Inferring meaning from variably intense emotion expressions

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Introduction | Background

Human vocalizations are potent sources of information to signal emotion. One commonplace assumption is that the ability to infer expressed meaning increases the stronger the underlying affective state. Is this true?

- Diverging evidence for the effect of intensity on classification processes [1][2]
- Underdetermined empirical basis of the representation and the perception of meaningful information in variably intense nonverbal vocalizations [3]
- Theoretical context: Discrete versus dimensional emotion

Goal:
Assess the role of intensity in emotion perception

Materials | Methods

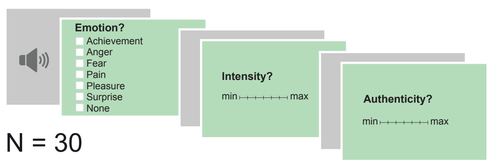
Database of nonverbal affective expressions (N = 480)

- Fully crossed design (6 emotions | 4 intensities | 10 speakers | 2 exemplars)

Affective states	Intensity levels
⊖ Anger, Fear, Pain (physical)	low, moderate, strong, peak
⊕ Achievement, positive Surprise, Pleasure (sexual)	

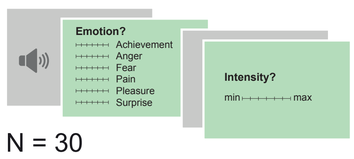
- Key features: natural variability | expressive diversity | authenticity

Exp. 1: Emotion categorization



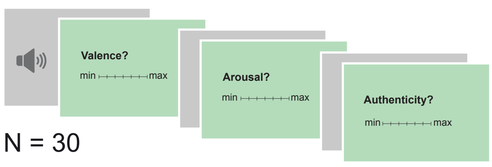
N = 30

Exp. 2: Emotion rating



N = 30

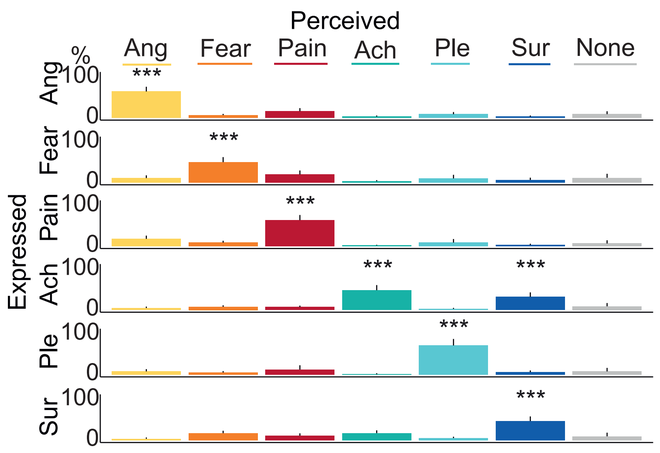
Exp. 3: Dimensional rating



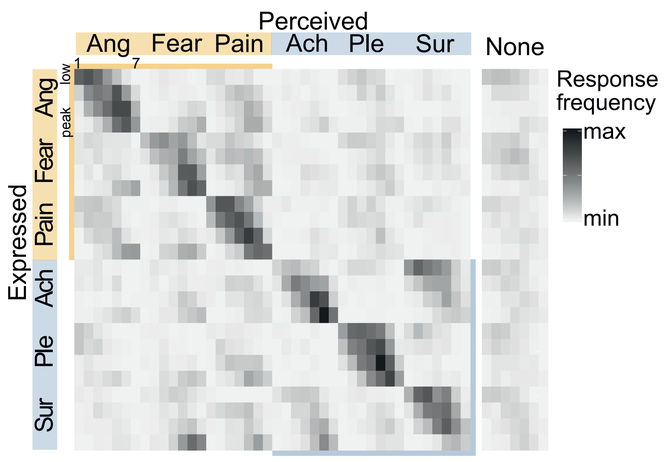
N = 30

Results

Experiment 1

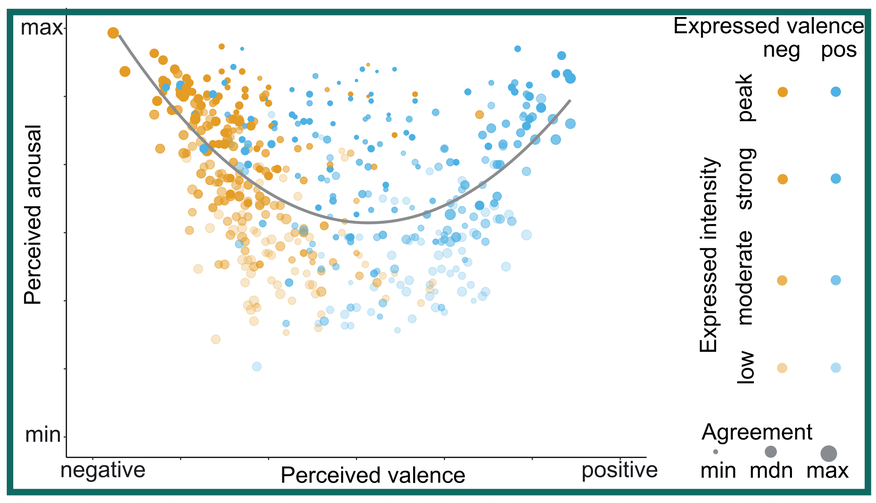


Emotion classification patterns for each expressed emotion. Main diagonal, correct classification. *** $p < .001$, raw hit rate higher than expected by chance (16.67%).

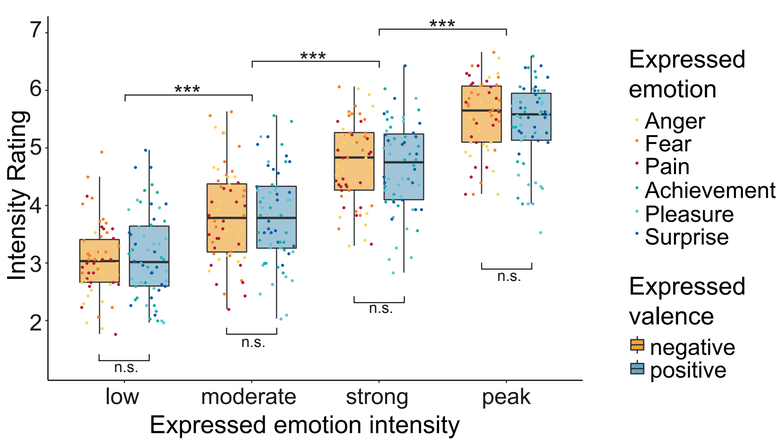


Confusion matrix for emotion categories (squares) and emotion x intensity combinations (tiles)**.** Main diagonal, correct classification. Upper left quadrant, within negative valence; lower right, within positive valence.

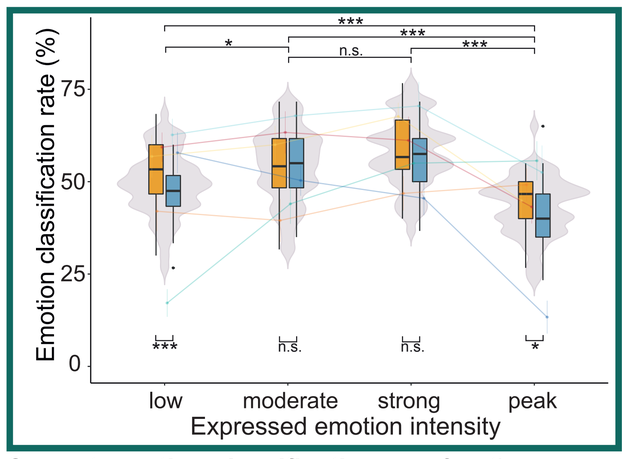
Experiment 3



Perceived valence and arousal of stimuli in a two-dimensional affective space. Significant quadratic relationship (grey line), characterized by higher ratings in arousal for sounds which are rated as either highly pleasant or highly unpleasant ($F(2, 477) = 72.6$, $p < .001$, $R^2_{adj} = .23$).



Intensity ratings for all stimuli grouped by expressed valence, emotion and intensity. Higher perceived intensity for peak > strong > moderate > peak expressed intensity (*** $p < .001$).



Correct emotion classification as a function of valence, emotion, and intensity. Violin plots, effect of intensity; box plots, interaction valence & intensity; lines, interaction emotion & intensity (* $p < .05$, *** $p < .001$).

Work in progress: Acoustic representation of affect

Acoustic cue	Valence		Intensity		Interaction		df1[a,b]	df2
	*F**	*p*	*F**	*p*	*F**	*p*		
Energy cues								
Int M	**3.86**	**.05**	**3.43**	**.02**	2.16	.09	2.98	466.58
Int SD	1.64	.20	**5.11**	**.002**	0.55	.65	2.99	464.64
Int max	**21.99**	**<.001**	**10.11**	**<.001**	**2.65**	**0.05**	2.99	456.34
Shimmer	2.28	.13	**17.44**	**<.001**	0.46	.71	2.99	466.01
Frequency cues								
F0 M	1.67	.19	**19.45**	**<.001**	**5.07**	**0.002**	2.91	435.11
F0 SD	3.29	.07	**4.02**	**.008**	1.44	.23	2.92	417.79
F0 slope	0.41	.52	**5.50**	**.001**	1.24	.29	2.97	440.60
Jitter	0.01	.92	**19.75**	**<.001**	1.37	.23	2.96	460.03
Spectral cues								
COG	**28.83**	**<.001**	**54.41**	**<.001**	0.76	.51	2.93	416.30
STD	**27.13**	**<.001**	4.25	.006	1.84	.14	2.95	443.60
Kurtosis	**25.82**	**<.001**	**12.48**	**<.001**	0.10	.96	2.96	446.86

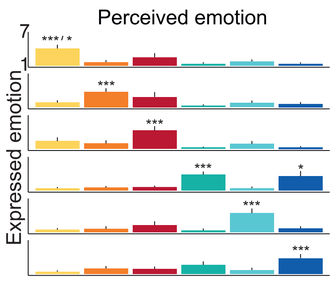
F* = the ANOVA-type statistic, a) df1 = 1 for the main effect of Valence, b) df-values are Box-corrected

Acoustic cue variability in vocal expressions. Nonparametric anova-type analysis. Sign. effects in bold. Int = intensity, F0 = fundamental frequency, COG = spectral center of gravity, STD = spectral standard deviation.

Emotion intensity with robust effects on various acoustic dimensions

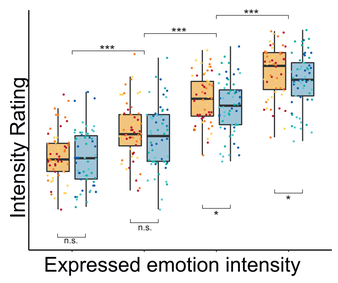
Experiment 2

Emotion classification

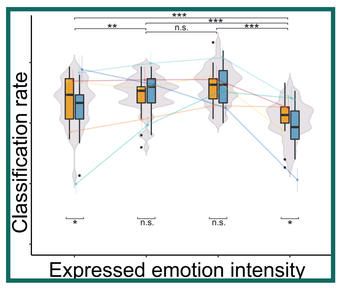


Confusion matrix

Intensity perception



Effect of intensity



Discussion | Conclusion

- New parameterized and ecologically valid database
- Robust effects of emotional intensity
  - Both categorical (Exp. 1 + 2) and dimensional (Exp. 3) approaches reveal intensity paradox
  - Sweet spot of emotional intensity for classification of moderate to strong emotion
  - Peak emotion with greater hedonic and categorical ambiguity, but informative percept of arousal and intensity

→ Inconsistent with prevailing discrete & emotion theories

Open Questions | Outlook

- Acoustic models and relation to perceptual evaluation
- Early auditory vs. higher-order cognitive specificities of affect perception in non-speech expressions

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CNS 2020 Virtual Meeting

References [1] Juslin, P. N., & Laukka, P. (2001). Impact of intended emotion intensity on cue utilization and decoding accuracy in vocal expression of emotion. *Emotion*, 1(4), 381. [2] Atias, D., Todorov, A., Liraz, S., Eidinger, A., Dror, I., Maymon, Y., & Aviezer, H. (2018). Loud and unclear: Intense real-life vocalizations during affective situations are perceptually ambiguous and contextually malleable. *Journal of Experimental Psychology: General.* [3] Arnal, L. H., Flinker, A., Kleinschmidt, A., Giraud, A. L., & Poeppel, D. (2015). Human screams occupy a privileged niche in the communication soundscape. *Current Biology*, 25(15), 2051-2056.

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