Assistive Technologies 2

Human Computer Interaction Group (HCI)

Institute of Visual Computing & Human-Centered Technology,
TU Wien

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Content of Block 5

Sign Language (Gebärde, Gebärdensprache)

„Native language“ (primary language of deaf people)
- In many countries recognized as a minority language
- No "translation" of the words of the respective national language but **independent language concept** with own rules (syntax, grammar, semantics)

Presentation of signs executed with (mostly both) **arms** and **hands** (in the head and chest area)

Additional attributes through **facial expression**

Visual aspects such as perspective important

Each gesture is thus a visual symbol, which is composed of certain hand forms, execution points and movements (once or repeatedly) and is supplemented by posture and facial expressions.

Verb: to sign, to use the sign language, example: She signs.
(German: gebärden, z.B.: Sie gebärdet.)

History of Sign Language (SL)

Beginnings go back a long way, but they are not documented

Martha's Vineyard (an island off Massachusetts, USA) in the early 18th Century up to 25% deaf persons (sign language was therefore the second language)

18th century used in teaching (France)

"Kulturkampf" (culture struggle) around the sign language

Deaf Pedagogue Congress in Milan (1880): Prohibition of Sign Language

Late official recognition as the language of a minority:

- European Parliament 1988, Czech Republic 1998, UK 2003, Austria 2005

Excursus - Controversy over the Sign Language (SL)

There is also a certain "religious war" about sign language.

- Supporters of the SL see it not only a very effective communication option but also champion the **right to their own cultural development of deaf people**.
- The opponents argue that this pushes deaf people (and here it is primarily about the children of hearing parents**) into a subculture or in a ghetto**. It seems more important to them that children adjust as much as possible to the hearing and speaking society and therefore learn to read lip-reading perfectly and are also able to articulate themselves in the language.

This dispute even escalated to the point that a congress of deaf pedagogues in Milan in 1880 resulted in a complete prohibition of sign language. Although this categorical attitude is no longer valid today, the degree of acceptance of the sign language still varies from school to school.

Recently, however, the idea prevails that **multimodal education** through the widest possible number of channels, in which sign language, written and spoken language are in a balanced and timely relationship with the child's development, provides the highest learning success.

The multimodal approach has also been proven itself in children with Down syndrome. Even if there is no hearing loss, these children are particularly encouraged by the parallel teaching of spoken language and gestures (one speaks of "total communication").

Excursus – History of British Sign Language (BSL)

200-year-old mug depicting the British Sign Language (BSL) alphabet

"This mug is symbolic of our Deaf history – showing the British Sign Language (BSL) alphabet from ca. 1820. Knowing that sign language was banned from education at the Milan conference in 1880 – we have come through, gaining strength to finally achieve recognition of BSL in 2003. We are proud of our identity, our language and our culture. This mug represents our journey through to today."

Matt Jenkins, Deaf Instructor at Exeter Royal Academy for Deaf Education

Sources: https://www.rammuseum.org.uk/celebrating-british-sign-language/

National / International Sign Languages (ISL)

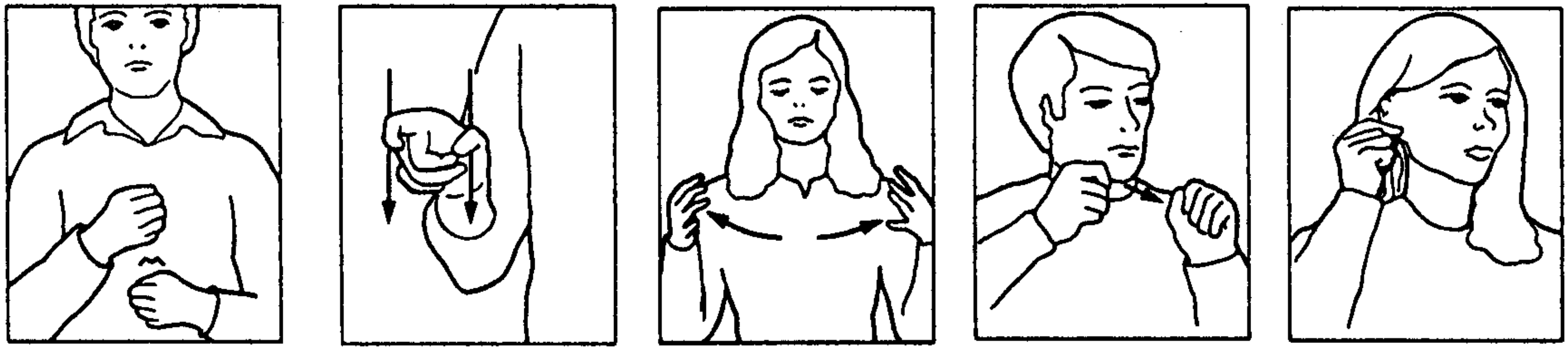
Gesture is a living language, it therefore develops temporally and spatially

No direct relation to the national language: ASL (American Sign Language) is different from BSL (British Sign Language) although English is spoken in both countries.

Even in small countries such as Austria different regional sign languages (ÖGS = Österreichische Gebärdensprache)

Attempts to develop international sign languages (Gestuno, ISL)

Examples from ISL (International Sign Language)



Arbeit	Person	groß	Bildhauer	Frau
work	**person**	**big**	**sculptor**	**woman**

Cataloging of sign languages

Phonetically-based languages know an alphabet (i.e. unified sequence of letters)

Thus, a sequence of words / terms can be constructed - dictionary, lexicon

In a purely visual language, these requirements are missing.

- Signs can not be put into an alphabetical order in a simple form, grouped together in a sign dictionary and thus distributed and unified

Earlier, signs were recorded through drawings or photos

Improvement only in the computer age through multimedia technology

Cataloging of Sign Languages

Description by notation (e.g., HamNoSys / DGS corpus)
SignWriting - Gebärden<u>schrift</u> (transcription)

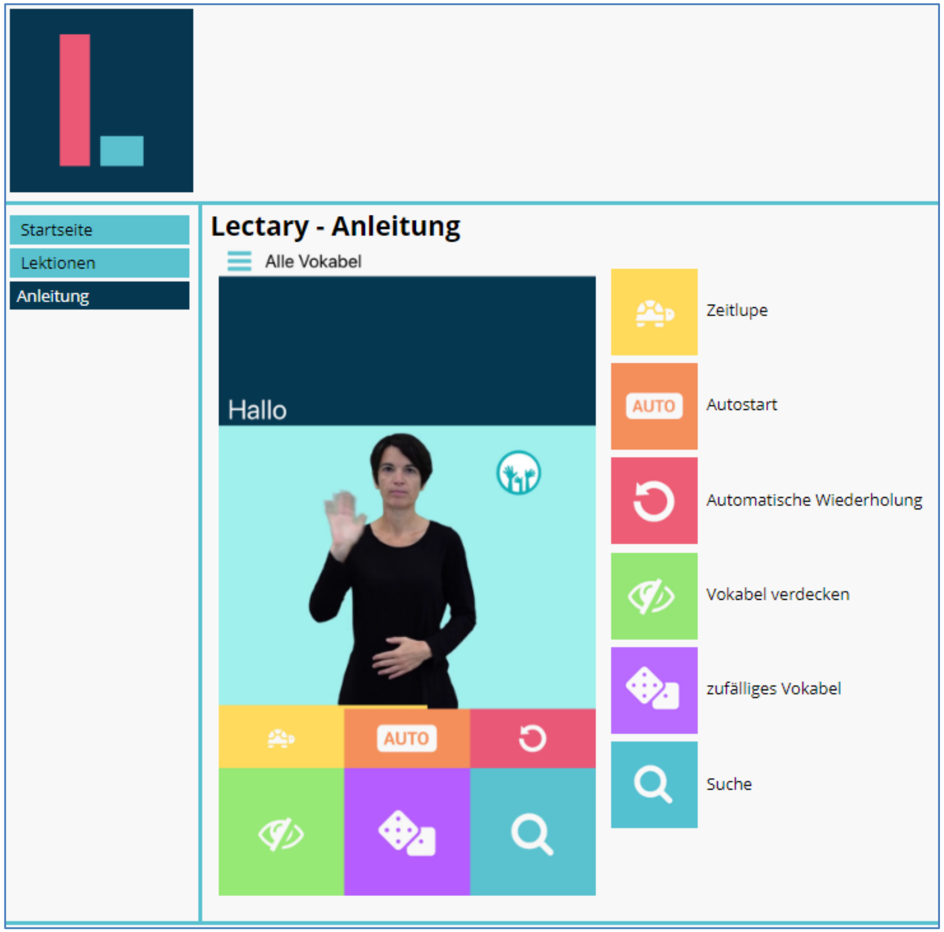
Cataloging with PC (Multimedia Databases on CD-ROM) - e.g. ÖGS-LEX, MUDRA, also for training
Online lexicon

Tools for training of Sign Languages

Example for
Austrian Sign Language

Collection of short videos
Runs as App
on Androids and iOS

Free download:
https://lectary.net/



GESTU – gehörlos erfolgreich studieren

(being deaf and study successfully)

The aim of GESTU is to enable deaf and hard-of-hearing students at tertiary educational institutions (universities, colleges, polytechnics, universities of teacher education) in Vienna to access the university without barriers.
http://teachingsupport.tuwien.ac.at/gestu

The counselling is provided as needed in Austrian Sign Language (ÖGS – Österreichische Gebärdensprache) or in German spoken language (deaf and non-deaf counselors).

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GESTU

Coordination of:

- Sign language interpreters
- tutors
- Scripture interpreters

Technical measures to assist in the design of a barrier-free teaching:

- Creation of live subtitles (e.g. through the use of re-talking and online script interpreting)
- Recording of Courses
- Collection of professional gestures
  https://fachgebaerden.tsc.tuwien.ac.at/startseite/

6: Visual Communication
6.4: Manually Coded Languages

Manually Coded Languages (MCL)

- Also “Signed English" or "Signed Exact English" (SEE)
- (in German: Lautsprachbegleitende Gebärden (LBG))

Transfer of the words of a spoken language in gestures

Visualized vocal language Note: In contrast to the sign language (SL), the MCL is not an independent language.

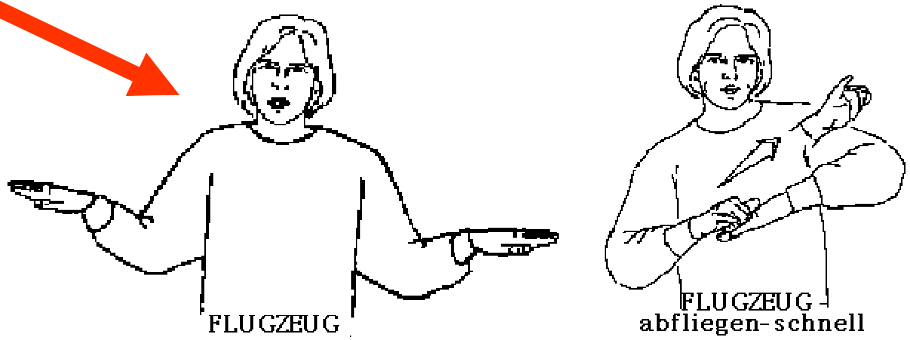
Support of lip reading (also mute)

Word order and grammar come from the vocal language

MCL is used as

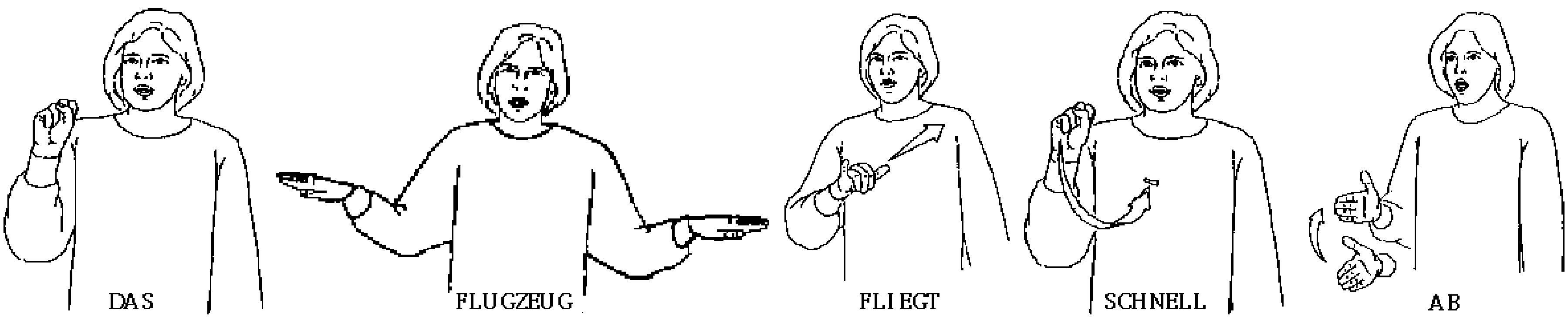
- Method of supporting communication between hearing and deaf people
- Preparation to learn the SL and to acquire the spoken language
- As a permanent means of communication, MCL is too slow and too uneconomical

Comparing MCL and SL



Plane

Plane
flies off - quickly



Das .... Flugzeug .... fliegt .... schnell ...... ab

The .... Plane .... flies ..... quickly.......off

Cued Speech (literally: language with hints)

Support of lip reading through visually presented phonemes

Hand signs near the mouth (mouth picture and hand position are observed at the same time)

Especially for the distinction of phonemes, which lead to the same viseme (lips) and thus cannot be differentiated by lip reading.

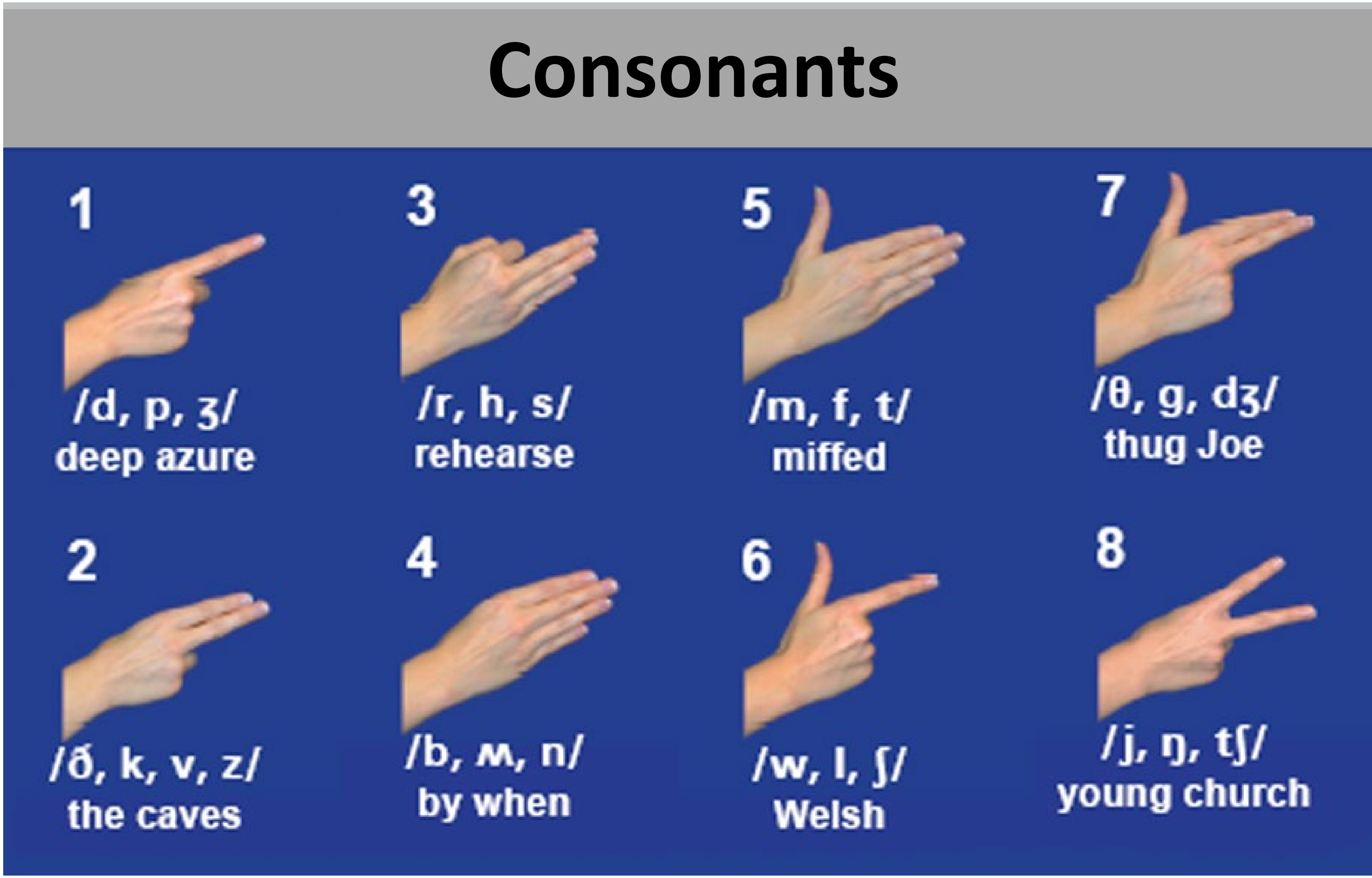
8 hand signs for the phonemes of the consonants

4 hand signs (hand positions) for the vowels

6: Visual Communication

6.5: Cued Speech

Important for the understanding of "Cued Speech" is that the hand positions do not represent graphemes (ie the characters with which a word is written) but **phonemes** (ie the phonetic units that make up a word)


Consonants
1
/d, p, ʒ/
deep azure
3
/r, h, s/
rehearse
5
/m, f, t/
miffed
7
/θ, g, dʒ/
thug Joe
2
/ð, k, v, z/
the caves
4
/b, ʍ, n/
by when
6
/w, l, ʃ/
Welsh
8
/j, ŋ, tʃ/
young church

Note taking

Transfer of a spoken message into a written (i.e. visual) form implemented by an human assistant

Examples:

- In the simplest case: paper and pencil
- Recording a lecture (interview) by assistant person
- Keywords on a piece of paper
- Display of text on notebook or tablet
- Use of your own display
- Subtitles on the canvas / screen

Subtitle generation

Quick writers on conventional keyboard

Using a special keyboard

(machine typography, Velotype, Veyboard)

Subtitle generation

Respeaking: speaking the text through "Respeaker" and dictating into an ASR system
(ASR = Automatic Speech Recognition)


Visual communication for deaf (or speech-impaired) people

Important distinction: which **aspect of the language is translated into the visual modality:**

Lip reading	Visual **lip image** (visemes)
Finger alphabet	Visual **letters**
Note taking, subtitle generation	Visual **letters**
Cued Speech	Visual **phonemes**
MCL (Manually Coded Languages) also called e.g. **SEE** (Signed Exact English)	Visual **words**
Signing	**Independent language**

Communication with deafblind people

Is particularly difficult

Only sense of touch usable for communication purposes

Depending on which of the two sensory deficits occurred first, the affected person usually already before the onset of deafblindness had either learned and practiced the handling of Braille or with gestures (or finger alphabet). This usually determines which of these two forms of communication will continue to be used.

The use of Braille takes place as with blind persons

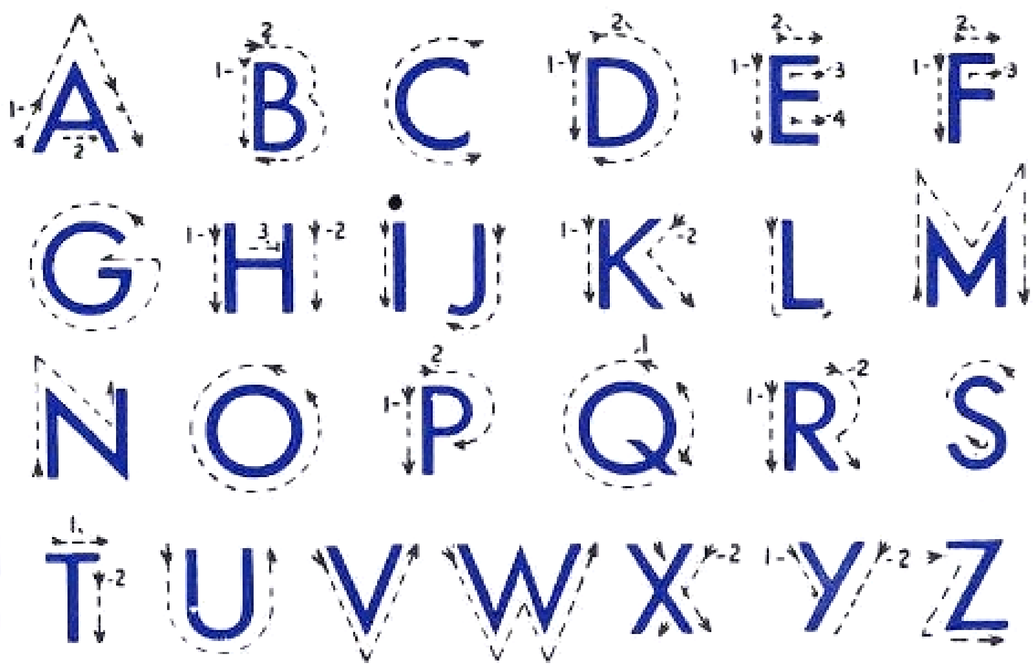
Other possibilities: e.g. Use of the finger alphabet and the tactile language according to H. Lorm

Communication with deafblind people

Print on Palm (POP)

Easiest way to communicate: Write capital letters in the palm of your hand.

The entire space on palm is used.



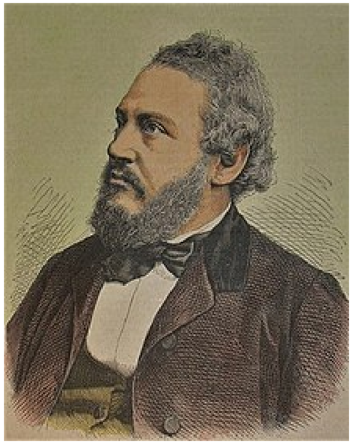
- Letters are written one at a time, one above the other.
- The writing finger always is in contact with the palm.
- if possible, all letters are written with a line without stopping (e.g. "M", "N" and "W").

Communication with deafblind persons

Tactile use of the finger alphabet

Own hand alphabets
(e.g., English hand alphabet
for deafblind persons)

Lormen - Hand alphabet by H. Lorm



Hieronymus Lorm (Heinrich Landesmann)

- 1821-1902, Austrian writer
- At 15, he was deaf and almost blind.
- Nevertheless, he studied philosophy and German literature in Vienna (long before Braille was spread in Europe).
- Later completely blind.

Developed communication method for letter-wise text transmission to a deaf-blind person by touching the palm and the fingers.

Introduction video: https://www.youtube.com/watch?v=dmMgujsomFs (Duration: 02:37)

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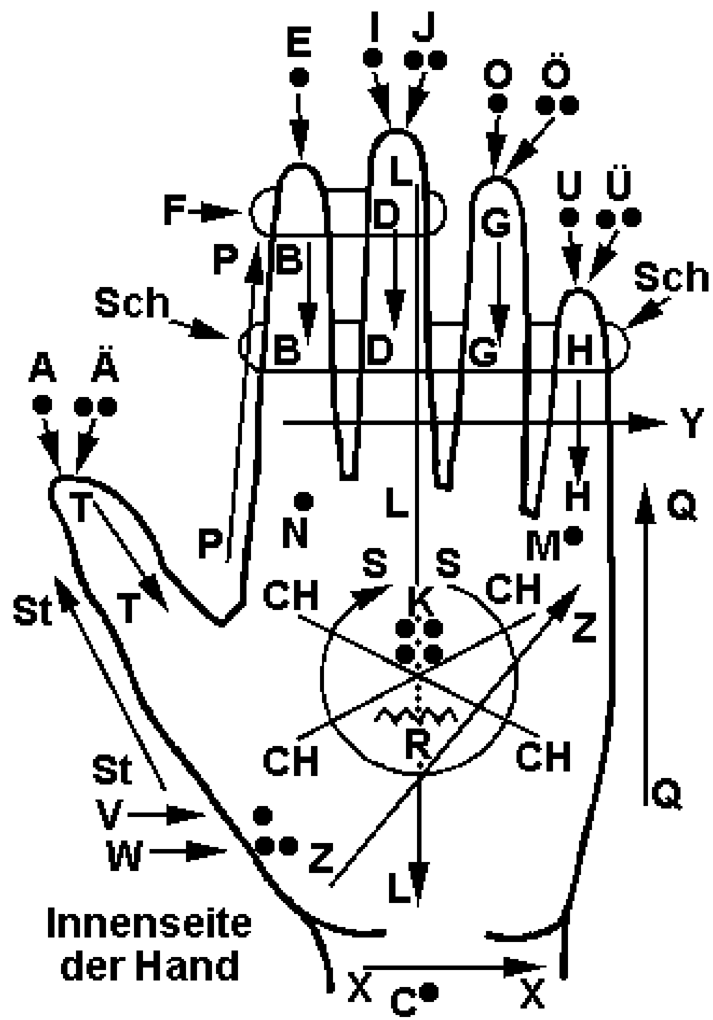
Lormen (Lorm Alphabet)

A = Punkt auf die Daumenspitze
E = Punkt auf die Zeigefingerspitze
I = Punkt auf die Mittelfingerspitze
O = Punkt auf die Ringfingerspitze
U = Punkt auf die Kleinfingerspitze
Ä = Zwei Punkte auf die Daumenspitze
Ö = Zwei Punkte auf die Ringfingerspitze
Ü = Zwei Punkte auf die Kleinfingerspitze
J = Zwei Punkte auf die Mittelfingerspitze
B = Kurzer Abstrich auf der Mitte des Zeigefingers
D = Kurzer Abstrich auf der Mitte des Mittelfingers
G = Kurzer Abstrich auf der Mitte des Ringfingers
H = Kurzer Abstrich auf der Mitte des Kleinfingers
T = Kurzer Abstrich auf der Mitte des Daumens
F = Zusammendrücken von Zeige- und Mittelfinger
P = Langer Aufstrich außen am Zeigefinger
K = Punkt mit vier Fingerspitzen auf den Handteller
L = Langer Abstrich von Fingerspitze zum Handgelenk
M = Punkt auf die Kleinfingerwurzel
N = Punkt auf die Zeigefingerwurzel
R = Trommeln der Finger auf den Handteller
S = Kreis auf dem Handteller
Z = Strich vom Daumenballen zur Kleinfingerwurzel
V = Punkt auf den Daumenballen
W = Zwei Punkte auf den Daumenballen
Ch = Schräges Kreuz auf den Handteller
Sch = Leichtes Umfassen der vier Finger
C = Langer Aufstrich außen am Daumen

X = Querstrich über das Handgelenk
Q = Langer Aufstrich an der Handkante
Y = Querstrich über die Mitte der Finger



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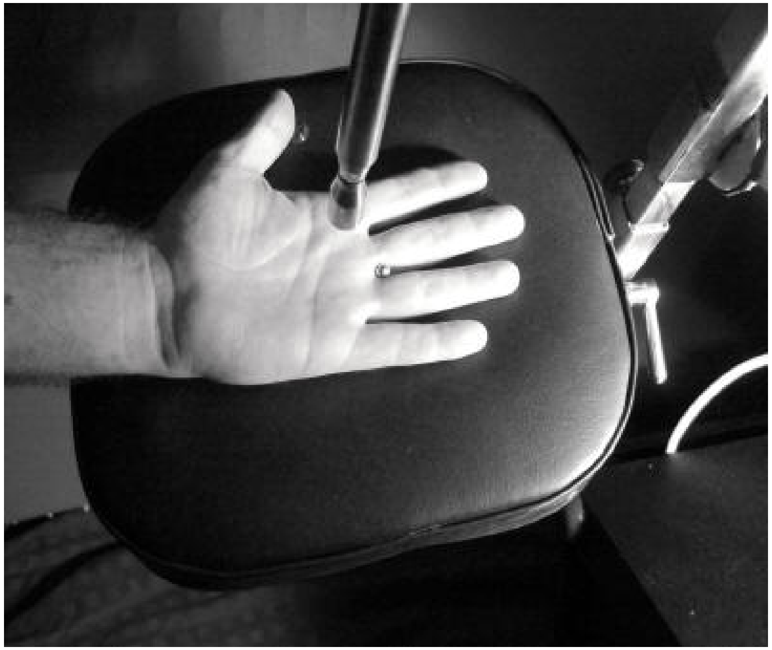
Lormen

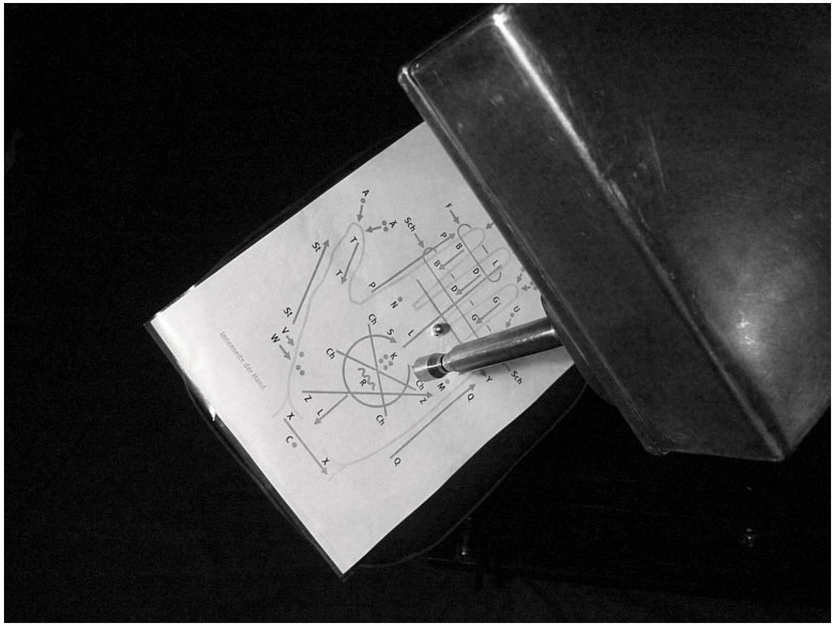
- The „Lormer“ – devices to output on the user‘s palm and fingers



Lormen

The„Lormer“ output device

See: http://www.lormer.com/



Lormer: variant with hemisphere grid, in which a pattern is blown onto the hand by means of a 3D movable arm with air outlet nozzle

Demovideo: https://youtu.be/vLx6zVvRn0I (Duration: 2:51)

Lormen „Mobile Lorm Glove“

Allows input and output via the glove and thus also access to telecommunication

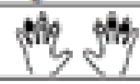
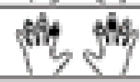
Demovideo: https://www.youtube.com/watch?v=FLfa9ni7X3I (Dur: 02:22)
Quelle: http://www.design-research-lab.org/?projects=mobile-lorm-glove
Univ. of Arts, Berlin, Germany

VC&HCT

Finger Braille

(from Japan) 6 fingers are used as a "Braille keyboard”

Table 1. Example of the translation a letter into a Braille code and a Finger-Braille code

Language:	Character:	Braille code:	Finger-Braille:
Japanese	ん	⠴	
English	E	⠑	

7: Tactile Speaking
7.2: Tadoma

Tadoma

Tactile equivalent to visual lip reading

Fingers used to acquire tactile information:

- Position of the jawbone
- Vibrations on the larynx

Communication in real time possible, but usually slower, years of training needed

Tadoma method was invented by Sophia Alcorn in early 20th century in Kentucky, US.

Name Tadoma comes from the first users, two deafblind children: Winthrop **Tad** Chapman and **Oma** Simpson

NEW YORK JOURNAL

NEW YORK, SATURDAY, JUNE 25, 1927

Silence and Darkness Defeated

Photo by Evening Journal Staff Photographer.
TAD CHAPMAN AND MISS SOPHIE ALCOM.

By placing his hand near teacher's mouth, twelve-year-old Tad Chapman, deaf and blind, can understand her. Tad, through this highly sensitized method, has learned to talk and is adding daily to his verbal repertoire.

Boys, Deaf and Blind, Learn How to Talk

By DOROTHY VAN DYKE.

There are no deaf mutes any longer, even among the blind.

A twelve-year-old blind and deaf boy talked in the auditorium of Public School for the Deaf at No. 225 East Twenty-third street and showed how he understood language by the feel of the speaker's breath against his hand.

Winthrop Clark Chapman of Redfield, S. D., who lost his sight and hearing at the age of four, gave a remarkable demonstration before the Society of Progressive Advocates at the School No. 47.

The society's object is to teach the deaf to speak instead of using sign language, and Winthrop, or "Tad," as he is called, is a striking example of what can be done.

He knows 2,000 words and can even talk to two people at once, and understands other people by vibration. Miss Sophie Alcorn, of Kentucky, his teacher, put his hand

Continued on Page 4, Column 1.

Source: http://tadoma.blogspot.com/

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Tadoma

Only very few deafblind people successfully use Tadoma in everyday communication and can comprehend at near listening rates.

Most users are much slower.

Nowadays rarely used, very difficult to learn, requires years of training and practice.

Video: https://www.youtube.com/watch?v=ZTp2vEiYT_M (Duration: 0:54)
https://www.youtube.com/watch?v=U_QMS-hzRMs (Duration 4:34)

Quality of the human voice determined by:

- respiratory system (lung)
- articulatory system
  - vocal cords
  - palate (regulation of air flow into the oral and / or nasal cavity)
  - tongue
  - teeth
  - lips
- Disability in one of these areas leads to reduced quality of pronunciation

Reductions in speech quality

Volume and duration

Breathy, whispering or hoarse pronunciation

Nasal pronunciation or absence of nasal sounds

Blurred, imprecise or uncoordinated pronunciation

Pitch and volume variations

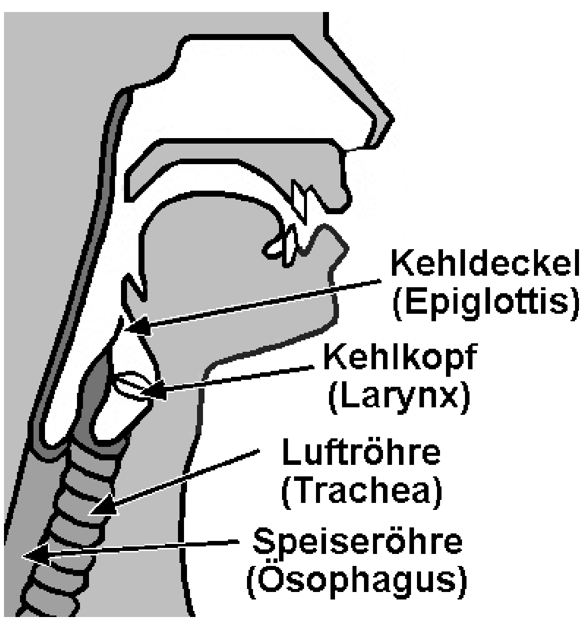
Rumbling and stuttering

Dysarthria: Collective term for voice formation disorders

Reinforcement of the voice

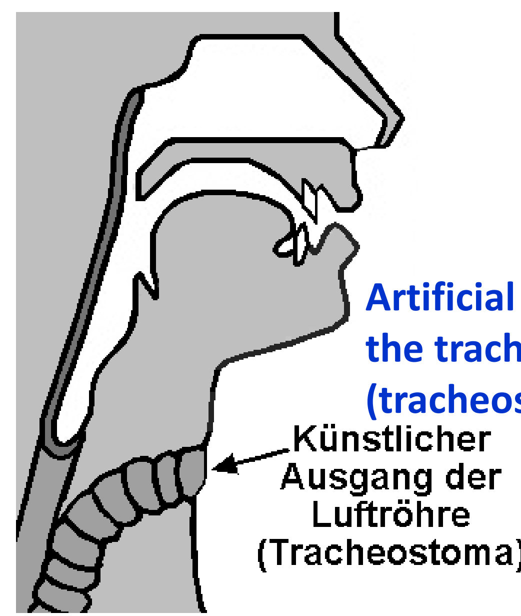
Electronic amplification of a quiet voice

Mostly after larynx surgery (laryngectomy)



Longitudinal section through the neck, throat and oral cavity

After removal of the larynx (laryngectomy)



Artificial exit of the trachea (tracheostoma)

Formation of the substitute voice

Esophagus voice (esophageal voice)

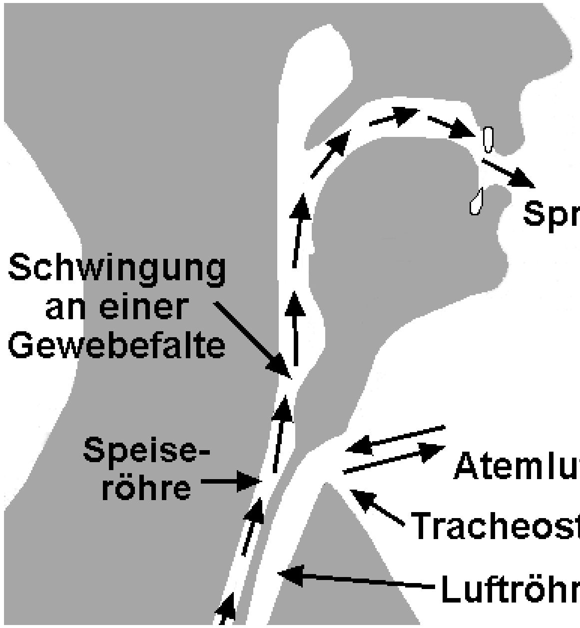
(German: Speiseröhrenstimme, Ersatzstimme)

Air in the esophagus "swallowed"

Controlled output

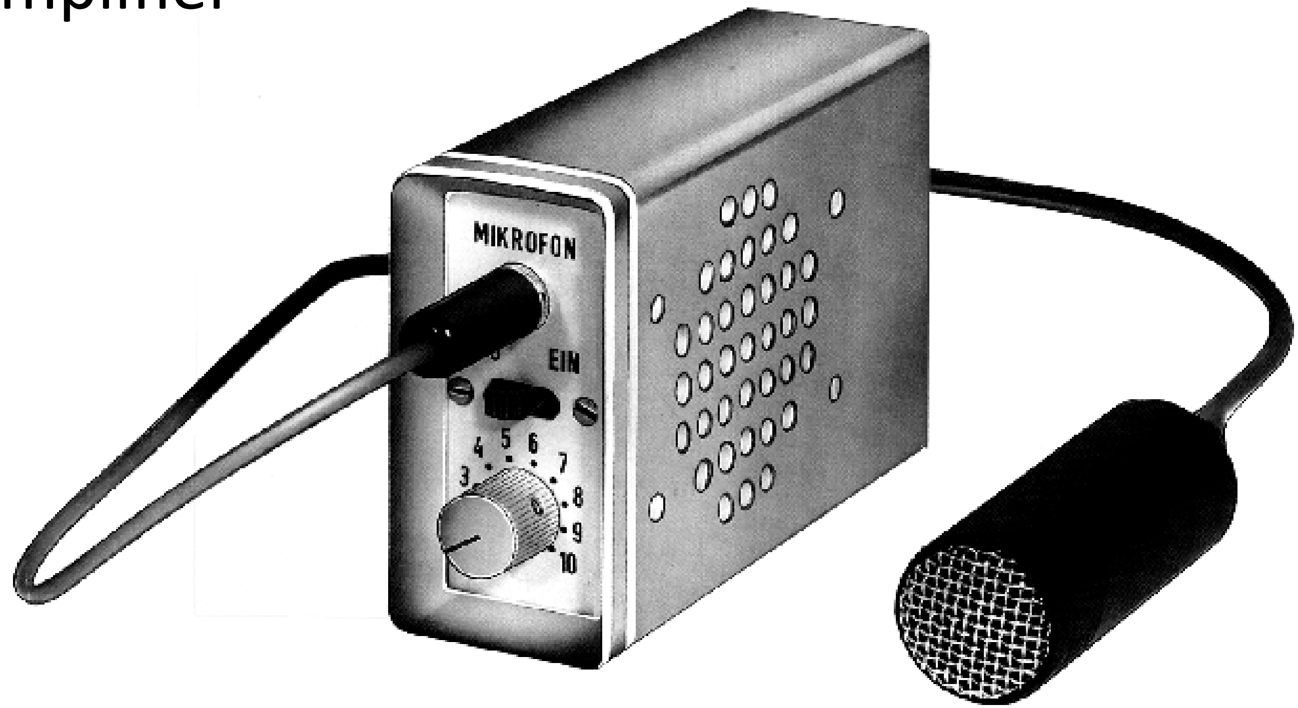
Voice formation on mucosal folds

Articulation in the oral cavity



Esophagos voice - Speech amplifier

- difficult to understand
- like burping
- quiet (about -15 dB)
- Electronic amplifier



Electronic larynx (German: Elektronischer Kehlkopf)

- Substitute for phonation (voice formation for voiced sounds)
- In cases when formation of a substitute voice (see before) is not possible. Extrinsic and intrinsic methods exist.

Extrinsic methods

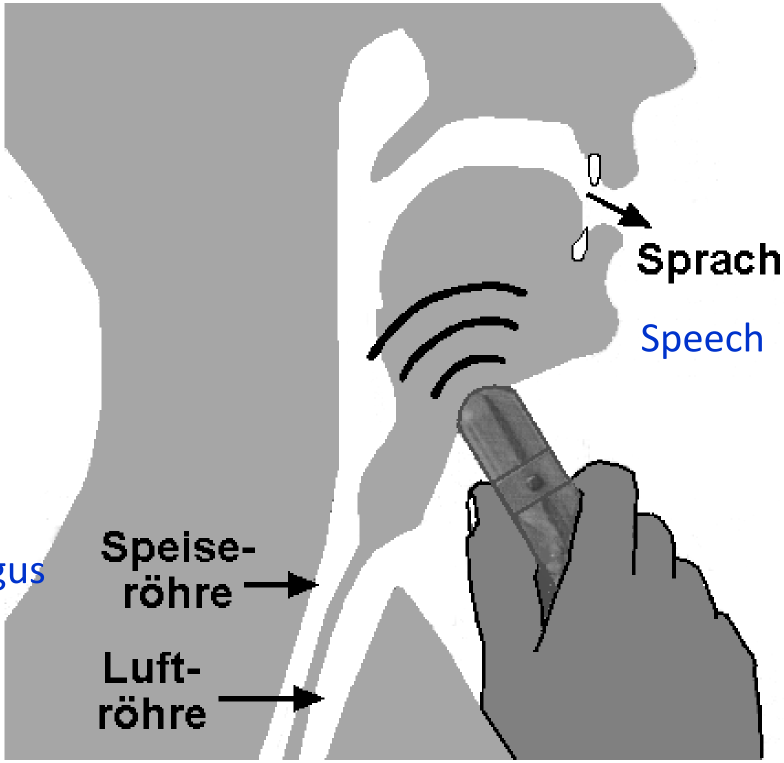
- Vibrations for phonation are generated outside the body and coupled into the pharynx (German: Rachenraum).
- Earlier (ca 1870) air was passed from a lip whistle into the oral cavity
- Today: electronic sound sources (resonators)
- Distinction depending on the type of coupling into the oral cavity
  - transcervical (neck-acting) resonators
  - intraoral (in the mouth) resonators.

Transcervical resonator

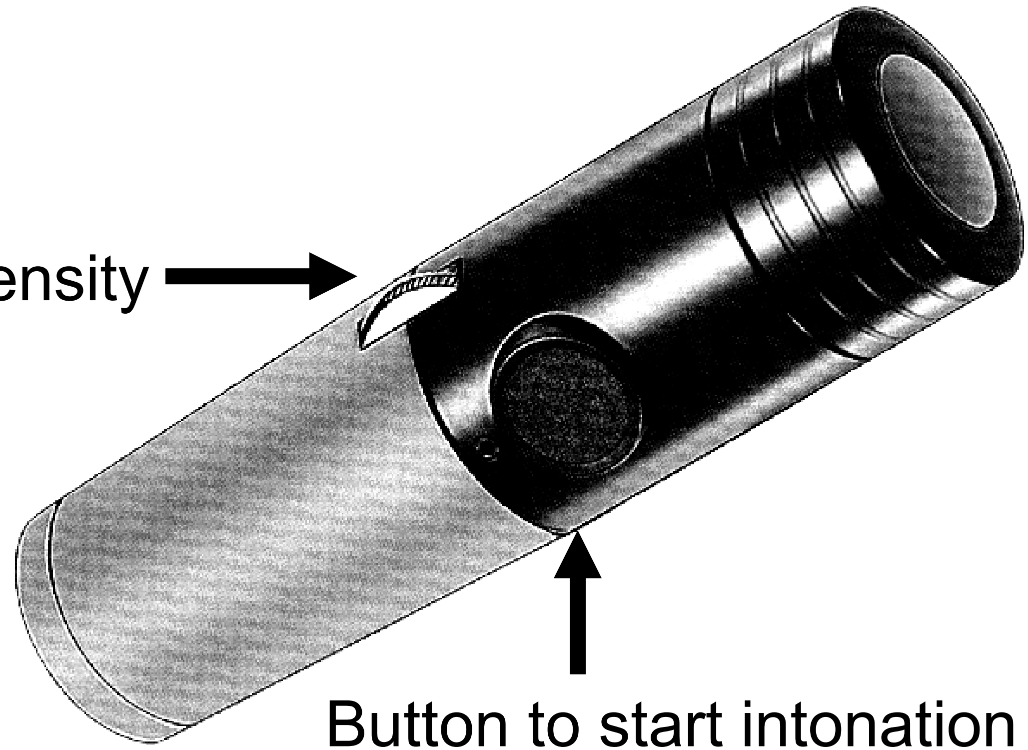
Vibrator attached to the chin

Sound input triggered by pressing a button

Older devices only one frequency (monotone sound)



Artificial Larynx (Elektronischer Kehlkopf)

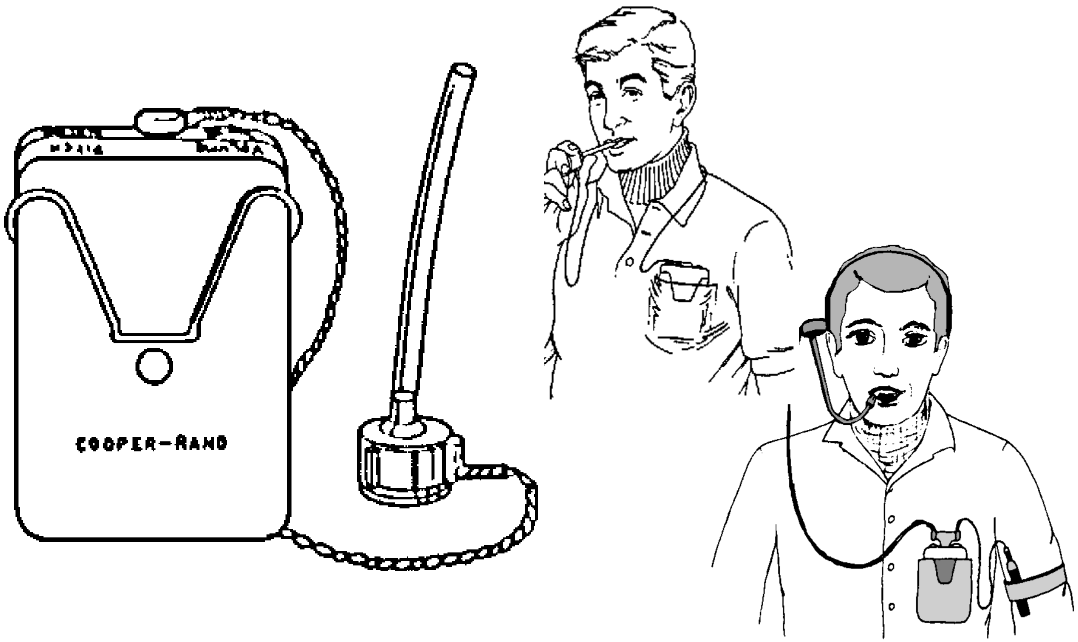



SERVOX digital

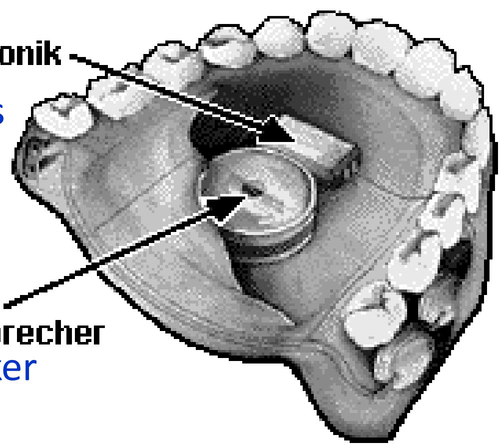
Practical examples: https://www.youtube.com/watch?v=AYydnhu6NbU (Duration 2:15)
https://www.youtube.com/watch?v=h3tWE5xOZOk German, duration 13:35

Intraoral and interoral resonators

Air in the oral cavity is set in vibration



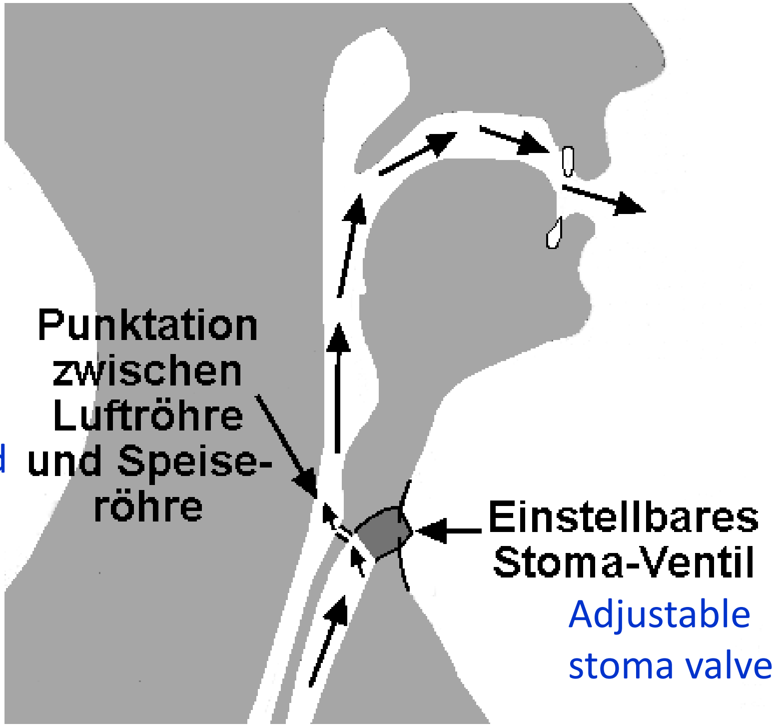
Intraoral resonator (Cooper-Rand), oscillating air is introduced via tube into the oral cavity. Mounting on headband and control via switch on the upper arm.



Interoral Resonator (UltraVoice): Electronics and sound generation are integrated in a palatal plate

Intrinsic Methods

- Tracheo-Esophageal-Puncture
- Adjustable valve between trachea and esophagus
- When exhaling the airflow is through mouth (as long as finger pressure on valve or valve is switched)



Puncture between trachea and esophagus

Adjustable stoma valve

Clarifier

In cerebral palsy, ALS, MS, Parkinson's, TBI, in addition to the quiet voice, there can also be a breathy, only slightly articulated voice.

Clarifiers not only amplify the quiet voice.

By filtering and other speech signal processing, the spectral composition is changed so that the sum of the signals sounds more understandable.

Changed auditory feedback

- Stuttering occurs as a speech disorder in 5 to 15% of children and in 1% of adults.
- There is also interruption of the flow of speech, swallowing of syllables, uncontrolled rapid speaking
- One suspects problems in the self-perception of one's own voice (auditory feedback)
- Improvement achievable by technical manipulation of the signal fed back to the ear

Changed auditory feedback

Altered Auditory Feedback (AAF)

Delayed Auditory Feedback (DAF)
Delays the perception of one's voice by 50 to 250 ms.
Stuttering can improve by 75%

Frequency-Altered Feedback (FAF)
pitch of the perception of your own voice shifted by about 1/2 octave. Stuttering improved up to 80%

Can be realized as a hearing aid behind the ear or installed in a telephone

Re-synthesis of one's own voice

- Prerequisite: voice is difficult to understand, but the articulation of individual sounds is differentiated and constant
- Automatic speech recognition is trained on the dysarthric voice
- Recognized text is rendered understandable with speech synthesizer

This still is in development

9: Alternative Voice Formation

Substitute for the voice

VC&HCT

Input of text - output via speech synthesis

Example: Lightwriter (Toby Churchill Ltd, now https://www.abilia.com)

Toby Churchill: inventor, user & manufacturer of Lightwriter receiving an honorary doctorate in 2010. Source: wikipedia

Input of text - output via speech synthesis

- Special properties
- Two displays, one for the transmitter, one for the receiver of the message (in addition to the synthesizer)
- Special keyboard arrangements ("ABCDE", "QWERY")
- Scanning with single switch instead of keyboard
- Text prediction
- Pairing with the phone

Recent trend: Instead of special hardware devices also notebooks / tablets running with suitable software

VC&HCT

Input of text - output also via text

- Simplest case: communication / letter board
- Electronic example:
- Canon Communicator
- (prints on endless strips)

Marketed by Canon USA since 1974. battery-operated, portable. Keyboard with the letters in alphabetical order, but which can be adjusted.

Input of text - output also via text

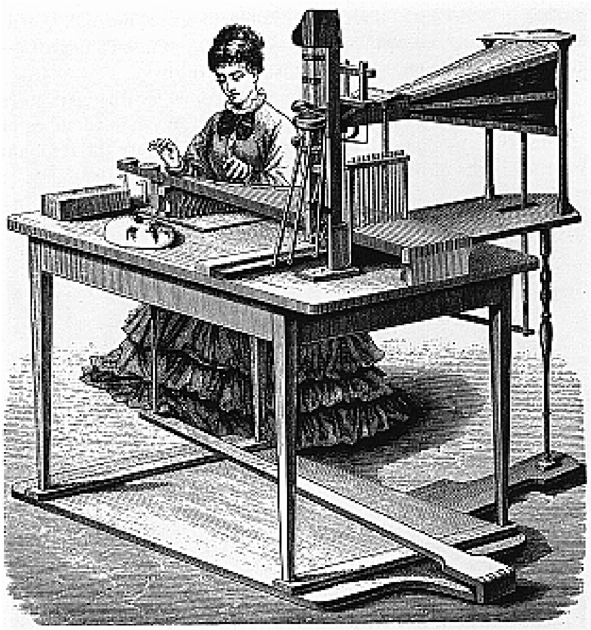
- Special features:
- Switch input instead of keyboard
- phrase Library

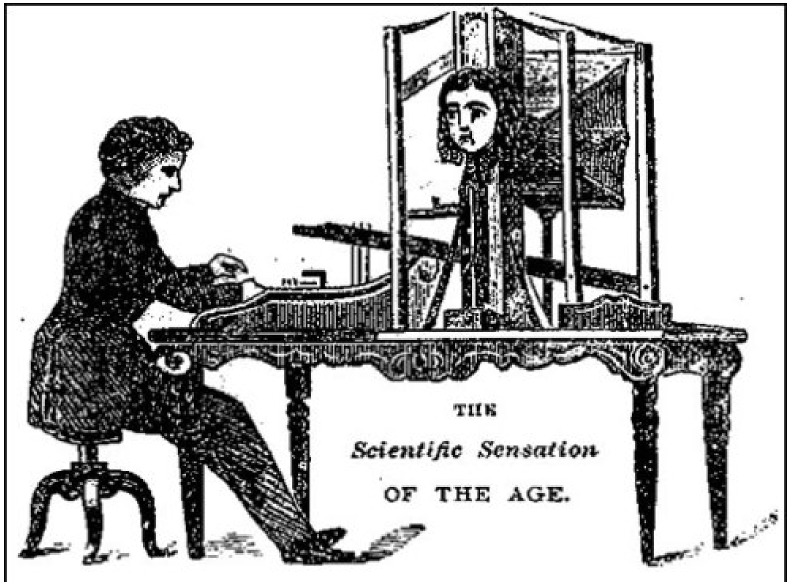
Modality change from spoken language to printed text can bring advantages / disadvantages:

- Permanently visible and non-volatile, can be shared (→ confidentiality)
- Do not need to be listen to / read right away (→ risk of discriminating against people with speech disabilities)

Input of gestures (hand movements) - output via synthetic language

- "Voice Organs" („Sprachorgeln“) have been around since the 18th century
- Voice organ of Joseph Faber (1846)





THE MARVELOUS TALKING-MACHINE.

The „VODER“ at the EXPO 1939

World Exhibition 1939: The "Voder" was introduced, a device consisting of tone generators, filters and resonators, with the help of which specially trained persons could produce spoken language via a combination of keyboard and pedals.

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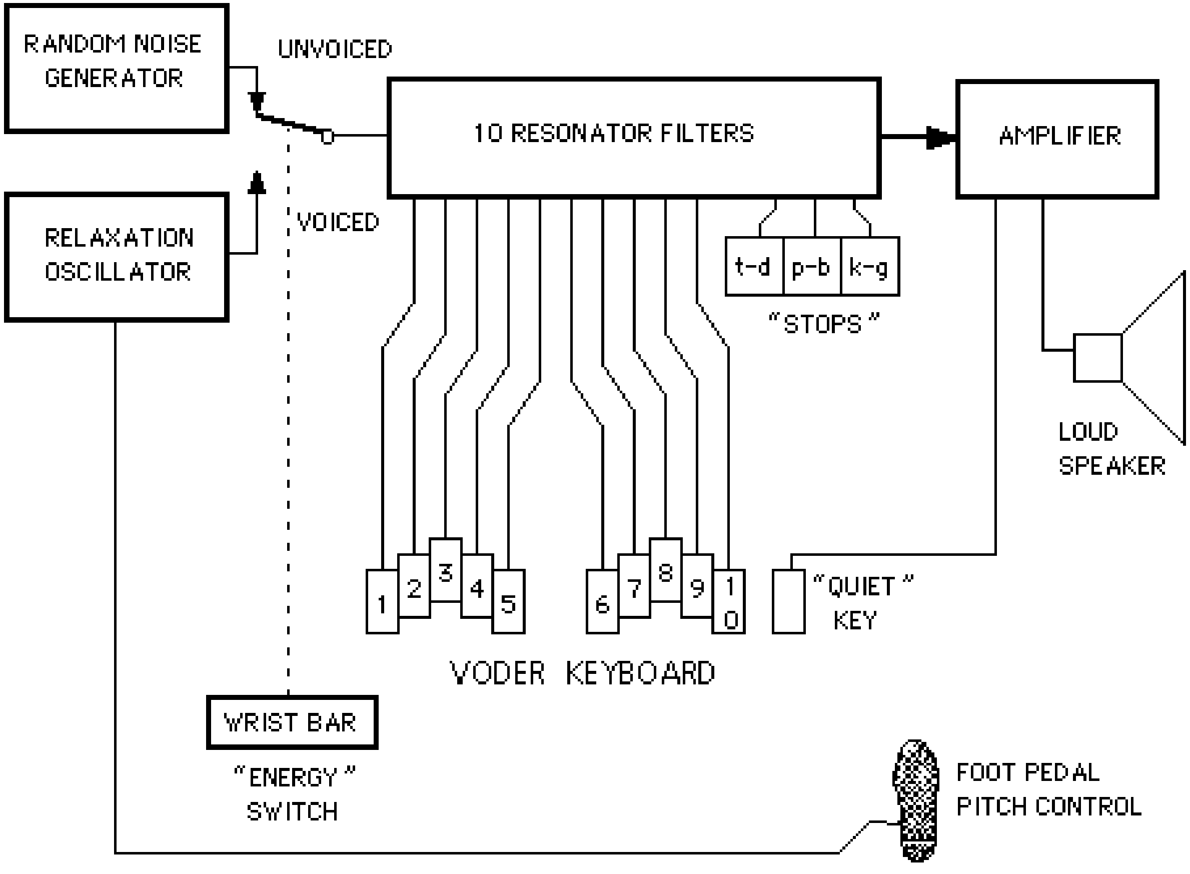
The „VODER“



These historical developments had no technical significance.
However, they proved that it is possible in principle with sufficient training to control an artificial articulation tract.
Improved man-machine interfaces such as data glove and neural networks allow hand movements to be converted into phonemes.

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Example: "Glove-Talk"

control of a speech synthesizer via immediate formation of speech parameters (formants)

Glove-Talk is not the control of a speech synthesizer via discrete letters of the finger alphabet but the **immediate formation of speech parameters (formants) by the changing hand position**, so that any articulation is possible with it.
After a practice time of only 100 hours and repeated adaptation of the user interface by training the neural network, a subject could formulate free sentences that could also be understood by untrained listeners.

Input via pictures or symbols - output via synthetic language

at the same time substitute for the voice

Communication via electronic picture / symbol board

Static (graphic tablet) - - - - - Dynamic (touch screen)

https://www.rehavista.de

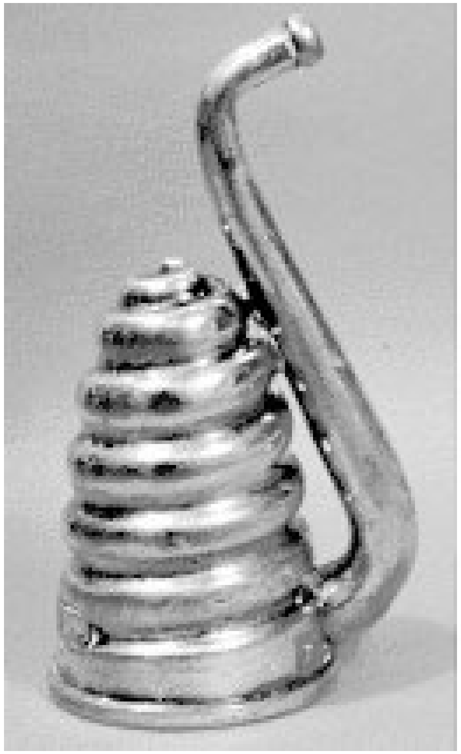
Communication boards

- For digitized language total text duration from a few minutes to almost an hour.
- Communication aids with semantic compaction (minspeak) use full synthesis.
- From a sequence of Bliss symbols grammatically correct sentences can be formed.
- Dynamic displays (touch screen) or appropriately equipped notebook PCs.
- Input via scanning and single switch possible.

History of hearing aids

Oldest "hearing aid" - Hollow hand, gain 14 dB

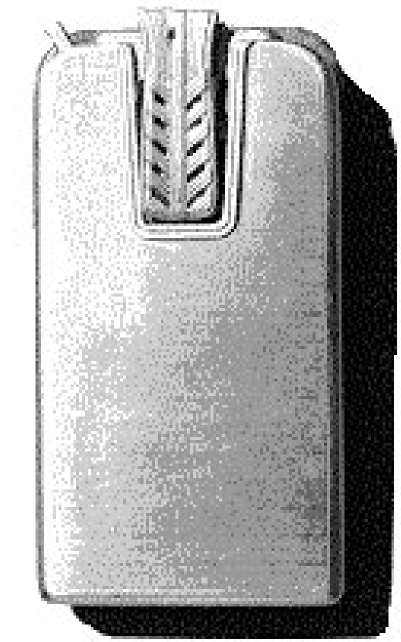
17th to 19th century: Various types of “ear trumpets” (“Höhrrohre”) – “Sound funnels” (“Hörtrichter”) with gains from 20 dB to 40 dB



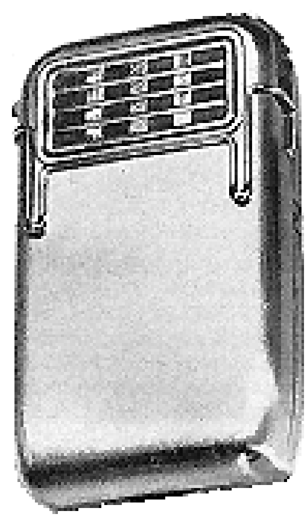
Earliest Electric Hearing Aid

from Deaf Teacher A.G. Bell (from which the telephone was developed in 1876).

1938 first hearing aids with tube amplifier



❖Later also hybrid technology: tubes / transistor



Structure of a hearing aid

- Basic building blocks: microphone, amplifier, handset (miniature speaker) + power supply
- Amplifier is frequency selective
- After detailed audiological measurement (threshold audiogram), the required gain for each frequency band is set individually.
- Objective: Compensation of the hearing curve to 0 dB HV

Hearing aid technology

First devices completely in **analogue** technology. Setting the parameters with potentiometers

Hybrid hearing aids: Analog signal path, parameterization via digital circuit - Interface to a PC for programming

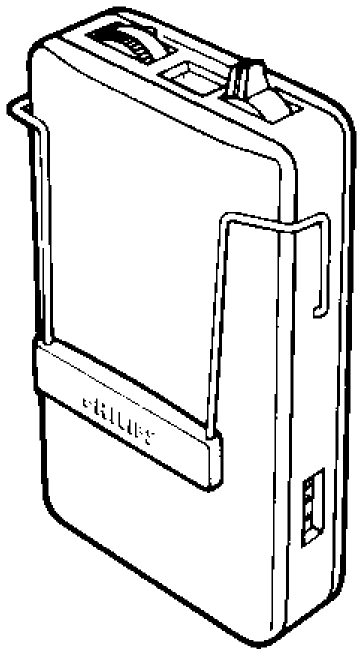
Quasi digital: analog sampling of the input signal and processing in CCD circuit

Full-digital: state-of-the-art technology, e.g. 20,000 samples per seconds, 12-bit resolution, pulse width modulation

Hearing aid types

Pocket hearing aid

- In tube age and at the first transistor devices this was only possible design (about cigarette pack size)
- Today only 0.3% market share
- Easy to use, handy switch
- Large distance between microphone and handset → low feedback tendency



10: Improvement of Hearing

10.2: Hearing Aids

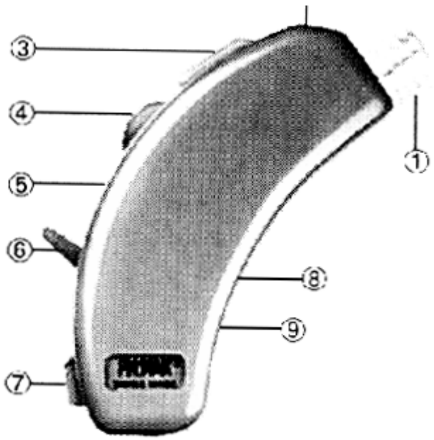
„Behind The Ear“ hearing aid (BTE)

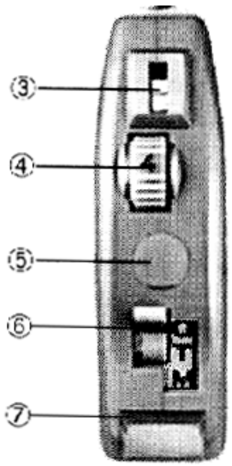
(German: HdO-Geräte – „Hinter dem Ohr“-Geräte)

Kidney-shaped housing, tube for earmold

Earmold (earmold, SE = Secret Ear)

Little space, high feedback tendency

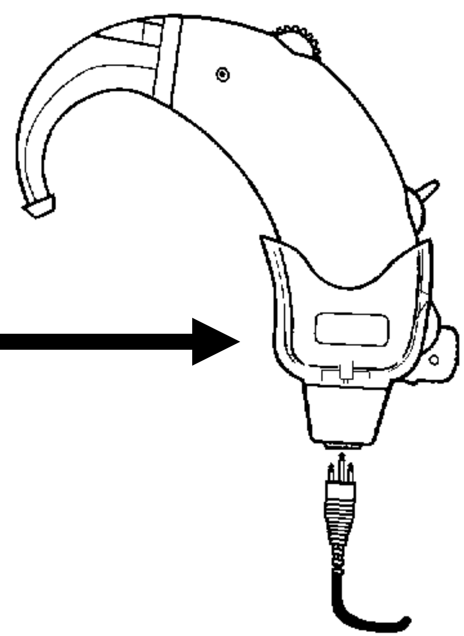




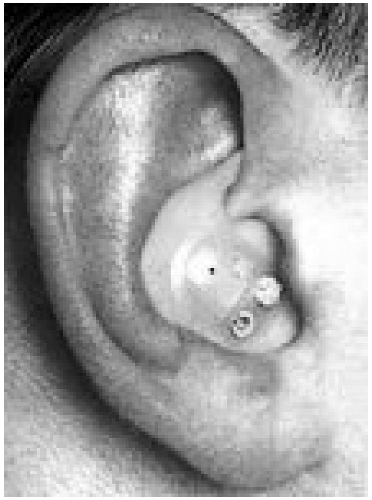
1=Hörer, 2=(Richt)Mikrophon, 3=Schieber für Veränderung der Richtcharakteristik, 4=Lautstärkeregler, 5=Programmierstecker (hinter Deckel), 6=M-T-O-Schalter, 7=Batteriefach, 9=Kontakte für Audio-Schuh

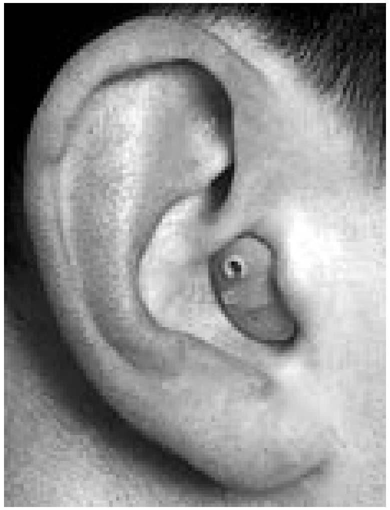
BTE hearing aids (HdO-Hörgeräte)

- Mostly built-in induction coil (Telecoil) for telephoning
- Switch for „M“, „0“ and „T“, sometimes „TM“
- Connection for accessories
- Audio shoe (Audio Schuh)



„In The Ear" hearing aid (ITE)
(German: IO-Geräte - Im Ohr Geräte)
in the auricle (outer ear)

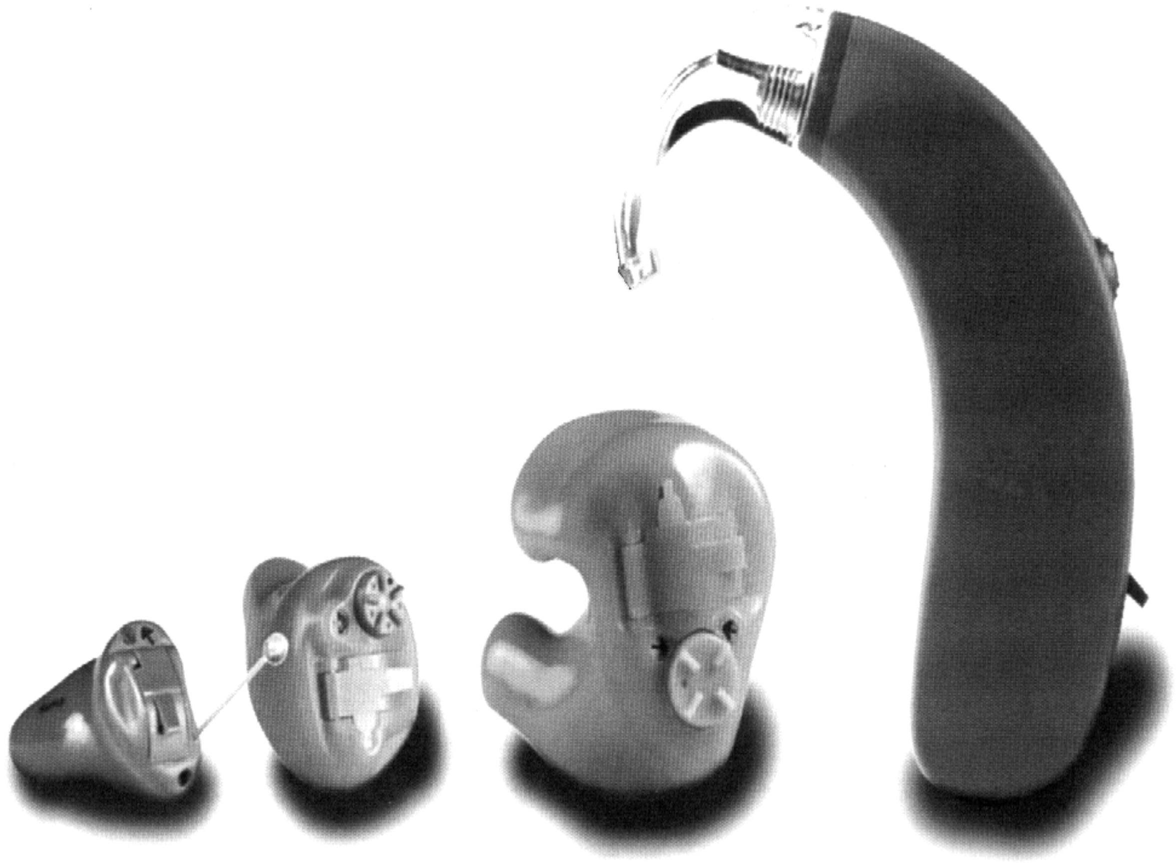




ITC = in the canal hearing aid →

CIC = Completely in the canal – in the ear canal (Gehörgang)

Size comparison of hearing aids



CIC, *ITC,* *ITE,* *BTE*

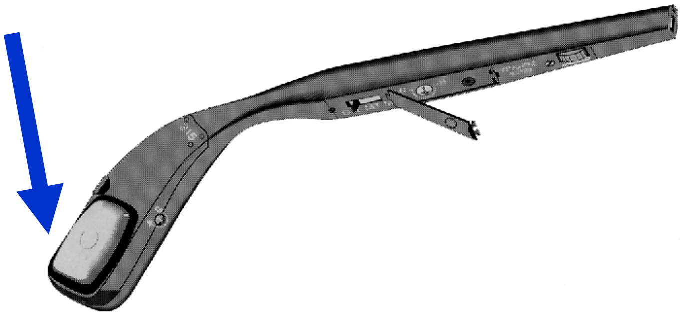
Special types of hearing aids

CROS - contraleteral routing of signal

In the case of deafness in <u>one</u> ear, signals from both sides of the head are brought together on <u>one</u> hearing aid

Bone conduction hearing aids

transmission of structure-borne sound via temples of eye glasses, market share only 0.1%



Bone conduction hearing aids (cont’)

BAHA – (Bone Anchored Hearing Aid)

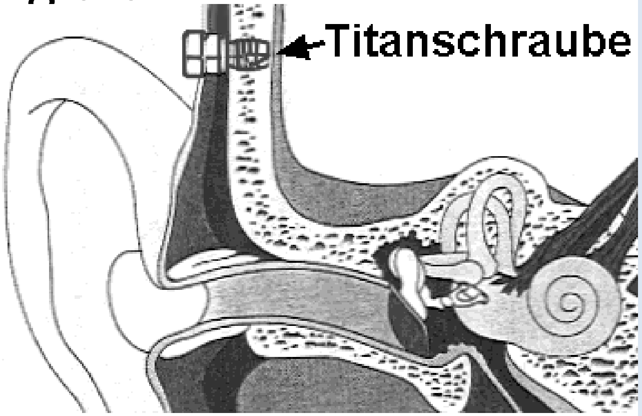
“Part-implanted" bone conduction hearing aid

A **titanium screw** is anchored in the skull bone

On this screw an **external sound amplifier** is snapped off

Its vibrations are transmitted by bone conduction to the inner ear

Titanium screw



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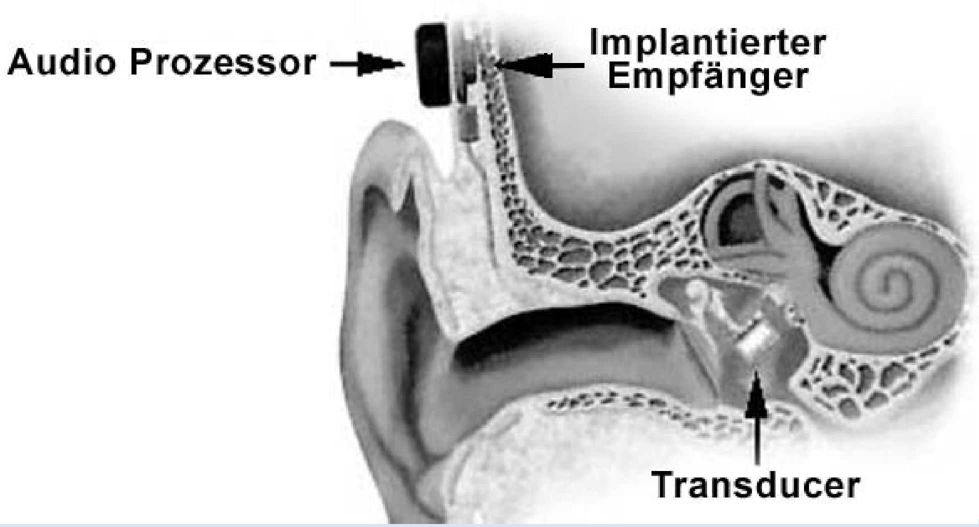
Implanted hearing aids

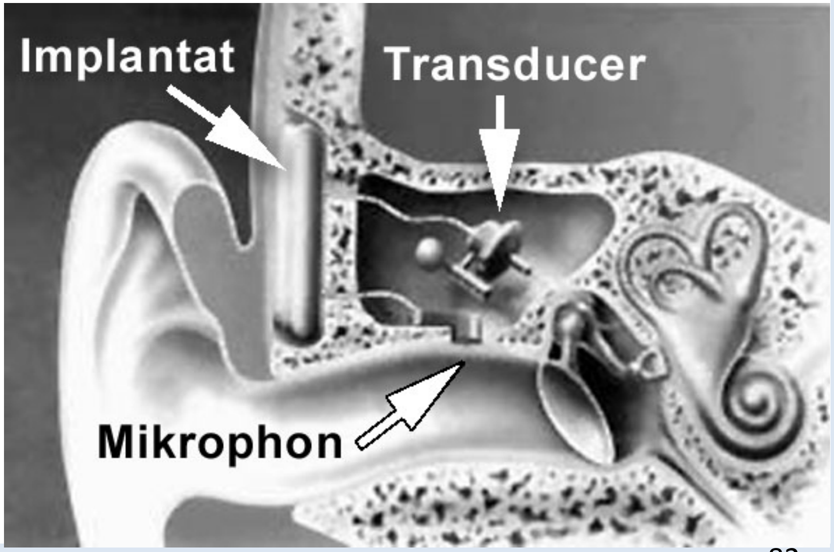
Part-implanted - Soundbridge (manufacturer: Symphonix)

Full-implanted - TICA (manufacturer: Implex)

Audio Processor

Implanted Receiver





Electromagnetic interference EMI in hearing aids

Harmonic content of steep-edged digital signals presents problems for hearing aids.

Problems mainly arise through mobile devices such as laptops, computer games and above all through GSM telephones.

Leads in the hearing aid act like small antennas, which pick up the high-frequency signals, which are then demodulated on any nonlinearity and thus reach the audible range.

Noise suppression - Directional microphones - Signal conditioning

Improving the ratio between useful signal and interference signal (S/N ratio) is difficult to achieve.
Although filters can improve the S/N ratio, they only slightly improve clarity.
Use of microphones with directional characteristics.
Contradiction to the required miniaturization.
State-of-the-art technology uses voice signal processing

Cochlear Implants - CI

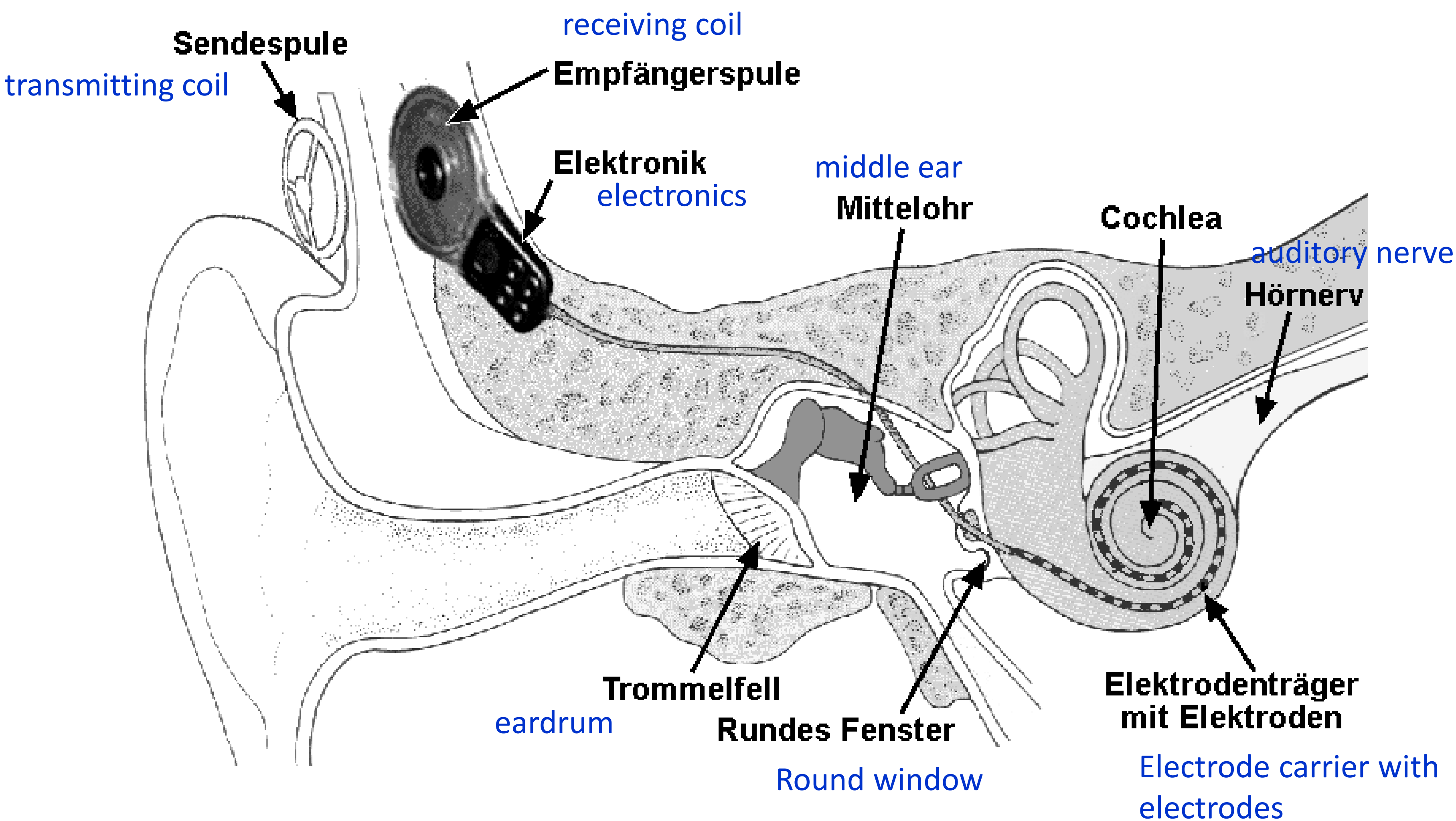
In the case of hearing damage in the area of the hair cells while auditory nerve (8th cranial nerve) is intact.

Two-piece design:

- External signal processor with wireless transmission to the implant (through the scalp)
- Implanted receiver with attached electrode inserted into the cochlea

The most significant differences of each modele:

- Type of signal conditioning
- Number of stimulation electrodes

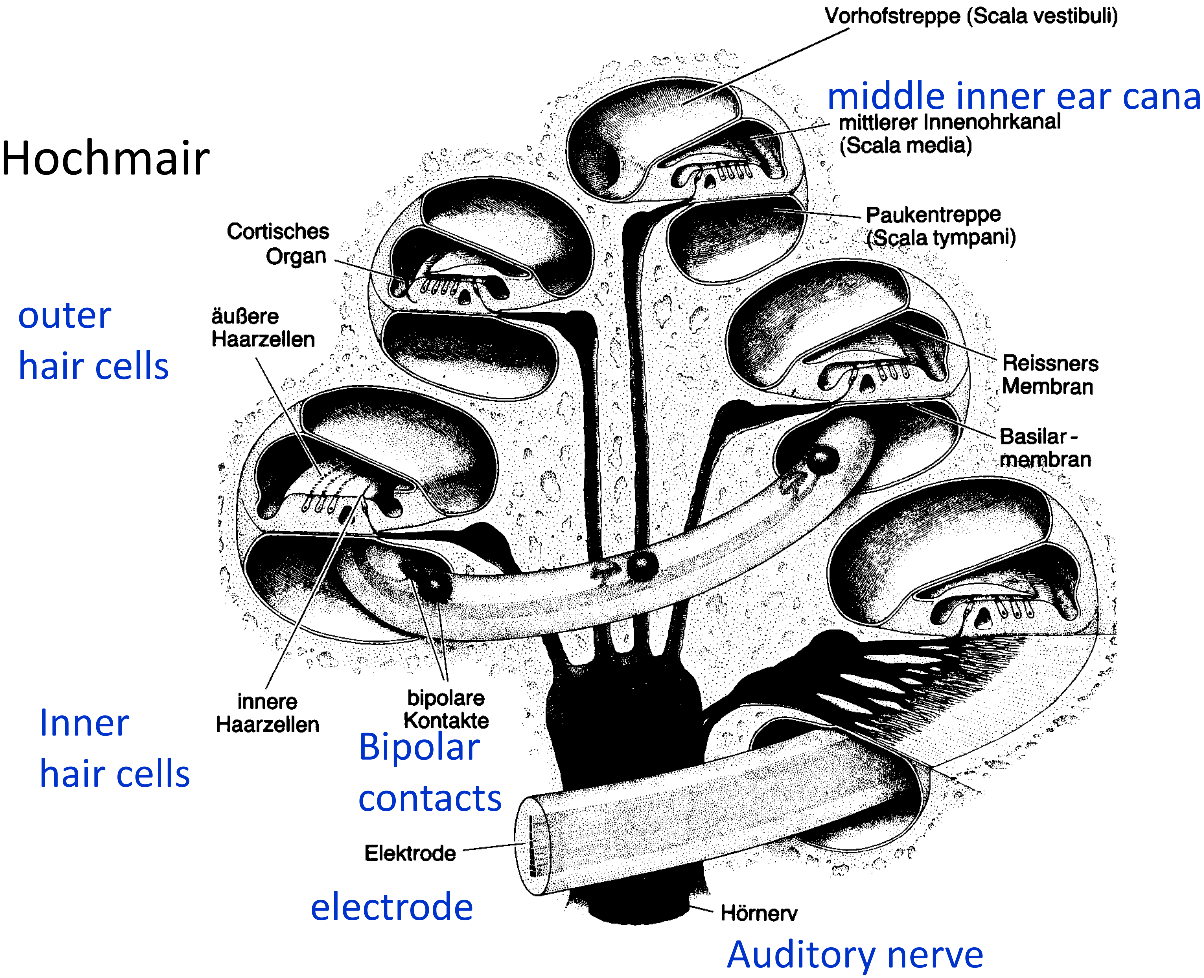


Sendespule
transmitting coil
receiving coil
Empfängerspule
Elektronik
electronics
middle ear
Mittelohr
Cochlea
auditory nerve
Hörnerv
Trommelfell
eardrum
Rundes Fenster
Round window
Elektrodenträger
mit Elektroden
Electrode carrier with
electrodes

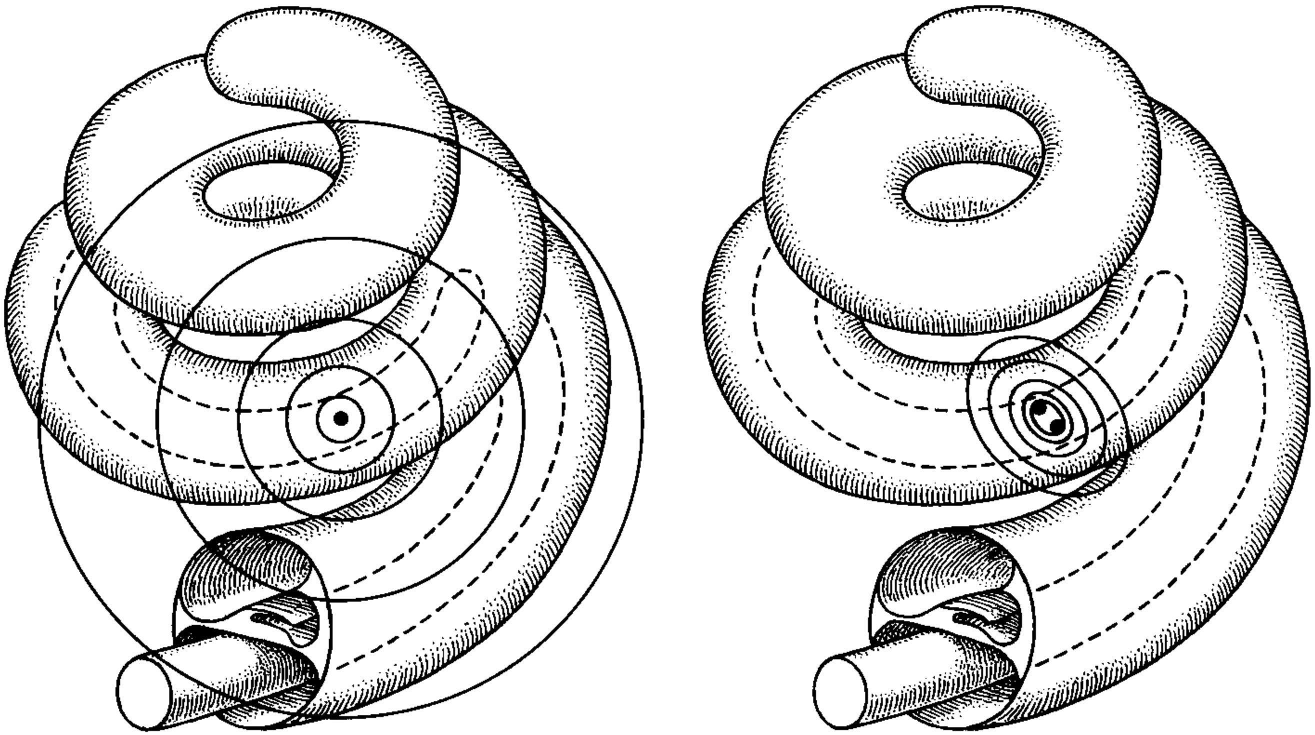
Multichannel (= multipolar) intra-cochlear electrode

First built by Hochmair & Hochmair 1977 (then TU Wien)

Nowadays often 8-channel implants used



Monopolar and bipolar electrodes



Bipolar electrodes more complicate to manufacture, but stimulation stimulus can be focused on a smaller area.

Cochlear Implants - CI

intensive configuration (of stimulation levels for each electrode) and adaptation (of processing strategy) needed. Also intensive training for speaking and hearing necessary.

Worldwide about 300,000 individuals have CI implants (2011), thereof 30,000 in Germany.

Pioneering Austrian company MED-EL (https://www.medel.com)

Interview with Ingeborg and Erwin Hochmair, Founders of MED-EL
http://cochlearimplantonline.com/site/journey-to-developing-med-els-cochlear-implant-interview-with-dr-ingeborg-and-professor-erwin-hochmair-founders-of-med-el/

Auditory Brainstem Implant (ABI)

(German: Hirnstamm Implantate)

- After operations (tumors) in which the auditory nerve has to be removed (and therefore CI are no longer applicable)
- Stimulation takes place on the 1st auditory nucleus (nucleus cochlearis)
- Technology (signal processing and coupling) equivalent to CI

Outlook to Block 6

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10. Improvement of Hearing
    10.4 Coupling of Hearing Aids
11. Replacement for hearing
12. Replacement for hearing and seeing
13. Augmentative and alternative Telecommunication
    13.1 For hearing impairments
    13.2 For Deafness
    13.3 For Deaf blindness
    13.4 Video telephony
14. Mass media
    14.1 AT for print media
    14.2 AT for TV, film and video