

How the Brain Reads Tone of Voice

As human beings, we respond to emotional cues in our social environment. It's an important part of living. We need to notice the emotions of the people we encounter and determine which ones are relevant to us.

What actually happens in our brains when we pick up emotional cues from people around us – such as anger? Recent research by psychologists from our Centre suggests that the human brain processes emotionally-charged input in different areas of the brain depending on whether we are paying attention to it or whether we are absorbed by some other task. What is more, emotional input seems to register with us involuntarily even when we are not paying attention.

The members of the research team were drawn from the Geneva Emotion Research Group and the Laboratory for Neurology & Imaging of Cognition.

They conducted a dichotic listening experiment (providing different speech input to the left and right ear simultaneously), and carried out functional magnetic resonance imaging (fMRI) of the brains of the subjects at the same time. MRI provides a picture of which areas of a conscious subject's brain are active as he or she performs a task. More than any other method currently available, it allows us to watch the brain at work. In this case, the psychologists were interested in finding out if emotional tone of voice triggers enhanced activity in particular brain areas.

The input heard was nonsense words, spoken by actors, some in a neutral tone, some in an angry tone. We all know that besides the meaning of the words used, tone of voice can have a remarkable effect on how we perceive what a speaker wants to express. Here, in the absence of meaning, only the tone of voice was significant. But this was not the actual task given to the subjects. They were instructed to pay attention

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selectively to one ear or the other and to determine whether it was a man or a woman speaking. This they did without difficulty.

The MRI showed, however, that whenever they heard an angry-sounding voice, a particular area in the brain, that of the superior temporal sulcus (STS) and amygdala, "lit up".

When they had to *pay attention* to an angry voice, the orbitofrontal cortex and the cuneus of the occipital cortex also became active. This suggests that different brain areas are involved in processing emotional cues from the social environment depending on whether these cues are the focus of attention or just "noticed in passing". The point of the experiment was to manipulate voluntary attention in a way that varied independently of tone of voice. The subjects were told to pay attention to the left or the right ear, when there was an angry voice in one, a neutral voice in the other, or when there were two

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neutral voices. So at times they were focussing on an angry voice, at other times ignoring an angry voice to focus on a neutral one.

It has been noticed in previous experimental work that something of emotional relevance attracts people's attention more than something neutral. For example, in dichotic listening experiments, if subjects hear their own names in one ear when they are supposed to pay attention to the other ear, they respond involuntarily. This also happens if subjects are shown pictures of faces expressing marked emotion.

We seem to pick up emotional cues from the environment whether we are focussing on them or not. It may be that the STS and amygdala constitute the initial, low-level processing mechanism for these, and that the orbitofrontal cortex is an "integrative" brain area that helps us to evaluate relevant emotional cues and decide what to do about them. It has been shown that the orbitofrontal cortex responds to emotional events both seen and heard, but what this experiment shows is that its functioning depends on *paying attention* to the emotional event in question. If attention is being paid to something else in the environment, it is just the STS-amygdala area that responds.

Why did the cuneus also "light up" when paying attention to angry voices, given that it is in the occipital lobe, the visual area of the brain? It may be that when we hear angry voices we "picture" angry people. Or it may be just a case of general sensory vigilance being triggered when we perceive a powerful emotional cue in the environment.

"Processing emotional cues is certainly an important social skill and has survival value."

Noticing or paying attention to the emotions of others affects our momentary hierarchy of needs and goals. There are individual differences in response, too. Prior to this experiment, subjects were tested for their anxiety level. Those who scored higher in terms of anxiety were likely to show more activity in the corresponding brain areas when paying attention to a voice that was angry.

Processing emotional cues is certainly an important social skill and has survival value. There has been research before on responses to pictures of emotional faces, but the Geneva experiment is the first work on responses to emotional voices.

Continuing work in this area promises to tell us more about the mechanisms regulating emotion in the brain. For now, the results suggest that the brain responds to emotional content – whether seen or heard – using much the same structures and mechanisms.

From Just War to Just Peace

In a book recently published by Oxford University Press, Pierre Allan, who is an associate of our Centre, and co-editor of the volume Alexis Keller argue for the notion of a just peace in the world order.

Just war has attracted considerable attention. The words peace and justice are often used together. Surprising, however, little conceptual thinking has gone into what constitutes a just peace. This book debates and develops such a concept. It includes contributions from some of the world's leading scholars on the topic, including a memorable exchange of views between an Israeli, Yossi Beilin, and a Palestinian, the late Edward Said. The problem with the idea of a just peace is that striving for justice may imply a just war. In other words, peace and justice clash at times. Therefore, one often starts from a given view of what constitutes justice, but this a priori approach leads – especially when imposed from the outside – straight into discord.

In their conclusion to the volume, Allan and Keller argue that just peace should be defined as a process in which emotion plays a role, resting on four necessary and sufficient conditions:

- *"thin" recognition*, whereby the other is accepted as autonomous;
- *"thick" recognition*, whereby the core identity of the other is understood and accepted with empathy;
- *renouncement*, requiring significant sacrifices from all parties; and finally,
- *rule*, the objectification of a just peace by a text requiring a common language respecting the identities of each and defining their rights and duties.

***What is a Just Peace?* edited by Pierre Allan and Alexis Keller, Oxford, OUP, 2006.**

News of Our Projects

There are currently ten major projects under way at the Centre for Affective Sciences.

Several of the projects have already achieved important breakthroughs, including relevant publications and conference contributions. A significant finding in the *Emotion Elicitation* project has demonstrated the central role of pertinence in emotion-antecedent appraisal, demonstrating attentional bias towards evolutionary prepared positive stimuli. The *Response patterning* project has shown that the individual relevance of stimuli predicts frequency, timing, and intensity of self-reported feelings. It has also provided initial evidence of the nature of multimodal organization in expressive behaviour.

Emergent collaborative projects promise advances in understanding the neural correlates of emotion recognition in schizophrenia and Parkinson's disease. The *Norm compliance* project has examined key components of the brain circuits involved in norm compliance induced by the threat of punishment. The project *Human values and emotions* has found that the value/norm distinction is central to the distinction between shame and guilt, and

that psychological theories of shame and guilt which are often thought to be alternatives are compatible and complementary. In the project *Work and emotions* ongoing pilot studies confirm the concept of dysfunctional social support as promising, and indicate that attempts at regulating emotions do not have the same predictive power as attempts at problem-focused coping. The project *Impulsivity and emotion regulation* has demonstrated the central role of impulsivity in adult and adolescent psychopathology.



Offices of the Centre in Geneva

Recent publications and conference papers

Pragmatic and Affective Prosody in Speech

Intonational prosody can express emotion but it is also embedded in the pragmatic coding of the language (such as question intonation). At the recent 3rd International Conference on Speech Prosody held in Dresden, Didier Grandjean and Klaus Scherer of the Centre presented a paper describing two empirical studies that exemplify the possibilities of dissociating emotional and linguistic prosody decoding at the neurological level.

How can the punishment fit the crime? Public perceptions

Members of the project on emotion and the law have just published a book (in French) featuring a pioneering sociological study of public perceptions of

sentencing and the “just” punishment for crime.

The results of the study show little public consensus and in fact considerable public uncertainty about the purpose of sentencing (punishment, rehabilitation, protection of society?) and the value of prison terms or the alternatives.

SwissNex Seminar

A colloquium on *Affective Sciences Emerging: the interdisciplinary study of emotion* took place at swissnex in San Francisco recently. Among the speakers were Klaus Scherer, Patrik Vuilleumier, David Sander and Didier Grandjean of the Centre, along with scientists and artists from across North America.

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A research centre for the interdisciplinary study of human emotion, funded by the Swiss federal government

Upcoming Events

Summer School: The Centre will hold its summer school in affective sciences for doctoral and postdoctoral students in September at the University of Genoa in Italy, in conjunction with the European Network of Excellence HUMAINE.

Workshop in Singapore: A workshop on *Human Emotions in Voice and Body: Approaches from the affective sciences and virtual reality* will be held in Singapore on December 14–15, 2006. It is being organized and presented by the Swiss Centre for Affective Sciences and MIRALab, Geneva, and the Swiss House, Singapore, with the participation of speakers from Singapore institutions of learning and research. This event is held in conjunction with the International Symposium on Chinese Spoken Language Processing (ISCSLP) 2006.

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