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Perceptual Evaluation of Attitudinal Expressions

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Abstract

Building upon previous experiments investigating the cross-cultural and cross-linguistic perception of short audio-visual expressions reflecting various attitudes, we conducted a comparative analysis of verbal responses from Indian and German participants to stimuli presented in Hindi. These responses were delivered in either English or Hindi for Indian participants and German for German participants, then normalized and translated into English for analysis. Leveraging a comprehensive study by Warriner et al., encompassing nearly 14,000 lemmas, we aligned our existing labels with their established reference system, enabling a cross-language evaluation. Our findings highlight significant influences of attitude type, participant language, and stimulus language on raters' responses across dimensions of valence, arousal, and dominance. Correlation analyses within and between rater groups indicate a notable replication of judgments between Indian and German evaluators.

Index Terms: social attitudes, Hindi, auditory-visual speech, free labeling

1. Introduction

Expressions of attitudes play a crucial role in speech communication, serving as a foundation for understanding and navigating dialogues. In conversational settings, we continuously observe our interlocutors' behavior, aiming to discern their intentions and attitudes while adjusting our own speech accordingly. Our beliefs about the world, encapsulated in our propositional attitudes, heavily influence our actions, interacting with social attitudes shaped by cultural norms. Therefore, clear expression and interpretation of attitudes facilitate effective dialogue management and goal achievement. During face-to-face interactions, we leverage information from both the acoustic channel, such as prosodic cues, and the visual channel, including facial expressions and gestures, to comprehend attitudes. This information encompasses not only linguistic elements, such as spoken words, but also paralinguistic components, particularly emotions. However, interactions between individuals from different cultural backgrounds can be susceptible to misunderstandings, leading to incorrect interpretations of attitudinal expressions.

In prior research, we extensively examined attitudinal expressions among speakers of German and Cantonese, uncovering significant parallels and differences in both production and perception. These studies drew upon the paradigm introduced by Rilliard et al. [3], which outlines

methods for eliciting, recording, and evaluating spoken utterances conveying various social affects. Sixteen distinct attitudes, such as arrogance, politeness, doubt, and irritation, were identified, each associated with specific communication objectives and social contexts. Table 1 in this article presents these attitudes along with their corresponding abbreviations for ease of reference.

Following perceptual evaluations of presenter performance [3], we selected the most compelling stimuli representing each attitude and subjected them to assessment through free labeling [4]. Experiments involving participants from both language groups were conducted using the respective corpora [5][6][7]. Participants were tasked with providing a single word to describe the perceived attitude for each stimulus. The collected response words underwent normalization and analysis within the three-dimensional emotional space of valence, activation, and dominance [9], along with consideration of linguistic distinctions between assertion and question. In a synthesis paper, we summarized the disparities and similarities observed among German and Cantonese perceivers, noting, e.g. Cantonese speakers appeared more adept at decoding German utterances than vice versa. Furthermore, we found that while valence judgments exhibited strong agreement, assessments of activation and dominance showed less consensus [10].

Expanding on our research, we collected attitudinal expressions of Hindi [11]. The current study presents results of free labeling of these expressions performed by speakers of Hindi as well as German and relates these to our earlier experiments with German stimuli [12]. As in these previous studies most of our Hindi-speaking participants resorted to English when assessing attitudes and not Hindi, one reason being that they were not familiar with typing Hindi on a keyboard. Hence, to aid our analysis, we utilized findings from Warriner et al.'s emotional analysis of English lexical words [13], derived from a rating experiment involving US American speakers and nearly 14,000 English lemmas, with freely downloadable results [14]. Their rating scale, ranging from 1 to 9, offers a finer granularity than our previous scale, which only encompassed values of -1, 0, and 1. However, we noted discrepancies in terminology and conceptualization between their framework and ours. While both systems position valence along a continuum from "happy" to "unhappy," Warriner et al. define "arousal" as the calmness vs. excitement invoked in the rater by a word, whereas we associated "activation" with the emotional investment perceived in a presenter. Additionally, "dominance" in their system relates to the degree of control felt by the rater, while in our interpretation, it signifies the degree of control exerted by the presenter on the perceiver. Consequently, while valence

values exhibit a very high correlation between the two systems (Pearson's r of .974, $p < .01$), correlations for activation/arousal are non-significant ($r = -.249$), and dominance correlations are weak ($r = .507$, $p > .05$). Notably, the distribution of arousal across all 13,915 lemmas is heavily skewed, with only 20% of items falling in the upper half of the 9-point scale. In our reference system, we observed a moderate correlation between activation and dominance, suggesting that highly activated attitudes, such as IRRI, also exerted strong dominance over the perceiver. In contrast, Warriner et al.'s system shows a strong correlation between valence and dominance, indicating that positively loaded words imply a high degree of control for the listener. Thus, it is important to recognize that the numerical values presented in this article for different attitudes are not directly comparable to earlier studies. However, given our aim to comparatively assess two groups of perceivers with different native languages (German and Hindi), these limitations are mitigated by our mapping of all responses onto the same reference system. This system offers higher granularity and is grounded in perceptual tests with a substantial number of subjects, rather than relying on the judgments of a select few experts. Another account of the distribution of attitude in the perceptual evaluation was done through a direct multidimensional analysis based on the lemmas derived from the free-labeling studies. This analysis shows a primary dimension that is akin to the "unpredictability" dimension described for emotional expressions [15] and opposes assertive to interrogative speech acts; the significance of the various dimensions organizing prosodic expressions is discussed.

2. Stimuli and Experiment Procedures

In our previous publications, we detailed the methodologies for eliciting attitudinal expressions, which we briefly summarize here. The 16 attitudes were elicited within a dialogue between the presenter and the experimenter, with each attitude portrayed through a scripted exchange to immerse the presenter in a suitable communicative scenario. This dialogue led to the utterance of target phrases, either "a banana" or "Mary was dancing," in the presenter's respective language. Short video clips of these utterances were extracted and utilized as stimuli for subsequent perceptual tests. For the experiment involving the Hindi corpus we selected the four male and female presenters rated best in [11], resulting in $8 \times 16 = 128$ auditory-visual stimuli, as we chose the target phrase that was rated best in each attitude condition for that respective presenter. These were supplemented by a subset of 32 of the 128 AV stimuli in reduced modalities: audio-only (AU) and silent video (VI), which were selected by choosing the best two exemplars for each attitude among the eight presenters, yielding a total of 192 stimuli. In all experiments the stimuli were presented via a survey on the PsyToolkit server [15][16]. After an introduction to the experiment design in Hindi or German, respectively, the stimuli were presented in a randomized order, first displaying for 900 ms a screen with a fixation cross in the location where the video was going to appear, then the video for its respective duration was shown. Subsequently the viewers were able to input their verbal judgment regarding the stimulus in a text box. They were able to replay each stimulus once. A progress bar was shown for orientation.

In the experiment involving German speaking subjects, we presented 160 stimuli, randomly chosen from the total of 192.

34 subjects aged 19-34 (median=22) took part, 26 males and eight females. They were students at Berliner Hochschule für Technik, participated in lieu of lab work and spent between 40 to 60 minutes to complete the task. 21 participants reported that their native language was German, followed by Turkish (N=5), Arabic (N=3), Vietnamese, Polish, Russian and Tamil. We yielded 5431 valid responses, with 3629 for AV, 910 for AU, and 892 for VI stimuli. As regards our experiment with Hindi-speaking participants and following a request of our partners at IIT Bombay, we reduced the number of stimuli presented in one session to 80 which again were randomly chosen from the total of 192. Participants were then required to invoke the experiment twice to complete 160 stimuli. The design proper was left unchanged. Participants were mostly students of IIT Bombay, as well as IIT Roorkee. A total of 35 participants were recorded (21 males, 14 female), aged 21-37 (median=25). However, as examination of results showed, of these participants only 11 had performed the task twice as requested. There was a wide variety of native languages reported, such as Hindi (N=9), Marathi (N=6), Bengali (N=3), Tamil and others. The participants took between 15-30 minutes to complete the task. Except for one participant who replied in Hindi, all responses were given in English, yielding a total of 3696 responses, with 2493 for AV, 591 for AU, and 612 for VI stimuli. German and Hindi response terms were translated to English using *GoogleTranslate*. The resulting terms were then checked for plausibility against the original terms, taking also into account the intended attitude of the stimulus. A common problem found was the confusion of present and past participles, such as "depressing" vs. "depressed", for instance. Finally resulting terms were checked whether they existed in the list of lemmas and replaced by suitable synonyms if necessary. Given that some responses were not single words, we had to map them accordingly, deleting expressions of degree and retaining the first response in cases of multiple items. After corrections we yielded 489 unique terms for the German raters and 369 for the Indians. As the last step we extracted from the list of 13,915 lemmas the mean ratings of valence, arousal and dominance for each term. To facilitate comparison, we linearly mapped Warriner et al.'s scale from 1 to 9 onto our original range between -1 and +1. We started from the above-mentioned lemmas to analyze attitude distributions according to their descriptions. We created a contingency table of the lemmas observed for each group of perceiver and language was created, grouping answers by attitude (16 rows) with the labels on the columns. These four matrices were concatenated row-wise to form a large matrix of 16 rows and 476 columns (once the lemmas with fewer than four observations were discarded). This large matrix was submitted to a Multiple Factor Analysis [18], applying individual correspondence analyses on the four sub-tables and regrouping them to reduce row divergences (here, the sub-tables are grouped according to their characterization of the 16 attitudes; we used the *MFA()* function in R's library *FactoMineR* [19]). The first five main axes of the global solution were kept; they explain about 65% of the total variance. The four perceiver groups had a balanced role on most axes: this shows the global coherence of their reception of the 16 attitudes. The attitudes are spread along these five dimensions; this spread was used as a basis for a hierarchical clustering algorithm (using *FactoMineR*'s *HCPC()* function). A solution with five clusters was selected.

3. Results

VAD Emotional space By computing the mean values of valence, arousal, and dominance for all normalized response terms corresponding to a specific attitude type, we derive the coordinates representing the location of that attitude in the three-dimensional emotional space. Table 1 presents the average values of all 16 attitudes in the AV condition, presenting the findings on the Hindi corpus, for German and Hindi speaking raters. For example, the data reveals that ADMI was rated as the most positive in valence, while CONT and IRRI are perceived as most negative. These findings are consistent with our previous results. As noted earlier, arousal values in this reference system tend to be relatively low, with a mean of -.12 and -.08, respectively, and almost none of the attitudes reach positive values. Notably, DECL and SINC are linked with the lowest level of arousal, followed by POLI. It is important to remember that this figure reflects the arousal experienced by a *reader* in response to the respective word stimuli and may be very different when viewing a video. Conversely, attitudes such as DOUB, IRRI, and SURP are situated at the higher end of the arousal scale, which seems plausible given their nature. Regarding dominance, perceivers appear to feel most in control when presented with attitudes like POLI, ADMI, and SINC, all of which have positive valence. In contrast, attitudes associated with insecurity include DOUB, UNCE, SURP, and WOEG, all implying potentially dangerous or embarrassing situations. An important difference between the rater groups appear to be generally higher valence ratings for positive attitudes in the Hindi speaking group (marked in red). Independent-samples Mann-Whitney-U shows significant group differences in all three emotional dimensions ($p < .001$).

Table 1: Sixteen attitudes and respective abbreviations. Positions of sixteen attitudes in the emotional space of Valence (V), arousal (A) and dominance (D), for German (Ger) and Hindi (Hin) speaking subjects, AV stimuli.

attitude	abbrev- iation	V A D			V A D		
		Ger	Ger	Ger	Hin	Hin	Hin
admiration	ADMI	.33	-.02	.21	.51	.13	.30
arrogance	ARRO	-.28	-.08	-.06	-.29	-.04	-.01
authority	AUTH	-.05	-.18	.07	-.00	-.19	.18
contempt	CONT	-.28	-.10	-.10	-.25	-.10	-.03
neutral statement	DECL	.04	-.25	.11	.06	-.25	.22
doubt	DOUB	-.06	-.02	-.05	.07	.00	-.02
irony	IRON	-.05	-.11	.01	-.04	-.08	.03
irritation	IRRI	-.24	-.05	-.06	-.26	.01	-.03
obviousness	OBVI	.00	-.18	.08	.07	-.18	.18
politeness	POLI	.32	-.24	.30	.40	-.14	.38
neutral question	QUES	.00	-.11	.02	.10	-.13	.07
seductiveness	SEDU	.19	-.09	.14	.35	.04	.23
sincerity	SINC	.20	-.31	.24	.20	-.24	.30
surprise	SURP	.12	.04	-.00	.27	.12	.05
uncertainty	UNCE	-.21	-.11	-.13	-.22	-.12	-.13
walking-on- eggs	WOEG	-.22	-.16	-.12	-.24	-.10	-.11
total		-.01	-.12	.04	.04	-.08	.10

Inter-language results We will now examine the similarities and differences between the two rater groups. To that end we performed a multi-variate GLM-based analysis of the

dependent variables *valence*, *arousal* and *dominance*. As independent factors we introduced the type of *attitude*, the *language of the rater*, and the *modality*. Results show that all three factors and some of their combinations have a highly significant influence on the three emotional dimensions (see Table 2 for *F* values, probabilities and variances explained).

Table 2: GLMs for valence, arousal and dominance depending on attitude, modality, rater language and their combinations. $p < .001$ unless otherwise indicated.

factor	df	valence	arousal	dominance
		F value		
attitude	15	86.8	83.5	78.9
modality	2	17.0	11.6	17.7
rater language	1	29.3	58.3	74.5
attitude* modality	30	9.9	4.8	8.1
attitude * rater language	15	4.0	5.0	1.7 (p <.041)
N=9126, R ² corrected		.23	.17	.22

Now we will examine the agreement between rater groups by comparing the stimulus-wise results. To that end we step away from the originally intended attitudes and examine the three emotional dimensions associated with how the perceivers interpreted those stimuli. We calculated means and standard deviations of valence, arousal and dominance for each stimulus in our experiments as a function of the rater group.

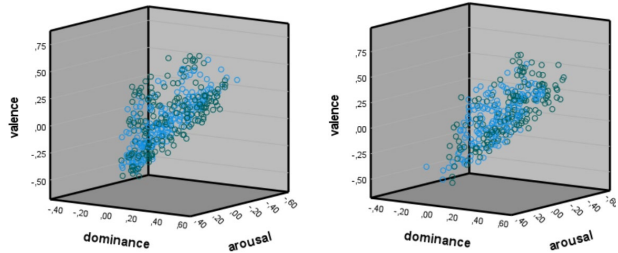


Figure 1: Scatterplot of stimulus-wise means for Hindi (left) and German stimuli (right). Rater languages German (blue), Hindi (green).

Table 3: Stimulus-wise intra- and inter-rater group correlations (Pearson's *r*), top: Hindi stimuli, bottom: German stimuli [12].

rater groups compared	valence	arousal	dominance
German split	.860	.777	.875
Hindi split	.803	.758	.747
German:Hindi	.828	.802	.834
German split	.799	.684	.765
Hindi:German	.671	.570	.683

A map of all AV stimuli in the three-dimensional space are shown in Figure 1, left panel. The strong correlation between the valence and the dominance dimensions is clearly visible. The tendency for Hindi speakers to rate more positively is also visible, however, there is also a cluster of stimuli with higher dominance values that they rated more negatively. We calculated correlations (Pearson's *r*) of the stimulus-wise judgements to examine the agreement between the two rater

groups. For comparison, we also calculated split-correlations inside the German and Hindi speaking groups on the Hindi stimuli (see Table 5, top).

This indicates that despite many significant differences, there is still a strong agreement between Hindi and German perceivers on the Hindi data.

Influence of the modality Kruskal-Wallis test of independent samples shows that audio-only presentation (AU) differs significantly from AV and VI whereas the latter two do not. Generally speaking, valence is moved towards neutral when the face is not visible, that is, for instance, ADMI is perceived less positive, and CONT less negative. Arousal is slightly reduced in AU condition for almost all attitudes whereas dominance increases.

Comparison with earlier experiment on German stimuli In Table 5, bottom, we list the stimulus-wise correlations found for the German stimuli in [12], that is, German split correlations and file-wise agreement between German and Hindi speaking raters on stimuli in German. As can be seen the values are considerably lower, especially for arousal. This may be explained by the fact that there were stimuli from 15 presenters in the set of German and only eight in the Hindi set. In [9] we had found that Cantonese speakers better replicated the results of the Germans than vice-versa, but both agreed best on valence. However, since the dominance dimension is strongly correlated with valence in the Warriner et al. paradigm, we do not seem to reproduce as clear a result here, and the valence judgment is not in better alignment than the dominance judgment. As stated above, we found considerably higher file-wise correlations for the Hindi data. An important difference between the data sets was that the original term normalization for the Germans' ratings on the German stimuli had only yielded 128 unique terms whereas there were 201 terms registered for the Hindi speaking raters that had already been normalized with Warriner's list of lemmas in mind. Hence, starting from the original German labels, we re-normalized them to the lemma list, now producing 366 different terms, hence more nuanced ratings. The file-wise correlations between German and Hindi speaking raters, however, remain almost the same (.679, .568, .626, for V/A/D, see Figure 1, right panel, for the positions of German stimuli).

Clustering on the MFA The clusters obtained from the multidimensional analysis of the lemmas are described hereafter, giving the attitudes regrouped in each and the 20 first lemmas that best characterize them for each of the four groups of perceiver/language pairs (German perceiving German; German/Hindi; Hindi/Hindi; Hindi/German. To distinguish the groups, the letters "gg/gh/hh/hg" were added to the lemmas)

Cluster #1 contains the attitudes DOUB and SURP; described by the following lemmas (in decreasing order of association strength): shock_hh surprise_hg surprised_hh astonished_gh surprised_gh surprise_hh astonished_hh shock_gh doubtful_dd enable_hh horrific_gh surprised_dd exclamation_hh curious_hh suspicious_hg questionable_hh doubtful_gh curious_gh skeptical_dd inquire_gh.

Cluster #2 contains QUES, UNCE, and WOEG; described as: unsure_dd unsure_gh lie_hh uncertain_hh query_hh hesitation_hh embarrassed_hh doubt_hh quest_hh remember_hh confused_hh hesitant_gh hesitant_hh nervous_gh question_hg pension_gh indifferent_hg questionable_gh fearful_dd worried_gh.

Cluster #3 contains ADMI, IRON, SEDU; described as: praise_hh happy_hg funny_dd glad_gh cheerful_dd funny_hh

joyful_dd amused_dd joyful_gh amused_gh happy_hh cheerful_gh funny_hg cheerful_hh exhaustion_gh excited_dd happy_gh delighted_gh peaceful_gh pleased_hh.

Cluster #4 contains ARRO, CONT, IRRI; described as: irritation_hh egotistical_hh frustrated_hh annoyed_hh arrogance_hh sulk_dd arrogant_hg anger_hh sulk_gh angry_gh annoyed_gh loudmouth_hh arrogant_hh disgusted_gh accusation_gh irritate_hh irritate_gh rude_hh provocative_gh dislike_hh.

Cluster #5 regroups AUTH, DECL, OBVI, POLI, SINC; described as: hectic_dd statement_hh normal_hh confident_hh calm_gh acceptance_gh information_hh neutral_gh honest_gh neutral_hh secure_gh calm_hh affirmative_gh confirmation_hh affirmation_hh emotion_gh fact_dd statement_hg convincing_hh explanation_dd.

4. Discussion and Conclusions

This study examined results from speakers of German and Hindi freely labeling corpora of German and Hindi expressions of attitude. We were able to show that based on the labels they were assigned we can locate the sixteen attitudes in the three-dimensional emotional space in a meaningful way. Although there are significant differences between the groups, e.g. the Hindi speakers assigning more positive ratings than the Germans, we still find high stimulus-wise correlations, even higher on the Hindi data than on the German. Audio-only presentation obviously compresses the valence dimension and reduces perceived arousal.

The analysis based directly on lemmas showed an interesting distinction that follows the main axis of the MFA analysis (thus explaining the largest part of the variance): clusters #1 and #2 are opposed along this dimension to clusters #4 and #5: this axis opposed thus expressions of interrogation, uncertainty or doubt to expressions of politeness, assertion, authority. This recalls a major linguistic (and thus communicative) function, with the sentence mode opposing interrogative to assertive utterances; this is described by [15] as a dimension opposing "[...] *appraisals of novelty and unpredictability (and behaviors such as jaw dropping, eyebrow raising, and spontaneous exclamations), as compared with appraisals of expectedness or familiarity.*" (p. 1051). It is important to stress the relevance of this dimension both at the emotional and linguistic levels: this exhibit the fundamental intrication of attitudes in between these two semiotic systems. The second dimension of the analysis opposes clusters #3 to #4 and is thus linked to valence. The third dimension tends to oppose most attitudes in clusters #1 to #2 and clusters #4 to #5 (but authority), making it interpretable as a dimension with a mix of Arousal and Dominance.

There are obvious shortcomings when using a lemma base that was created based on text, not audio-visual stimuli, especially if translation to English is required. Nevertheless, we found, that even after translation from German to English 85% of the variance was preserved. One could argue that the valence/arousal/dominance ratings could also be polled directly from the perceivers to avoid term translation, however they would not facilitate a semantic analysis as we were able to present here. Furthermore, subjects would be confronted with three tasks, not one, considerably raising the cost for these experiments.

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