Continuation/Research Progression Projects Form (7)

Required for projects that are a continuation/progression in the same field of study as a previous project.
This form must be accompanied by the previous year's abstract and Research Plan/Project Summary.

Student's Name(s) Emma Guarini

To be completed by Student Researcher: List all components of the current project that make it new and different from previous research. The information must be on the form; use an additional form for previous year and earlier projects.

Components	Current Research Project	Previous Research Project: Year: '18-19
1. Title	The Social Effect of Linguistic Alignment on Speech Production and Comprehension	The Effect of Cognitive Load on Lexical Alignment
2. Change in goal/ purpose/objective	Determine if there is a social aspect of alignment meaning that one's tendency to align may be based on there feelings towards their conversational partner.	Determine if alignment is mostly used to benefit the speaker or listener by measuring alignment levels when either the speaker or listener was under stress
3. Changes in methodology	Included a digit span test to determine how many numbers to use. The time during the task in which memory load would be administered changed for different subjects who were in one of four groups.	Included a pilot survey to determine preferred named for different pictures. Memory Load would be given either to the subject or experimenter and there were a total of three groups. This experiment only measured high school students
4. Variable studied	Alignment levels based on experimental group, age group (HS vs. adult), and the subjects feelings towards the experimenter, as well as other demographics	Alignment levels based on experimental group as well as other demographics.
5. Additional changes	This experiment measured both high school students and adults to determine if there is a difference in alignment level based on age	

Attached are:
☒ Abstract and Research Plan/Project Summary, Year 2018

I hereby certify that the above information is correct and that the current year Abstract & Certification and project display board properly reflect work done only in the current year.

Emma Guarini — Emma Guarini — 05/01/19

Student's Printed Name(s) — Signature — Date of Signature (mm/dd/yy)

Guarini, Emma

Research Plan

a. **Rationale**: Analyzing language may provide insight into aspects of the brain scientists have yet to understand. Studying alignment, the convergence of vocabulary between two speakers, may show how the brain processes incoming information and produces new information. Linguistic alignment has already been shown to correspond positively with communication effectiveness as measured by comprehension and task completion. Trends in alignment may also provide information into the underlying processes the brain uses to improve communication effectiveness. Additionally, by studying communication, researchers can understand how to improve human-AI interaction. In order to make AI more effective, we need to understand how to make communicating more efficient and understandable, which could be done using designs based on the human brain. Analyzing alignment will provide insight into how computers should be programed to adapt to their users, increasing productivity and making user experience better overall.

b. **1. Research Question, Hypothesis, Goal, Expected Outcomes:** It is unknown which words people will use when shown a picture with multiple descriptions. It is hypothesized the each of the critical pictures will have a preferred and dispreferred description. Our goal is to identify the pictures with preferred and dispreferred descriptions so they can be used in the experiment described in B2 and C2.

c. 1. Procedures, Risks and Safety, Data Analysis

- **Procedure**:
    A. Determine preferred and dispreferred descriptions
        1. Collect black and white line drawing images from the international picture naming project that could have multiple names. Images will be of common everyday objects (ex: apple, chair, backpack). There will be no inappropriate or inflammatory pictures. (see attached for full survey)
        2. In the survey, include questions confirming that the participant understands that the survey is anonymous, voluntary, and that they may stop at any time
        3. Include a question which requires the parent's consent for minors
        4. Ask age, gender, the languages the participant speaks and when the participant learned English
        5. Ask the participant to write the name of each given picture
        6. Ask the participant if the given name is an acceptable description for the given picture
        7. Send and collect pilot survey responses from 100 local high school students
        8. Choose images from the pilot survey that had a clear preferred and dispreferred description based on the results
- **Risk and Safety**: There are no risks or safety hazards associated with this experiment.

B2. **Research Question, Hypothesis, Goal, Expected Outcomes:** This study will analyze how lexical alignment is affected when the speakers are under memory load. It is unknown if when someone is under memory load, meaning they are simultaneously remembering other information, they lose some skills generally used to improve communication. It is hypothesized that when the subjects are under memory load, they will align less to the dispreferred prime descriptions of their partner. This could indicate that working memory capacity is a critical parameter for linguistic alignment. These results would also

provide evidence supporting the theory that alignment is used primarily for a comprehension benefit rather than a production benefit. This would help explain how the brain is subconsciously trying to help others understand what is being communicated.

C2. **Procedures**

Test linguistic alignment with and without memory load

A. Design experiment
    1. Print and laminate 18 critical, 30 filler, and 24 extra picture cards
    2. Make 6 groups each with 3 critical, 4 extra, and 5 filler pictures, and 1 group with 6 extra pictures
    3. Create 2 different orders for each picture group (one for the experimenter and one for the participant) excluding the 4 extra cards
    4. Create two laminated 2x4 grids
B. Run Experiment
    1. Legal guardian of subject will sign consent permitting participation in experiment
    2. Place grids on either side of a table with a divider separating the subject from the experimenter
    3. The experimenter will begin by reading the rules and instruction to the subject. They will be informed that participation is completely optional and they may decide to stop at any time
    4. The experimenter and subject will sit on opposite sides of the table with headset microphones on to record their speech
    5. The experimenter will lay out the 12 cards for round one on the subject's side
    6. The experimenter will read the 8 cards in the preset order and the subject will match the cards on their grid
    7. The experimenter will collect the cards from the subject's side
    8. Deliver memory load: if subject load, experimenter will read the preset 4 digits; if experimenter load, the subject will create their own 4 digits and read to the experimenter
    9. The experimenter will give the subject their round one description sheet
    10. The subject will describe the pictures in that order for the experimenter to place on their grid
    11. Either the subject or experimenter will recall their memory load and it will be recorded by the opposite person
    12. Repeat steps v-xi for rounds 2-6
    13. The subject will complete the post-experiment questionnaire

- **Risk and Safety**: There are no risks or safety hazards associated with this experiment.
- **Data Analysis**:
    1. Record all experimental data in a spreadsheet (words the subject used to describe the pictures)
    2. Assign all preferred descriptions with a 0 and dispreferred descriptions with a 1
    3. Add to find the total alignment score for each subject
    4. Average these alignment scores for the memory load and non-memory load groups
    5. Determine if there is a significant statistical difference between the two averages
    6. Create tables and/or graphs to display results

d. **Works Cited**:

Abel, J., & Babel, M. (2016). Cognitive Load Reduces Perceived Linguistic Convergence Between Dyads. *Language and Speech, 60*(3), 479-502. doi:10.1177/0023830916665652

Branigan, H. P., Pickering, M. J., & Cleland, A. A. (2000). Syntactic co-ordination in dialogue. *Cognition, 75*(2). doi:10.1016/s0010-0277(99)00081-5

Branigan, H. P., Pickering, M. J., Pearson, J., Mclean, J. F., & Brown, A. (2011). The role of beliefs in lexical alignment: Evidence from dialogs with humans and computers. *Cognition, 121*(1), 41-57. doi:10.1016/j.cognition.2011.05.011

Brennan, S. E., & Clark, H. H. (1996). Conceptual pacts and lexical choice in conversation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22*(6), 1482-1493. doi:10.1037//0278-7393.22.6.1482

Brennan, S. E., & Hanna, J. E. (2009). Partner-Specific Adaptation in Dialog. *Topics in Cognitive Science, 1*(2), 274-291. doi:10.1111/j.1756-8765.2009.01019.x

Fusaroli, R., Bahrami, B., Olsen, K., Roepstorff, A., Rees, G., Frith, C., & TylÃ©n, K. (2012). Coming to Terms. *Psychological Science, 23*(8), 931-939. doi:10.1177/0956797612436816

Gillberg, C. (n.d.). Outcome in the longer term: Adults with Asperger syndrome. *A Guide to Asperger Syndrome,* 95-99. doi:10.1017/cbo9780511543814.013

Gordon, P. C., Hendrick, R., & Levine, W. H. (2001). Memory-load interference in syntactic processing. *PsycEXTRA Dataset*. doi:10.1037/e537102012-414

Krahmer, E., Goudbeek, M., & Theune, M. (n.d.). Referring expression generation in interaction: A graph-based perspective. *Natural Language Generation in Interactive Systems,* 126-148. doi:10.1017/cbo9780511844492.006

Nenkova, A., Gravano, A., & Hirschberg, J. (2008). High frequency word entrainment in spoken dialogue. *Proceedings of the 46th Annual Meeting of the Association for Computational Linguistics on Human Language Technologies Short Papers - HLT '08*. doi:10.3115/1557690.1557737

Xu, Y., & Reitter, D. (2015). An Evaluation and Comparison of Linguistic Alignment Measures. *Proceedings of the 6th Workshop on Cognitive Modeling and Computational Linguistics*. doi:10.3115/v1/w15-1107

1. **Human participants research:**

   a. Participants: Participants will be high school students ages 13-18 of all genders and racial/ethnic compositions. Participants will be minors.

   b. Recruitment: Participants will be recruited from Yorktown High School in Westchester, NY. They will be invited to participate via email or a paper flyer describing the purpose of the experiment and what will be asked of them if they choose to participate. Students will be given a

consent form that they must take home and have signed by a parent or legal guardian before participating in the experiment.

c. Methods: Participants will be asked to identify and describe black and white images of various objects to the experimenter. After the experiment, participants will be asked to complete a short post-experiment questionnaire. It should take 20-25 minutes to complete the task and each participant will only take part in the experiment one time.

d. Risk Assessment: There are no physical or emotional risks involved with taking part in this experiment. It will take approximately 20-25 minutes for the participant to complete the experiment. The results of the experiment will help to understand cognitive function and improve communication effectiveness.

e. Protection of Privacy: No identifiable information will be collected. All data will be confidential and anonymous. The data from the pilot survey will be collected digitally and put into a spreadsheet. The data from the experiment will be recorded first on a hard copy and then transcribed into a spreadsheet. The data will be stored in box with access only by the experimenter (Emma Guarini), her mentor (Rachel Ostrand), and her teacher (Michael Blueglass). After the study is complete, the data will be stored in a box repository.

f. Informed Consent Process: Participants will be informed about the purpose of the study, what they will be asked to do, and that their participation is voluntary and that they have the right to stop at any time on the consent form and immediately prior to the start of the experiment. No minor will participate without a signed consent form from a parent or legal guardian.

OFFICIAL ABSTRACT and CERTIFICATION

The Effect of Cognitive Load on Lexical Alignment

Emma Guarini
Behavioral & Social Sciences

Communication is important to convey ideas and information; however, it is not always effective. A natural linguistic process, called linguistic alignment, has demonstrated in previous studies to improve communication effectiveness, however, it is unknown if alignment is performed for the production benefit of the speaker or the comprehension benefit of the listener. This study addressed this problem by measuring alignment during a picture naming task. Thirty-six participants were asked to name images of everyday objects after the experimenter primed them with the less common name. Participants were assigned to one of three groups: subject-load where the participant was under memory load, experimenter-load where the experimenter was under memory load, and no-load. We found that the subject- and experimenter-load groups both aligned significantly less than the no-load group ($p<.01$, $p<.005$). This indicates that added stress may hinder alignment, which weakens communication effectiveness. These results support neither a comprehension nor a production benefit, suggesting an alternate benefit of alignment such as a social benefit. Future research intends to explore this alternative benefit to determine why humans align their speech and how alignment can be used as an indicator of cognitive function.

Category
Pick one only — mark an "X" in box at right

- Animal Sciences
- Behavioral & Social Sciences
- Biochemistry
- Biomedical & Health Sciences
- Biomedical Engineering
- Cellular & Molecular Biology
- Chemistry
- Computational Biology & Bioinformatics
- Earth & Environmental Sciences
- Embedded Systems
- Energy: Sustainable Materials and Design
- Engineering Mechanics
- Environmental Engineering
- Materials Science
- Mathematics
- Microbiology
- Physics & Astronomy
- Plant Sciences
- Robotics & Intelligent Machines
- Systems Software
- Translational Medical Sciences

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check ALL that apply):

   ■ human participants ☐ potentially hazardous biological agents
   ☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

2. I/we worked or used equipment in a regulated research institution or industrial setting: ■ Yes ☐ No

3. This project is a continuation of previous research. ■ Yes ☐ No

4. My display board includes non-published photographs/visual depictions of humans (other than myself): ☐ Yes ■ No

5. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only ■ Yes ☐ No

6. I/we hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work. ■ Yes ☐ No

This stamp or embossed seal attests that this project is in compliance with all federal and state laws and regulations and that all appropriate reviews and approvals have been obtained including the final clearance by the Scientific Review Committee.