

# Two Cultures One Brain

Who's really in charge?



An AI-Powered MRI Analysis into the Neurobiological Correlates  
of Acculturation and its impact on  
Cognitive Flexibility, Moral Decision-Making, and Identity  
Formation

Natania Mathew Varghese  
Grade 10

Queen Elizabeth High School, Calgary, AB



# Why does this matter to me?

## **The Global Landscape**

- Over 280 million people worldwide are international migrants.
- Millions of second and third generation individuals face identity conflicts and psychological stress as they balance multiple cultural realities.

## **Personal Motivation**

- My experience as a second-generation immigrant navigating dual identities inspired this research,
- Cultural adaptation affects mental health, and this project seeks to understand the neural and psychological impacts of this process.



# Big Questions - What intrigued me into this topic?

- ❖ What are the effects of Acculturation?
- ❖ How extensive are the research and studies on it?
- ❖ Does it impact the way we function and behave?
- ❖ How does acculturation influence brain activity, emotional regulation, and identity formation?
- ❖ Can AI models accurately predict acculturation stress and identify at-risk individuals?

# Acculturation

/əˌkəlCHəˈrāSH(ə)n/

- Acculturation refers to the social, psychological, and cultural process through which individuals or groups adopt the cultural practices, values, and traditions of another culture. This process typically occurs when people come into direct contact with a different culture, leading to an exchange and assimilation of cultural elements.

# John Berry's Acculturation Model

Do they value maintaining identity and characteristics of greater and majority culture?

Do they value maintaining their original identity and characteristics?

	No	Yes
Yes	Assimilation	Integration
No	Marginalization	Seperation

## Project Hypothesis

Individuals who adopt an **integrated** acculturation strategy and balance both culture identities will exhibit greater neural adaptability in brain regions associated with **emotional regulation and identity processing, specifically in the medial prefrontal cortex, & anterior cingulate cortex parts of the brain.**

This should result in lower acculturation stress and increase adaptability and performance of these individuals.

# What are the effects of Acculturation?

Values

Beliefs

Languages

Customs

Thoughts

Mannerisms

Cuisines

Dietary habits

Activity levels

Substance use

Art

Technology  
and Media

# How does acculturation affect you individually?





## Study on Acculturation and its Impact

Purpose: This form is intended to collect data on the impacts of Acculturation on Children and Youths, to be used for the data analysis, for a Science Fair Project

Study conducted by: Natania Mathew Varghese (Grade 7, Calgary Science Fair Project 2022)

Disclaimer: Any personal information in the form will not be shared with any other parties. Data will only purely be used to gather graphical metrics.

Thank you

[nataniav1@educbe.ca](mailto:nataniav1@educbe.ca) [Switch account](#)

\* Required

Email \*

Your email

Name \*

First name, Last name

Your answer

Age \*

Your answer

Gender \*

Your answer

Please choose the most appropriate answer \*

Not at all Moderately Very much

How different is your culture from that of North America/Canada?

☐ ☐ ☐

How much did you have to change to fit into North America/Canada culture or standards?

☐ ☐ ☐

How much impact does acculturation have on family family relationships and dynamic?

☐ ☐ ☐

Do you think there are enough representation of other cultures in TV, movies, books and mainstream media in North America?

☐ ☐ ☐

Were you Stereotyped with questions like do you dad work for... or do you do ... or do you eat...?

☐ ☐ ☐

Name your biggest challenge as result of acculturation? \*

Acculturation is a process of social, psychological, and cultural change that stems from the balancing of two cultures while adapting to the prevailing culture of the society.

How approachable are your parents/family in helping you overcome these challenges

	Non-approachable	Moderately approachable	I can openly talk about this to them
Mother	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Father	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Siblings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other family members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friends / Peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How more do you want them to help you with this?

	Much more	Can try a bit more harder	I am good with the current support
Mother	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Father	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Siblings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other family members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friends / Peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

# Survey Snapshots

Name your biggest challenge as result of acculturation? \*

Acculturation is a process of social, psychological, and cultural change that stems from the balancing of two cultures while adapting to the prevailing culture of the society.

Long answer text

Have you faced any of the below challenges among North American/Canadian peers? \*

	Not At All	Moderately	Very Much
Non-acceptance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lack of support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Depression and/or Stress	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discrimination	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Isolation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Less opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

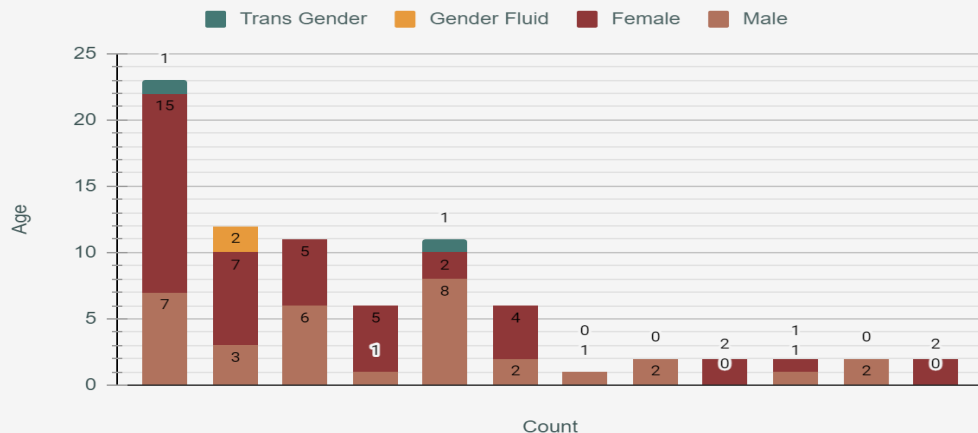
How have you dealt with these challenges? \*

- ☐ Not at all - Ignored them
- ☐ Affected you - Moderately (Was moderately there, but was able to over come it)
- ☐ Affected you very much - impacted your self confidence, stressed and depressed (Can't function)

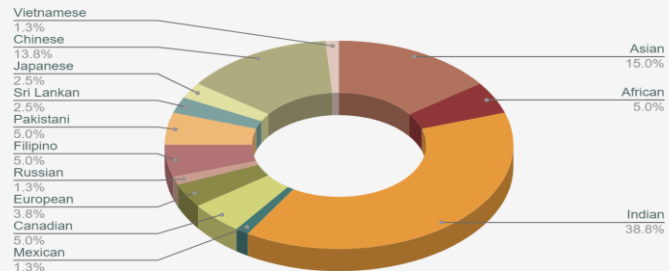


# What are the major demographics of the Study?

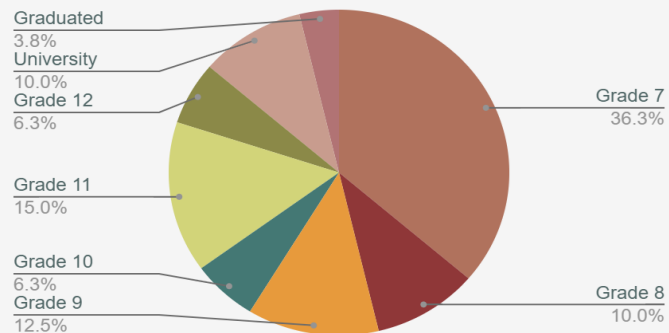
## Survey Demographics



## Ethnicity

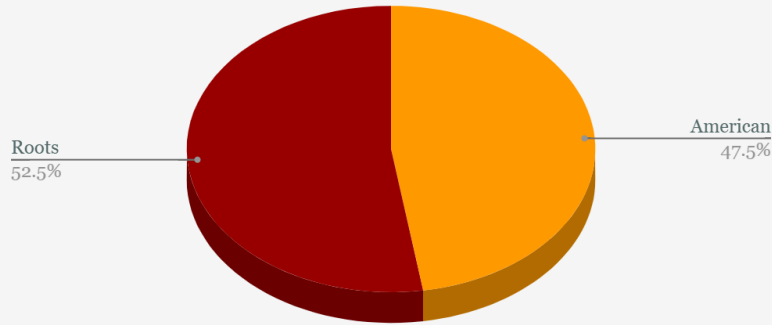


## Education



# Identity – How do you like to be called?

Do you prefer to call yourself American or by your Ancestral Roots?



Chinese

American

Canadian

Asian

Russian

European

African

Indian

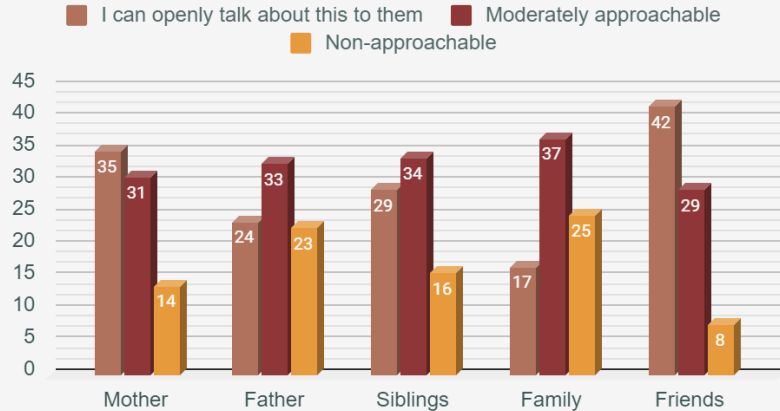
Middle  
Eastern

Cuban

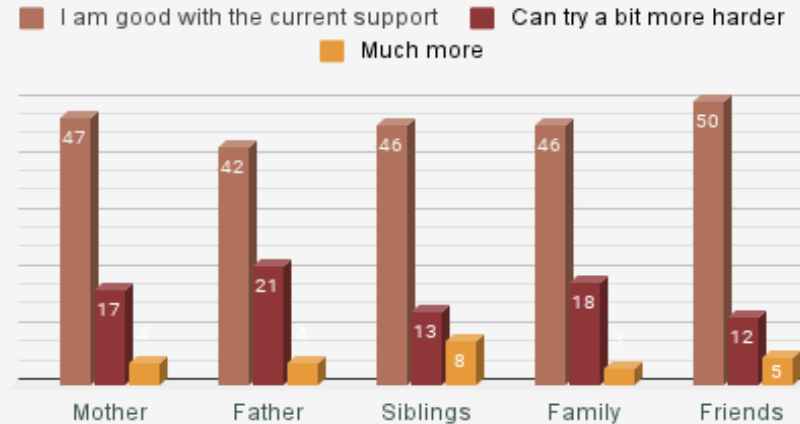
Ukrainian

# What is my level of support?

## Support Model

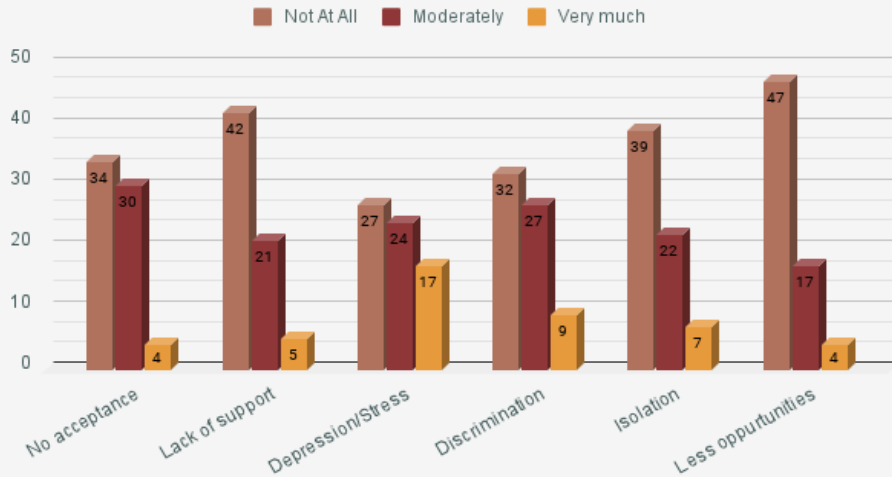


## Level of Support - Expectation

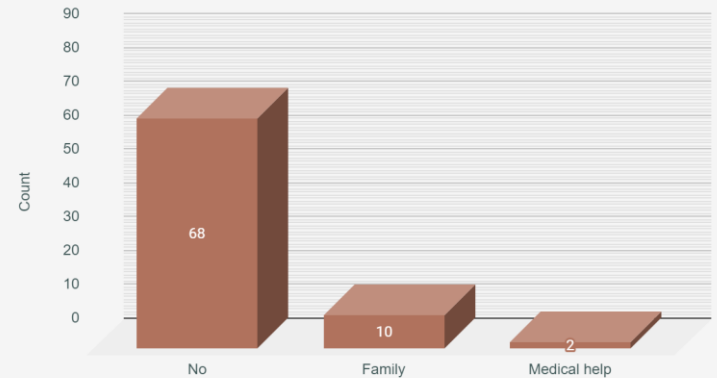


# How does acculturation affect mental health?

## Acculturation Impact



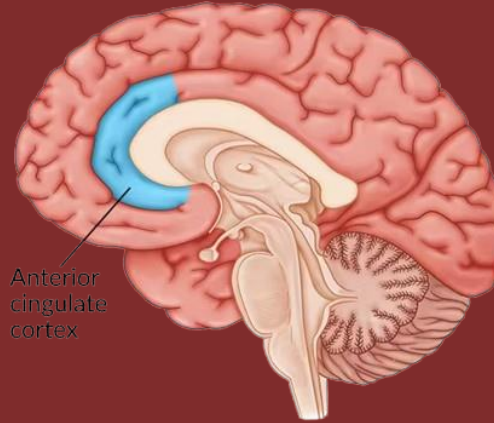
## External Help



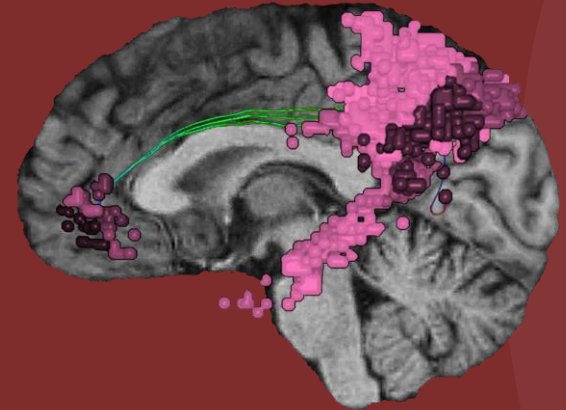
# Parts of the Brain



**Medial Prefrontal  
Cortex (mPFC)**



**Anterior Cingulate  
Cortex(ACC)**



**Default Mode  
Network (DMN)**

# Research Objectives

## Neural Marker Identification

Employing advanced fMRI techniques to identify and map the neural correlates of acculturation stress.

## Predictive AI Modeling

Build robust AI models by integrating MRI data with detailed survey responses capturing the immigrant experience into feasible results.

## Personalized Therapeutic Development

Translate insights into practice by developing personalized therapeutic strategies.



# Step 1 - MRI Data Preprocessing

**Objective :** Prepare MRI Scans for AI analysis by extracting functional connectivity features.

**Process :**

1. *Align all MRI scans to a standard brain template*
2. *Extract time-series data from key brain regions*
3. *Compute functional connectivity matrices, which measure how brain regions interact*

**Outcome :** A connectivity matrix representing how different brain regions communicate during cultural adaptation



# Step 2 - AI Model to Simulate Bicultural Brain States

**Objective :** Develop an AI model that can generate synthetic bicultural brain activity patterns.

**Process :**

1. *Train a Generative Adversarial Network(GAN) on functional MRI(fMRI) connectivity matrices*
2. *Generate synthetic bicultural brainactivity maps based on real-world MRI scans.*
3. *Compare synthetic vs. real bicultural brains to identify key adaptation markers.*

**Outcome :** A neural simulation of a well-adapted bicultural brain that can be used to study adaptation strategies.

# Step 3 - Comparing Bicultural vs. Normal Brain Activation

**Objective :** Identify key neural differences between bicultural and non-adapted brains using AI-generated synthetic brain activation patterns.

**How it Works :**

- 1. Train GAN on MRI data to generate synthetic bicultural brain patterns*
- 2. Compare real vs. synthetic brains using statistical analysis*
- 3. Identify functional differences in key brain regions*

**Outcome :** A clearer neural roadmap for enhancing cultural adaptation through brain stimulation & AI therapy

# Step 4 - AI-Powered Acculturation Stress Prediction

**Objective :** Predict an individual's acculturative stress level based on MRI connectivity.

## **Machine Learning Approach**

- 1. Train a Logistic Regression / Deep Learning Model on MRI connectivity patterns*
- 2. Predict Acculturation stress risk based on brain activity.*
- 3. Identify which brain regions correlate with high adaptation difficulties.*

**Insight :** Higher amygdala activity + weaker prefrontal connectivity = **greater adaptation stress**

**Outcome :** AI model that can predict who is at risk of acculturation stress **before symptoms appear.**

# Step 5 - Reinforcement Learning for Personalized Therapy

**Objective :** Develop an AI-Driven therapy recommendation system.

**How it Works :**

1. Train a **Reinforcement Learning(RL)** model to optimize therapy strategies.
2. Use real-world neurofeedback & brain stimulation studies as training data.
3. AI recommends personalized **brain stimulation targets** to enhance adaptation.

**Innovation :** AI learns which brain stimulation sites reduce cultural stress most effectively.

**Outcome :** A dynamic AI-driven therapy model that adapts in real time based on brain response.

# Immigrants and Cultural Diversity

## Medial Prefrontal Cortex(mPFC)

Functions : Self-referential processing, moral reasoning, social cognition

## Default Mode Network(DMN)

Functions: Introspection, identity formation, autobiographical memory

## Insula

Functions :sensory processing and plays an important role in emotions and empathy

## Anterior Cingulate Cortex(ACC)

Functions: Conflict Monitoring, emotional regulation

## Amygdala

Functions: involved in the processing of emotions and memories associated with fear.



# Project Conclusion

## Survey Conclusions :

- ★ The existence of bicultural integration underscores the cognitive and psychological capacity to navigate multiple cultural frameworks.
- ★ The observed relationship between biculturalism and cognitive flexibility suggests that acculturation enhances neural adaptability.
- ★ Individuals with higher psychological resilience reported greater success in cultural adaptation, reinforcing that traits such as self-efficacy, emotional regulation, and optimism serve as protective buffers.

## Model Conclusions :

- ★ Neuroimaging data confirms the medial prefrontal cortex, anterior cingulate cortex, Amygdala, insula, and default mode network are key cultural identity processing and adaptation regions.
- ★ Functional connectivity analyses reveal that bicultural individuals demonstrate increased intrinsic connectivity between the mPFC and ACC, facilitating greater cognitive flexibility and conflict resolution in response to acculturative stress.
- ★ Amygdala downregulation suggests a more adaptive emotional regulation

# Citations

## Websites

- <https://www.sciencedirect.com/topics/neuroscience/acculturation>
- [https://www.aacap.org/App\\_Themes/AACAP/Docs/families\\_and\\_youth/Acculturation-Development.pdf](https://www.aacap.org/App_Themes/AACAP/Docs/families_and_youth/Acculturation-Development.pdf)
- <https://www.thoughtco.com/acculturation-definition-3026039>
- <https://news.harvard.edu/gazette/story/2015/09/measuring-assimilation/>
- <https://scholars.wlu.ca/cgi/viewcontent.cgi?article=3551&context=etd>
- <https://psycnet.apa.org/record/2004-19634-012>
- Acculturation and SES Effects on Mexican-American Parents' Concepts of Development
- <http://mindsmattermagazine.com/is-there-a-relationship-between-acculturation-culture-and-mental-health/>
- [https://en.wikipedia.org/wiki/Third\\_culture\\_kid#Psychological\\_effect](https://en.wikipedia.org/wiki/Third_culture_kid#Psychological_effect)
- Acculturation Vs Assimilation
- <https://srcd.onlinelibrary.wiley.com/doi/10.1111/cdep.12346>
- [https://www.aacap.org/App\\_Themes/AACAP/Docs/families\\_and\\_youth/Acculturation-Development.pdf](https://www.aacap.org/App_Themes/AACAP/Docs/families_and_youth/Acculturation-Development.pdf)
- The Cambridge handbook of acculturation psychology
- The relationship between acculturation and mental health
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5604855/>
- <https://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=1009&context=pclc>
- <https://www.child-encyclopedia.com/immigration/according-experts/immigration-acculturation-and-parenting>
- [https://www.tandfonline.com/doi/full/10.1080/10474412.2016.1275650#:~:text=Acculturation%20can%20serve%20as%20a,\(2012\).](https://www.tandfonline.com/doi/full/10.1080/10474412.2016.1275650#:~:text=Acculturation%20can%20serve%20as%20a,(2012).)
- <https://www.slideserve.com/brennan-frank/acculturation-and-adaptation-of-immigrant-youth>
- <https://open.maricopa.edu/culturepsychology/chapter/berrys-model-of-acculturation>

## Books

- J.W. Berry, in Encyclopedia of Applied Psychology, 2004

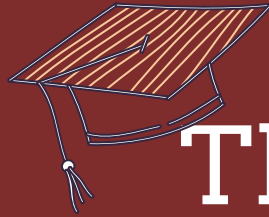
## Citations

- Cole, Nicki Lisa, Ph.D. "Understanding Acculturation and Why It Happens." ThoughtCo, Dec. 30, 2020, [thoughtco.com/acculturation-definition-3026039](https://www.thoughtco.com/acculturation-definition-3026039).

# Acknowledgements

- My Teachers
- My Parents
  - Who challenged me to take up this project
  - Helped me in my experiment and its analysis
  - Helped me with the slides
- My Sister
- My School Science Fair Coordinators
- Calgary Youth Science Fair
  - For the opportunity and acceptance to present my project





# Thanks!

By: Natania Mathew Varghese  
Grade 10  
Queen Elizabeth High School

CREDITS: This presentation template was created by Slidesgo,  
including icons by Flaticon, and infographics & images by  
Freepik and Storyset.

