**CS 535: Homework 1**

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**Answer 1:**

Verbal and nonverbal behavior of a person helps us in determining whether their opinion is positive, negative or neutral. In the study of the videos several variations in these behaviors are observed from person to person for each opinion.

Positive opinions of the people were reflected both in their verbal and nonverbal behaviors. Verbal behaviors include usage of words like love, happiness which expressed the positive opinions. People also exhibited several nonverbal cues to express their positive opinions. People usually tend to laugh, smile when expressing positive opinions. This was observed in most though not all of the videos where speakers had positive opinions. In many videos, it was observed that subject’s eyes widened and their eyebrows got raised when they expressed positive opinions. Change in voice pitch was also observed when people expressed positive opinions. Voice pitch changed when people wanted to express a positive opinion than when they had a neutral pitch seconds before while expressing neutral opinion. People changed their speaking rate sometimes when talking about positive topics and sometimes change of speaking rate was used just to emphasize certain parts of the verbal communication. People also used hand gestures to express their positive opinions. But there were many variations in hand gesture movements which were observed depending on the topic and also on idiosyncrasy of the person.

The verbal behavior for negative opinions involved usage of certain words, whose context taken into consideration, heavily swayed the opinion to one side. Words like hate conveyed the negative opinions of the speaker. In some cases metaphors were used like comparing a person to vulture to express a negative opinion. Speakers also used profanity to express their negative opinion. Usage of profanity undermined the nonverbal cues in analyzing the opinion of the speaker. Nonverbal behavior for negative opinions included closing of both eyes, clenching of teeth, eyebrows moving inward, inhaling deeply and hand gestures. Hand gestures for negative opinions varied greatly from person to person as observed in case of positive opinions as well.

In one video while expressing negative opinion with sarcasm speaker uses finger quotes. In some cases people stressed on some word syllables while expressing negative opinions. Change in voice pitch, speech rate was also observed when people expressed negative opinions.

While expressing neutral opinions the verbal behavior consisted of words whose connotations were neither positive nor negative. There was no rise and fall in pitch when people expressed neutral opinions. In a couple of videos people had smile on their face when expressing neutral opinions but there was not any change in speech rate and pitch in those cases as well. No variation in pitch, speech rate and monotone voice were the most significant nonverbal cues observed for neutral opinions.

By the study of verbal and nonverbal behavior for different speaker opinions, we observed that speaker’s words along with eyebrow movement, smile, laugh, eye widening, variation in pitch, speech rate were the most common observed discriminatory behaviors.

**Answer 2:**

The nominal Krippendorff’s Alpha value is 0.5845. If the alpha value is >= 0.8, then it is considered reliable. If 0.8 > alpha >= 0.667, we can draw tentative conclusions about agreement. Anything less than 0.667 should be discarded is the general rule of thumb. So, if we go with the general guideline, this alpha value is not reliable. However, our alpha value still provides some information about inter-rater agreement. We observe that at least two of the raters agree for most segments. However, there are times when all three of them completely disagree with each other or all three of them completely agree with each other.

**Answer 3:**

We picked five behavioral cues. The visual cues picked were mouth openness, right eye openness, smile intensity and face up down level. The acoustic cue picked was NAQ.

As NAQ refers to tenseness in voice, we hypothesized that a person would be more lax, and not tense while exhibiting negative emotions. The reason behind being, one tends to mumble out words loosely when they are sad or depressed, while they would be more tense with their pronunciation if they were happier. From the boxplots and ANOVA test, we find that the NAQ gives an extremely really low value of p=0.000266 and shows progressively higher median values for negative to positive with positive having more higher values as well.

Just like NAQ, mouth openness seemed like a more positively connoted feature. A happy/excited person would open their mouth more while talking. We notice that ANOVA and the boxplots correlate with our opinion with a low p value of 0.007821 and very similar boxplots as NAQ – progressively higher median values and higher values in positive in comparison to negative. For right-eye openness, we took into consideration eyes in general and observed that eyes tend to be widened while exhibiting more positive emotions. This hypothesis was more or less validated by our analysis. ANOVA gave a p value although not lesser than 0.05, was still quite low (0.154573). The boxplots show that the median is highest for positive and also 50% of the data is nicely spread over the larger values; this was more than neutral and negative. Next, we looked at the smile intensity. As per our observations, smile signified positive emotions more as we felt there was no sarcasm involved. Unfortunately though, the ANOVA results gave a very high p value of 0.685063. The boxplots show that the medians don’t follow any pattern and are highest for neutral. But, we find that for positive the points go higher showing that high intensity smiles can be used to show positive emotions.

Finally, we observed that face up would display more confidence and hence be more positive, while face down would display nervousness or even sadness and hence be associated with negative emotions. But the ANOVA showed an extremely high value of p (0.921035). Also the boxplots showed that the medians did not follow any pattern, with highest being for neutral. In fact, the boxplots show that higher values (faced up) are present for negative emotion which is the opposite of our observations.

As the first three features (NAQ, mouth openness and right eye openness) gave very good values and validated our hypothesis, we understand that they are good features that can be used to identify emotions well, while with the last two (smile intensity and face up down), we can’t say anything about the state of emotion as they can be used more widely across all emotions.