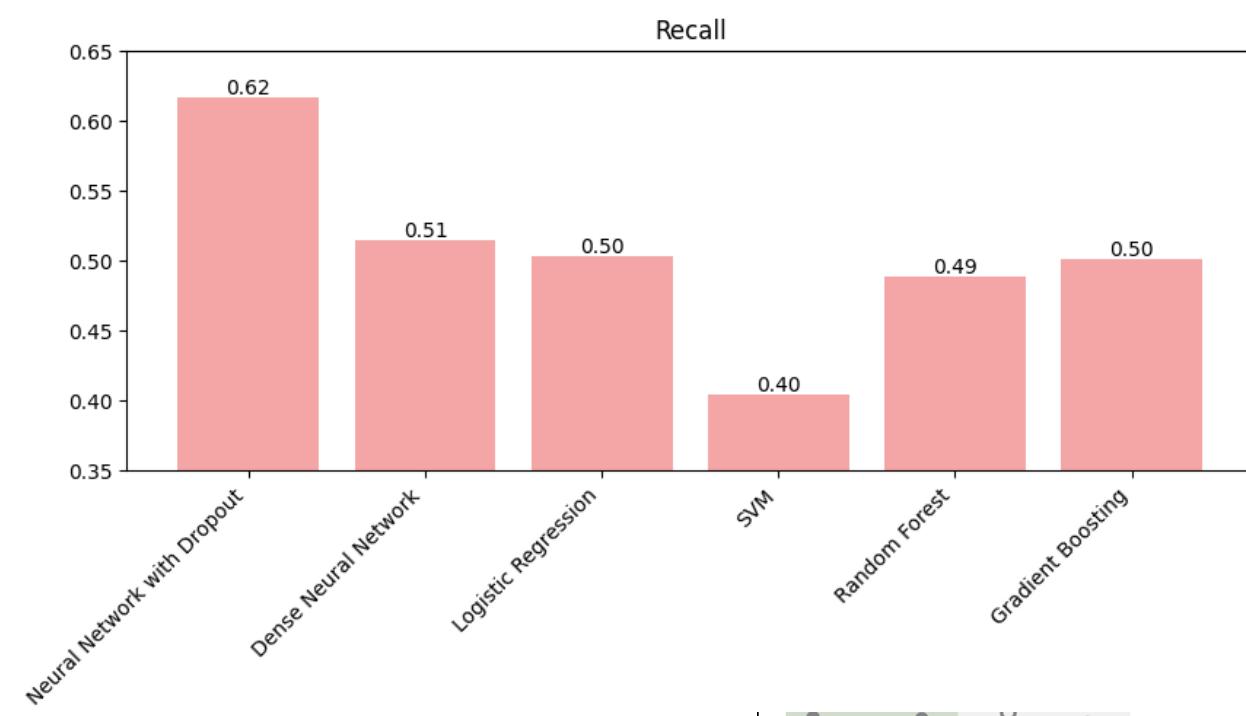
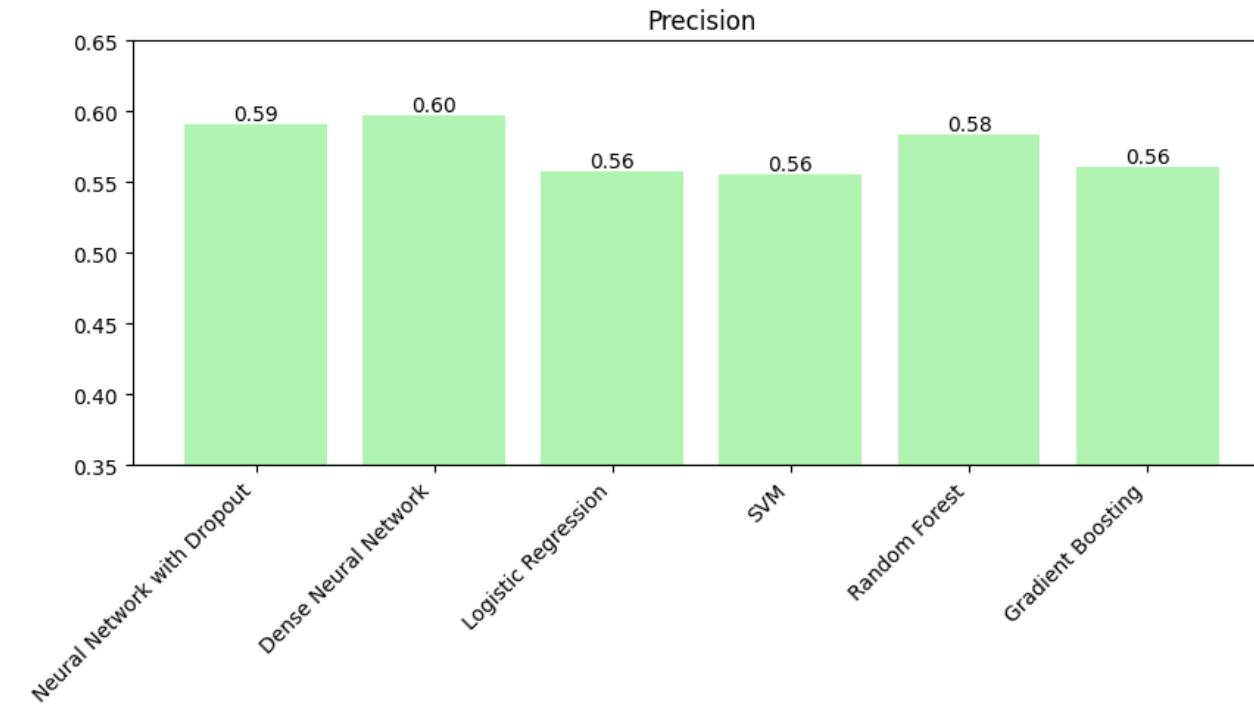
Balanced dataset:



Shuffled labels:

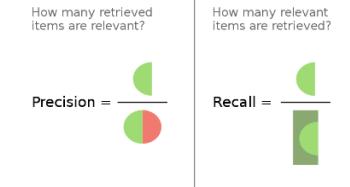
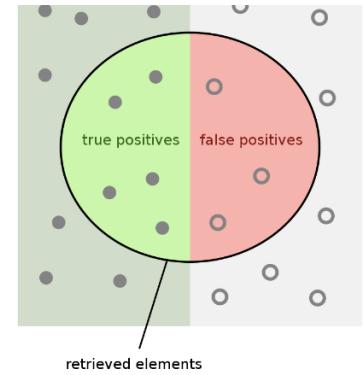


category	Category_index	left_matching	reviewText	label	rank	overall	n_words
Office_Products	7479	4373629	I bought these to include thank you cards in t...	0	1.0	h	81.0
Office_Products	10670	10631	DOWNTON ABBEY has won the hearts of countless ...	0	1.0	h	259.0
Office_Products	11998	12011	One of the very best all around ferret books a...	0	1.0	h	62.0
Office_Products	14974	14897	good quality	0	1.0	h	2.0
Office_Products	18364	18367	I wanted to love these! While I do like them, ...	0	1.0	m	212.0
...
Tools_and_Home_Improvement	8960818	8960818	Needed some light to maneuver around in the AM...	1	0.0	h	44.0
Tools_and_Home_Improvement	8965606	8965606	I should start by saying that I received this ...	1	0.0	h	272.0
Tools_and_Home_Improvement	8971765	8971765	Nice well made wire wheel but not sized proper...	1	0.0	m	26.0
Tools_and_Home_Improvement	8976956	8976956	I do a fair amount of residential light switch...	1	0.0	h	53.0
Tools_and_Home_Improvement	9006904	9006904	Need some solder to repair some small diameter...	1	0.0	h	16.0



$$\text{Accuracy} = \frac{\text{correct classifications}}{\text{all classifications}}$$

$$F_1 = \frac{2}{\text{recall}^{-1} + \text{precision}^{-1}} = 2 \frac{\text{precision} \cdot \text{recall}}{\text{precision} + \text{recall}} = \frac{2\text{tp}}{2\text{tp} + \text{fp} + \text{fn}}.$$



Label Distribution:

0 11603

1 11603

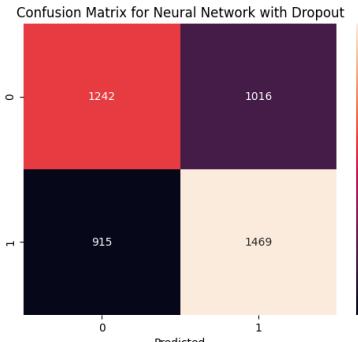
Name: label, dtype: int64

Data is balanced.

Vector Size: 50

Total Number of Samples: 23206

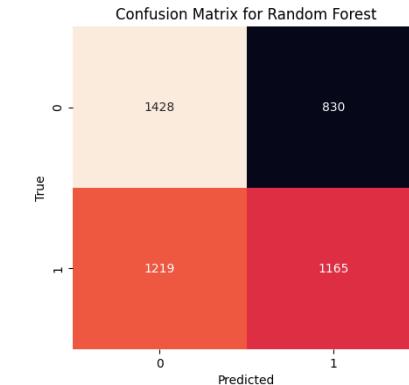
Training Samples: 18564, Testing Samples: 4642



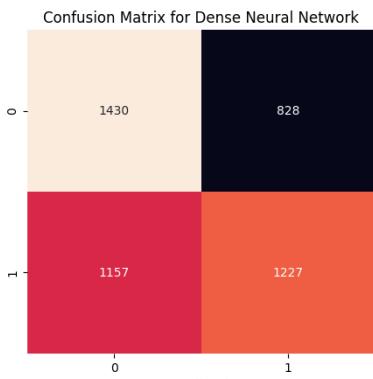
Accuracy for Neural Network with Dropout: 58.40%
Precision for Neural Network with Dropout: 0.5911, Recall: 0.6162, F1-Score: 0.6034
t-test for Neural Network with Dropout prediction vs 0.5:
t-statistic: 11.6121968884876, p-value: 9.474245208230307e-31
95% Confidence Interval for Neural Network with Dropout Accuracy: [0.5698, 0.5982]
The results for Neural Network with Dropout are statistically significant with a p-value of 0.00000000455.



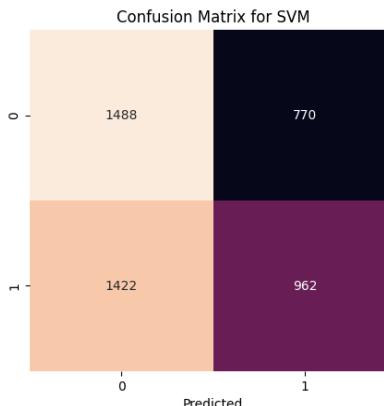
Accuracy for Logistic Regression: 54.01%
Precision for Logistic Regression: 0.5579, Recall: 0.5034, F1-Score: 0.5292
t-test for Logistic Regression prediction vs 0.5:
t-statistic: 5.476984972302375, p-value: 4.554379901611354e-08
95% Confidence Interval for Logistic Regression Accuracy: [0.5257, 0.5544]
The results for Logistic Regression are statistically significant with a p-value of 0.0000000455.



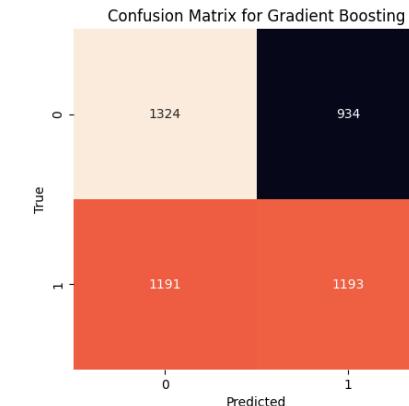
Accuracy for Random Forest: 55.86%
Precision for Random Forest: 0.5840, Recall: 0.4887, F1-Score: 0.5321
t-test for Random Forest prediction vs 0.5:
t-statistic: 8.039007811355228, p-value: 1.139644270411154e-15
95% Confidence Interval for Random Forest Accuracy: [0.5443, 0.5729]
The results for Random Forest are statistically significant with a p-value of 0.0000000000.



Accuracy for Dense Neural Network: 57.24%
Precision for Dense Neural Network: 0.5971, Recall: 0.5147, F1-Score: 0.5528
t-test for Dense Neural Network prediction vs 0.5:
t-statistic: 9.967104894833966, p-value: 3.624289678459361e-23
95% Confidence Interval for Dense Neural Network Accuracy: [0.5581, 0.5866]
The results for Dense Neural Network are statistically significant with a p-value of 0.0000000000.



Accuracy for SVM: 52.78%
Precision for SVM: 0.5554, Recall: 0.4035, F1-Score: 0.4674
t-test for SVM prediction vs 0.5:
t-statistic: 3.792208238794596, p-value: 0.0001512114439079136
95% Confidence Interval for SVM Accuracy: [0.5134, 0.5422]
The results for SVM are statistically significant with a p-value of 0.0001512114.



Accuracy for Gradient Boosting: 54.22%
Precision for Gradient Boosting: 0.5609, Recall: 0.5004, F1-Score: 0.5289
t-test for Gradient Boosting prediction vs 0.5:
t-statistic: 5.773521409300151, p-value: 8.268846003238204e-09
95% Confidence Interval for Gradient Boosting Accuracy: [0.5279, 0.5566]
The results for Gradient Boosting are statistically significant with a p-value of 0.0000000083.

Controls

1) Products ✓

Balanced dataset (0:1)

category	Category_index	left_matching	reviewText	label	rank	overall	n_words	
Office_Products	7479	4373629	I bought these to include thank you cards in t...	0	1.0	h	81.0	
Office_Products	10670	10631	DOWNTON ABBEY has won the hearts of countless ...	0	1.0	h	259.0	
Office_Products	11998	12011	One of the very best all around ferret books a...	0	1.0	h	62.0	
Office_Products	14974	14897		good quality	0	1.0	h	2.0
Office_Products	18364	18367	I wanted to love these! While I do like them, ...	0	1.0	m	212.0	
...	
Tools_and_Home_Improvement	8960818	8960818	Needed some light to maneuver around in the AM...	1	0.0	h	44.0	
Tools_and_Home_Improvement	8965606	8965606	I should start by saying that I received this ...	1	0.0	h	272.0	
Tools_and_Home_Improvement	8971765	8971765	Nice well made wire wheel but not sized proper...	1	0.0	m	26.0	
Tools_and_Home_Improvement	8976956	8976956	I do a fair amount of residential light switch...	1	0.0	h	53.0	
Tools_and_Home_Improvement	9006904	9006904	Need some solder to repair some small diameter...	1	0.0	h	16.0	

2) Review length ✓

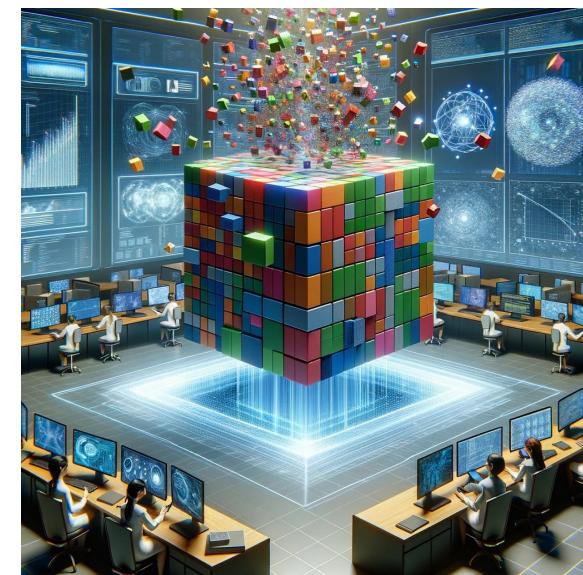
3) Ratings ✓

4) Train – test data leakage

- User ID

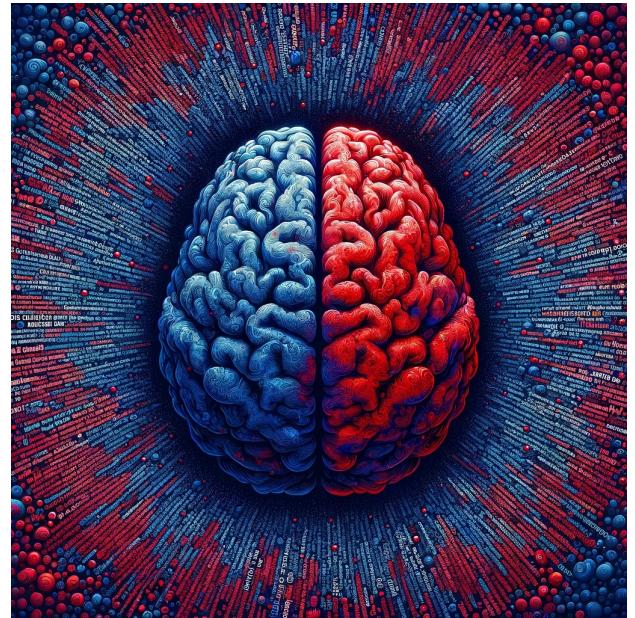
Additional Steps

- Different embeddings (GPT, Bert)
- External significance
 - Category etc.
- Expanding the dataset
 - Further categories
- Robustness check



Continued Research

- Explain the significance. Assumptions:
 - Cognitive difference
 - Keyboard - specific letters
 - “Lefties” Users
- Predictions:
 - Find “lefties”
 - Predict handedness
- Amazon reviews
 - Methodology



Questions

