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# An Investigation of Linguistic Complexity by Sex and Minority Status Under Stress

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An Investigation of Linguistic Complexity  
by Sex and Minority Status Under Stress

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## Abstract

Is the speech between men, women and minorities different under stress? Moreover, are these differences also found between speaking and self-reported experiences? The present study investigated these differences in two studies: an in-person stress task with a verbal social stress task, and an online self-reported task, with not evaluation and non-verbal responses. In particular, we were interested in what insights these differences might provide for student experiences under stress (common at a college level) and for specific identity related cognitions including one's status, sense of authenticity and belonging, and affective and cognitive events. In Study 1, following stress (induced via the Trier Social Stress Test) we tested whether or not there were sex differences in linguistic complexity under duress, we expected that men would score higher for complex speech than women based on the results of Newman et al. (2008). In Study 2, we analyzed the contents of an open-ended survey which elucidated differences in linguistic complexity depending on sex and minority status. We also included mean differences of well-known indices of perceived stress, daily discrimination (overt), and microaggressions. There was evidence of speech differences by sex but not by minority status. Moreover, males were significantly higher in status related measures, whereas females reported higher experiences of identity related stress and subtle discrimination. These results suggest a need to consider more specific early interventions and inclusion strategies for students that explicitly address how to interface with such experiences during their college years. Moreover, these findings posit a need to bridge the gap between speech differences, as these minute linguistic variation may yield differences in college performance and consequences in broader society.

An Investigation of Linguistic Complexity  
by Sex and Minority Status Under Stress

Often many individuals such as students are tasked to perform a speech or participate in a complex debate. Such common occurrences elicit a stress response which is measured by a neuroendocrine response which causes a series of feelings and physical arousals. Suddenly a student finds that their hands get sweaty, their heart rate rises, and their language complexity decreases. It is important to consider what may cause this cognitive impairment brought about by an acute stressor such as social speaking. (Saslow et al., 2014).

The “gold-standard” method to induce acute stress and thus a cortisol response involves the use of the Trier Social Stress Test (TSST). The protocol was originally proposed by Kirschbaum (1993), which included three components: an anticipation period, a speech task and a verbal mental arithmetic task. The researchers further augmented the stress response by informing the participants that they would be video recorded and that their performance will be evaluated. The evaluator will, in fact, be a confederate and adopt a non-responsive demeanor to additionally affect the participant. Prior to and at varying intervals saliva samples are taken either overnight or at twenty-four-hour intervals to evaluate the amount of free cortisol in the participant. The major hormonal stress system is the hypothalamic-pituitary-adrenal (HPA) where primarily cortisol is analyzed as it is the best biomarker for acute stress reactivity (Hellhammer et al., 2009). Cortisol from saliva has been widely used as it is less invasive than methods involving serum and because the free cortisol levels are better reflected in saliva rather than serum cortisol (Hellhammer et al., 2009).

While the TSST is considered a validated and reliable method to induce an acute stressor, the TSST was evaluated by Kudielka et al. (2004). Data from five studies were analyzed to study the HPA axis responses which included: adrenocorticotrophic hormone (ACTH) response, total plasma cortisol response and free salivary cortisol. This was in response to an acute stress caused by a stress task such as TSST in a lab setting. The different age groups consisting of older adults, young adults, and children. The results showed significant differences in ACTH and plasma cortisol levels between age groups. Interestingly, for young adults and children, there were no significant sex differences. Thus, it was thought that TSST can be considered an asset to reliably induce a stress response in a lab setting.

A 2017 meta-analysis by Jenny et al. (2017) found that when components of the TSST are reproduced, there is often a slight variation in cortisol in a sampled study group post TSST. The researchers aimed to highlight differences in cortisol levels between biological sexes and limited themselves to that rather than considering the discussion of sex being a construct. These differences were suggested to be caused by modifications to the TSST such as length of tasks, the presence of confederates and the length of recovery or acclimating when taking saliva samples. The results drawn from the 34 studies analyzed there was significant heterogeneity in the salivary cortisol levels at peak and recovery periods. Specifically, they found that women have lower cortisol at both times than compared to men. Therefore, similar to previous findings, biological sex is a significant factor in cortisol response to acute social stressors and cortisol output (Kirschbaum et al., 1993). The researchers also noted that standardized protocol for TSST was quite robust to variations, as there were no significant differences in salivary cortisol.

While the findings by Jenny et al. (2017) illustrate sex differences in cortisol response, the study was limited by several factors. Firstly, the researchers did not account for confounds such as diet, sleep or ethnicity which could affect cortisol output and reactivity. Secondly, the studies that were analyzed had TSST being used as a tool for measuring memory for example, rather than a benchmark for stress response. The researchers noted that salivary cortisol can be influenced by many interactive systems such as hormones within the body, including androgen, testosterone, and estrogen. The Kudielka et al. (2004) study was limited in a similar manner in that it used five studies used had varying protocols, which created the issue of confounding variables. They also appreciated a minor contradiction in their results as elderly men showed higher cortisol levels than elderly women which could not be fully explained. The researchers suggest that this may be a result of endocrine baseline levels which differ from individuals of varying sex and age due to prior conditions which are similar to the explanation provided by Jenny et al. (2017).

A study by Taylor et al. (2014) further explored the sex differences in cortisol reactivity. The researchers noted that women may be more susceptible to the social-evaluative components of the TSST. Thus, the cardiovascular and subjective stress reaction between one hundred and eighty-five military members military survival trainees were evaluated. This was collected the via physiological indices including the subject's heart rate, systolic and diastolic blood pressure after a 24-hour period after a mock captivity exercise. The researchers found that females reported greater impact based on lower systolic and diastolic blood pressures. This study was limited by its majority male sample and did not have a representative sample of females in military training.

Based on multiple meta-analysis and studies it seems that TSST has yielded similar cortisol levels for both sexes which makes it an adequate moderator for cortisol response and sex (Jenny et al., 2017; Taylor et al., 2014; Kirschbaum et al., 1993; Kudielka et al., 2004).

While public speaking tasks have been linked to acute emotional stress, it is important to further discuss the effects of emotional stress physiologically. When an individual experiences an acute stressor, certain components of the brain are affected by the releases of hormones such as cortisol (Saslow et al., 2014). Specifically, it is the prefrontal cortex (PFC) that is affected the most (Arnsten, 2009). The PFC is the most developed part of the human brain and is the source of complex cognition. The PFC houses a series of connections to the brain's subcortical structures such as the amygdala and the hypothalamus which are complicit in generating emotions and thought as well as cortical regions associated with motor functions and reality testing, which is a component of one's self concept (Arnsten, 2009).

Recent research has implicated the medial region of the prefrontal cortex (mPFC) as the region responsible for social cognition and self evaluation, and has also been theoretically associated with the concept of the self (Somerville et al., 2013). The researchers found an age dependent mechanism where there is higher levels of mPFC activity in adolescence, as social evaluation piques around this age, and children tend to constantly evaluate themselves in a dynamic social setting (Somerville et al., 2013).

Arnsten's (2009) research showed that certain stress signaling pathways such as the HPA response can impair affect the structure and function as well. Therefore, even mild acute stressors can affect PFC cognitive abilities. Some of the earliest evidence of stress and its effects on cognition were explored in WWII. The same air force pilots who were skilled during

peacetime crashed their planes. This was thought to be a result of mental errors caused by the severe stress of battle. Later research also showed that PFC's main function is working memory, which is the ability to store a memory and recall this information for thought. The PFC also regulates behavior in that it allows to respond to environment meaning shifting focus on a new topic or call upon deeper thinking (Arnsten, 2009).

A big issue that this paper highlights is the subject's sense of control over a stressor. Subjects who felt in control of a situation, even a simulated one, were not as impaired by stress exposure (Arnsten, 2009). This has been verified through animal studies in the work of Greiveldinger et al. (2009) as well. Ethically all subjects must have some control in a study and be allowed to leave the experiment at any time. Therefore, this factor of control poses a particular problem stress research in human subjects.

While previous work has shown that a combination of cognitive and public speaking task has been associated with greater physiological response, relatively recently researchers have also explored how acute stress could affect cognitive complexity while speaking specifically (Saslow et al., 2014). It is thought when people encounter a stress such as the one caused by TSST, an individual reaches an alarmed state and this stage is concurrent with lower thought complexity (Suedfeld, 1992). This is known as the disruptive stress hypothesis, where greater stress leads to decreasing complexity of thought.

This complexity of thought while speaking has been studied extensively. James Bradac (1986) first explored if there were any repeatable patterns in speech. He noted that words that individuals use are can elucidate social relationships and help understand human beings as a whole. Historically Freud wrote about tongue slips and Rorschach about how people described



ink blots; the words and phrases helped to study the inner workings of the mind. Later work was conducted by Gottschalk and associates who allowed subjects to speak for five minutes, and transcribed the text which was later analyzed by judges; this helped to diagnose cognitive impairments and mental disorders (Tausczik and Pennebaker, 2010).

To automate the text analysis, Phillip Stone and others developed software, called the general inquirer, which was flawed in that it relied too heavily on algorithms generated by the user and it was unclear as to how it would score the language (Stone et al., 1966; Tausczik & Pennebaker, 2010). In the 1980s, James Pennebaker developed the Linguistic Inquiry and Word Count (LIWC) software to address three errors with older research that was manually transcribed and judged by experts. Firstly, the judges were often in disagreement. Secondly, Moreover, it was time consuming and expensive to manually transcribe the speech to text. Finally, the judges who were scoring the data experienced depression from reading the sad stories they were tasked to transcribe.

The software developed by Pennebaker (2010) LIWC has two components, a processing center where the text is analyzed and a dictionary section from which the text is compared with. After comparing the text to the dictionary component, the words are placed into one of eighty categories. The software is able to distinguish content words which is what an individual says, and style words, which is how words are placed together. Style words are categorized as exclusive words, for example, these may be words such as 'except, however and unless' (Saslow et al., 2014; Tausczik & Pennebaker, 2010). These style words are able to aid in the understanding of an individual's mental state and using more style words are related to speaking with greater cognitive complexity (Saslow et al, 2014). While the LIWC is a robust means of

speech content analysis, it is unable to detect subtext such as irony and sarcasm (Tausczik & Pennebaker, 2010).

Given the HPA axis and brain activity inhibition by stress hormones and the disruptive stress hypothesis, Saslow et al., (2014) hypothesized that greater stress reactivity would relate to lower linguistic complexity. They note that an individual with a higher linguistic complexity most likely has higher PFC activity which reduces cortisol reactivity. It is also possible that higher cortisol reactivity would lead to impairment of the PFC which would result in lower linguistic complexity. The researchers used linguistic measures for cognition, which were extracted from the LIWC software. They ran three studies all of which studied the stress response from a psychosocial stressor such as a TSST (Saslow et al., 2014).

Study 1 by Saslow et al., (2014) involved speaking to a stranger and the researchers found that individuals who had lower linguistic complexity also had greater stress reactivity namely greater average heart rate. In study 2 and 3 involved subjects undergoing the TSST and the results showed greater cortisol reactivity and lower levels of linguistic complexity. The researchers also employed an emotional stress and positive reactivity survey, through which they found a positive correlation between positive emotions and greater cognitive complexity. This means that individuals with greater linguistic complexity tend to be more resilient to stress tasks. While the results of this study are intriguing, it is limited in how its sample of subjects was collected. It is possible that their sample contained individuals who experience chronic stress, who may have physical changes in their neural pathways that lead to extremely low or high-stress reactivity. It is also lacking in that two-thirds of the study sample were exclusively women and that there may be a sex difference which Saslow et al. (2014) suggest for future

study. In current and past research, a relationship between cortisol reactivity and acute stressors such as the one presented by the TSST have been explored. But sex and linguistic complexity have not been explored in as much depth.

In the vast literature, a single meta-analysis by Newman et al. (2008) studied the sex differences in language use through an analysis of text samples. They found that the main difference was that women tended to use more social words whereas men tended to use more complex language. One notable study however studied one distinct difference between male and female discourse. The researchers looked at two types of filler words which included as *like*, *um* & *you know* and conducted a psychometric analysis via content analysis through LIWC (Laserna et al., 2014). The first type that was studied were discourse markers such as *I mean* & *like* which serve no grammatical purpose but are often used when individuals are making inferences or are transitioning to another phrase and previous research has found that females use more of these (Laserna et al., 2014). The second type explored were short phrases or filled pauses, for example, *um* & *like* which are associated with complex thought processing (Laserna et al., 2014). Previous research has found that increased use of filled pauses is associated with the speaker being uncertain in what is being said but paradoxically are perceived as less anxious and being of the female sex and having a lower education (Laserna et al., 2014; Tottie 2011).

The researchers used LIWC in a novel way to analyze transcriptions from a sample of males and females from three age groups, which were college, early adulthood, and adulthood and employed the big five inventory to determine personality. They found that females especially when they are younger tend to use more discourse markers, but this sex effect is not as strong in older age individuals (Laserna et al., 2014). The researchers suggest that this may be associated

with females being more conscientiousness, as conscientiousness people tend to be more aware of others in a social group and may use filler words to aid in discourse in groups. They also found the lack of sex differences in older individuals may be explained by a natural transition into adulthood where a career role transition leads to differences in the use of filler words (Laserna et al., 2014).

Research Question Study 1: We hypothesized that there would be differences by sex and minority status for the in-person speech stress task, with men scoring higher for linguistic complexity under stress, and women and minorities scoring higher in negative emotion LIWC categories?

Research Question Study 2: We explored whether the same findings would be obtained in a larger (N= 292) sample using written responses to identity related stress surveys.

## **Method**

### **Study 1**

The goal of this project was to identify if linguistic complexity is affected in a well-established stress task. In order to achieve this goal, the following research objectives were developed to specifically enhance student outcomes:

1. Characterize the linguistic complexity of a given population and study if there is indeed any difference by sex in linguistic complexity via stress reactivity.
  - a. Analyze/interpreting the data
2. Suggest ways that this disparity or differences can be addressed.
  - a. Public speaking class
  - b. Include help in writing center

- c. Specifically address how students can interface with implicit social stressors.

The following chapter outlines the methodologies employed to gather the data and analyze it to achieve the research goals.

## **Recruitment**

The participants of this study will be comprised of individuals from the Worcester area as well as students from Worcester Polytechnic Institute. The subjects will be gathered using the online web tool SONA systems. This is an online platform used by many researchers that allow data to be collected through surveys and to prescreen participants for this study.

The final participant pool for this study included 34 people between the ages of 18 and 23, with 50% male and 50% female each. The participants are prescreened for cardiovascular or psychiatric issues that may affect the linguistic analysis.

## **Measures and Procedure**

### **Trier Social Stress Test (TSST)**

The experimenter instructs the participant about a short speech task and a math task which involves instructing the participant that they will be allotted five minutes to prepare and then deliver a 5-minute speech to a panel of evaluators, who are trained in reading body language to study presentation abilities. This study will only consider the speech component for the data analysis. All participants are given the same speech topic by the experimenter, the topic is to imagine that they are interviewing for their dream job. They are then asked to describe characteristics that would make them an ideal candidate for the mock position that will be proposed.

The standard TSST task involves a trained evaluator present during the speech. During the speech, the evaluator occasionally takes notes. If the participant continually stopped for longer than 30 seconds, the evaluators were trained to prompt them with a list of questions from the TSST such as:

1. “Why do you think you’re qualified for the job?”
2. “Why do you think you’re better than other applicants?”
3. “Please complete the sentence ‘I’m the best in...’” follow up with “why?”

Regardless of the condition, the participants will perform their speech in front of a microphone and a video camera. The subjects were informed that they will be recorded when the informed consent was applied. The videos were recorded to preserve the audio of the participant’s speech which would later be used for the linguistic analysis.

### **Transcription & Linguistic Cognitive Analysis**

Before the speech’s content could be analyzed, it had to be transcribed at the LIWC software only accepts files in .txt format. Google docs were used as the word processing software used to transcribe the videos. The voice typing tool was heavily implemented as it allowed for faster transcription of videos. The voice typing tool was used while the video was allowed to play, and any necessary adjustments were made after the video would be completed. Then the video was played for a second time to fine tune the grammar and spelling, which the voice typing tool had incorrectly processed.

According to the operators manual for LIWC, the text had to be prepared and organized in a certain way. The main consideration that had to make was labeling non-fluencies or filler words with a prefix of “rr.” In practice language used as filler words were labelled as “rrlike” for

example. This presented a challenge, however that it was not always clear which words were filler words or being used grammatically correctly. Another issue that presented itself during the transition was how to consider stutters or short pauses. The operator manual for the LIWC software notes that the software does not recognize traditional transcriber comments such as “(pause)”, or “(silence).” Instead hm, hmm, uh, uhh, uhm, um, umm, and er were used to denote such moments. This highlighted another issue in that it was left to the transcriber’s discretion as to how many uh’s were appropriate.

In order to keep track of all the transcribed videos, a simple naming scheme was used which was the sex, denoted by an F or an M followed by the date or subject ID. Once all the data was collected it was transferred to the LIWC software for content analysis

A relatively novel approach will be used to analyze the speech from the TSST. Linguistic Inquiry and Word Count (LIWC) software developed by Pennebaker et al. (2010). Individual text files will be made for each participant and then run through the software. The LIWC software analyzes speech by comparing the input text and its percentage within more than seventy categories.

### **Limitation**

The sample size is a total N=34, 50% female and may be considered a pilot data set.

## **Study 2**

### **Participants /Recruitment**

Participants were recruited online via SONA recruitment database for students and the community. A final sample included 292 participants from a private STEM university in the

northeast, ages 18-23 and 48.2% female. Participants were awarded course credit for their participation.

### **Sociodemographic**

Participants were asked their age (in years), sex, and college status (freshman-senior). Participants were asked their primary heritage group: American Indian or Alaska Native (0%), Asian (13.4%), Black or African American (2.7%), Latin American (2.4%), Native Hawaiian or Pacific\_Islander (0%), White (71.9%), or Other (7.6%), Missing (2%). Race was recorded into two groups: minority and non-minority status.

### **Stress Measures:**

#### **Daily Discrimination (Williams, 1999).**

This is a reliable and validated measure of perceived DD, using a Likert scale from zero-four, where zero = never, one = almost never, two = sometimes, three =fairly often, and four = very often, for example, “how many times daily are you treated with suspicion?”. Four items were reversed scored before averaging, such that a higher endorsement reflected higher perceived stress (Cronbach  $\alpha = 0.86$ ).

#### **Modified Microaggressions Scale as a Stress Measure (MMS; Nadal, et al., 2011).**

This is a reliable and validated measure of the frequency of microaggression experiences. The Likert scale is rated from zero-five, where zero = did not experience, one = about once a year, two = about once every few months, three = about once a week, four = about once a week, five = at least 3 times per day (Cronbach  $\alpha = 0.78$ ). The modification included adding an open-ended question after items where respondents were asked the primary reason they were treated unfairly for categories other than race. These included: sex, sexual orientation, age,



weight, foreign-born status, or other. For example, “Someone assumed that I would not be intelligent because of my race, sex, sexual orientation, age, weight, foreign-born status, or other.”

### **Transcription & Linguistic Analysis**

Data from the modified microaggression scale was compiled in an excel file, and these open responses were analyzed for their content. A protocol similar to study 1 was used.

### **Limitation:**

Although this study had a much larger sample size (292 participants), only 25% identified as a minority, this sample could be balanced in the future study.

### **Results**

Study 1. Data were first examined for normality and missing data. All variables were normally distributed and there were zero missing data points ( $N = 34$ ). Independent t-tests examined mean differences by sex (2) in content analysis output where the variables were 1.5 standard deviations above the mean of other categories; these included analytic, clout, authentic, pronoun, and focus present.

Trends were found for two linguistic categories, including analytic (trending significance  $p = .06$ ),  $t(1, 32) = 1.946$  and authentic,  $t(1, 32) = 1.946$ ,  $p < .05$ , where males were higher in both categories (analytic  $Mm = 43.00$ ,  $Fm = 32.40$ ; authentic  $Mm = 80.00$ ,  $Fm = 69.03$ ).

Study 2. Data again were first examined for normality and missing data. All variables were normally distributed and there were zero missing data points ( $N = 292$ ). T-tests were utilized to analyze differences by sex (2) and minority status (2) on content analysis categories where variables were 1.5 standard deviations above others; these included analytic, clout, tone, words per second, social, friend, female, male, sexual, achieve, and reward. Minority status was status

controlled where it was not a predictive subject variable in the models. Age and college status were entered as covariates.

The t-tests examining sex differences obtained significant results for PSS ( $t(1, 288) = 2.89, p < .05$ ), and MMS ( $t(1, 289) = 2.35, p < .05$ ), and SD ( $t(1, 289) = 3.96, p < .001$ ). Females reported higher negative experiences in all reports. The t-test examining DD was not significant by sex ( $p > .05$ ). While minority students reported greater experiences of these events, there were no significant differences by minority status in the scales.

### **Linguistic analysis.**

Several of the primary content words were significantly different by sex. These included clout, words per second, friend, female, male, sexual, achieve, and reward (all  $ps < .05$ ). Trending were tone and social ( $ps = .06$ ). Specifically, females were higher in content categories of friend, female, sexual, achieve and reward, where males were higher in clout and words-per-second. In addition, numerous categories were significantly different by minority status (white/non-white self-identified). The categories included analytic, clout, male, female, cognitive processing, insight, and power. Specifically, the minority identified students were higher in analytic, female, and insight words, and white students were higher in all other categories ( $ps < .05$ ).

### **Discussion**

We predicted that there would be sex differences between men and women that would present themselves via the LIWC analysis. We also hypothesized potential differences between minorities compared to males or non-minorities. The experiment yielded interesting results, however, it was challenging to interpret what the LIWC means meant for our results. To explore

this further the literature was consulted to interpret the results. The 2015 version of LIWC was outfitted with multiple new summary variables based on prior research that are content categories that are able to provide rich insights: authentic, analytic and clout (Pennebaker et al., 2015). Is it possible that these linguistic cues may affect how an individual is perceived?

Study 1 showed that males scored for both analytic and authentic categories, and it is important to consider the implications of this. Indeed, it is possible to learn about people via their distinct linguistic styles, such as their authenticity which is associated with greater use of self-references, other-references and lower negative emotional words (Newman, 2003). First, the use of self-references or first-person singular is consistent with true stories, and liars may avoid this to distance themselves from a narrative (Newman, 2003). Second, telling a false story leads the speaker to feel guilt which is reflected through the use of more negative emotion words (Newman, 2003). Finally, authentic individuals speak with greater linguistic complexity, as telling a lie uses cognitive resources leading to a simpler narrative which is seen through a lower use of pronouns (Newman, 2003).

Speaking authentically consistent with the linguistic cues of an introverted person, as certain categories of the LIWC are associated with an individual's disposition. Introverts tend to speech consists of a more concrete and descriptive style which can be explained by the more calculated way in which they speak (Beukeboom et al., 2013). Introverts also tend to perform better in written cognitive tasks and thus score higher for cognitive processing via LIWC analysis (Beukeboom et al., 2013). In contrast, extroverts differ in two ways: first, they speak more abstractly which involves mostly describing feelings/traits and second, they tend to use more words per second (Beukeboom et al., 2013).

Speaking with greater abstractions can totally change the flow of a conversation and can make the speaker more personable (Beukeboom et al., 2013). An example of an abstraction would be, Paul is honest, by saying that statement in a conversation a lot of information can be generalized and interpreted from that one statement (Beukeboom et al., 2013). This can have a profound impact in a job interview setting such as that of the TSSTs from the studies. Introverts are more cautious in conversation settings, and thus use a more concrete linguistic style to combat the fear of social judgment, whereas extroverts tend to use more abstractions and thus are more relatable (Beukeboom et al., 2013). An example in a job interview setting would be saying that you are a hard worker, this would clue in the interviewer about your personality, whereas an introvert may be more reserved and say they have done a lot of work and provide concrete examples.

The next summary variable of interest was analytic, as we predicted that there would be sex differences for this in the LIWC analysis results. Previous research has found that a higher GPA or scholarly efficacy is related to the use of small words such as personal pronouns (Pennebaker et al., 2014). The researchers looked at college admission essays which were graded based on a standardized grading system (Pennebaker et al., 2014). The result was that GPA was negative correlated with the use of pronouns and personal pronouns which is associated with a lower score in the analytic category (Pennebaker et al., 2014).

It is important to consider that pronoun use is also related to another variable of interest which was social hierarchies or clout. Higher clout is the relative position, power or status of a person in a given group (Kacewicz, 2014). This dimension has also been explored via LIWC analysis. Previous research which included five different studies where the status of the subjects

varied has looked at the natural usage of pronouns in a group setting and found that those with a higher status used fewer pronouns (Kacewicz, 2014).

The results of study 2 were somewhat consistent with the findings of Tausczik & Pennebaker (2010), where they cited a previous study, that involved individuals in a ship's crew, an occupation where a professional hierarchy exists (ranging from the captain to a lieutenant). They noted that those who view themselves in lower status tended to have more insightful responses, and study 2 showed that minority identifying students scored higher in the LIWC variable of insight words which is related to the usage of words such as *think* or *know* (Pennebaker et al., 2015). It is possible that the usage of these words could be the result of being unsure of what is being said or could be related to placing oneself in lower status. Somewhat perplexing is that these students scored higher in the analytic summary variable, which is associated with higher linguistic complexity. Perhaps this due to the analytic category being associated with a higher word per sentence count, which may be a result of compensating (Tausczik & Pennebaker, 2010). It is interesting to note that in a group setting, team members rate one has assertive or dominant based on their total word count (Tausczik & Pennebaker, 2010).

Based on our results, we propose the following recommendations:

- 1) Extrovert Workshop

- a) Women and minorities perhaps due to a variety of factors based on our study seem to be more score less in the authentic category due to their linguistic style. This, as a result, makes them appear less authentic based on LIWC, which could

have various implications for a project-based institution, such as group evaluations and even future job interviews.

2) Improve diversity on campus

- a) This would involve SGA sanctioned or SAO or even club led activities that would aid in helping minorities be more welcomed and heard around campus by specifically addressing implicit negative biases which are usually not under the control or awareness of the person with the negative association. While well-meaning to consider that these biases do not exist, initiatives should discuss how students can interface with such interactions when they occur. For example, the results of Study 1 showed that females were lower in 'authentic' and study 2 illustrated that minority students were lower in 'clout' and thus may feel perceived as untrustworthy or lower status, common negative biases, which can be mitigated by such activities.
- b) Give further opportunities to minorities to empower those students. The result of study 2 shows that minorities score lower for clout and therefore may not hold themselves in high status than compared to non-minority students.

3) Writing/Speaking workshops

- a) In both study 1 and 2 women score lower and in study 2 minority student score lower in the analytic category. This would involve teaching people to use less personal pronouns, adverbs, and negations and instead write and speak in a more categorical way or formal way. Speaking more informally and diving into too makes one have the appearance of being less analytic or less cognitively adept.

## **Conclusion**

WPI as an institution that has made considerable strives in providing opportunities to women and minorities which include the recent diversity, inclusion and equity initiative. Our results suggest that these efforts work in some instances but could be further improved upon.

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