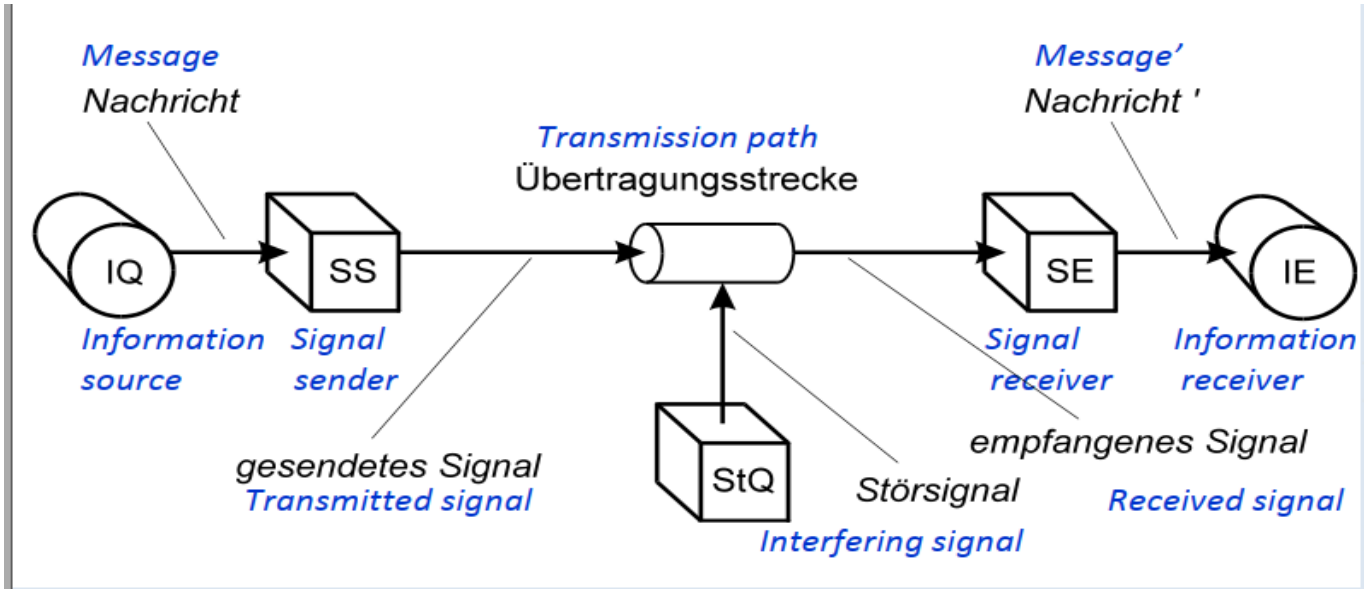
AT2 Study Sheets

Communication

It means more than only to exchange information or data - (joint) acting where thoughts, emotions, ideas, knowledge and needs are shared but also newly created.
Involves two or more parties: **offering, transmission, reception+perception, exchange/dialogue**
One can not not communicate (gestures, facial expression, posture, nonverbal, silence, absence)
Presumption: transmitted signals have a fixed meaning to the involved parties
convention and language

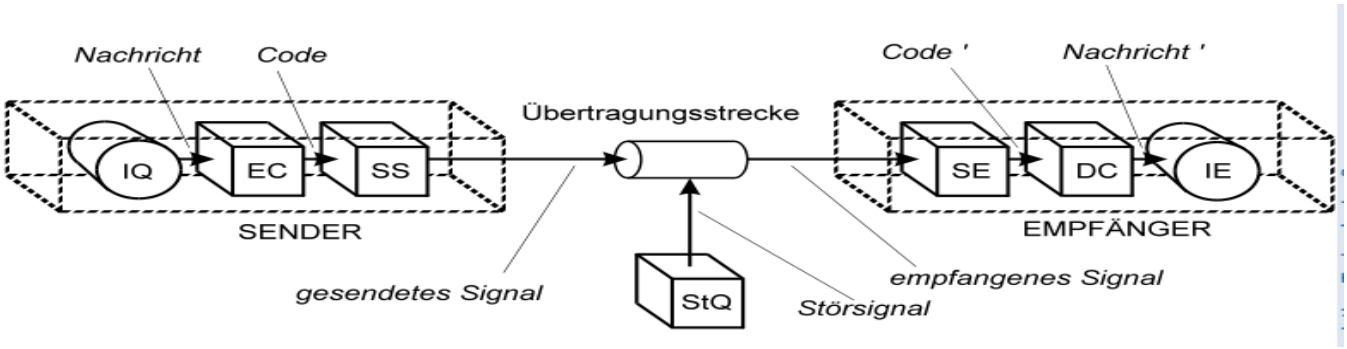
Change paradigm: person in foreground, person with disability or in wheelchair, learning difficulties
Differently abled person - multidimensional, not one-dimensional !correct terms, common lang!
Avoid inadequate language, name-calling and images -> **people first**, more than a disability
disabled-friendly -> barrier free, mongoloism -> down syndrom (double discrimination)
no Invalid(not strong/powerful), **Pflegefall**, **deaf-dumb** (Taubstumm - deaf does not imply stupid)
talk about hearing loss/muteness, not deaf and stupid or numb
^Check background and origin of terms to avoid discrimination!^

Elemental components of technical and biological communication systems

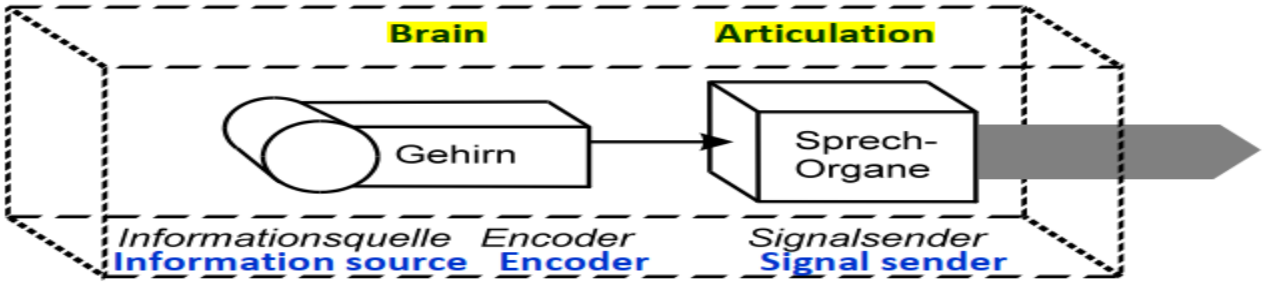


Difference between: message(identical sent and received) and transmission signal
Deviations: impaired sender/receiver and path disturbance.
Bi-directional or one-way communication (channels)

Language(semantic) vs Speech/Writing/Signing (phonetic)
Extended model:



Example **human language creation and voice forming**

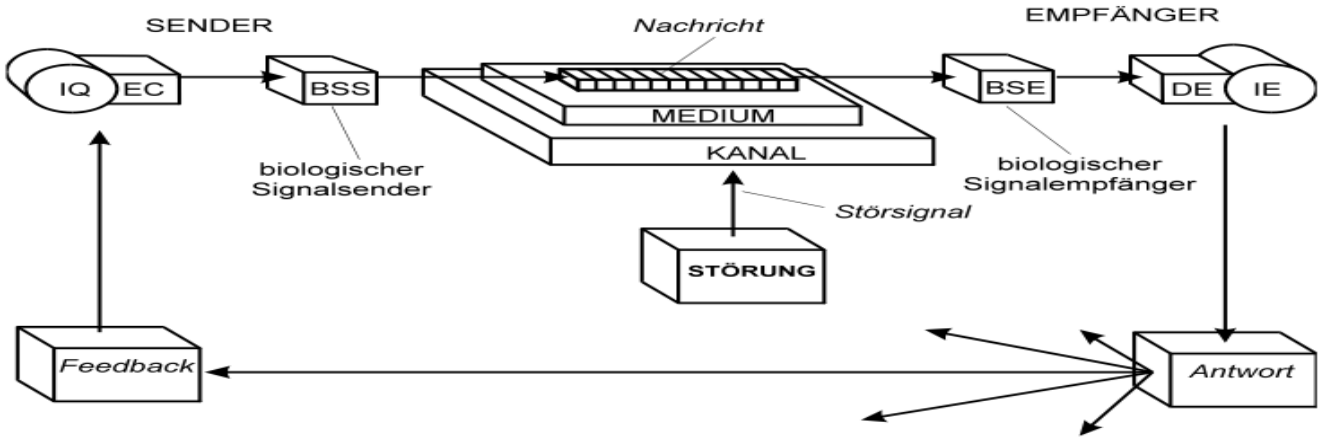


Words encoded as Phonemes
Thoughts as Sequence of symbols

Phonemes as Air Vibration
physical form(organs, hands, fingers)

Differentiate among **Human-(Tech)-Human** and **Human-Machine**

Direct interpersonal communication



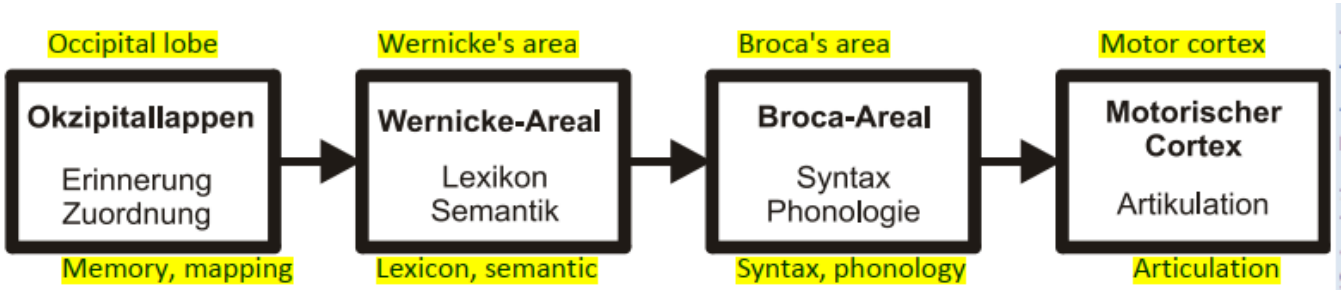
Message = all sent symbols
Medium = representation of message (sign language, spoken, written)
Channel = physical transmission (vibration, light)
Code/Decode = match symbols with meanings

Reply = reaction of receiver to the message
Feedback = (part) of receiver answer
Disturbance = interruption of transmission or distortion of message
=> **Amplify signal (augmentative) or replace (alternative) medium/channel**

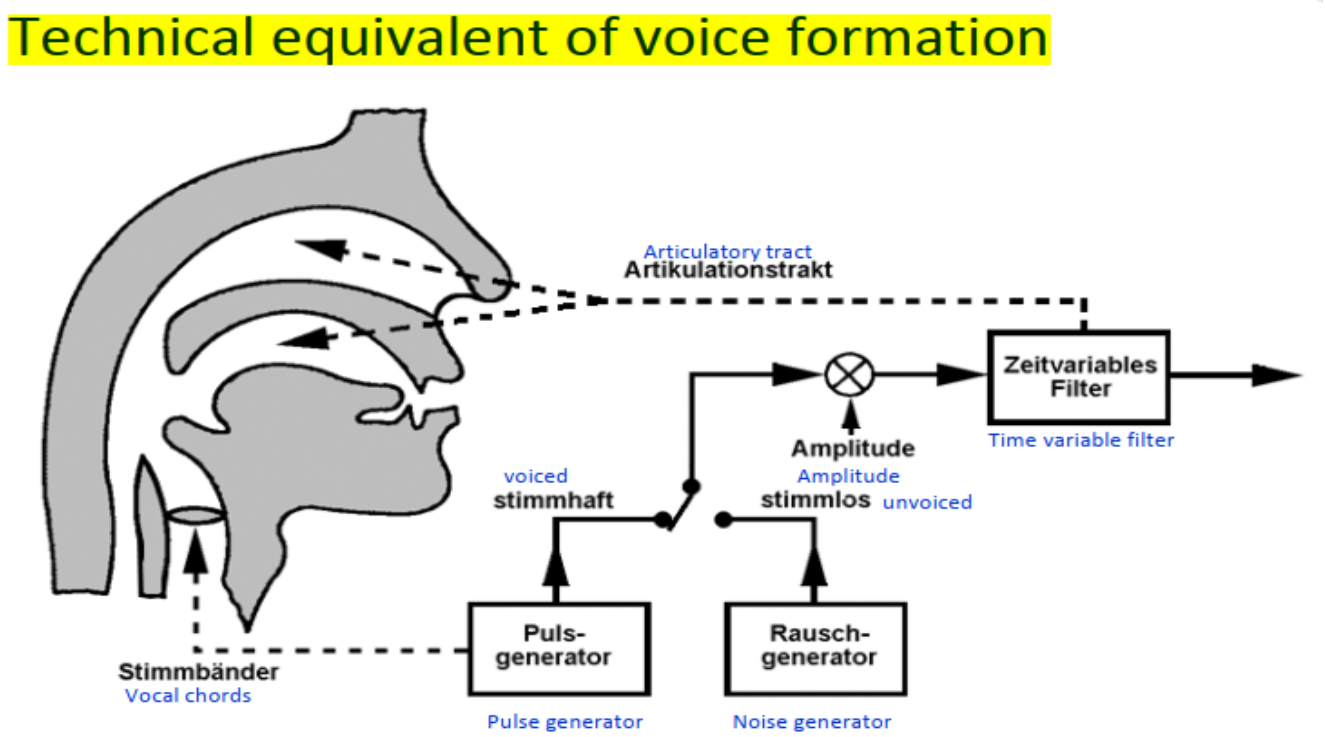
Language as a conventional system, based on a limited character set with unlimited messages (no animals) - morphemes arranged to syntax.
Speech as active vocabulary + syntactic rules + message modality (mono, bi, multi)

Vocabulary, active versus existing; complexity of language vs easiness to learn as a child
-> principles of all languages and parameters of particular ones

Articulation chain (Wernicke-sensoric-lexicon and Broca-motoric-grammar)



Voice formation (phonation) - respiratory system (lungs, airways), larynx, vocal cords, articulatory system (throat, oral+nasal cavity), hearing (feedback own voice)



Cavity resonator - larynx, throat, tongue, jaw and lips - four resonance frequencies (Formants)
Vowel - oscillate vocal cords, different formant frequencies
Consonants - noises, voiceless, no oscillations, only articulatory tract constrictions

Methode der Kommunikation	Buchstaben / min
Gesprochene Sprache	800 bis 900
Nichtbehinderte Schreiber über Tastatur	150 bis 300
Tastatureingabe über Mundstab	75 bis 120
Eingabe über Einzelschalter und Scannen	3 bis 10

Language Disorders:
Aphasia (literally: speechlessness)
Occurs after language acquisition
Paraphasia (omissions and reordering)
Dysphasia (restricted language, mainly verbs)
Agrammatism, Dysgrammatism (telegram style)
Alexia, Dyslexia (reading and spelling disorder)
Acalculia, Dyscalculia (calculatory disorder)
Agraphia (writing disorder)

Speech Disorders:

Dysarthria (coordination disorder of speech muscles)
Anarthria (no articulation)
Aphonia, Dysphonia (disorder of phonation)

{**aphasia** also for signs and sign language; sensorial - lexikon and semantic; motoric - syntax and phonologie; amnesic - word finding}
{**speech - weak respiratory system** (volume and duration), **kehlkopfbereichstörung** (whisper, quiet, hauchig, heiser, slow), **palate/gaumen malfunction** (nasal articulation or lack of it), **vorderen artikulationssyste**m (washed, slow, imprecise, uncoordinated), **other** (diff tones, volumes, speed, poltern, stottern, rythm)}

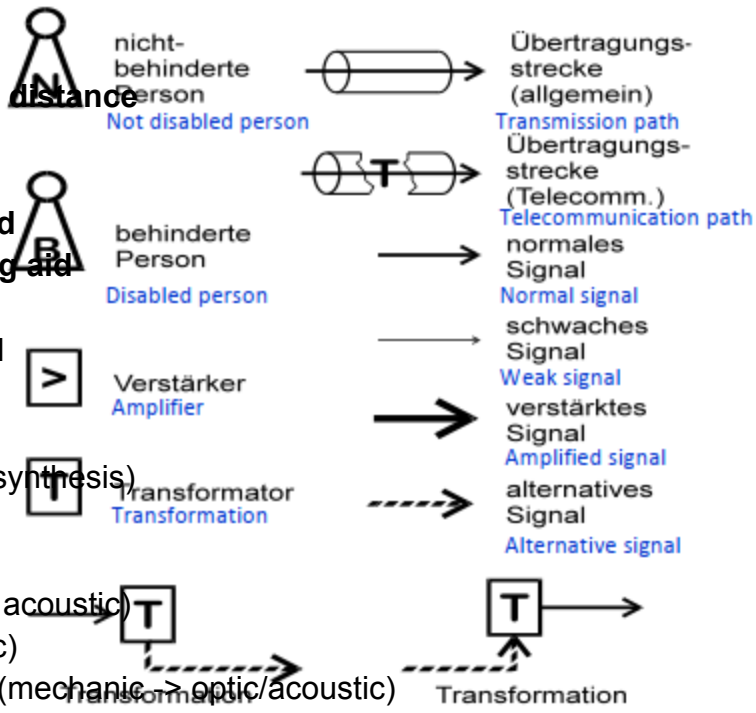
Disorders on the boundary between language and speech:

Dyslalia (phonemes changed or replaced)
Echolalia (repetition of heard)
Bradylalia (slowing of speech)

Communication Aids

Direct Communication

same place, conventional, no disabilities and distance



ICT defined + Aids usage
augmentative - no change of modality, use aid
alternative - change of modality, use replacing aid

Conventional *acoustic communication* N -> N
talk between persons and groups
Augmentative B > -> N
speech amplifier, clarifier, ASR-TTS (speech-re-synthesis)
hearing aid (cochlea implant) **N -> > B**
Alternative B - T -> N
keyboard input - speech synthesis (mechanic -> acoustic)
finger alphabet/sign language (mechanic -> optic)
data-glove input for finger alphabet 0 display/tts (mechanic -> optic/acoustic)
text/image writing/showing (mechanic -> optic)
N -> T - B
ASR -> subtitles (acoustic -> optic)
Finger alphabet/sign language (mechanic -> optic)
-||- hand alphabet/signal (mechanic -> tactile)
Braille in direct dialogue (mechanic -> tactile)
Conventional *optic communication* N -> N
blackboard, flipchart, display, screens
Augmentative B > -> N || N > -> B
special keyboards, switch input + accelerators, magnified overhead projection
spectacles, binoculars, electronic vision aids **N -> > B**
Alternative B - T -> N
dictation to human assistant (acoustic -> optic)
ASR (acoustic -> optic)
images/symbols instead of text (optic -> optic)
N -> T - B
human assistant reading loud(optic -> acoustic)
optical character recognition with speech output (OCR) (optic -> acoustic)
OCR with Braille ouput (optic -> mechanic/tactile)
images/symbols instead of text (optic -> optic)

Tele-Communication

technical media transmission, alternative several systems combined

Conventional *acoustic tele-communication* N - T <-> T - N
telephone, radio
Augmentative B > -> N
speech amplifier, clarifier
built-in hearing amplifier (telephone) **N -> > B**
Alternative B - T -> N
keyboard input - speech synthesis (mechanic -> acoustic)
telephone relay service (writing -> operator talks)
sign language over video telephony (mechanic -> optic)
N -> T - B
ASR (acoustic -> optic)
Text telephone relay service (acoustic -> optic)
Sign language, finger alphabet via videophone (mechanic -> optic)
Braille terminal/Dexter (mechanic -> mechanic/tactile)
Conventional *audio/video tele-communication* N -> N
unidirectional, TV
Alternative N > -> B
exchange letters, newspapers, books, fax, teletype, email, sms, chat, www
Conventional *optic tele-communication* N -> N
unidirectional, TV
Augmentative B > -> N
special keyboards/switch input + accelerators
glasses, magnifiers, electronic vision aid, screen magnification **N -> > B**
Alternative B - T -> N
audio tape letter/acousting recording by mail (acoustic -> optic)
ASR to letter/mail (acoustic -> optic)
symbol language via mail, fax, videophone, Braille, Moon, tactile graphcis (optic -> mechanic)
N -> T - B
audio books, electronic newspapers, OCR -> TTS (optic -> acoustic)
books, news in Braille, browser with speech output (optic -> acoustic)
browser with Braille output (optic -> mechanic/tactile) **N - T -alt> B**

Special Cases
B - > N - none know, disabled sender, aid for receiver
B -alt> B - Braille between two blind persons, Sign language between two mute/deaf p.
B -alt> T - N - Braille read by OBR device (optical Braille recognition) reading device (blackwrite)
B - T -alt> T - B - text telephone, SMS, mail, aids for deaf people

TODAY: mail instead of voice or optical communication

Tactile (skin)/Haptic (spatial perception and association) Communication

area for same amount of information: **visual < tactile dynamic < tactile static**

Type	Fitting stimulus	Speciality
SA I (Merkel corpuscle)	Pressure, static vertical deformation	Near to surface of skin, small receptive fields, **high spatial resolution**
SA II (Ruffini corpuscle)	Pressure(and velocity ?), static (and dynamic ?) vertical and tangential deformation	In deeper layers of skin, react to friction, big receptive fields
RA (Meissner corpuscle)	Velocity, vibrations of 5 Hz to 40 Hz	Near to surface of skin, **high density**, small receptive fields, good resolution
PC (Vater-Pacini corpuscle)	Velocity (acceleration ?), vibrations of 40 Hz to 400 Hz	In deeper layers of skin, very big receptive fields, displacements of few µm are sufficient

Peculiarities of tactile sense:
Occultation = hands exploration reveals access to hidden from the eye areas
Perspective= distance from observer max arm length, constant experience in direct contact
Shadowing= no equivalent in haptic perception for blind persons

Relief Writing

Valentin Hauy embossed and enlarged Latin Letters
Wilhelm Klein Stachelschrift, sting from the backside apparatus
Charles Barbier Nachtschrift 2x6 dots
Louis Braille Raphigraphy, replication of black/normal print letters for relatives of blind + writer by Foucault
Tactile writing by James Gall, readable maps for blind persons

Braille Base Alphabet 2x3 dots, 63 symbols, no mandatory standard but common dimensions(2,5-3,5) - upper four dots for 10 letter, then add 3 dot, rest has dot 6 (1-4, 2-5, 3-6); not all combinations used to avoid mistakes

American Modified Braille optimize number of dots depending on frequency e, n, o, p, r, s, t; writing speed advantage diminished with typewriters

New York Point considers frequency and space for optimisation, 8-dot scheme, allows to represent capital letters

Fishburne tactile markings suitable for labers and short notes, tags with letters, for people who became blind later in life and can not use Braille

Florian Alphabet uses Morse characters coding, for people who became blind later in life and can not use Braille

Fakoo Alphabet connection between 6-dot-Braille and black print, for impaired, blind and normal sighted to communicate better

Braille won nevertheless and is widespread

- Read with the finger pulp and the sensitivity of it
- Mostly printed into dry paper
- Same sound same sign
- Depending on context and coding system the form can have several meanings
- 3 fundamental coding systems:

English: Grade 1/2/3 German: Base/Full/Shorthand-(Stenography)

Braille Base with extension - Indicate numbers, capital letters (single or sequence) by leading special form, punctuation or umlaut characters

Braille Full - lowest form of coding, encodes diphthongs, only allowed if real groups, no accidental combinations

Braille Shorthand - reduce characters necessary (30%), faster writing, save place; shorter sound groups, syllables and words; rules for valid combinations;shortening of pre- and suffixes; word and word stem shortenings (articles and prepositions); single form shortening with leading announcement dot (modal verbs ++); other single form shortenings (word prefixes, all, sleb, wurd); other two form shortenings

Braille Shorthand additional Stenography - more abbreviations, leaves out unnecessary characters; for taking notes; individual to writer; mostly 6-point notation but also ⅞

Computer Braille - Base coding less suited for computer use Not character accurate for numbers => German number indicator by dot 6

8-dot Braille extension - Euro/Computer-Braille; ISO standard 11 548-2

Sometimes multiple assignments of characters (ambiguities)

Mathematics Braille - Marburger System, Nemeth Code

Music Notation Braille - Tone encoded in upper 4 dots (c, d, e, f, g, a, h) duration (1/1, ½, ¼,…) in the lower 2 dots. Note: „c“ is not the same form as „c“ for texts but starts with “d” to always have a dot in first column. 7 Octaves Symbols, Chords based on the root tone representation.
More Braille - Phonetics, Chemical formulas, Electrical schematics, Chess, Knitting patterns
International Alphabets in 6-dot Braille – national differences
International alphabets for 8-dot Braille - Other than Latin based alphabets regulated in ISO standard 11 598-1; Own tables e.g. for Greek, Arabic, Bengali, Kanji or Katakana
Shifting by „Shift Marks“
Reading Braille
Two-handed method (as trained) using both index fingers. Reading starts with both index fingers. Left index finger afterwards used to search start of next line position while right index finger still reading. Left index finger starts reading while right index finger is moved to start of line.
speed: 100 words if experienced (30%-50% of normal sighted); many become blind only through diseases (diabetes) so they do not learn Braille. Information in public space should be also available as raised/protruding standard letters or tactile markings/symbols. Alternatives are audible information.

Relief Script after W.Moon
Symbols similar to Latin characters (easier to learn for late blind persons).
Are embossed into moist papers on objects, medicine.

+ Similar to normal black print.
+ Easier for late blind persons.
- Quick reading not possible (the recognition of lines, angles, arcs is difficult for blind persons)
- Difficult to write by hand

Originally read in „meanders“ (alternating left-right with rightleft reading direction). Uses „guidelines“ at the end of lines --> fingers can sty on paper. Still found in old books. This change in reading direction was dropped when adopting Moon for computers in 1980 in UK.
Mostly replaced by Braille, used for impaired children and late blind persons, few countries still use it as standard script.

Writing Braille

1. **Braille-stencil (stylus)** on paper between matrices (Braille Template/board/slate), could check only after writing and taking the paper out, also from right to left. -> portable, diff sizes, quick note taking
2. Typewriters: Picht, **Perkins(most widely used)** -> improved speed, read while writing, purely mechanical
   Kleidograph for New York Point
   Marbuger Bogenmaschine - sheet wound up on the roller
   Blista - Blindenstudienanstalt in Marburg

Elotype - electric
Mountbatten - battery powered, speech feedback, automatic paper feed, 6&8 point, display
Ohtsuki typewriter - for education, prints also blackprint
Banks Pocket Braille Writer IBM
Stainsby/Marburger Stripe Machine for **Stenography**
Dymo or 3M for labelling wheels
Possum Moon Writer and Draw for Moon

Screenreaders, Smartphone Apps, new Hardware -> Braille is declining, too tedious and voluminous texts. Lowers the literacy of people, only 10% now nowadays.
To get a quick overview in Braille is not as easy as with normal black print or screen, but still quicker than with speech output and offers more freedom to the reader (e.g. in education or occupation!)
Braille can be used for markings and labels on objects, medicine.

Production of Braille documents: Hallmark machine for large editions (cheaper and constant with increased volume), copies from embossing template; Electronic printers for medium to small prints (constant price and more expensive price with increased volume)
Mind also Braille hand presses and **Two-sided braille print** (slight offset, interpoint Braille, saves space but quality suffers)
Earlier: translation and production ---- Today Internet-based, screenreader, embossing for cards, labels, medicine

Graphic tactile material is required for:
Understanding charts, Capturing spatial relationships, Drawing, Plans, Maps
Presentation: tactile (only the essentials, explanation on side leaves), tactile and acoustic (for example for additional explanations)
Manual production
The first tactile graphics were made by hand: suitable materials such as wooden sticks, cardboard, sandpaper etc. were cut to size and glued to a base. Hand drawings, liquefied wax, ..
Deep-drawing/Thermoforming
“Vacuum thermoforming machine" Production of graphics with more than two levels possible, deep drawing maps
Swell-Paper
Printing with conventional laser printers or copiers. Heating in the "fuser" leads to swelling of the dark (printed) areas
Graphic printer
Braille printer with narrow dot matrix
Audited graphics
A combination of tactile graphics and spoken messages can compensate for this deficiency.

Audited/Auditively supported Graphics

Braille displays

Dynamic display systems for braille. Alternative to screen for sighted persons
Stimulation of the sense of touch by:
• Pressure (static)
• Vibration (time-varying pressure)
• Electrical irritation of the skin (electro-cutaneous stimulation)
• Surface texture
• Heat (thermal stimulus)
Important is a relative movement between finger and display. Tangential movement + Vibration
Technologies used for Braille Displays:
Electromechanical displays (**obsolete**)
Bi-stable construction/design
Reversing a magnetic core
Mechanical locking
Rotary movement of the pins due to changing polarization

BUT
Expensive
High space requirement
Sensitive to pollution
Only limited graphics capability
High power consumption
Not mobile usable
New technologies
Shape Memory Alloys (metals with shape memory) Ni-ti Alloys
Electroactive polymers PVDF
Electrorheological (hydraulics, change in viscosity in the
electric field)
Electrocutaneous (electrodes act directly on the skin)
Electrostatic (change of surface adhesion)
Evaporation (principle of the steam engine)
Electrochemical (vapor pressure by electrolysis)

Displays in piezo technology (**today's technology**)
2 strips of piezo ceramic glued together
Working principle like bimetal
Elongation and shrinkage depending on the polarity
Exemplary construction of an 8-point display
2 rows of piezo ceramic strips in 4 levels

Graphic Braille Displays - Rose Reader (push pin by spring force heating), Stuttgarter Stiftplatte (expensive and voluminous)
Virtual Braille Displays - Are moved with the finger (over the surface). Only a few points. Problems due to lack of relative movement between groping finger and Braille cell.
Full replacement for conventional computers /notebooks - **Braille Notebooks (**Versabraille, Notex, Braille Note Apex, Braille Lite, Active Braille, Accessories - displays with 40-80 shapes, Voice output Braille'n'Speak)
Often no longer necessary these days because of screen reader and voice output. Lack of Braille skills. Smartphones. Speech output.
Screenreader - offer an advanced operating concept via the keyboard of computers, H jump, CTRL+Up previous. Websites require WAI-ARIA to operate.
Every work should be accessible in barrier free format. Innovative Apps - Blindsquare, RoboBraile service. Copyright problem in accessible formats.

Picture and Symbol Languages

Assisting persons with disabilities in reading and / or writing.
Also for people with poor reading skills (illiterate, foreign language).
The terms pictorial writing and pictorial language are mostly interchangeable in the context of the **AAC ("Augmentative and Alternative Communication")**, because these "writings" are used as an alternative "language".
The human language is in its essence "not iconic", so not pictorial.
By and large, however, our words are arbitrarily assigned to the terms that designate them.
Therefore in the individual languages this is often completely different.
Visual languages:
Advantages: language independence, universality
Problems: no direct transferability, less expression possibilities
Brainpower is necessary when working in a visual language to remember:
what a particular **symbol** does mean
which symbol to use
where the relevant **symbol** can be found (for example,
when using a **symbol** board, symbol folder or keyboard)

Design of visual languages

Easy for image-generating words. Here, a term can be immediately assigned a pictorial expression (tree, house, money ...).
Difficult for non-image-generating words. A term must be paraphrased or expressed with an abstract symbol (e.g., work, gross national product).

Types of symbols

[1] Pictographic or iconographic symbols - simplified illustrations of real objects. No expression of abstract grammatical content.

[2] Ideographic symbols - Mostly stylized symbols for a (even abstract) concept. Pictorial mediation of an idea: Hieroglyphs, Chinese characters, **Bliss**
[3] Arbitrary symbols - for terms for which neither pictographic nor ideographic symbols can be found: Bliss

Application of image communication

Where there is no understanding of text due to disability. "Spelling skills" and "reading skills" can be different. In case of speech impediment to communicate faster ("1 picture for 1000 words"). Great scope in meaning.

Image communication systems:

Rebus - symbols with letters, simple grammatic
Aladin and **PCS** - detailed and situational

Makaton - combined with gestures, based on British Sign Language. Gestures available as drawn pictorial symbols. Useful not only for deaf people. The additional stimulus (bimodal communication) supports people with learning disabilities.Advantage: Signs do not need any further aids (such as symbol boards, computers).Disadvantage: Signs are harder to learn for both communication partners than pictorial symbols

Bliss - complex and powerful picture language, possible to be read by people who do not speak with each other due to linguistic difficulties (**Bliss Tool in JAVA!)**, Semantography - one writing for one world.
A communication system for disabled people. Natural languages are mainly oral, while Blissymbols is just a writing system dealing with semantics, not phonetics.
Based on 9 basic forms. Size, location and orientation of the elements determine the meaning. Ongoing development. New symbols can be formed from existing components so that readers can recognize the meaning of a new symbol from the analysis of the components used. For this purpose, the reader must know the meaning of around 120 key symbols in order to deduce the meaning of all other symbols.
The **strengths** of Bliss include the presence of symbols for:
Tenses: past - present - future
Question and **command** form
Proprietary pronouns
Singular and **plural** (plural markers)
Bliss symbols, like the letters of a word, are combined into concepts and subsequently term by term into sentences. Bliss consists of pictographic and ideographic elements. Added to this are "arbitrary" symbols (neither pictographic nor ideographic) that were created simply because they were needed. e.g. introduction
Basic form changed by "**indicators**" - The symbol becomes a noun, adjective or verb.
"**Accents**" form the time form of verbs, for nouns the plural.

Bliss knows the gender-neutral form in addition to male and female form. Formation of personal pronoun in Bliss by adding a number.
Formation of Possesiv pronoun in Bliss is formed from the personal pronoun a "+" indicates that something belongs to the person.
Own symbols are made by combination and included by the "combination indicator". The Combination Indicator is only required for your own (personal) creations and indicates that this term is not (yet) an official Bliss symbol found in the standard vocabulary.

Augmentative and Alternative Communication" (AAC)
To improve the communicative possibilities of people with difficult to understand or missing spoken language The user group of non (understandable) speaking people includes: Children, adolescents and adults, both with congenital and traumatically acquired speech and language impairment.
Discrimination: **"Augmentative": supplementing the spoken language; "Alternative": replacement of the spoken language**.
Both should improve the communication between the communication partners
Further distinction: AAC as a means of expression in people with good language understanding.
AAC as a temporary measure to support language acquisition
AAC as the (only) means of communication for mentally severely disabled people.
AAC concept distinguishes: Body's own communication form (gestures, facial expressions, eye movements, gestures). External communication form (communication boards, books, folders and electronic communication aids (called "talker")). Suitable forms of communication complement one another: People who communicate via AAC can, e.g. use communication
board and a talker and use their own gestures to communicate. Since many AAC users do not yet / no longer have sufficient reading ability, **often symbol-based AAC** is applied.
AAC is used in addition to speech therapy intervention; as an independent funding concept.
Challenges: **Extremely reduced communication speed**. **Dominance of the communication partner**. **Barely bridgeable asymmetry in the conversation**. **In symbol-based communication, the interlocutor is often also in a dual role**. (a) as a **co-designer** who verbalizes the content / messages and (b) as **a conversation partner**. Therefore, it is important to reflect critically on one's own speech behaviors in conversation with assisted communicating people.
AAC & participation: For people who can communicate insufficiently in spoken language, **improved communication is a very important step towards participation in social life**.
Counseling services: Person-oriented advice; Manufacturer independent advice; Workshops and training; Advice / support for grant applications; Rental options for testing devices in the familiar environment.
Body's own forms of communication: Facial expressions; Eye movements; Showing movements; Gestures; Fingeralphabet; Individual signs; Speech; Sounds; Vocalizations; **Non-electronic communication aids**: Panel/Board; Books; Poster; Boxes; Using materials, e.g.: photos, symbols, drawings, Real objects miniatures;

Electronic communication aids: Buttons; So-called talker; Writing based aids; Communication Apps; Input methods: Eye control (vision-controlled communication aid) encoding, Scanning method, Buttons, Special keyboards + key guards, Push button + sensors, Tracker (head mouse)

AAC method comparison:

	Literacy	Length of symbol combination	Number of symbols required	Symbol sequence length	Promotes message automaticity
Single Meaning Pictures	Not required	Short	Large	Short	No
Alphabet-Based Systems	Required	Long	Small	Long	Yes
Semantic Compaction	Not required	Short	Small	relatively short	Yes

Communication Boards - For digitized language total text duration from a few minutes to almost an hour. From a sequence of Bliss symbols grammatically correct sentences can be formed. Dynamic displays (touch screen) or appropriately equipped notebook PCs. Input is also possible via scanning and single switch.
Communication Tables - Input via pictures or symbols - output via synthetic language
Collect in edit line (ABC table top left) **or** Pronounce immediately after selection (symbol panel on the right)
(Bliss dynamic) Editing line to compose a message. Speak in synthetic language or print.
(for Children) Impairment of perception; Manual scanning: 2 large buttons (YES = SELECT,NO = CONTINUE Scanning), as many senses as possible are addressed.
Each animal has an animal voice assigned. Later on actions will be added in the environment.
Technical Assistance System **AUTONOM** emulates mouse and keyboard input for the desktop PC.
Mask for EPROG (Introduction to Programming).
Semantic Compaction - Method using pictorial language to formulate any sentences. Strategy such as in Chinese. Typical: 50 pictorial symbols, sentence formation consisting of a sequence of only 4 symbols.
"**Selection set**" Total number of items available for selection in a system.
Natural languages consist of semantic units (lexemes) linked by syntax.
Based on concepts Language is based either on:
• **Concepts**: e.g. hieroglyphs began in their original form as a collection of images to express certain thoughts and things
• or **Phonetics**: As the need for communication increased, more and more phonetic elements were added.
"Our" languages are completely phonetics based.
"Secondary Image Meaning" Primary image meaning is the "superficial" image meaning. The picture means exactly the represented object, snowflake means snowflake. Secondary meaning:

"white", "cold", "winter". Associated concepts are added.
Clear patterns used for organizing vocabulary: E.g. verb is always 1 or 2 icons, followed by the VERB key.
Target user groups are people with with speech impairments, motor impairments, learning disabilities. Only a small number of icons to be learned (40 – 80) Icons on the display stay in a fixed location. Patterns applied to say a word can be used when learning to say new words.
Commercial Product.

Alternative communication can replace the function (lack of speech or voice) but is often decidedly slower. Disabilities that have a negative effect on voice and / or language are often associated with motor disabilities => slow input on keyboards etc.
Specification of the communication speed Usually stated in words / minute.
When converting to letters or strokes / minutes, consider the following:
The language used AND The kind / type or content of the communication.

Method of Communication	Letters / min
Spoken language	800 to 900
Non disabled writer on keyboard	150 to 300
Keyboard input with mouth stick	75 to 120
Input with single switch and scanning	3 to 10

Alphabetical arrangement of the letters - Loss of time through long scanning paths
Sort by character frequency - Frequency or probability of occurrence - Put frequent letters at the beginning ---> \L: space
Advantage: time savings
Disadvantage: needs getting used to
Each language contains a high degree of redundancy. It can therefore be attempted to generate the same information with fewer letters (keystrokes)

Speedup

Abbreviation (expansion) - 30% savings in Braille
Phrase catalog (picture communication) is fast but limited in the expression range.Phrases in an electronic catalog that are addressed by shortcuts or symbols (on keys). Hierarchical-dynamic management of the icons on the screen Increasing time required for navigation and selection! Always limited to previously prepared context.
Text prediction If interpersonal communication is done via an alphabet board, the other party will try to guess the rest after the first few letters of a word. - **60% saving**
Using an alphabet board Definition of a coherent text, approx. 100 characters long
Slow pointing to the letters. Another person who does not know the text tries to guess the sequel.
Text prediction with the computer.

Keystroke Saving Rate (KSR)

$$KSR\,[\%] = 100 \cdot k_{sav} = \frac{n_{st} - n_p}{n_{st}} = 1 - \frac{n_p}{n_{st}}$$

k_{sav} = Savings factor
n_{st} = Number of stops with conventional input
n_p = Number of stops with predictive input (letters + selection)

Every word searched for is already in the selection list before the first letter is entered.
Each word generated with a single stop

Calculating the benefits of text prediction

Let **k** be the writing speed (stops / sec)
Let **B** be the number of letters in a text
Let **W** be the number of words (usually equal to the number of spaces plus the number of paragraphs)
Let **A** be the number of strokes to produce this text on a keyboard, where A = B + W.
Tk Total time for conventional text input

$$T_k = \frac{B + W}{k} = \frac{A}{k} \quad [\text{sec}]$$

Any savings on strokes is time-saving. Writing with word prediction also takes time for change of view from the keyboard to the screen and back. Search the suggestion list.
Alternative input strategy. Make suggestions only after several strokes. KSR decreases, but search times also decrease.
Optimization strategy: suggestions only after several strokes.
The later the search of the list starts, the lower the number of searches per produced letter on the one hand, and on the other hand the lower the KSR.
Necessary to read suggestion lists and at same time do not forget what should actually be said.

This can be problematic for some users with disability. Saved key strokes are not the only criterion. Is there an increase in communication speed? Or a reduction of the effort associated with the writing? In many cases, despite saved key strokes, the desired acceleration effect does not occur.

Additional benefits with text prediction

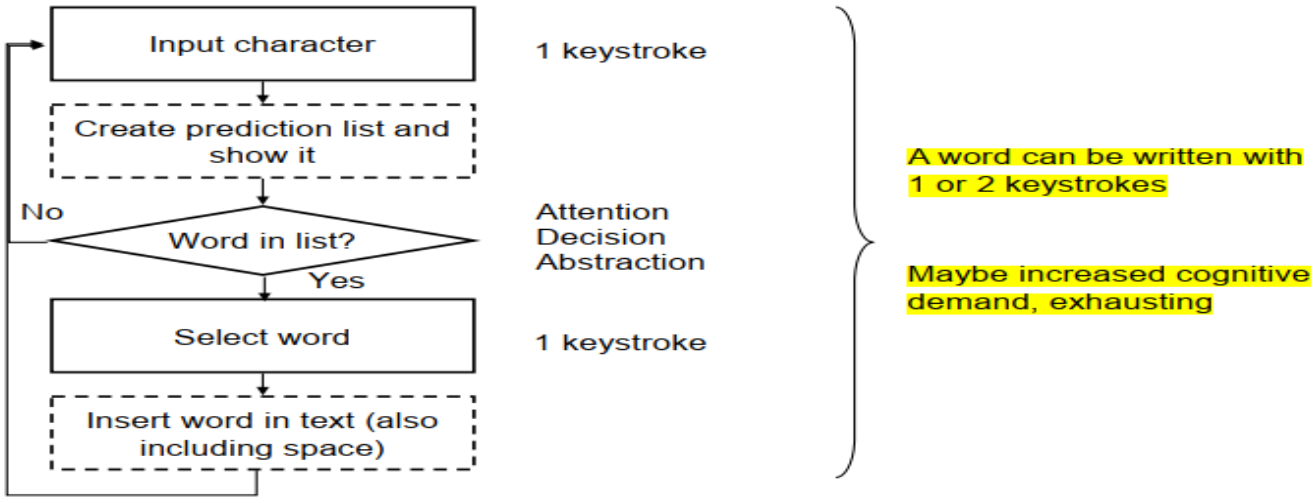
Even if no direct time savings can be achieved - For individuals with typing or spelling problems (dyslexia, dyslexia) or with difficulty finding words:

It's easier to pick the right word from a list of suggested words than to compose a word of letters yourself.

Increase in efficiency

Prefer long words; Do not re-propose rejected words; Optimization of the length of the suggestion list; Adapted or adaptive vocabulary with appropriate size; Consideration of the relative frequencies (word frequencies, "frequency"); Considering the topicality of a word ("recency"). Separate treatment of word stem and ending. Especially good for heavily inflected languages. Inclusion of grammatical and syntactic rules in the vocabulary each entry has corresponding grammatical markings (tags).

Predictive Typing – EMU sequence



EMU sorting of lists - **alphabetical** - word length, probability, word classes. **Suggestion list** Free positioning. **Forecast** Multiple word prediction.

Prediction of compound words

Generating arbitrarily composed words "from scratch". Consideration of preceding parts of speech Two words of one kind do not usually follow each other directly. Suggestions matching the text also with free movement of the cursor.

EMU settings - Basic setting suitable for many situations. Various adjustment options. Changes mostly directly visible.

1. **On border of screen -** Fixed position, easier to find, Text is not obscured, Often used; Limited number of suggestions, Limited length of presentable suggestions, Desktop smaller, Big look focus change
2. **Docked below -** Fixed position easier to find, Text is not obscured; Limited number of suggestions, Limited text length, Application window smaller
3. **Docked right -** Fixed position, easier to find, Text is not obscured, Text length freely selectable; Application window smaller, List length depends on window size
4. **Free positioned -** Position according to user request, Avoiding obscuration, Text length freely selectable, List length freely selectable; Possible look focus change
5. **Following the cursor -** Text length freely selectable, List length freely selectable, Glance focus change low; Text may be obscured

Early prediction systems still had handcrafted dictionaries **PAL** - "Predictive Adaptive Lexicon" from Dundee was able to add new words ("recency") while writing.

Visual Communication

All of our direct, interpersonal communication,while reliant primarily on conveying verbal content, always contains visual components whose importance must not be underestimated. Body language, facial expressions and gestures contribute much to the interpretation of what is conveyed in words.

verbal = based on language convention. Therefore, speaking, writing, gesturing is verbal. Colloquially, nonverbal is often referred to as "non-vocal" communication, that is, communication that operates without the use of voice. Watzlawick describes non-verbal communication as analog communication, verbal communication as digital. **Facial Expressions, Gesture, Body Language**

Early optical messaging - Smoke signals and fire signals as encoded messages. Optical telegraph, wing telegraph, semaphore - towers on which movable wings were mounted. Each position of the wings corresponded to a letter and could be observed and forwarded for long distances

from the nearest telegraph station. Flag signals between ships.

Visual communication for deaf (or speechimpaired) people

Differentiation: which aspect of the language is converted into the visual modality:

• **Lip reading**: **visual lip appearance** (viseme) **30% of the information**
Co-articulation: different viseme depending on the preceding phoneme
Appropiate distance, light, no covering

• **Finger alphabet**: **visual letters**

Letters are expressed by hand and finger position. Known since the 16th century, to inform “deaf-mute" children. Use of the finger alphabet requires the appropriate knowledge and practice on both sides. Since each word is formed letter by letter with hands, the speech rates (even in skilled individuals) are rather modest compared to an auditory conversation.

• **Notetaking, subtitling**: **visual letters**

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

Subtitling: Quick writers on conventional keyboard, using a special keyboard.

Respeaking: speaking the text through "Respeaker" and dictating into an ASR system.

• **Cued Speech**: **visual phonemes** (literally: language with hints)

Support of lip reading through visually presented phonemes. Hand signs near the mouth. 8 hand signs for the phonemes of the consonants - 4 hand signs (hand positions) for the vowels

• **LBG** (phonetic accompaniment sign, manually coded language): visual words 1:1
Manually Coded Languages (MCL) "Signed Exact English" (SEE) (LBG)

Transfer of the words of a spoken language in gestures. Visualized vocal 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.

• **Sign language**: independent language

Native language for deaf people. 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. Sign Language (SL) right to their own cultural development of deaf people, into a subculture or in a ghetto, multimodal education. British and International Sign Languages (ISL). Gesture is a living language, it therefore develops temporally and spatially.

Phonetically-based languages know an alphabet. Thus, a sequence of words / terms can be constructed - **dictionary, lexico**n. In a purely visual language, these requirements are missing. Earlier, signs were recorded through drawings or photos Improvement only in the computer age through multimedia technology. Cataloging signs. **GESTU** an der TUWien: sign, scripture, creation of live subtitles, recording courses.

Phoneme: The smallest meaningful sounding segment of a language.

Visem: Smallest segment distinguishable at the lip image.

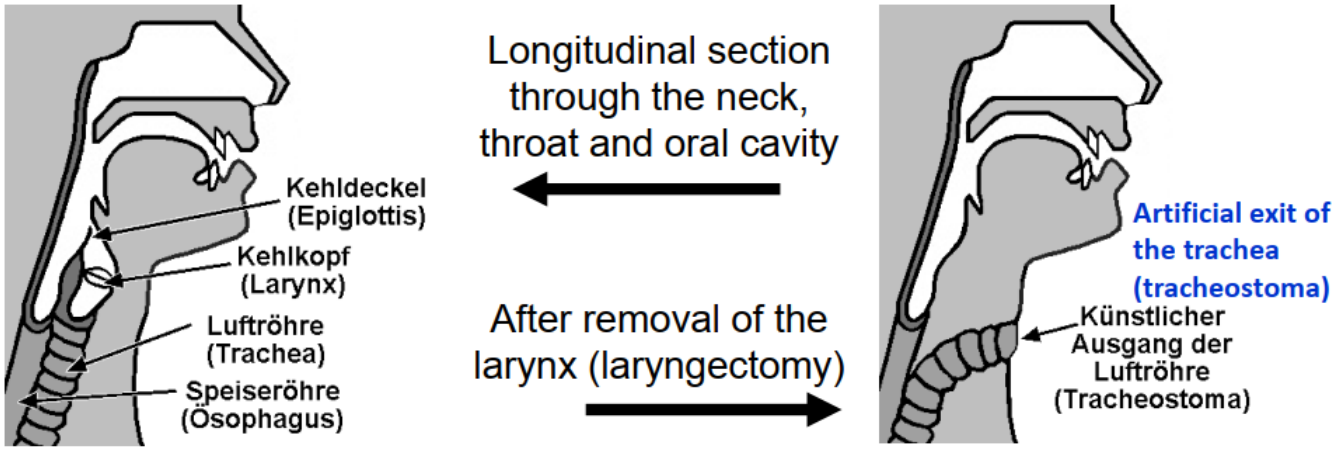
Tactile Communication

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.
Print on Palm (POP) - Easiest way to communicate: Write capital letters in the palm of your hand.
Lormen - Hand alphabet - Developed communication method for letter-wise text transmission to a deaf-blind person by touching the palm and the fingers. The **„Lormer**“ – devices to output on the user‘s
palm and fingers. Lormen „**Mobile Lorm Glove**“
Finger Braille - 6 fingers used as Braille keyboard.
Tadoma - Tactile equivalent to visual lip reading Fingers used to acquire tactile information: Position of the jawbone AND Vibrations on the larynx. 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.

Augmentative Voice Formation

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)**
Reinforcement of the voice: Electronic amplification of a quiet voice. Mostly after larynx surgery (laryngectomy).



Formation of the substitute voice - **Esophagus voice** (esophageal voice):
Air in the esophagus "swallowed" -> Controlled output -> Voice formation on mucosal folds -> Articulation in the -> oral cavity

Amplification of Voice

Esophagos voice - Speech amplifier difficult to understand, like burping, quiet (about -15 dB), Electronic amplifier

Electronic larynx - Substitute for phonation

Extrinsic methods - Vibrations for phonation are generated outside the body and coupled into the pharynx

Transcervical resonator - Vibrator attached to the chin, Sound input triggered by pressing a button, monoton or multiple frequencies

Artificial Larynx

Intraoral and interoral resonators - Air in the oral cavity is set in vibration

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)

Improvement of Voice

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.

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.

Alternative Voice Formation

Output via Speech Synthesis (Lightwriter) Two displays, one for the transmitter, one for the receiver of the message. Recent trend: Instead of special hardware devices also notebooks / tablets running with suitable software.

Input of text - output also via text Canon Communicator. 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", VODER
Improved man-machine interfaces such as data glove and neural networks allow hand movements to be converted into phonemes.
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)
Communication boards
For digitized language total text duration from a few minutes to almost an hour.

Improvement of Hearing

Ear trumpets, oldest ones.
Earliest Electric Hearing Aid from Deaf Teacher A.G. Bell
First were in **analogue technology**. Setting the parameters with potentiometers
Later also **hybrid technology**: tubes / transistor (**Pocket hearing aid**). 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.
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

Nowadays examples:

„**Behind The Ear**“ hearing aid (BTE) Kidney-shaped housing, tube for earmold
Earmold (earmold, SE = Secret Ear) Little space, high feedback tendency
Mostly built-in induction coil (Telecoil) for telephoning
Switch for „M“, „0“ and „T“ (Telecoil or Telephone), sometimes „TM“. Connection for accessories.
Audio shoe (Audio Schuh)
„**In The Ear**“ hearing aid (ITE)
ITC = in the canal hearing aid
CIC = Completely in the canal
Size: CIC < ITC < ITE < BTE
Special types of hearing aids
CROS - contraleteral routing of signal
In the case of deafness in one ear, signals from both sides of the head are brought together on one hearing aid.

Bone conduction hearing aids transmission of structure-borne sound via temples of eye glasses, market share only 0.1%. **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.

Implanted hearing aids

Part-implanted - Soundbridge

Full-implanted - TICA

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

Multichannel (= multipolar) intra-cochlear electrode

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

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

Auditory Brainstem Implant (ABI)

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.

Hearing aid coupling

Transmission of an audio signal to a hearing aid or cochlear implant (CI).

Possibilities: Via cable and connector, Inductive, Infrared, FM radio.
Inductive hearing aid coupling Wireless transmission of an audio signal to a hearing aid or cochlear implant (CI)
Coupling to the magnetic field of a telephone receiver
Coupling with a stationary fixed in space induction loop
Coupling to a body-worn induction loop (neck loop)
Induction receiver - Receiver coil (telecoil) installed in the hearing aid
Stationary (fixed) inductive loop
Induction loops - Ring line, optimal in head height, but also floor is possible. Whole room or part area. Always provide empty conduit / piping (Ger: Leerverrohrung).
E.g. in customer areas, alternative loop in the wall of the switch;
Distance between the conductors should not exceed 4 m. Laying in several loops;
On the body: neck look, ear hook (BTE)
Infrared transmission systems (own receiver, headphones)
Advantages: Easier / faster to set up than induction loops. Good privacy (no eavesdropping from outside). Multi-channel operation possible (induction systems only single-channel).
Disadvantages: Connection with a hearing aid often difficult to handle. Receiving only with visual contact (problem of shading in close seating). Disturbances due to direct sunlight possible
FM Transmission Systems (own receiver or BTE)
Advantages: Good value for money. Easy installation (even spontaneous use of a system brought by the hearing impaired person is possible). No shadowing or interference from sunlight as with IR systems
Disadvantages: Interference from other radio signals is possible. No security against eavesdropping.Not standardized.

Replacement for Hearing

Target group are people without usable residual hearing (German: Hörrest)
Tactile (haptic) mediation: bandwidth only about 1/100 of hearing, hence in general (only as) addition to lip reading
Visual mediation: simple optical signals, visually displayed text, visually represented phonemes, (synthetic) sign language
Vibrotactile hearing prostheses - Distribution of the speech signal by bandpass filter in several channels or signal processing
Simple vibrators: MiniVib-4: simple vibration system. Allows deaf person to become aware of environmental noise through vibration. Vibrator also follows the rhythm of a conversation and the amplitude of the voice - support in lip reading.
Mechanocutaneous Sound Communication (MKS) - Stimulus vest with 14 channels. For schoolchildren without residual hearing.

Imparting via tactile displays - The fingertips are best suited for the tactile perception of acoustic signals. Experiments with one or two-dimensional tactile displays (similar to Braille displays); matrices in the size 3x16 and 4x16 pens. Tactile representation of sound patterns. Significant improvements in lip-reading performance were observed in experiments. But: Without lip reading, the recognition rate did not exceed 55%

Tactile imparting after Automatic Speech Recognition (ASR)

Requires high concentration - Probably without practical use

Visual imparting via optical signals

Communicating the speech rhythm and voicing of the language optically. Representation of some speech parameters (voicing, frication) in a spectacle display.

Visual imparting via text - subtitles - Manual subtitle generation. "**Closed Captioning**" (CC) - "Production of subtitles for a limited circle of users"

Real-Time Captioning

Use of machine shorthand technology. Comes from the court and parliament shorthand. Capturing whole syllables with a stop. Transcription in full text is done via computer.

CAN - Computer Assisted Notetaking

Subtitle creation with Automatic Speech Recognition (ASR)

Although not yet generally in use, but already available as a commercial service. Speaker dependent, previously needed training. Either the lecturer him/herself or as an aid to the person who creates the subtitles and dictates instead of writing in the computer and controls the result. Do not forget: Lower phonetic competence of many deaf persons. A literal transfer in subtitles often unhelpful.

Visual imparting via phonemes

Automatic speech recognition (ASR) is not yet error-free. To assist deaf persons, orthographically correct transcription is not required. Alternatively, transcription into a phonetic representation: phonetic script. Technically much easier, because the phonetic "vocabulary" is lower. Increase the recognition performance. Less delays - better in sync with the image of the lips.

Visual imparting via sign - Human sign interpreter

Teleworking via data line. Mobile use via video telephony possible. Using ASR and animated computer graphics (Avatar) e.g. for talks at the customer counter

Replacement for Hearing and Seeing

Direct communication with deafblind persons: Braille communication, Mechanical Braille communication device

Electronic Braille communication with vibrating buttons (**DIALOGOS**)

The Tactuator A mechanical replica of the TADOMA method, which is used successfully (albeit with a lot of training) by deafblind people to read spoken language via the sense of touch in real time from the face of the person speaking. Sensing of vibrations (tactile) and movements (haptic) of three bars. Information transfer around 12 bit/s

Communication via finger alphabet, text and braille
Deafblind person uses data glove for finger alphabet and reads from a braille display.
Non-disabled person uses keyboard and LCD display. Wireless connection between the devices.
Communication via tactile Morse code
Easy to implement is the use of vibro-tactile transmitted Morse code.

Augmentative and Alternative Telecomunication

Hearing Impairments

Telephone sound amplifier (originally for landline phones)
With additional (higher) gain a limiter (AGC, clipping) must be present to never exceed pain threshold. Frequency adjustment (as hearing aid) is not made.
For predominantly use by a hearing-impaired person: settings should be maintained after the end of the conversation. In mixed use: Automatic return to normal gain after end of call.
Improvement of the understanding
Not only the absolute volume but the ratio of useful signal to noise is of importance for clarity. Therefore, it is also advantageous to cover the microphone while listening or to use a PTT (push-to-talk) switch.
Telephone receiver with bone conduction
Electrical hearing aid coupling
Acoustic coupling “Telephone handset” and “hearing aid” always associated with disadvantages. Frequency selective losses. Tendency to feedback (generation of an acoustic short circuit by the telephone receiver held to the ear). Presence of background noise. Direct electrical connection to the hearing aid thus creates better conditions for several reasons.
ETSI standard ETS 300 679 - The signal should be taken from the connection to the telephone receiver (handset). It must not be possible to feed a signal into the telephone system.
Realisation of the electrical coupling
On the side of the hearing aid: Audio Shoe (DAI = Direct Audio Input). On the side of the phone: 3.5 mm stereo jack plug (socket on the phone, not in horizontal surfaces to avoid contamination) signal on "tip" and "ring", screen (optional) on "sleeve".
Level measurement and adjustment - generator at 14dB, 1kHz at output with -35 dB
Inductive coupling
Earlier telephone receivers had an electromagnetic speaker with a strong stray field.
Audio signal could therefore be easily picked up with an induction coil.
Hearing aid is to be operated in position "T", microphone is switched off.
Interference problems with GSM and DECT
Disturbances by the TDMA method (Time Division Multiple Access). Makes a buzzing sound.

Interference:
Disruption due to external use or by self-use.
Possible countermeasures: Shielding of the hearing aid by metallic conductive lining of the housing. Shorting the interspersed frequencies with blocking capacitors. Avoidance of "antennas in the hearing aid“. Increasing the distance to the source of interference.

Deafness

Text phone (telecommunications device for the deaf = **TDD**, teletypewriter = TTY)
Telegraph/teletypewriter-compatible communication device that operates over the PSTN (Public Switched Telephone Network, landline). Stationary devices (rare). **Nowadays replaced by modern smartphones.** All acoustic information must be visualized. Very late transnational cooperation. Rarely in the public sector

International ITU Standard V.18
To overcome the national barriers in the Text-telephone traffic. Backward compatible with all previous standards. Connection is always at the highest possible level. In addition, also fixing the international character sets. Multi-Mode: Allows simultaneous transmission of text and speech.

Text Telephones - Relay Services (TRS)
Sender and receiver must each have a (compatible) text phone. Otherwise, switching service must be inserted.

Mediation / exchange services
Voice Carryover (VCO) - In one direction, the voice (the audio signal) is transmitted directly to the remote station (for people who cannot hear but can speak).
Hearing Carryover (HCO) – the voice is transmitted directly from remote station to local station (for people who cannot speak but can hear).
Mediation service can also be done using sign language. In future, use of ASR is expected.

Fax machines and Internet (-chat)
Low penetration of text telephones and the lack of exchange services in some countries led to the search for alternatives: • Messages via fax, • e-mail, • Internet chat, • SMS
All these types of communication are visually accessible but do not allow a real dialogue like the telephone (speech and counter-speech).

Deaf Blindness

Electronic Braille communication For deaf-blind people who are proficient in Braille (usually if the blindness occurred early and before the hearing impairment). Telecommunication via a computer equipped with a Braille display (Braille line). Earlier: connection to the telephone network via modem, now Internet.

Telecommunications with mechanical hand (DEXTER)
For deaf-blind people using tactile hand alphabets (usually when deafness has occurred early and before visual impairment). Mechanical replica of a hand (finger alphabet). Control via interface of a text telephone.

Video Telephony

Transmission of picture and sound. Decisive for the image quality is the resolution and the repetition rate (fps = frames per second).

Use for hearing and speech impairment Support communication through the usual visual components (gestures, facial expressions). Lip reading. Finger alphabet. Possibility to transfer texts (for example, proper names, numbers) should be given.

Use for signing

Use of video telephones in conjunction with symbol languages

For people with intellectual disabilities, any additional modality means a gain in communication. Seeing a conversation partner makes telephoning easier to understand.

Videophone and visual impairment

Support of the video telephone by a sighted person (e.g., to read aloud or explain in words what is shown on the picture telephone)

For old and isolated persons:

Video telephony creates more social relationships than traditional telephony.

Touch screen videophone for the elderly Simple and intuitive to use.

Mass Media

Audio Book - analog, foils, digital (Daisy Players - expensive hardware),

cassettes - Index marks = Sounds that are audible only in cue / review mode, Production Process: Recording the text in the recording studio,

Making a master tape or a master audio cassette, Duplicate by Quick Copy (for example x16), Shipping.

Maximum running time 8 hours (at C 120, 4 tracks and 2.4 cm/s). "Reading" only sequentially possible - looking up information difficult. No international standard.

Newspapers for blind people - Extraction of text and structure from the publishing data. Distribution via FM radio, RDS (Radio Data Signal), teletext, telephone (modem), e-mail

TODAY Distribution via internet, accessibility of websites according to WAI

Newspapers for speech impaired people - Simplification of press texts using NLP (Natural Language Processing)

TV, Film, Video - Improvement of the intelligibility of the TV sound (treble sound - **Presbyacusis**) + **Subtitling of TV programs** - For deaf and severely hearing-impaired people => "**Open Captioning**" (visible to all) "**Closed Captioning**" (= CC, only visible with decoder)

Enter text before broadcasts. For news broadcasts, use "teleprompter" texts. Machine shorthand for live broadcasts. Automatic Speech Recognition (ASR). Problem with 38% "Paralanguage" (e.g., emotions). Instead insert (small picture with interpreter) for sign languages.

Rear Window - Mirroring subtitles in the cinema and theater

Audio-Description - accessible to blind viewers.

AAL Recap

Communication in the field of AAL

• Supplement / support in everyday life through technology as a form of augmentative / alternative communication
• (Social) communication, emergency call
• Human - machine communication
• Technology and people as a "team"
• Assistive technology (AT) with consideration of age specific restrictions
• By this we mean communication of information and communication between people and their environment
• For old people, living alone can also become a barrier
• The AAL area is not just about old people but also information / communication for relatives
• So far in the lecture it has been focused on communication through AT, in the AAL area it is also about the social element in communication

Interaction takes place via the "user interface" -> multimodal interaction

Explicit interaction - deliberate control of the system

Implicit interaction - behaviors that do not require the attention focus of theuser

Simplification / clarity of operation

Intentions-based interaction - the system learns / estimates which functionalities the user desires and hides the remaining

Goal-based interaction - the user formulates goals that the assistance system should implement

AAL aims with the use of intelligent products and providing new services (such as in the elderly care) … 2012 in Austria - people are in the focus of AAL, based on ICT

• to extend the time while the elderly can stay in their
familiar environment; • to increase their autonomy; • and to assist them in doing daily work to overcome barriers

Subsuming concepts, products and services that combine new technologies and the social environment with the aim of improving the quality of life for people in all phases of life, especially in old age.

The technology consequently adapts to the needs of the user - and not vice versa.

Universal design that are increasingly aimed at all generations.

Technical Assistance Systems - Promote autonomy, mediate or provide auxiliary services in the domestic environment and create an intelligent environment that adapts to the needs of the user. People are relieved, especially in situations of excessive demands, fatigue and excessive complexity, and are able to largely compensate for age- or disability-related functional limitations.

AAL therefore includes … • methods; • concepts; • (electronic) systems; • products as well as services; o which support the daily life of the people; o depending on the situation (Context Awareness); o in an unobtrusive way

An AAL system is … • user centric; • individually geared to the specific individual; • integrates into its direct living environment; • the technology used in the AAL environment can be modular and

networked to allow adaptation to individual needs and the individual environment; • More than a single tool equal for all

Demographic Change" – facts as driving force behind AAL

The situation is complex And AAL cannot solve everything but it can extend independence.

Root of AAL: technical design of the living environment for the disabled and the elderly:

Emergency call systems (Social alarm systems), Environmental Control Systems = ECS

User Interface, Controller, Transmission channel, Receiver, Target device

Smart Homes -> AAL Network of sensors and actuators

AAL technologies are much more user-centered (especially for the elderly), are integrated into the personal living environment (embedded, integrated), adapt to the user, are modular and interoperable

AAL users do not represent a homogeneous user group (and are not typical “consumers”).

primary, secondary, tertiary users

Application Areas: Support for comfort and quality of life, Support for safety and health, Social contacts and communication, Displaying information, Communication, Fall detection, Prompting Devices

Technology - Aspect of the overview knowing of what is going on (**sensors**),
and to be able to do something (**actuators**)

Non-invasive sensors for AAL - Switches / contacts on doors, windows, drawers, boxes etc. Contacts on various controls, toilet flushing etc. (activity monitoring). Contact mats, sensor carpets (Localization). Movement and presence detector (PIR). Temperature sensors. Heat radiation (stove monitoring). Light. Vibrations, floor vibrations (fall detector). Water and energy consumption. **Non-invasive: not detailed, Not invading in privacy … But: "Big Data" also gives insights**

Invasive sensors for AAL: Cameras. Video images, better: Thermal images, outlines, motion vectors, better: 3D images (Kinect). Microphones. Voices, sounds. Person localization: Electronic markings to persons (radio, RFID etc.), in order to be able to determine their place. **Important: collect as little data as possible, locally processed, not or only saved (cf. GDPR/DSGVO)**

Context Awareness = communication with the environment - AAL needs more „active“ devices, connected by the Internet.

Social Robots (Social Service Robots) - either show a higher degree of mobility or by their nature build a higher social relationship than the smart home. **Uncanny valley, PARO.**

Service Robots - Functional Robot, Pet / Tamagotchi Robot, Therapeutic Robot, Robot as interface, for communication or for "telepresence", Universal robots that can (also) do “work”

Ethical Questions

Conflicting goals between privacy and security

The conflict between hoped for help and feared side effects.

Privacy protection = To detect dangerous deviations from the normal process, to intervene to help.

What happens to this data?
Where are they stored?
Which conclusions are drawn from this?
Where are they being forwarded to?
Who has access to this data?
When and how are they anonymized?
How long are they kept?
When will they be deleted?

All these questions need clear and honest answers. EU General Data Protection Regulation (GDPR/DSVGO)

Protection against laziness and rusting

AAL solutions must not undermine one's own agility.
One must not unnecessarily be "lazy and comfortable".

Important principles

1. **Homes that do everything themselves destroy existing skills, make the residents lazy.**
   The positive aspects of help could be overshadowed by a kind of "over-protection".
2. **All concerned must be made aware of what is happening with the many data collected.** In a context-aware system, a wealth of sensor data (patterns of behavior, medical data) must be collected.
3. **The benefits of AAL must be easy to convey and understand, they must be obvious.**
   They have to be very practical and non-technical.
4. **AAL technology must be conveyed convincingly and carefully.**
   AAL technique should possess and express an inner persuasiveness
5. **AAL technology must be robust, reliable and sustainable.**
   It need to be built into existing homes - so wireless, modular and adaptive systems are an advantage.
6. **Residents must always stay the rulers in the house.**
   The decision on the use and non-use of the system is the sole responsibility of the users

AAL is working in a socially sensitive area. Therefore, application of AAL Technology should always be ethically „monitored“ and the implications assessed ⇒ **MEESTAR-model**.
Application of AAL also should be based on voluntary consent of the user based on being well informed ⇒ **Informed consent** (also legally important).
Is evidenced in writing, dated and signed, or otherwise marked, by that person so as to indicate his/her consent, or if the person is unable to sign or to mark a document, his/her consent is given orally in the presence of at least one witness and recorded in writing.

The subject has had an **interview** with the investigator, in which he/she has been given the opportunity to understand the objectives, risks and inconveniences of the trial and the conditions under which it is to be conducted. The subject has been informed of his/her right to withdraw from the trial at any time. The subject has given his/her informed consent to taking part in the trial. The subject may, without being subject to any resulting detriment, withdraw from the trial at any time. The subject has been provided with a contact point where he/she may obtain further information about the trial.