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# Sprache, Sprechen, Stimme. Kommunikative Aspekte in der Forensik

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PUK Psychiatrisches Kolloquium / 01-03-2024

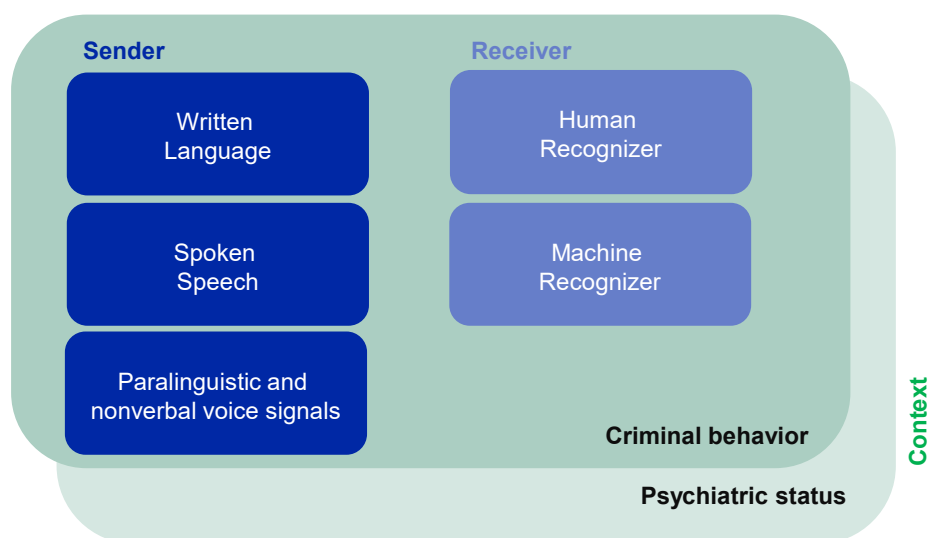
Sprache in der Psychiatrie und Psychotherapie

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## Speech and voice as communication signals

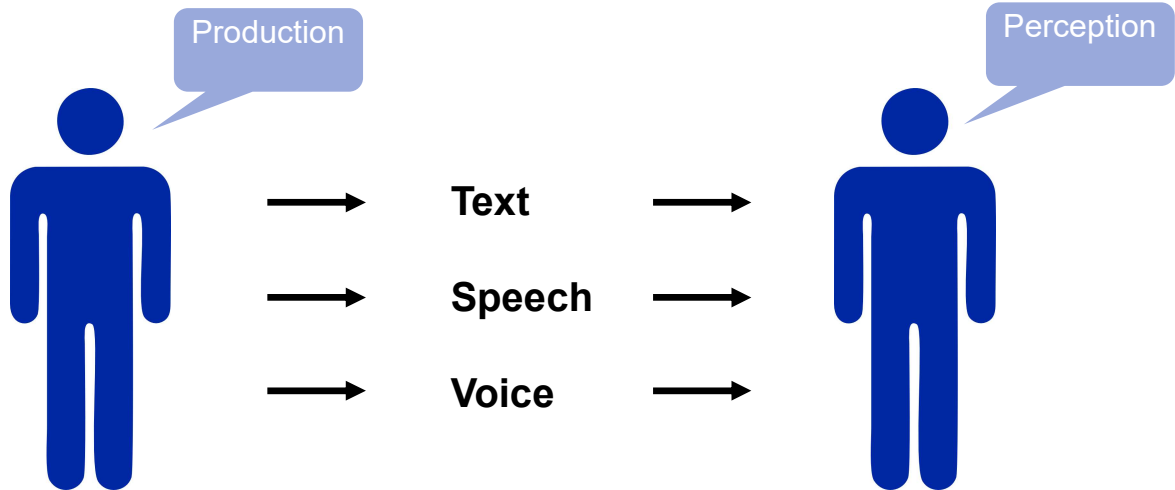


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## Production and perception of communication signals



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## Forensic Linguistics

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## Ransom letters



Sie haben Ihre Zahlungsbereitschaft Am Telefon mitgeteilt  
Das geld Übergabe könnte nur mit eine Gelb Farbige  
Fiat 600 stattfinden  
Wie schon geschrieben wir/en Brauch das Geld nur in  
Gebrauchte HundertMark scheinen Halten sie das  
Geld in eine koffer bereit wir werden sie Anrufen  
Nach unsere telefon anruf Fahren Sie mit ihre  
Wagen und Mit das Geld sofort Los Wir werden Am  
Telefon Genau Sagen wohin / Fahren Sie nur allein und nicht  
Schneller als 90 km/h / Halten Sie ein Genau  
unsere Anweisungen / Machen sie kein Fehler

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## Ransom letters



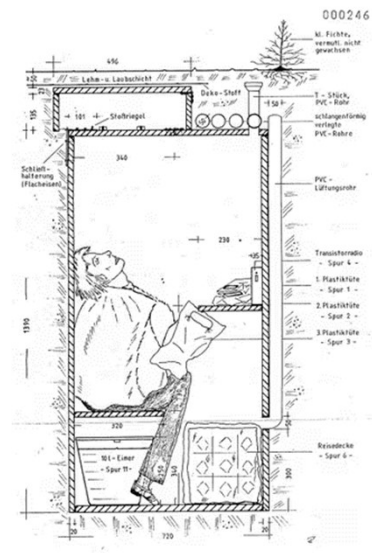
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## The case of Ursula Herrmann (1981)



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## Extortion letters: Real or hoax ?

### DDoS cyber attacks

- ▶ Distributed denial of service
- ▶ Multiple systems flood the bandwidth or resources of a targeted system

Subject: DDoS Attak

FORWARD THIS MAIL TO WHOEVER IS IMPORTANT IN YOUR COMPANY AND CN MAKE DECISION!

We are Armada Collective.

<http://imgtfv.com/?q=Armada+Collective>

You will be **DDoS-ed** starting Thursday (April 21) if you don't pay protection fee - 20 Bitcoins @

If you don't pay by Thursday, attack will start, yours service going down permanently price to stop will increase to 40 BTC and will go up 20 BTC for every day of attack.

This is not a joke.

Our attacks are extremely powerful - sometimes over 1 Tbps per second. And we pass CloudFlare and others remote protections!

So, no cheap protection will help.

Prevent it all with just 20 BTC @ 1Paks2kYKdHBoiq3WSPSeKvPlLeUYEbpyJ

Do not reply, we will not read. Pay and we will know its you. AND YOU WILL NEVER AGAIN HEAR FROM US!

Bitcoin is anonymous, nobody will ever know you cooperated.

### CYBERSECURITY

TECHNOLOGY | CYBERSECURITY

### 'Armada Collective' hackers rake in \$100000 from companies by making fake DDoS threats



By India Ashok

04/27/16 AT 8:21 AM BST



A hacker group claiming to be the Armada Collective, known for its extortion rackets, has taken cybercrime to new levels. The hacker group has duped companies into paying \$100,000 (£68,628) by sending them emails with fake threats of launching a DDoS (distributed denial of service) attack.

In just two months, the hacker group has raked in thousands from companies around the world, who failed to realise that they were being tricked by a mere threat of a potential DDoS attack. According to security firm CloudFlare, the Armada Collective emailed business around the globe demanding ransom in Bitcoin and threatening a hack unless a payment was made.

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## Suicide notes and letters

I hope this is what you wanted

Dearest Mary. This is to say goodbye. I have not told you because I did not want you to worry, but I have been feeling bad for 2 years with my heart. I knew that if I went to a doctor I would lose my job. I think this is best for all concerned. I am in the car in the garage. Call the police but please don't come out there. I love you very much, darling.  
Goodbye.  
Bill

Dear Mom, In the last week a number of occurrences have forced me into a position where I feel my life is not worth continuing. Friday I lost the job I have held for the past seven years. When I told my wife she packed her bags and left me. For six years she has been living with me, not for me but for my money. Mom please take care of Mary for me. I'm leaving and I don't want Betty to have her.  
I have nothing left to live for so I'm just checking out  
- I love you Mom, Bill

Schneidman and Farberow 1957

### Genuine suicide notes

- ▶ **Unequivocal proposition**, even if apparently bizarre or unusual
- ▶ Simply phrased:
  - ▶ thematic, i.e. first clause of the sentence/clause
  - ▶ direct
  - ▶ directed at the addressee and relationship
- ▶ **Necessity / desirability**: not just the **best** course of action, but the **only** course of action
- ▶ **Short**: <300 words, little or no extraneous material
- ▶ **Situational context** of the suicide note is not always obvious and rarely stated directly

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## Forensic Phonetics

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## Forensic phonetics: Speech and voice

### Main areas

- **Content identification:** Speaker factors (e.g. speech pathologies or nonstandard speech patterns, intoxication, screaming), technical factors (e.g. background noise, channel interference)
- **Earwitness evidence:** Inherent factors (witness), contingent factors (circumstances of the exposure of a witness), operational factors (voice parades)
- **Speaker profiling:** Sex, age, dialect, foreign accent, sociolect, medical conditions, health status
- Distinction between **organic** and **learned** features

### Applications

- **Forensic speaker comparison (FSC):** Recordings of known vs. unknown speaker
- **Automatic speaker recognition (ASR):** Automation of the workflow of FSC

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## Automatic speaker recognition (ASR) software

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## “Yorkshire Ripper” (Peter Sutcliffe)

“Wearside Jack” (1978/79)



### Phonetic features indicating dialect

- ▶ Vowel quality of the pronoun ‘I’: Not from Tyneside or North Yorkshire
- ▶ Word ‘**strike**’ close to received pronunciation, but not County Durham
- ▶ **H-dropping**: not pronouncing the /h/ in the words ‘have’ and ‘hope’, unlikely for areas north of the River Wear

*“I’m Jack. **I** see you still **having** no luck catching me. **I have** the greatest respect for you, George, but, Lord, you are no nearer catching me now than four years ago when **I** started. **I** reckon your boys are letting you down, George. They can’t be much good, can they? The only time they came near catching me was a few months back in Chapeltown when **I** was disturbed.”*

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## Artificial intelligence (AI) generated deepfakes



BuzzFeed <https://www.youtube.com/watch?v=cQ54GDm1eL0>

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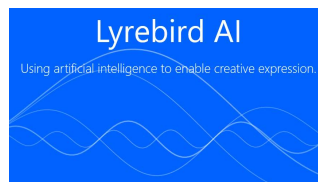
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## Voice ID deepfakes

Freely accessible  
speech and  
voice samples



AI software for  
creating synthetic  
voice profiles



Biometric  
security access  
systems  
(e.g. banking)



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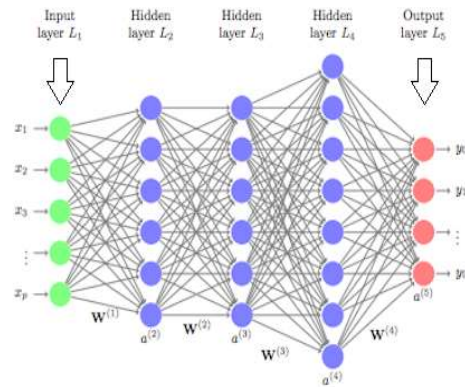
## Voice ID deepfakes

Original voice

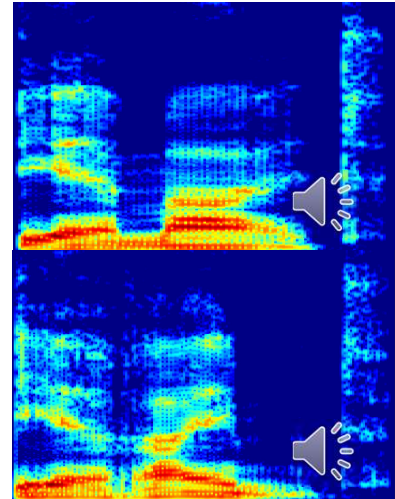


Deep neural  
network (DNN)

Voice ID profile of person



Deepfake voice

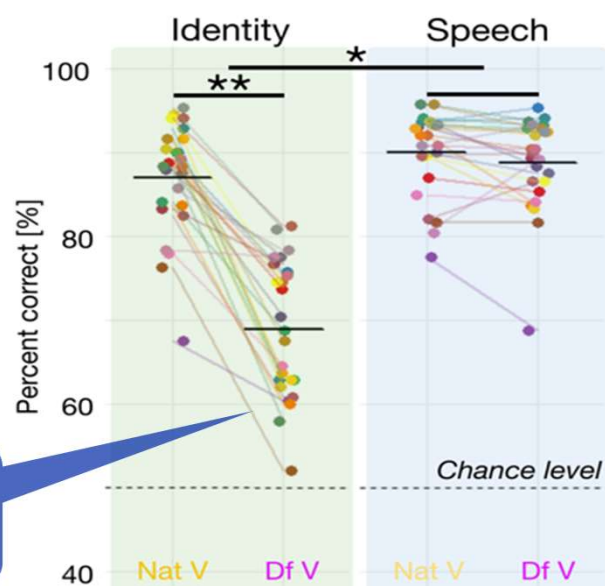


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## Detection rate for deepfake voices



Humans partly detect  
deepfake ID, but are  
partly also deceived  
by deepfake IDs

Roswandowitz et al submitted

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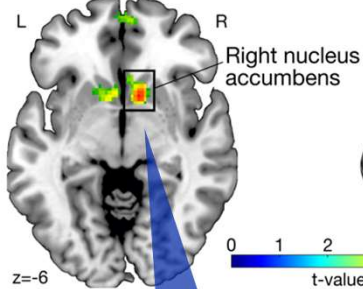
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## Voice ID deepfakes

### A Local brain responses distinguishing natural and deepfake vocal identities

**Natural > deepfake identity**

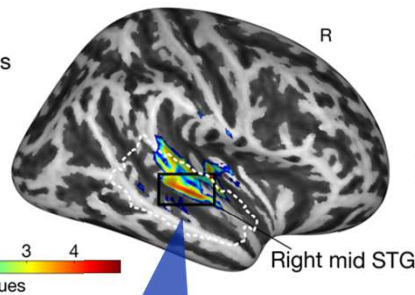
Ventral striatum



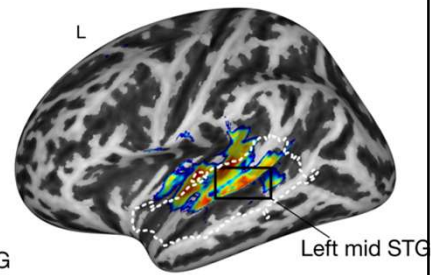
NAcc sensitive to  
natural voices

**Deepfake > natural identity**

Auditory cortex



Acoustic analysis  
of deepfake voice  
in auditory cortex



Roswadowski et al submitted

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## Voice ID deepfakes and cybersecurity



Thomas Brewster Forbes Staff

Associate editor at Forbes, covering cybercrime, privacy, security and surveillance.

Follow



Oct 14, 2021, 10:05am EDT



Cybercriminals cloned the voice of a company director in the U.A.E. to steal as much as \$35 million in a huge and complex heist.

**AI voice cloning is used in a huge heist being investigated by Dubai investigators, amidst warnings about cybercriminal use of the new technology.**

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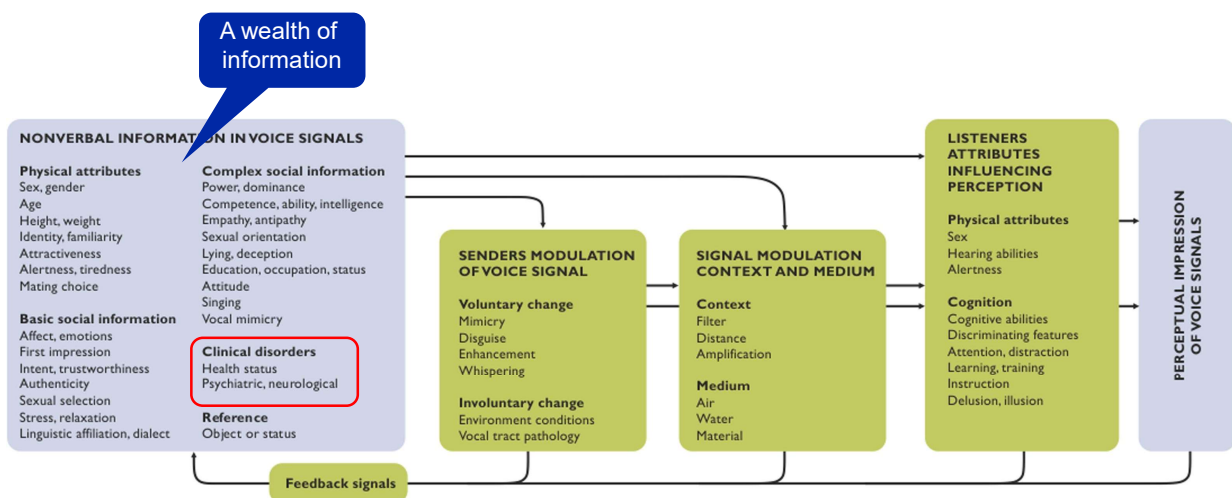


## Voice as nonverbal carrier of social and health information

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## Nonverbal information in voice signals



Frühholz &amp; Schweinberger 2020 Prog Neurobiol

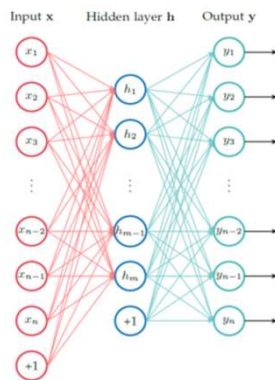
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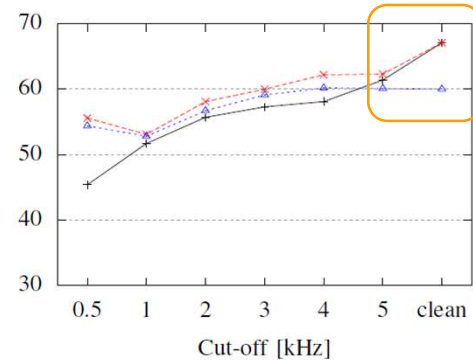
## The voice as a nonverbal carrier of social information

- Acoustic profile of voice samples quantified by common voice features
- Information decoding from acoustic profile patterns
- Can acoustic profiles of voice samples predict the psychiatric classification ?



**Diagnosis based on voice recordings up to 67% correct classification**

- Autistic disorder
- Specific speech impairment
- Other developmental disorder



Frühholz et al 2016 *IEEE Access*

Deng et al 2017 *IEEE Sig Proc Lett*

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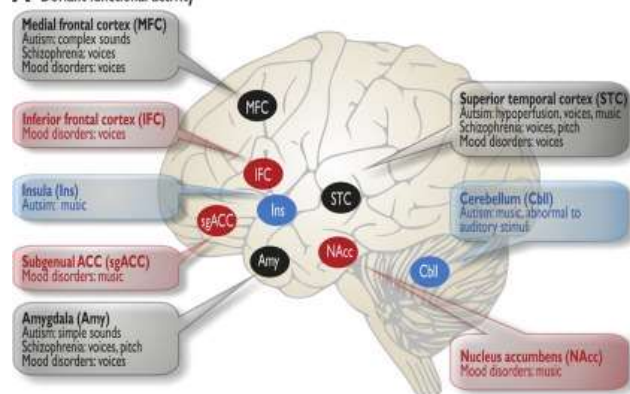
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## General observations in forensic populations

### Schizophrenia in forensic patients

- **Negativity bias** in schizophrenia and schizoaffective disorders [Premkumar et al 2008]
- Deficits in **emotional prosody** processing in schizophrenic patients [Lin et al 2018]
- Forensic patients with schizophrenia with reduced discrimination and under-rating of **negative emotions in speech** [Lesham et al 2020]
- **Forensic patients** perform better in emotional speech recognition than **non-forensic schizophrenic patients** [Lesham et al 2022]

### A Deviant functional activity



**ASD + Schizophrenia + Mood disorders**

**Mood disorders**

**ASD autism spectrum disorders**

Staib & Frühholz 2018 NBR

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## Psychopathy

### Speech production

- **Language of psychopaths:** more past tense, higher frequency of disfluencies (“uuh”, “mmh”, etc), fewer references to social needs etc. [Hancock et al 2011]
- **Deviant narrative styles** associated with high levels of psychopathic levels [Gawda 2021]: (1) egocentric-dogmatic, (2) reserved-repetitive

### Recognizing emotions from voices

- Pervasive deficits in vocal emotion recognition [Dawel et al 2012]
- Deficits in identifying emotion in word-length stimuli [Mackenzie & Logan 2012]
- Poor emotional expression, associated with general mental ability [Olderbak et al 2021]

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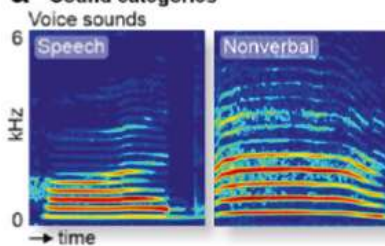
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## The voice as social stimulus ... and psychopathy

### Human voice as social stimulus



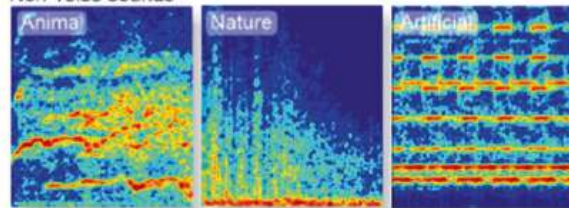
#### a Sound categories



### Other non-social sounds ....



#### Non-voice sounds



Skjeggstad et al 2022 Transl Psychiatr

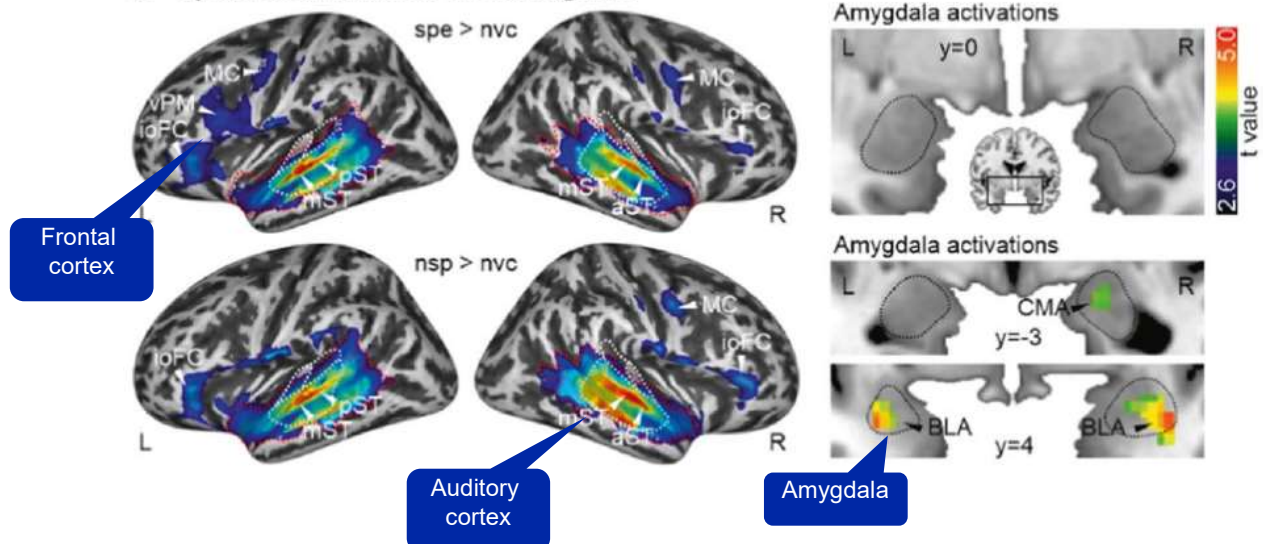
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## Brain activations for voices compared to other sounds

### b Specific activations for voice categories



Skjogstad et al 2022 Transl Psychiatr

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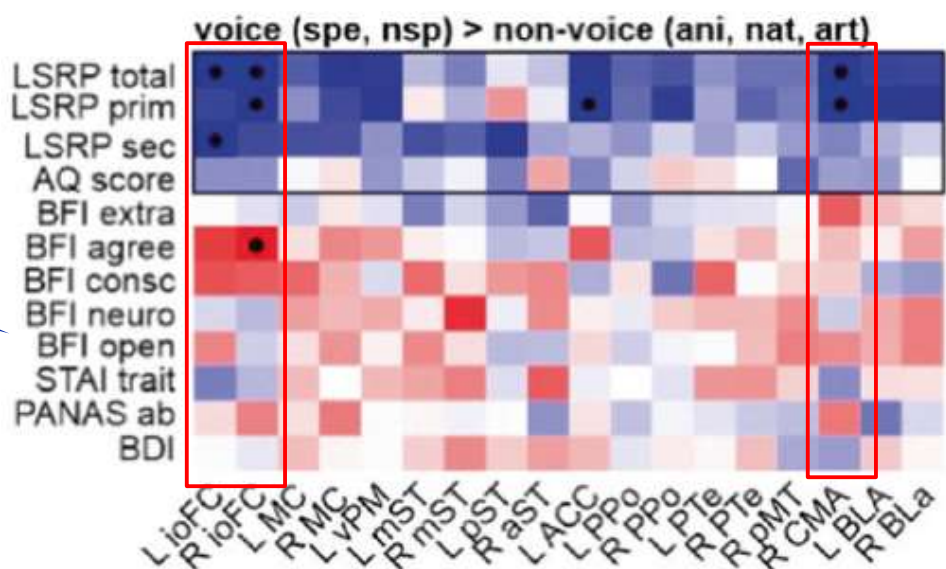


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## Negative correlation for psychopathy

Psychopathy

General  
personality  
traits



Skjogstad et al 2022 Transl Psychiatr

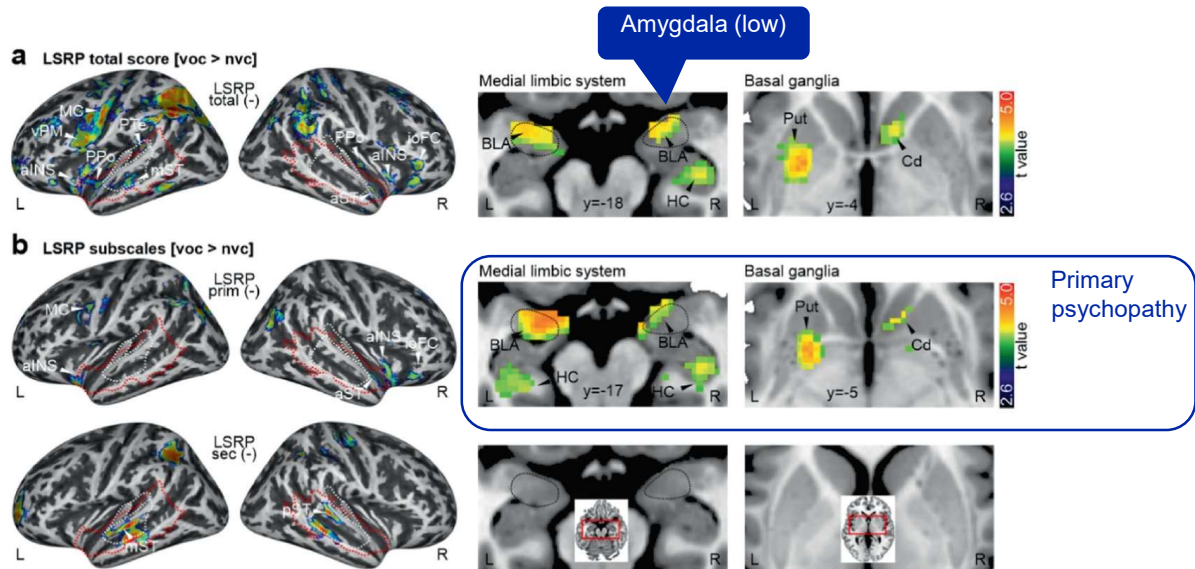
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## Reduced brain activity for high levels of psychopathy



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## Summary

### Production

- ▶ Author profiling
- ▶ Author identification
- ▶ Authenticity: Real or hoax ?
- ▶ Plagiarism
- ▶ Health status

### Perception

- ▶ Health status
- ▶ Psychopathology
- ▶ Level of functional deviance
- ▶ Deviance in cognitive and neural mechanism
- ▶ Victimology and vulnerability

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**Thanks for your attention.**