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Pragmatic Competence of Bilinguals: An Interface of Educational, Computational, and Neuro Linguistics

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Abstract

This study uses a different lens to describe the concept of pragmatic competence in bilinguals. Focusing on Persian-English bilinguals in virtual reality environments, this mixed-method, ethnographic research brings together three areas of educational, neuro, and computational linguistics and discusses how they all shape, and are shaped by, the concept of pragmatic competence in bilinguals. A review of the literature in all these areas reveals a clear need for more research on Persian language and a noticeable gap in the research beyond the level of syntax and semantics, which is the level of discourse and pragmatic competence. In order to address these needs, this study aims at exploring the possibilities and challenges in virtual reality environments to enhance Persian-English bilinguals' pragmatic and metapragmatic knowledge. It also investigates what brain regions are activated, and if there are cross-linguistic differences, when participants are involved in tasks which require processing pragmatics. Finally, the study discusses the implications for the type of deep learning techniques used in the research on machine identity and machine to machine/machine to human interactions.

Aim

This is a dissertation proposal for a multidisciplinary research which aims at observing and exploring pragmatic competence of Persian-English bilinguals, in face to face and Virtual Reality (VR) environments, examining neural correlates of this information in a bilingual brain, and discussing its implications for educational, computational, and neuro linguistics. Pragmatic competence in the context of this study is defined as the participants' ability to produce and respond to appropriate "speech acts" in their conversations. Speech acts under investigation in this study are requests, refusals, complements, and complement responses.

Problem

This proposal is motivated by the lack of transdisciplinary research which studies the overlapping areas of educational, computational, and neuro linguistics. Computational and neuro linguistics are the two main disciplines in linguistics which are significantly influenced, in the past few decades, by the recent research and findings in the field of Artificial Intelligence (AI).

Natural Language Processing (NLP) is a branch of AI which gives machines the ability to *read* and *understand* human *languages*. Most of the current research in NLP is tied to three key words in definition of NLP: read, understand, and languages. As far as reading is concerned, there has been many studies investigating machines' ability to "decode" the morphological and

lexical units in a sentence. Although more studies are still needed in this area before generalizations can be made, at least literature can confidently claim that machines are able to "read".

However, if machines are "understanding" what they are reading, and what "languages" they are, or should be, able to read and understand are still unanswered questions in the literature. Understanding a language is beyond the level of syntax and semantics, and there is clear lack of cross-linguistic research at the more complicated level of discourse and pragmatics in the overlapping areas of computational linguistics and NLP.

Another branch of AI which, like NLP, has transformed the field of neurolinguistics is Deep Learning (DL). The goal of research on DL is to enable machines to mimic the neuron activities in human brain. The machine "learns" to recognize patterns in digital representations of sounds, images, and other data". This concept is closely related to the distinction that DL makes between supervised and unsupervised machine learning. "Unsupervised learning is the ability to find patterns in a stream of input, without requiring a human to label the inputs first. Supervised learning, on the other hand, includes both classification and numerical regression, which requires a human to label the input data first".

Therefore, pattern recognition is based on unsupervised learning, and unsupervised learning is informed by the exact imitation of neuron activities in human brain. This clearly implies the need for more studies, and more accurate information, about what regions of brain are activated during certain linguistic activities. Similar to the gap in research on NLP, very few studies have focused on the neuron activities at discourse and pragmatics level, and there are even fewer studies focusing on cross linguistic differences, or less commonly taught languages including Persian.

Motivated by these gaps in the two disciplines of computational and neuro linguistics, and due to the need, in the field of educational linguistics, for more research on pragmatic competence of bilinguals and the affordances of Virtual Reality (VR) technology for teaching and learning pragmatics, this study, which is a three-phase mixed-methods research, seeks to investigate how bilinguals process pragmatic information, what are the possible effects of instruction on enhancing bilinguals pragmatic and metapragmatic knowledge, what areas of the brain are involved when processing information at pragmatics level, and finally what the implications are for the field of computational linguistics.

These are the main research questions which will be addressed in the three Phases of data collection in this study:

Phase 1

- What is the level of pragmatic and metapragmatic knowledge of Persian-English bilinguals in virtual and face to face environments?

  How do explicit and implicit instructions impact Persian-English bilinguals' pragmatic competence?

Phase 2

- What areas of the bilingual brain are activated when processing speech acts?

Are there any differences in the neural correlates of pragmatic processing in explicitly and implicitly instructed adult bilinguals?

Phase 3

- How does the findings of Phases 1 and 2 contribute to the research on Deep Learning?

Methods

This study is a three-phase design research which aims at observing and exploring pragmatic competence of Persian-English bilinguals and testing the effects of instruction, in face to face and VR environments (Phase 1). It will also examine neural correlates of pragmatic processing in a bilingual brain (Phase 2) and discuss the implications for computational linguistics (Phase 3). Figure 1below indicates the three main phases of this study.

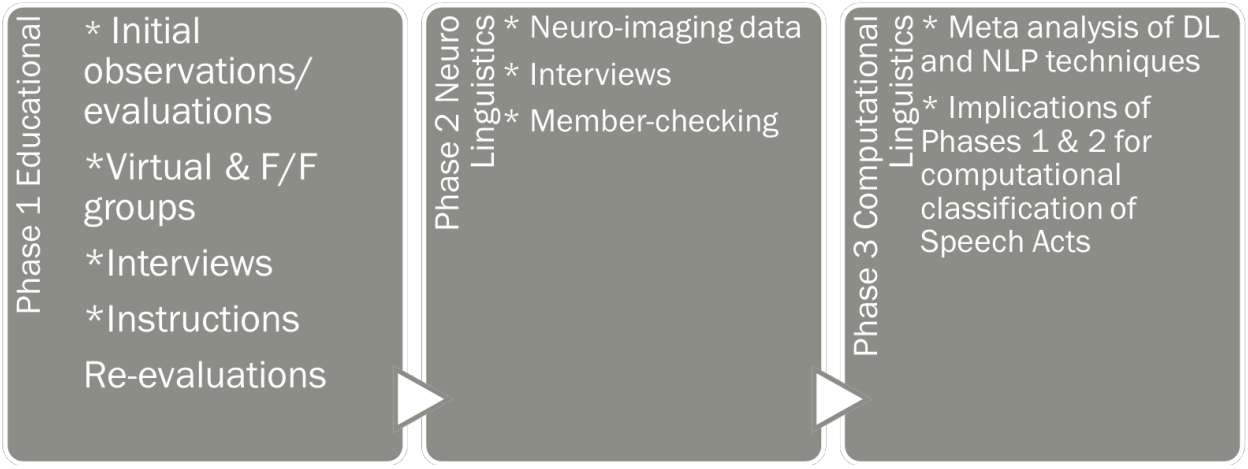

Figure 1. Three phases of the study

Phase 1: Educational Linguistics

The first research question of the study will be addressed in this phase. The focus will be on exploring pragmatic competence of the participants in real versus virtual environments and how it might be influencing, or influenced by, their metapragmatic knowledge. Also, the effects of explicit versus implicit instruction methods on raising metapragmatic awareness of the participants and improving their pragmatic competence is tested in this phase.

In the first stage of this phase, which is "initial observation and evaluation" stage, a written discourse completion test will be given to the participants in order to test their initial level of pragmatic competence. This DCT tests the participants' knowledge of four speech acts, requests, refusals, complements, and complement responses, in both Persian and English.

In the second stage, the participants will be randomly assigned into two groups of virtual and face-to-face. In the virtual group, the participants will be involved in authentic conversations with other users in a virtual environment, both in English and Persian. They will meet twice a week for three weeks, each meeting will take 30 minutes, and participants are provided with a conversation theme and instructions to follow. In order to rule out the possible effects of test environment and elicit more authentic responses, in the first two meetings the participants will be

involved in conversations not related to the purpose of the research. In meetings three to six, they will be exposed to pragmatically appropriate and inappropriate utterances in their conversations. The researcher's field notes and observations about participants' responses to different speech acts in the conversation will be recorded.

Interview and member-checking are the focus of the third stage of phase one. The purpose of this stage is to gain a deeper understanding of the participants' responses and reactions in the first two stages. The participants will be involved in highly structured interviews which will uncover the participants' level of metapragmatic knowledge in both Persian and English.

In stage four, the participants will be divided into two groups of implicit and explicit instruction. The purpose of this stage is to test the efficiency of two types of instruction on enhancing English pragmatic competence of the participants. For three reasons, it is hypothesized that the bilingual participants in this study need instruction to improve their English, versus Persian, pragmatic competence. First, Persian is their dominant language. Second, although they have received formal instruction in English, that instruction has rarely been on pragmatic aspects of English language. Third, there are culture-specific differences in speech act realizations, which will not be learned by exposure only (Rose, 2005; Rose and Kasper, 2006).

And finally, in stage five, which is the "re-evaluation stage," the DCT and group activities of phases 1 and 2 will be repeated and compared with the findings in the initial iteration of data collection and the possible effects of instruction will be tested.

Phase 2: Neuro Linguistics

The second research question of the study will be addressed in this phase. A functional near-infrared spectroscopy, i.e. FNIRS, neuroimaging technique will be employed to investigate what brain regions are activated, and if there are cross-linguistic differences, during speech act processing in bilingual speakers of Persian and English. Also, the data will be examined to test if there are any differences in the neural correlates of pragmatic processing in explicitly and implicitly instructed adult bilinguals.

The participant will take part in two sessions of data collection. In the first session, the FNIR data is collected while the participants are taking a Discourse Completion Test. The DCTs are the English as well as Persian version of the tests used in previous studies on interlanguage pragmatics (Eslami, et. al., 2015, Beeb, et. al., 1990). To rule out any potential effects of reading and writing skills on the participants' DCT performance, the oral version of the DCT is given to the participants.

In the second session, each participant will be interviewed with the purpose of gathering more in-depth interpretation of their responses. This is a structured interview with specific focus on exploring the participants' metapragmatic knowledge. The interviews will be conducted in the participants' dominant language which is Persian to ensure their answers are not affected by their language proficiency. They will listen to their recorded answers to DCT items and be asked to explain their answers in terms of what alternatives they would have and why they would choose to answer each item in a certain way.

Phase 3: Computational Linguistics

The third research question of the study will be addressed in this phase. A meta-analysis of Deep Learning and Natural Language Processing techniques will be done with a focus on Persian language. Implications of the findings in phases 1 and 2 for computational linguistics will be discussed in here.

Implications

This study will have implications for

- Persian as a foreign language learners, teachers, and curriculum developers,
- educators/researchers in the fields of bilingualism, learning technologies, educational linguistics and neurolinguistics, and also
- Computational linguists and researchers/scholars in the field of Artificial Intelligence: machine-machine and machine-human interactions, bilingual machines, and machine identity.

Author Biography

Shadi Dini is a second-year doctoral student in the PhD in Education program with a concentration on STEM education. She has a PhD in Applied Linguistics and joined Drexel School of Education in 2015 as a visiting faculty. She has done research on technology in language education, instruction and evaluation of second language pragmatics, and bilingualism in her previous positions as a Fulbright Scholar at the University of Pennsylvania and visiting research scholar at Texas A&M University.

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