



# Perception of Audio-visual Expressions in German and Cantonese by Native Speakers of Hindi

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## Abstract

Following up on earlier experiments on the cross-cultural and cross-language perception of short audio-visual utterances produced with varying attitudinal expressions, we compare the verbal responses of native speakers of Hindi with those of German and Cantonese-speaking evaluators to stimuli in the latter two languages. Contrary to our expectations, however, most Indian participants felt most confident rating the stimuli in English and not Hindi. As we had already previously translated all reply terms by Germans and Hong Kong raters to English, we decided to stay in the same language for the cross-language evaluation and draw on ratings of valence, arousal and dominance from a study of almost 14,000 lemmas. We converted our pre-existing labels to this reference system and compared them to the responses of the Hindi speakers. We found that the type of attitude, the rater language but also the stimulus language had significant influence on the raters' responses that differed in at least two of the dimensions. When we calculated correlations within and between rater groups, we found that the speakers of Hindi were better able to replicate the judgments of the other two groups on stimuli in their own languages than the group ignorant of that language. Semantic analysis of responses revealed that attitudes associated with strong negative emotions such as doubt and anger are picked up well by the non-speakers, whereas more complex attitudes, viz. seductiveness and irony are not.

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

## 1. Introduction

Expressions of attitudes are an integral basis of speech communication. In a dialog situation we continuously monitor our interlocutor's behavior and aim to assess his/her intention and attitude while adjusting our own speech acts in real-time. Our *propositional attitudes*, in short, our ideas of the world are highly predictive of our behavior[1]. These interact with *social attitudes* shaped by the cultural environment. Hence expressing attitudes unambiguously and decoding those of our dialog partner helps us control the dialog and achieve the goals of the conversation. In face-to-face talk we can draw on information from the acoustic channel, i.e. prosodic cues, as well as the visual channel, evaluating facial expressions and gestures. This information not only comprises the linguistic

component in terms of words uttered, but also the paralinguistic component which includes, above all, emotions. Interactions between partners from different cultures may be compromised by misunderstandings, that is, wrong interpretations of attitudinal expressions [2].

In earlier work we extensively studied attitudinal expressions by speakers of German and Cantonese and discovered important parallels as well as differences in their productions as well as perceptions. These studies are based on Rilliard et al. [3] who presented a paradigm for eliciting, recording and evaluating spoken utterances that express different social affects. A total of 16 types of attitudes, including arrogance, politeness, doubt and irritation, are defined with designated communication goals and social contexts. The two left columns of Table 1 list the 16 attitudes and their abbreviations used throughout this article.

After perceptually evaluating the performance of presenters [3] we selected the most convincing stimuli for each attitude and had them assessed by the method of free labeling[4]. Experiments with participants from the two languages were carried out on both of the corpora [5][6][7]. The subjects were asked to freely specify one single word to describe the perceived social attitude for each presented. The collected response words were normalized and analyzed in the three-dimensional emotional space of valence, activation and dominance [8], as well as the linguistic opposition between assertion and question. In a synthesis paper we summarized the differences and commonalities of German and Cantonese perceivers and found interesting asymmetries in that Cantonese speakers appeared to be better able to decode German utterances than vice-versa. We also found that valence judgments were in much better agreement than those on activation and dominance [9].

In the current article we expand our studies further by including perceivers whose native language is Hindi. They were asked to evaluate the German and Cantonese stimuli employed in our earlier studies. Culturally and geographically speaking, India occupies a position between Europe and East Asia, is presumably more collective-oriented than Germany and presents an interesting tertium comparationis. Hindi is neither a stress-timed language nor a tone language and our subjects had no prior knowledge of either German or Cantonese. Furthermore, as will be shown in the next section, unexpected to us, our Hindi speaking subjects preferred to turn to English when evaluating expressions of attitudes which led

us to eventually perform our comparison with the German and Hong Kong raters in English as well. To facilitate this analysis, we employed results from the emotional analysis of lexical words in English in Warriner et al. [10] who performed a rating experiment with US American speakers on almost 14,000 English lemmas, the results of which are freely downloadable[11]. The scale of rating ranging from 1 to 9 is much more fine-grained than the one that we applied so far which only had the values -1, 0 and 1. However, we also realized that whereas valence is similarly placed on a continuum between “happy” and “unhappy”, “arousal” is defined by the calmness vs. excitement that the word invokes in the rater, while we had related “activation” to the apparent emotional investment of a presenter. Furthermore, “dominance” is defined by Warriner et al. by the degree of control that the rater experiences with the word to be rated, whereas we interpreted the term as *the degree of control exerted by the presenter on the perceiver*. Consequently, the correlation between valence values for the same word in the two systems is very high (Pearson’s  $r$  of .974,  $p < .01$ ), but non-significant ( $r = -.249$ ) for activation/arousal and weak for dominance ( $r = .507$ ,  $p > .05$ ). Besides these differences, the distribution of arousal for all 13,915 lemmas is strongly skewed with only 20% of items lying in the upper half of the 9 point scale. In our reference system we had found a moderate correlation between activation and dominance, meaning that highly activated attitudes such as IRRI also exerted a strong dominance on the perceiver. In contrast, in Warriner et al.’s reference system, there is a strong correlation between the valence and dominance dimensions, indicating that positively loaded words also imply a high degree of control on the part of the listener. It follows – especially for arousal and dominance - that numerical values we shall present in this article for the different attitudes are not directly comparable with earlier studies. However, since we aim to compare relatively the three groups of perceivers with different native languages, i.e. German, Cantonese and Hindi, these shortcomings are compensated by the fact, that we map all responses on the same reference system which has a higher granularity and is based on perceptual tests with a reasonably large number of subjects, and not on the judgments of few experts.

## 2. Stimuli and Experiment Procedures

The designs for eliciting attitudinal expressions has been described in detail in our earlier publications. Therefore, we only provide a condensed summary. The 16 attitudes were elicited in a dialog between the presenter and the experimenter. The portrayal of each type of attitude is prepared by a dialog meant to immerse the presenter in a suitable communicative situation. Then a short exchange leads up to the target utterances either being “a banana” or “Mary was dancing” in the respective language of the presenter. Short video-clips of the target utterances were extracted and serve as stimuli for the ensuing perceptual tests. Due to the better matching of syllable numbers we used the phrase “a banana” (*eine Banane*) for German and “Mary was dancing” (*Mary 跳緊舞*) for Cantonese.

For each of the 16 attitudes the six best-rated samples for each language were selected, yielding 96 auditory-visual (AV) tokens. These were augmented by a subset of the 96 AV stimuli in reduced modality: audio-only (AU) and silent video

(VI). This yielded a total of four stimulus sets, two for German and two for Cantonese. The Hindi speaking participants, 13 males and 7 females, aged 23-38, were students or members of staff at IIT Roorkee. Each of them evaluated one German and one Cantonese set of stimuli. Instructions to the experiment were presented in Hindi, followed by a warm-up phase of eight audio-visual stimuli not included in the assigned test set to get familiar with the test procedures and the type of stimuli. No response was required in the warm-up session. Subsequently all test stimuli were presented in random order, and the subject was asked to use a single word to describe the attitude he/she could perceive from each stimulus. The subject could replay a stimulus as many times as he/she wished. The whole experiment took 30 – 45 minutes to complete. A total of 3451 valid responses were collected. The number of valid responses for AV, AU and VI were 1870, 791 and 790, respectively. Contrary to our expectation and with the rare exception of one of the staffers all responses were provided in English. Asked about the reasons, subjects commented that they found the task easier to perform in that language, also because they were much more used to typing English on the computer keyboard than Hindi.

In consequence, we decided to also employ English as the common language for the ensuing comparison with the German and Hong Kong raters, as outlined in the Introduction. Response terms in German and Cantonese had already been translated to English for presentation purposes, and though we are aware that nuances may become levelled we were confident of the result, as translations were performed by native speakers with a high proficiency in English. Still there is a chance that since the lemma ratings were provided by US American subjects, we introduce a certain bias.

As several of the Hindi speakers’ responses were no single words, we had to map them accordingly. Expressions of degree were deleted, and in the case of multiple response items we kept the first one. Finally, we had to map all responses onto the available list of 13,915 lemmas which sometimes entailed changing the word form, or even selecting the closest synonym. For better comparison, we also linearly mapped Warriner et al.’s scale from 1 to 9 onto our original range between -1 and +1.

## 3. Results

**Emotional space** By averaging over the assigned values of valence, arousal and dominance for all normalized response terms to the stimuli pertaining to a certain type of attitude, we obtain the coordinates of this attitude’s location in the three-dimensional emotional space.

Table 1 lists the average values of all 16 attitudes in the AV case, pooling the results *from all six experiments*, that is, speakers of German, Cantonese and Hindi rating attitudinal expressions in German and Cantonese, respectively.

It can be seen, for instance, that ADMI was judged most positive in valence, whereas CONT is perceived more negative than IRRI. These figures match our previous results.

As mentioned earlier, arousal values in this reference system are relatively low (mean of -.1664), and none of the attitudes reach positive values. Interestingly, DECL is associated with the lowest level of arousal, followed by POLI. We need to bear in mind that this figure reflects the arousal felt by the reader of the respective word responses. On the other end of

the arousal scale we find attitudes such as DOUB, IRRI and SURP, which appears plausible.

As for dominance, perceivers seem to feel most in control when confronted with POLI, ADMI and SINC, all of which have positive valence. In contrast, the attitudes that perceivers associate most with insecurity are DOUB, UNCE, SURP and WOEG. These are all attitudes implying potentially harmful situations.

Table 1: Sixteen attitudes and respective abbreviations, Positions of sixteen attitudes in the emotional space, pooled results from all six experiments, AV stimuli.

attitude	abbrev- iation	valence	arousal	domin- ance
admiration	ADMI	.4641	-.0978	.3641
arrogance	ARRO	-.1216	-.2146	.0723
authority	AUTH	-.0713	-.2250	.1253
contempt	CONT	-.2833	-.1496	-.0185
neutral statement	DECL	.1896	-.3100	.2739
doubt	DOUB	-.1881	-.0655	-.1151
irony	IRON	.1631	-.1380	.1944
irritation	IRRI	-.2252	-.0834	.0023
obviousness	OBVI	-.0055	-.1766	.1113
politeness	POLI	.2850	-.2826	.3487
neutral question	QUES	-.0925	-.1740	.0149
Seductiveness	SEDU	.2346	-.1561	.2538
sincerity	SINC	.3030	-.2383	.3331
surprise	SURP	-.0391	-.0078	-.0413
uncertainty	UNCE	-.1960	-.1511	-.0637
walking-on-eggs	WOEG	-.1985	-.1929	-.0319
	total	.0125	-.1664	.1138

**Inter-language results** We will now examine the similarities and differences between the three 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 stimulus* and the *language of the rater*. Results show that all three factors and some of their combinations have a highly significant influence on the three emotional dimensions, except for stimulus language vs. dominance (see Table 2 for *F* values, probabilities and variances explained).

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

factor	df	valence	arousal	dominance
		F value		
attitude	15	141.6	51.0	144.5
stimulus language	1	30.4	15.1	5.4( $p < .021$ )
rater language	2	53.0	77.7	84.1
attitude* stim. language	15	11.8	11.2	11.2
attitude * rater language	30	7.1	17.2	7.3
N=8813, R <sup>2</sup> corrected		.255	.162	.260

To explore the differences between the rater populations as a function of the emotional dimension and the stimulus language, we performed Mann-Whitney-U tests of significance. Table 3 shows which emotional dimensions are rated significantly different as a function of the stimulus language *within* each rater population. Whereas German raters

differ in their judgments on all three dimensions on the Cantonese stimuli, Cantonese and Hindi speakers only with respect to arousal and valence, respectively.

Table 3: Differences within rater populations depending on the stimulus language being either German (DE) or Cantonese (CAN), AV stimuli, direction of difference and confidence level.

raters	valence	arousal	dominance
German	DE>CAN $p < .001$	DE>CAN $p < .002$	DE>CAN $p < .019$
Cantonese	$p = .858$ (n.s.)	DE>CAN $p < .001$	$p = .210$ (n.s.)
Hindi	DE>CAN $p < .001$	$p = .378$ (n.s.)	$p = .335$ (n.s.)

Table 4: Differences between rater populations depending on the stimulus language. V- valence, A- arousal, D – dominance, AV stimuli. German (DE), Cantonese (CAN) and Hindi (HI).

pair of rater languages	stimulus language	
	German	Cantonese
German: Cantonese	A, DE>CAN, $p < .001$ V, DE>CAN, $p < .008$ D ( $p = .053$ ) n.s.	A, DE>CAN, $p < .001$ V, DE>CAN, $p < .001$ D, DE>CAN, $p < .001$
German: Hindi	V, DE<HI, $p < .001$ A, DE>HI, $p < .001$ D, DE<HI, $p < .001$	A, DE>HI, $p < .001$ D, DE<HI, $p < .001$ V ( $p = .092$ ) n.s.
Cantonese: Hindi	V, CAN<HI, $p < .001$ D, CAN<HI, $p < .001$ A ( $p = .487$ ) n.s.	V, CAN<HI, $p < .001$ D, CAN<HI, $p < .001$ A ( $p = .131$ ) n.s.

Table 4 shows on which emotional dimensions the distributions of judgments differ between the three rater populations and the direction of the difference. In each pair of language groups at least two of the dimensions are assessed significantly different. For instance, there appears to be a trend for speakers of Hindi to rate stimuli - regardless of the language - more positively. In contrast, Germans perceive higher levels of arousal. We will later explore further these differences with regards to the intended attitude.

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. Maps of all AV stimuli in the three-dimensional space are shown in Figure 1 for German (left) and Cantonese (right). The strong correlation between the valence and the dominance dimensions is clearly visible, though it is weaker for the German stimuli which are more scattered. 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. In the Cantonese stimuli there appear to be a few outliers with low dominance that the Cantonese speaker rated more positively than the other groups. Interestingly, these are all expressions of surprise. We calculated correlations (Pearson's  $r$ ) of the stimulus-wise judgements to examine the agreement between the three rater groups. For comparison, we also calculated split-correlations inside the German and Cantonese speaking groups on the stimuli in their native languages (see Table 5).

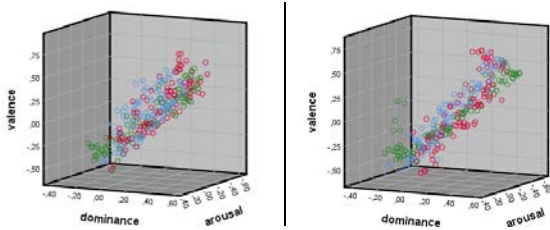


Figure 1: Scatterplot of stimulus-wise means for German (left) and Cantonese stimuli (right). Rater languages German (blue), Cantonese (green) and Hindi (red)

Table 5: Stimulus-wise intra- and inter-rater group correlations (Pearson’s  $r$ ), top: German stimuli, bottom: Cantonese stimuli.

rater groups compared	valence	arousal	dominance
German split	.799**	.684**	.765**
German:Cantonese	.554**	.296**	.681**
German:Hindi	.671**	.570**	.683**
Cantonese split	.859**	.824**	.863**
Cantonese:German	.695**	.288**	.736**
Cantonese:Hindi	.752**	.298**	.770**

These figures suggest that the Hindi raters are in better agreement with both the German and the Cantonese raters on stimuli in their respective languages. In [9] we had found that Cantonese speakers better replicated the results of the Germans than vice-versa. However, since the dominance dimension is tightly locked with valence to begin with, we do not seem to reproduce as clear a result here, and the valence judgment is not in better alignment than the dominance judgment.

For space restrictions we only present some observations about the influence of the modality on the emotional ratings. Audio-only presentation (AU) seems to shift the valence ratings towards neutral, as compared to AV or VI. Means for ADMI, for instance, drop from .46 to .19, and means for CONT rise from -.28 to -.01 when only the audio is presented. We did not find any significant changes for arousal, though, which is in line with [14]. In the case of dominance, for positive attitudes, seeing the interlocuter’s face raises the confidence of the perceiver, while for negative attitudes, he/she experiences a loss of control. Compare dominance means for ADMI of .15 and .36 for AU and AV, and of .14 and -.02 for CONT, respectively.

**Semantic Analysis** We now look at the differences in the preferred labels assigned by the rater groups for each attitude, restricting the presentation, however, to the German stimuli. We determined the top three response terms for all attitudes depending on the rater language (percentages given in brackets). For space reasons we can only present a subset:

**ARRO** DE arrogant(20), conviction(14), neutral(15); CAN arrogant(10), calm(9), gentle(8); HI normal(22), sad(11), accept(7), calm(7)

**AUTH** DE neutral(23), determine(20), annoyed(7), conviction(7); CAN confirm(13), impatient(11), calm(9), gentle(8); HI normal(33), neutral(9), anger(7), calm(7)

**DOUB** DE question(32), doubt(22), amazed(14); CAN doubt(45), suspicion(38); HI surprise(26), confused(19), shock(9)

**IRON** DE amused(18), doubt(11), cheerful(7); CAN glad(16), confirm(13), helpless(8); HI happy(31), funny(6), normal(4)

**OBVI** DE annoyed(18), obvious(13), neutral(10); CAN confirm(12), glad(12), doubt(7); HI happy(15), normal(11), shock(6)

**POLI** DE neutral(35), determine(14), conviction(11); CAN confirm(22), glad(11), statement(8); HI normal(30), happy(15), acceptance(9)

**QUES** DE question(50), neutral(14), uncertain(9); CAN doubt(21), suspicion(17), calm(7); HI normal(37), question(7), anger(6)

**SEDU** DE excited(20), seductive(10), amused(7); CAN glad(24), confirm(10), cunning(8); HI happy(28), normal(13), explanation(6)

Most of the preferred response terms chosen by the Germans reflect the intended attitude relatively well, as they are operating in their native frame of reference. In the case of the Cantonese speakers, they often seem to pick up a positive valence even when not intended such as in ARRO, AUTH and OBVI and frequently turn to expressions like *glad* or *calm*. They also fail to decode the conflicting cues in IRON and interpret SEDU as a happy expression, like the Hindi speakers. This is mirrored by results in [18] for Japanese raters perceiving English. POLI is special in that German do not have a special politeness register. Consequently, Cantonese and Hindi speakers latch on the generally positive connotation without diagnosing a specific attitude. In contrast to complex attitudes such as IRON and SEDU, negative attitudes implying impositions such as DOUB and IRRI are well decoded. Surprisingly, the neutral question QUES carries quite negative connotations for the Cantonese raters (doubt, suspicion) whereas only few of the Hindi listeners marked them as questions at all.

## 4. Discussion and Conclusions

This study expanded our series of German-Cantonese free labeling experiments of audio-visual attitudinal expressions to incorporate native speakers of Hindi. In contrast to our previous work we relied on a list of almost 14.000 lemmas for the emotional evaluation of expressions collected in the three dimension of valence, arousal and dominance, the latter two of which were also defined differently than in our earlier experiments[6]. As in previous studies we found a high agreement for valence, communicative dimension that is cross-culturally expressed and perceived, and our silent video and audio-only results suggested that mostly facial cues are responsible for the valence ratings. Arousal is the dimension most difficult to evaluate by non-speakers of a language. This is in line with our earlier results on activation, but we could not fully replicate the finding that speakers of Cantonese were significantly better at judging German expressions than vice-versa. Correlation analysis on stimulus-wise means, however, also indicated that speakers of Hindi appear to be slightly better at decoding Cantonese stimuli than German raters, as well as better at decoding German stimuli than the Cantonese raters. This may be because they occupy a geographic and cultural middle ground between Europe and East Asia. In future work we will examine our current results in finer detail and collect attitudinal expression by speakers of Hindi to have them evaluated by perceivers in Berlin and Hong Kong.

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