

*STEM Learning through Research:
the Kingsborough Collaborative Research &
Conference Bootcamp (KCORE)*

Fostering Excellence in Teaching Award

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Communications & Performing Arts

The need

- Attrition higher in community college students
- Research experiences of various kinds have been identified as some of the best ways to recruit students into STEM majors and support their persistence to graduate with a STEM degree
- College students who receive mentoring have improved success in terms of their grades, retention, satisfaction with college and social integration into academic settings
- Students learn more rapidly, retain knowledge longer, and develop more sophisticated critical thinking skills when they are actively engaged in the learning process, particularly in the process of “discovery guided by mentoring”
- However, community colleges typically lack a culture of research
- **Bridging this gap requires creating opportunities for community college students to engage in a variety of research experiences that meet their needs**

Background

- Undergraduate research (UR) experiences can increase students' sense of preparedness and interest in STEM career
- Enhanced critical thinking skills, academic performance, content knowledge, self-confidence and self-esteem
- Generate excitement, teamwork, the development of leadership skills, and a sense of safety and support
- **Critical to UR: hands-on involvement and faculty enthusiasm**
- **Most effective: students participate in the entire research process from research design to data collection, analysis, and interpretation**
- **Students likely to be more fully engaged when they themselves collect and analyze local data on topics of personal interest**

K-CORE

- Research-in-the-Classroom (RIC) project and CRSP
- **CUNY RESEARCH SCHOLARS PROGRAM**
 - Students paid \$5,000 stipend for 10+ months
 - Mentors also receive research funds
 - 400 hours of research with faculty member
 - Bi-weekly professional development and training workshops
 - Summer & Winter Symposia
- RIC project: *Many Countries, One Language: Using Phonetic Analysis To Create A Linguistic Map Of Kingsborough Community College*

Differences



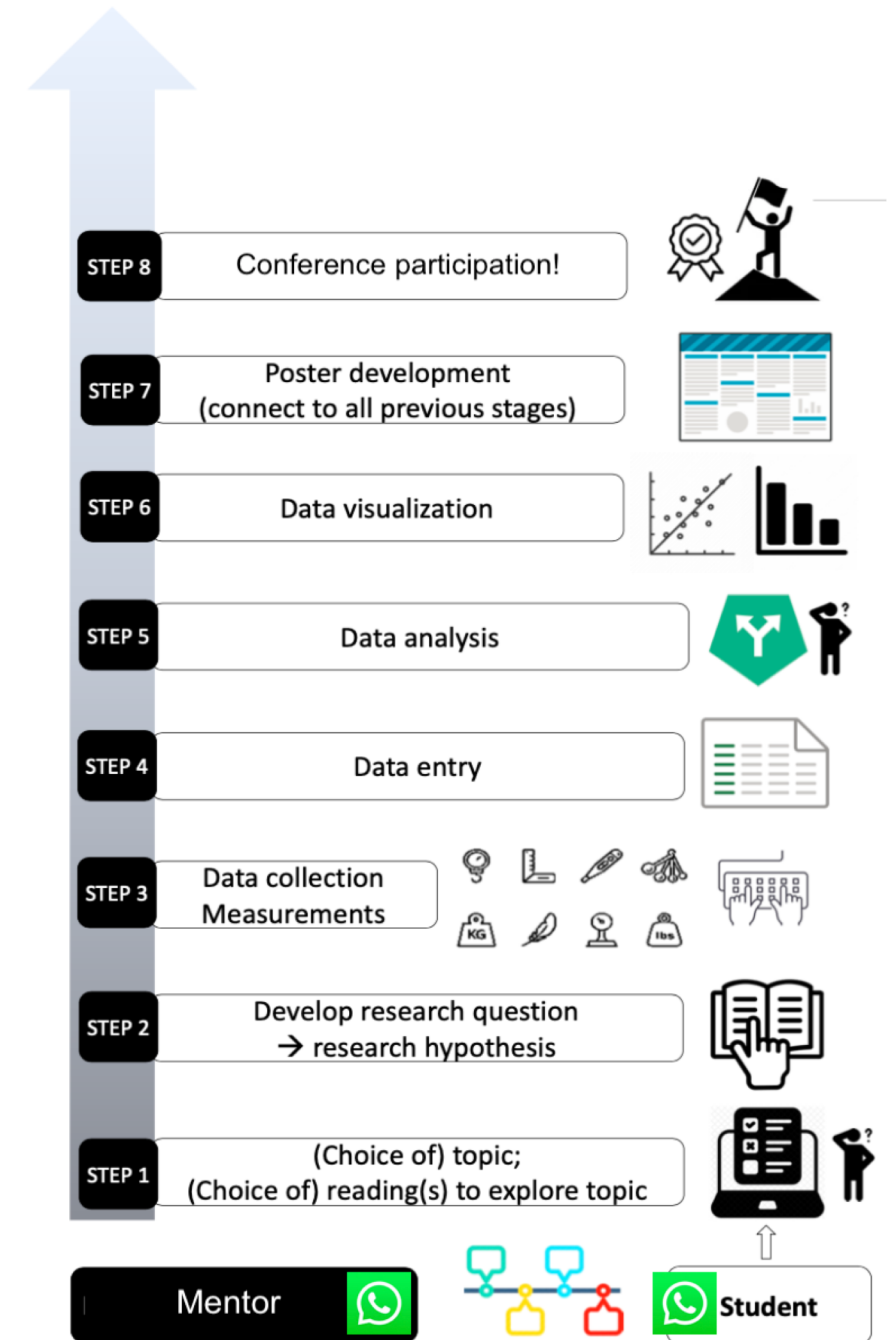
- The focus is on **group work**
- Emphasis is on hooking students from **non STEM or non-traditional STEM majors** with conceptually accessible/exciting topics having to do with language/speech
- Large-scale domestic or international professional conferences (e.g. meetings of the Acoustical Society of America)
- Use advanced students as research aides and role models for the students



- Typically **1-on-1** with mentor
- Emphasis on **STEM majors**
- CRSP (CUNY-wide) Symposia

Program structure

- Student aide selected from previous cohort
 - Recruitment phase
- Workshop 1: benefits of research and conference participation
 - Divide students into groups based on interest and availability
- Workshop 2: selecting research topics and a bibliography
 - Consultations with faculty and student aide, also other faculty members from my network
- Workshop 3: basic stats and experimental research methodology
 - The groups design their own experiment
- Workshop 4: applying to conferences and creating our poster
 - Follow up appointments, frequent communication via What's App, LinkedIn, etc.



Examples of projects

Auditory Sensory Memory and Executive Function in Monolinguals and Bilinguals

Mentor: Dr. Laura Spina
Celeste McKenzie, Kingsborough Community College

Abstract

An increasing number of studies over the past decades suggest the bilingual brain has cognitive advantages over the monolingual one (Bialystok 2018, Spina et al. 2018, Manzanera & Conway 2018, Kitteran et al. 2012). Though these findings are still controversial (Shih et al. 2018, Harizanov 2018, Page & Greenberg 2018). Among others, bilinguals have exhibited a greater ability to remember (Spina 2022), focus, and multitask (Bialystok et al. 2012).

In our experiment, participants will complete two tasks: a lexical task testing one aspect of access to lexicon (i.e. interference/lexical resolution), and a digit span task addressing auditory sensory memory. The tasks will be administered using the Pavlova and Qualtrics platforms, and each participant will be experienced separately via Zoom teleconferencing. We will compare statistically the performance of the two groups on all three tasks using multivariate ANOVAs, and we will also evaluate the degree of correlation between these.

21-22 CRP Findings

- 27 participants (22 English monolinguals and 5 bilinguals) ranging from ages 18-58 completed an arithmetic task where they memorized a sequence of numbers.
- Bilinguals were better able to multitask and be mentally flexible.
- Monolinguals were able to maintain focus in baseline, but struggled to multitask during harder tasks.

Methodology

- Participants were given five tasks. The first was the Lexical task. This tests executive function (interference/lexical resolution), and involves making right and left responses to four stimuli.
- The second task is the arithmetic task. This task tests auditory sensory memory, which involves participant repeating a sequence of numbers.

Acknowledgments

- I would like to thank my mentor, Dr. Laura Spina, for all her assistance and advice during this process. I would also like to thank Frances Tam and Dr. P. Tamara at Kingsborough Community College for their guidance.
- Finally, I would like to thank the CUNY Research Scholars Program (CRP) for allowing me to conduct research at the undergraduate level.

Introduction

According to the U.S. Census Bureau, approximately 1 in 5 adults speak a language other than English. With so many bilinguals in the U.S., investigating the bilingual advantage is of interest.

The purpose of this experiment is to examine the bilingual advantage in the context of auditory sensory memory and one aspect of executive function (i.e. interference/lexical resolution).

Executive function refers to abilities that regulate cognitive processes. The *Oxford Encyclopedia of Mental Health* defines executive function as, "a set of cognitive abilities that control and regulate other abilities and behaviors" (Shore, 2012).

These abilities include flexibility, working memory, task initiation, planning, etc. Auditory sensory memory refers to storage of auditory information in memory.

Materials

This experiment was conducted remotely using Zoom teleconferencing, Pavlova, and Qualtrics platforms.

Hypotheses

- Bilinguals will outperform monolinguals on all 3 tasks.
- Executive function correlates with performance on the Lexical Task.
- Auditory Sensory Memory correlates with performance on the Digit Span Task.

Conclusion

- The results of this experiment will add to the existing body of work concerning the bilingual advantage. There are aspects of this experiment that could have improved the end result.
- Disparate participant groups, small group sizes, and differences in language spoken and age amongst participants all affected data. The data set of this experiment was composed of eight English speaking monolinguals and 8 bilinguals of varying backgrounds. The languages spoken by the bilinguals include Italian, Creole, French, Russian, and Spanish.
- The bilinguals also had a range of level of self-reported fluency in their second language. Ages of participants ranged from 17-58 years of age. All participants are able to speak and write in their English. Any of these factors could have affected data.

References

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Research with Wordle: does slower bilingual performance on lexical decision tasks carry over to more holistic tasks involving word retrieval?

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BACKGROUND

- Despite bilinguals having been shown to exhibit cognitive advantages in executive function (Bialystok 2018, Hayakawa & Marian 2019, Marian & Hayakawa 2021), other studies reported certain disadvantages compared to monolinguals during lexical retrieval, even in their native language, mainly in terms of reaction times (Mancilla-Martinez et al. 2020, Gollan et al. 2008; Rodriguez-Fornells et al., 2005; Sandoval et al. 2010).
- Similarly, Sadat et al. (2012) reported longer articulatory durations for bilinguals compared to monolinguals in a noun phrase production task.
- According to Gollan et al. (2002), a possible source of the disadvantages is cross-language interference – a conclusion further supported by neuroimaging studies (Park et al. 2012, Parker Jones et al. 2012). Another potential explanation is that bilinguals process even their first language differently from monolinguals (Proverbio et al., 2002, Martin et al. 2012).
- In light of these findings, Higby et al. (2013) suggest that to understand both the cognitive advantages and disadvantages in multilingual speakers, we must consider the linguistic system as a whole and how the effective management of more than one language affects all aspects of cognition, both linguistic and nonlinguistic.

Effects of word length & frequency

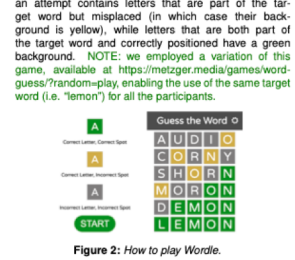


Figure 4: Mean reaction times (left) and accuracy (right) for bilinguals (blue) and monolinguals (red) for 1- and 2-syllable words. Non-words (N), real words (Y).

OUR STUDY

- We address the question whether in a more holistic, real-life situation bilinguals' executive function advantages (or possibly other mechanisms) can override slower reaction times for lexical access, making their performance similar to (or better than) that of monolinguals.
- Following Higby's (2013) suggestion, we expand previous research on retrieval to a real-life situation, specifically the increasingly popular Wordle game (Match 2022), requiring players to guess a 5-letter word in at most 6 attempts.

Participants

To date, we have analyzed the responses of 15 undergraduate students at the City University of New York (various campuses), mean age 23.2.

English Monolinguals: 5 female speakers of the NYC dialect of English.

English - Other Bilinguals: 10 speakers (8 F, 2 M) of English and another language, specifically Haitian Creole, Spanish, Arabic, Chinese, Kazakh, and Twi.

The participants completed a linguistic background questionnaire (the LEAPO, Marian et al. 2007) and were asked to report their level of prior familiarization with the Wordle game and other types of word games. Except for one participant, the others did not report playing Wordle or other word games regularly.

Figure 5: Mean reaction times (left) and accuracy (right) for words of different frequencies.

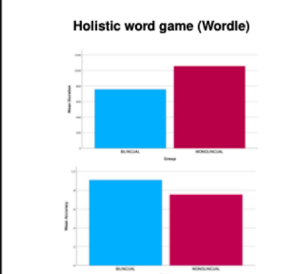


Figure 5: Mean reaction times (left) and accuracy (right) for words of different frequencies. NOTE: 0 least frequent, 3 most frequent. Non-words (N), real words (Y).

HYPOTHESES

Based on previous lexical decision findings:

HYPOTHESIS 1a: Bilinguals will exhibit slower lexical decision reaction times compared to monolinguals.

HYPOTHESIS 1b: Bilinguals will exhibit lower lexical decision accuracy compared to monolinguals.

RESULTS

Lexical decision task

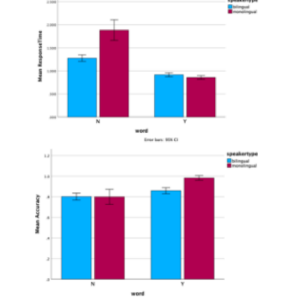


Figure 3: Mean reaction times (top) and accuracy (bottom) for bilinguals (blue) and monolinguals (red) for non-words (N) and real words (Y) of English.

EXPERIMENT

Experimental Tasks & Procedure

Both tasks were administered online via Zoom, in a 1-on-1 setting, under continuous supervision by a member of the research team.

- Lexical decision:** participants were shown a single word in orthographic transcription in the center of a computer screen and were asked to decide, as quickly and accurately as possible, whether it is a real word in English (following Vanlangenendonck et al. 2020). This task was administered using the Pavlova platform for experiment generation (Peirce et al. 2019).

SUMMARY & DISCUSSION

The limited number of participants analyzed prevents us from making strong generalizations. We are simply reporting tendencies here.

Hypothesis 1a: Bilinguals tended to be faster at recognizing non-words in the lexical decision task, but slightly slower than monolinguals at recognizing real words.

Hypothesis 1b: Bilinguals tended to be less accurate at recognizing real words in the lexical decision task.

Hypothesis 2: Bilinguals were faster and more accurate in the Wordle game compared to monolinguals.

CONCLUSIONS

- While very preliminary, our study adds to existing research on bilingual cognition and is innovative through its inclusion of a real-life, holistic task meant at investigating not only the existence of a cognitive bilingual advantage but also its potential benefits to more holistic situations.
- We also observed some effects of word status (no group differences in accuracy with non-words compared to words), word length (bilinguals are faster than monolinguals at making lexical decisions with 1-syllable non-words) and word frequency (bilinguals perform slightly worse than monolinguals on lower-frequency words).
- Limitations:** online testing, novice status of experimenters, low number of participants (for now) - all to be addressed in future work.
- Future work:** to further explore this mechanism, we plan to include executive function tasks and examine correlations with word game performance.



Figure 1: Lexical decision task.

What have we achieved so far?

Current and Past Research Assistants



Rawan Hanini



Beckie Dugaillard



Anastasiia Myslyk



Mariana Vasilita



Crystal Gilbert

What have we achieved so far?

Selected papers first-authored by K-CORE students

- Hanini, R., Spinu, L., Rafat, Y. and Alkhudidi, A. Childhood language exposure: does early experience affect sound perception and production in speakers with reduced language proficiency? Rao, Rajiv (ed.). Forthcoming (late 2022/early 2023). *The Phonetics and Phonology of Heritage Languages*. Cambridge: Cambridge University Press.
- Dugailard, B., & Spinu, L. (2019, December). [An investigation of articulatory skill in monolingual and bilingual speakers.](#) In Proceedings of the International Symposium on Monolingual and Bilingual Speech (pp. 31-37).
- Mosseri, N., & Ortega, J. [A gamified approach to teaching the expression of emotion in English to native speakers of tone and stress languages.](#) *ESLLI & WeSLLI*, 149.
- Ciccone, M., Hanini, R., & Sciannantena, M. [A Cross-Linguistic Examination of Geminate Consonant Attrition.](#) *ESLLI & WeSLLI*, 173.

Presentations by K-CORE students

2023

- **The 184th Meeting of the Acoustical Society of America**
 - Exploring bilingual effects on iconic memory using 2D and 3D visuospatial recognition tasks
- **CUNY GC Speech-Language-Hearing Sciences Student Research Poster Day**
 - Research with Wordle: does slower bilingual performance on lexical decision tasks carry over to more holistic tasks involving word retrieval?
 - Does articulatory skill differ by gender?
 - Childhood language exposure: does early experience affect sound perception and production in speakers with reduced language proficiency? The role of sensorimotor mechanisms in phonetic and phonological learning
 - Exploring bilingual effects on iconic memory using 2D and 3D visuospatial recognition tasks
 - Learning a novel accent: does specific language background modulate phonetic and phonological learning in bilingual speakers?

Conference presentations by K-CORE students

2022

- [**The 183rd Meeting of the Acoustical Society of America**](#)
 - The role of sensorimotor mechanisms in phonetic and phonological learning
 - Bilingual effects on lexical retrieval and performance on a word guessing game
- [**Bilingualism Matters Research Symposium 2022**](#)
 - [A Sensorimotor Perspective in Bilingual Cognition: Exploring the Connection Between Phonetic Learning, Articulatory Skill, and Auditory Sensory Memory](#)
 - [Research with Wordle: does slower bilingual performance on lexical decision tasks carry over to more holistic tasks involving word retrieval?](#)

2021

- [**The 5th biennial meeting of the CUNY Language, Society and Culture Conference**](#)
- [**The 180th Meeting of the Acoustical Society of America**](#)
 - [Testing phonetic and phonological learning skills remotely: Common challenges and solutions](#)

Conference presentations by K-CORE students

2020

- [Northwest Linguistics Conference](#). Virtual presentations available:
 - <https://osf.io/bx2jh/>
 - <https://osf.io/x6hpm/>
 - <https://osf.io/cp4nm/>
- [Annual Meeting of the Canadian Linguistic Association](#)
- [Web Summer School in Logic, Language, and Information \(WESSLI – Brandeis University\)](#)
- [Acoustics Virtually Everywhere: The 179th Meeting of the Acoustical Society of America](#)
- [12th International Seminar on Speech Production \(Yale University\)](#). Posters available online:
 - https://issp2020.yale.edu/S09/franceschina_09_16_198_poster.pdf (Team 1)
 - https://issp2020.yale.edu/S09/hanini_09_17_199_poster.pdf (Team 2)
 - https://issp2020.yale.edu/S02/vasilita_02_27_175_poster.pdf (Team 3)
 - https://issp2020.yale.edu/S09/mosseri_09_14_178_poster.pdf (Team 4)
 - https://issp2020.yale.edu/S09/gilbert_09_13_177_poster.pdf (Team 5)

2019

- [International Symposium on Monolingual and Bilingual Speech](#) (Chania, Greece)
- [178th Meeting of the Acoustical Society of America](#) (San Diego, CA)

Plans for this award?

- Keep up the good work!
- Fund students' participation to conferences
- Increase our numbers
- By presenting here, hopefully expand my network with interested mentors - maybe we can start replicating this in other disciplines

Thank You!
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BENEFITS FOR MENTORS

- Rewarding on a personal level
- Networking, collaboration
- Advising and interpersonal skills
- Motivation
- Own research

Thank You! Ispinu@kbcc.cuny.edu

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