Assistive Technologies 2

Human Computer Interaction Group (HCI)

Institute of Visual Computing & Human-Centered Technology,
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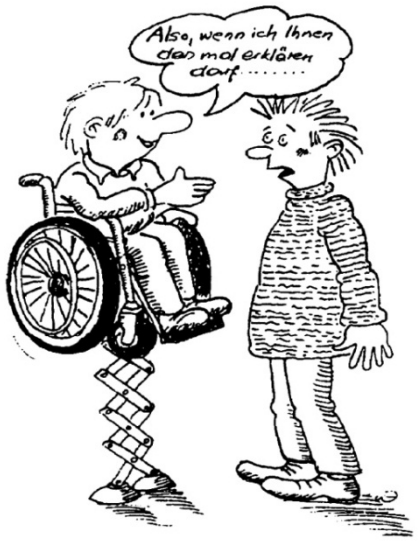


Contents of Block 2

Direct-communication:

All forms of communication between two or more people in the same place, where messages are exchanged without a (remote/tele-) transmission system for distance.

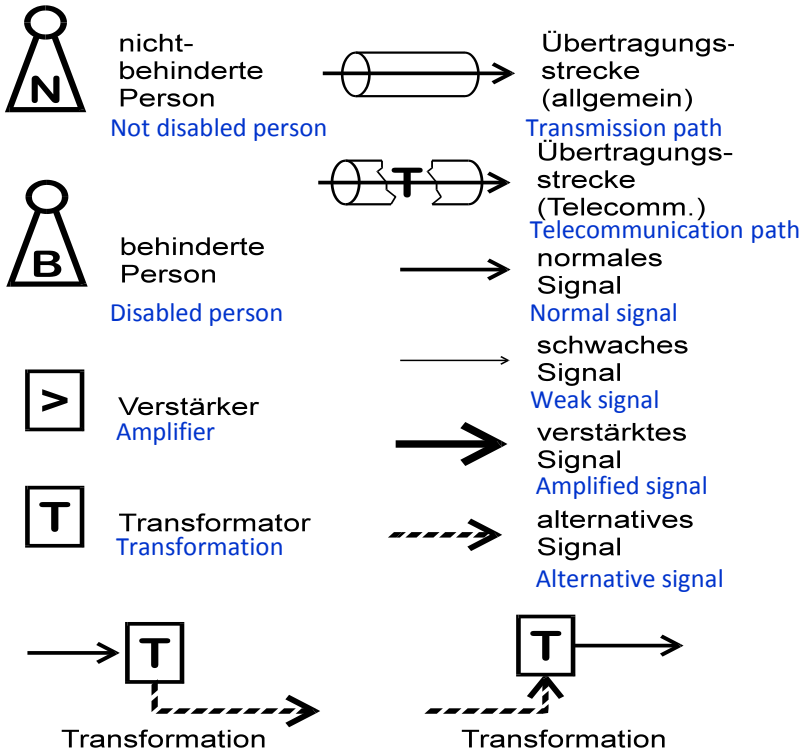
This applies in general for persons without disabilities, i.e. for „conventional“ communication (e.g. talk between 2 persons opposite to each other).

Tele-communication: Already in the conventional Tele-communication technical media are used for transmission.

There not only is Telephone or Fax, but also other methods, like letters, newspapers and books, nowadays Internet.

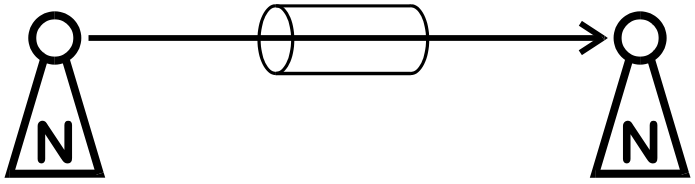
In alternative Tele-communication often several technical systems are used. The assignment is performed to the one channel responsible for transmission over distance.

Symbols used for abstract systematics:



Starting point:

Ausgangspunkt der nachfolgenden Betrachtung:



Conventional communication of not disabled persons

Konventionelle Kommunikation zwischen nicht-behinderten Personen

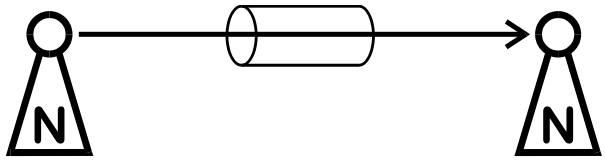
Conventional acoustic communication

w/o use of an aid

Speaking → Hearing

Talk between 2 persons

Talk to a group



Direct-Communication:

For disabled communication partners for
augmentative (amplified) communication or
alternative (replaced) communication
… the use of technical devices on either side can be required.

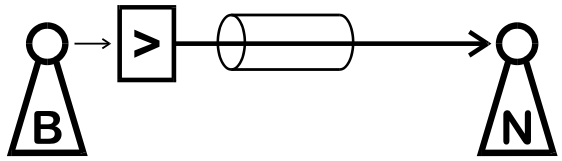
=> Examples for most important communication by acoustic or optic means are given.

Augmentative acoustic communication

By use of an aid

No change of modality

For speaking



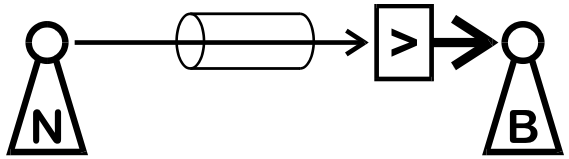
Speech amplifier

Clarifier (transforms by speech processor)

Speech-Re-Synthesis (ASR ➔ TTS)

(ASR=Automatic Speech Recognition, TTS=Text To Speech)

For hearing



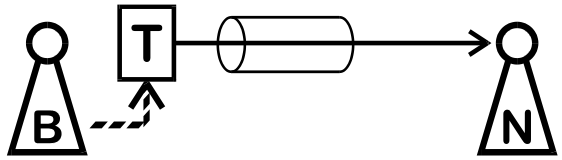
Hearing aid

(Cochlea Implant – special, inserting, same modality just bridging gap)

Alternatives for acoustic communication

By use of an replacing aid

With change of modality



For speaking

Keyboard input -> Speech synthesis

Modality change: ***mechanic → acoustic***

Finger alphabet / sign language

Modality change: ***mechanic → optic***

Data-glove input for finger alphabet → Display / TTS

Modality change : ***mechanic → optic / acoustic***

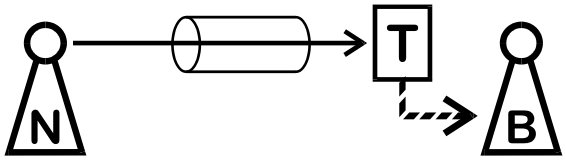
Text / image writing / showing

Modality change : ***mechanic → optic***

Alternatives for acoustic communication

By use of an replacing aid

With change of modality



For hearing

Automatic speech recognition ➔ subtitles

Modality change: ***acoustic ➔ optic***

Finger alphabet / seeing sign language

Modality change: **mechanic ➔ *optic***

Finger alphabet / hand alphabet / hand signal

Modality change: **mechanic ➔ *mechanic / tactile***

Braille in direct dialogue

Modality change: **mechanic ➔ *mechanic / tactile***

Conventional optic communication

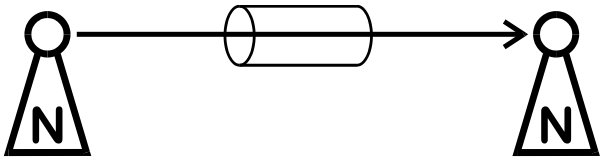
Without use of an aid

Writing → Reading

Blackboard, flipchart

Displays, screen

Body language, gestures, mimics (nonverbal communication)



Augmentative optic communication

By use of an aid

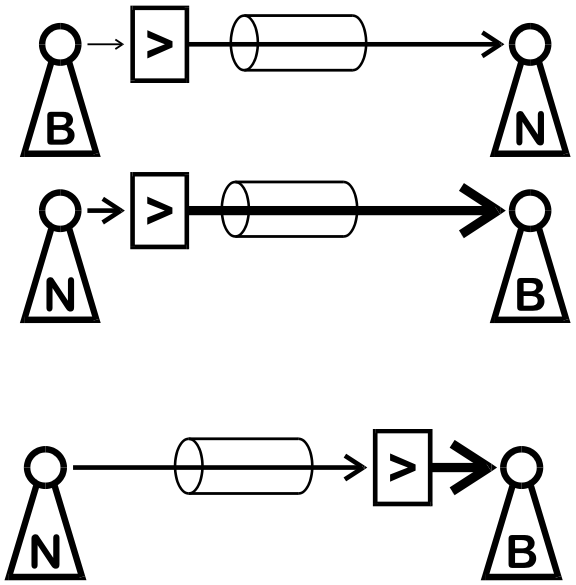
No change of modality

For writing

- Special keyboards / switch input
- Input accelerators
- Magnified overhead projection

For reading

- Spectacles
- Binoculars
- Electronic vision aids



Alternatives for optic communication

By use of an replacing aid

With change of modality

Replacement for (mechanical) writing

Dictation to human assistant

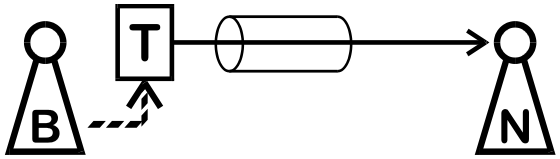
Modality change: ***acoustic → optic***

Automatic Speech Recognition – ASR

Modality change: ***acoustic → optic***

Images / symbols instead of text

(Modality change: ***optic 1 → optic 2)***

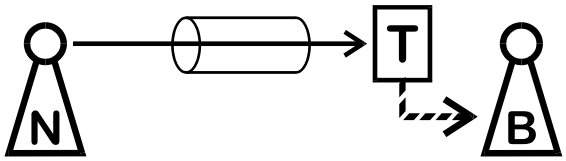


Alternatives for optic communication

By use of an replacing aid

With change of modality

Replacement for (optical) reading



Human assistant (reading aloud)

Modality change: ***optic → acoustic***

OCR - Optical Character Recognition with speech output

Modality change: ***optic → acoustic***

Optical Character Recognition with Braille output

Modality change: ***optic → mechanic / tactile***

Images / symbols instead of text

(Modality change: ***optic 1 → optic 2)***

Conventional acoustic Tele-communication

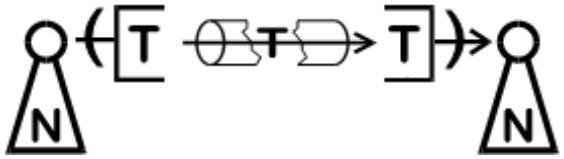
Without using aids

Speaking → Hearing (bidirectional)

Telephone

Only hearing (unidirectional)

Radio



Note: depending on Tele-communication media different special Tele-communication aids can be applied.
Some like Fax, text telephone are nowadays outdated and replaced by Internet and Smartphones.

Augmentative acoustic Tele-communication

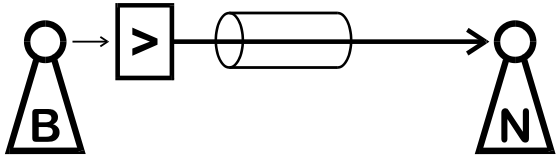
By use of an **amplifying** aid

No modality change

For speaking

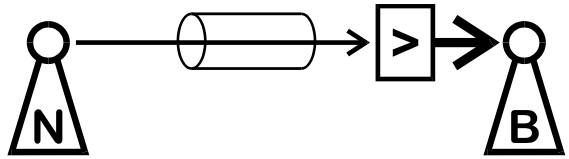
Speech amplifier

Clarifier (transformed by speech processor)



For hearing

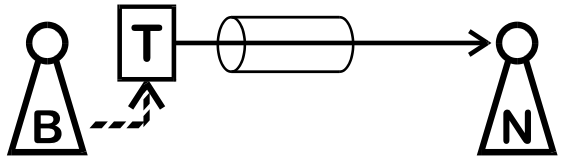
Built-in hearing amplifier (e.g. in Telephone)



Alternatives for acoustic Tele-communication

By use of a **replacing** aid

Modality change



Replacement for speaking

From keyboard to speech synthesis (TTS)

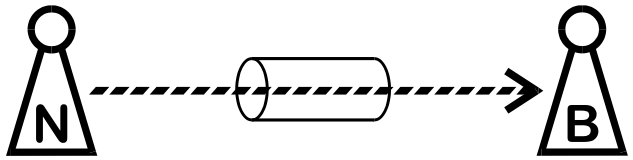
Modality change: ***mechanic ➔ acoustic***

Telephone Relay service (writing ➔ operator talks)

Modality change : ***mechanic ➔ acoustic***

Use of sign language over video telephony

Modality change : ***mechanic ➔ optic***

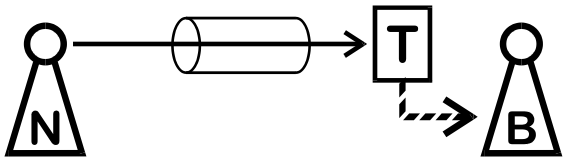


Alternatives for acoustic Tele-communication

By use of a **replacing** aid

Modality change

Replacement for hearing



Automatic speech recognition

Modality change: ***acoustic → optic***

Text telephone via Relay service

Modality change: ***acoustic → optic***

Sign language/ Finger alphabet via Videophone

Modality change: ***mechanic → optic***

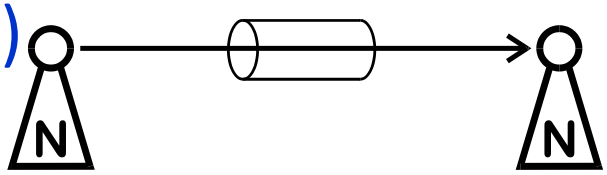
Braille terminal / Dexter (mechanic hand for finger alphabet)

Modality change: ***mechanic → mechanic / tactile***

Conventional audio/video Tele-communication

Hearing and seeing (unidirectional)

TV



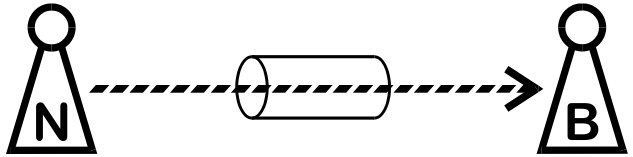
Alternative audio/video communication

Using a **replacing** aid

Modality change

Replacement for hearing

TV subtitles



Replacement for seeing

Acoustic TV scene description

Conventional optic Tele-communication

Without using an aid

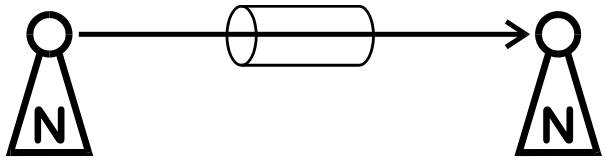
Writing → Reading

Exchange letters, newspaper, books

Teletype, Fax (both outdated)

E-Mail, Text chat

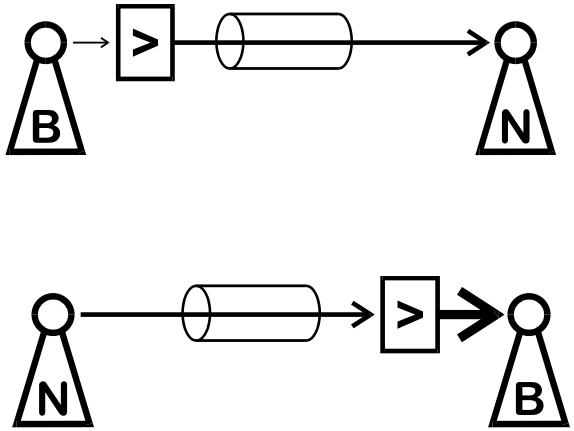
WWW (also other modalities)



Augmentative optic Tele-communication

Using an **amplifying** aid

No modality change



For writing

- Special keyboards / switch input
- Input accelerators

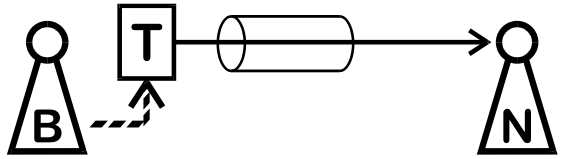
For reading

- Glasses
- Magnifiers
- Electronic vision aid
- Screen magnification

Alternatives for optic Tele-communication

Using a **replacing** aid

Modality change



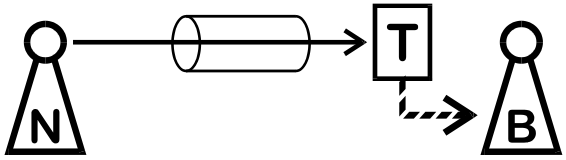
Replacement for (mechanical) writing

- Audio tape letter/acoustic recording (sent by mail)
- ASR to letter, e-mail
- Modality change: ***acoustic → optic***
- Symbol language via e-mail, Fax, Videophone
- Braille, Moon, tactile graphics

Alternatives for optic Tele-communication

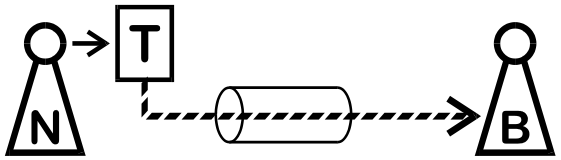
Using a **replacing** aid

Modality change



Replacement for (optic) reading

- Audio books, electronic newspaper, OCR ➔ TTS
- Modality change: ***optic ➔ acoustic***
- Books and newspapers in Braille
- Browser with speech output
- Modality change: ***optic ➔ acoustic***
- Browser with Braille output
- Modality change: ***optic ➔ mechanic/tactile***



German summary

Interpersonelle <u>Direkt-</u> Kommunikation:

- Augmentativ,
- Konventionell,
- Alternativ

	AUGMENTATIV	KONVENTIONELL	ALTERNATIVER KANAL		
			AKUSTISCH	OPTISCH	MECHANISCH
AKUSTISCH	**Beim SPRECHEN** Sprachverstärker, Clarifier Sprach-Re-Synthese	**SPRECHEN – HÖREN** Gespräch zwischen zwei Personen Vortrag vor einer Gruppe	**ALTERNATIVEN FÜR SPRECHEN** *nach Tastatureingabe*: Sprachsynthese	Fingeralphabet / Gebärde, Text/Bilder schreiben/zeigen	
	Beim HÖREN Hörgerät, Cochlea Implantat		**ALTERNATIVEN FÜR HÖREN** Spracherkennung *... weiter dann optisch*	Fingeralphabet / Gebärde Text lesen	Fingeralphabet / Gebärde tastend, Braille direkt, Lormen
OPTISCH		**SCHREIBEN - LESEN** (Visualisieren) Tafel, Flipchart, Overheadprojektor	**ALTERNATIVEN FÜR SCHREIBEN** Diktieren an Menschliche Assistenz, Spracherkennung	Bilder /Symbole statt Text	
	Beim LESEN Brille, Fernglas, elektronische Hilfen	**MIMIK - GESTIK** Nicht-verbaler Teil eines Gespräches	**ALTERNATIVEN FÜR LESEN** Menschliche Assistenz (Vorlesen)	Bilder/Symbole statt Text	Braille direkt (nicht gedruckt)
MECHANISCH		**BERÜHRUNGEN** Händeschütteln Umarmung Auf-die-Schulter-Klopfen			

German summary

Interpersonelle Tele-Kommunikation:

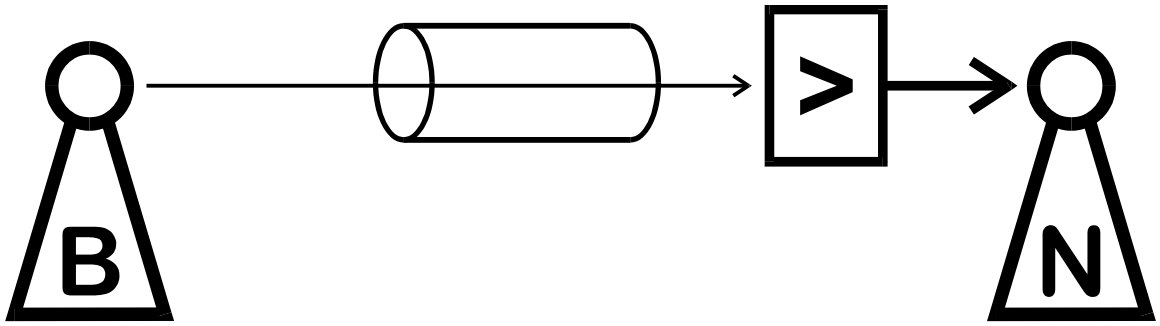
- Augmentativ,
- Konventionell,
- Alternativ

	AUGMENTATIV	KONVENTIONELL	ALTERNATIVER KANAL		
			AKUSTISCH	OPTISCH	MECHANISCH
AKUSTISCH	**Beim SPRECHEN** Sprachverstärker Clarifier **Beim HÖREN** Hörverstärker	**TELEPHON** (Sprechen und Hören) **RADIO** (nur Hören)	**ALTERNATIVE FÜR SPRECHEN** *nach Tastatureingabe:* Sprachsynthese Relay-Service **ALTERNATIVE FÜR HÖREN** Spracherkennung, Texttelephon über Relay-Service *weiter dann optisch*	Texttelephon Internet Chat, Fax, Gebärden über Videophon Texttelephon Internet Chat, Fax, Gebärden über Videophon	Braille Terminal Dexter
AKUSTISCH + OPTISCH		**FERNSEHEN**	**ALTERNATIVE FÜR SEHEN** TV-Szenen-beschreibung **ALTERNATIVE FÜR HÖREN**	**ALTERNATIVE FÜR HÖREN** TV-Untertitel	
OPTISCH	**Beim SCHREIBEN** PC unterstützte Texteingabe **Beim LESEN** Lupen, Vergrößerungs- Lesegerät, PC mit Vergrößerung	**BRIEFWECHSEL** **PRESSE** **BÜCHER** **FERNSCHREIBER** **FAX** **E-MAIL** **WWW**	**ALTERNATIVE FÜR SCHREIBEN** Tonbandbrief **ALTERNATIVE FÜR LESEN** Hörbücher, elektronische Zeitung, OCR, Browser mit Sprachausgabe	**ALTERNATIVE FÜR SCHREIBEN** Spracherkennung *(weiter optisch)*, Symbolsprache über e-mail, fax **ALTERNATIVE FÜR LESEN** Symbolsprachen	**ALTERNATIVE FÜR SCHREIBEN** Braille, Moon taktile Graphik **ALTERNATIVE FÜR LESEN** Braille, Moon, taktile Graphik elektr. Zeitung (Braille Ausgabe)
MECHA-NISCH		**VIRTUELLE REALITÄT** Data Glove, Data Suit			

Augmentative Communication

Disabled sender

Aid at receiver side

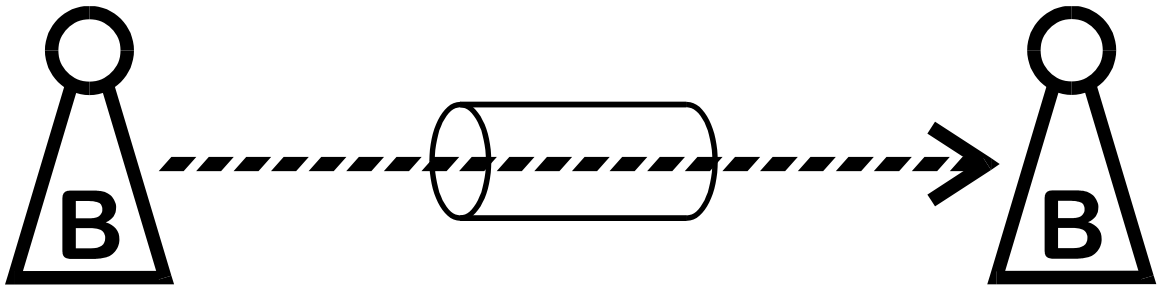


Example

- *keines bekannt / none known*

Alternative communication

Two disabled communication partners use alternative communication



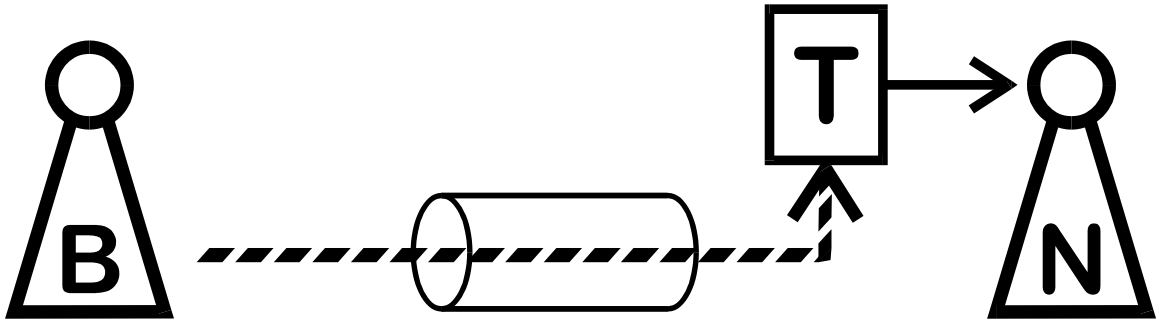
Example

- *In Blindenschrift (Braille) geführter Briefwechsel zwischen zwei blinden Personen (ohne Verwendung einer besonderen technische Hilfe), Gebärdensprache / Braille, sign language*

Alternative communication

Disabled sender

Aid at the receiver side



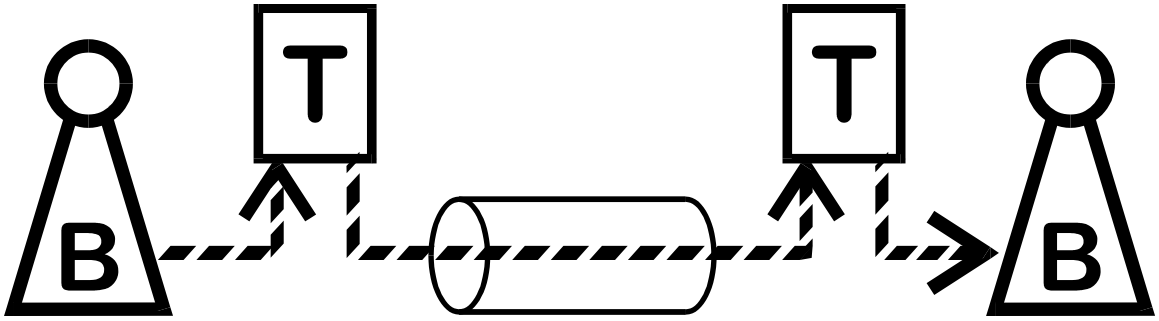
Example (unusual)

- *Schriftstück in Blindenschrift wird von sehender Person mittels Lesegerät (OBR = Optical Braille Recognition) in Schwarzschrift umgesetzt, Gebärdenübersetzung / Braille read by OBR device*

Alternative communication

Communication in alternative form

Aids at both sides

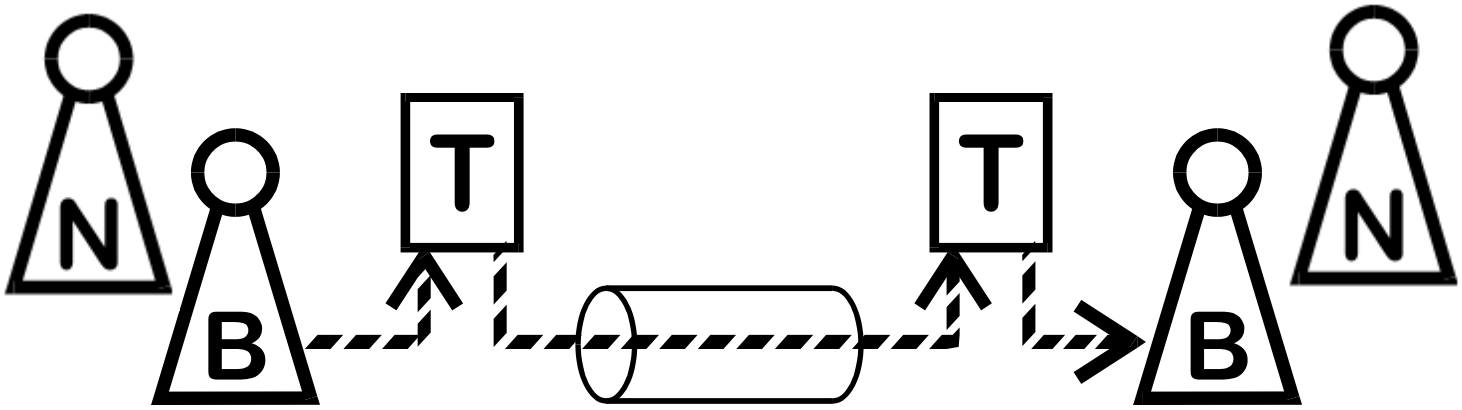


Example

- *Verwendung von Texttelephonen zwischen gehörlosen Kommunikationspartnern (heutzutage SMS, Email…) / text telephone or nowadays SMS, e-mail*

Communication today

Communication in alternative form „normal“
„Aids“ at both sides (Computer, Smartphone)



Example today

- *Verwendung von Email zwischen gehörlosen und/oder nichtbehinderten Kommunikationspartnern / Email instead of voice or optical communication*

Differentiation of

- augmentative (amplifying) communication (Modality unchanged) and
- alternative (replacing) communication (Modality changed)

and

- Direct-communication and
- Tele-communication

as well as

use of aids on one or both sides, by disabled or non-disabled person.

By the new Information and Communication Technologies (ICT) the „conventional“ communication (independent from a disability) has become „normal“ in „alternative“ form same as the use of „aids“ (Smartphone, Tablet, Computer)

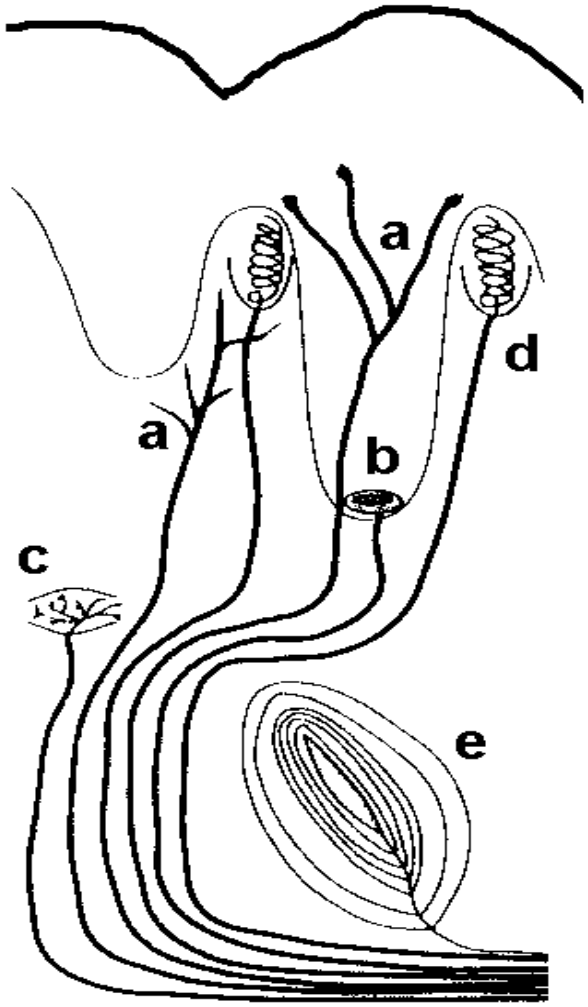
Definitions

tactile: using the tactile sense (of the skin) alone - „palpable“ information

haptic: addition of Proprioception (spatial perception and association) of the own body/ the own limbs (and their posture)

Tactile sense
Mechanoreceptors in the skin

a: free nerve endings
b: Merkel corpuscle
c: Ruffini corpuscle
d: Meissner corpuscle
e: Vater-Pacini corpuscle



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

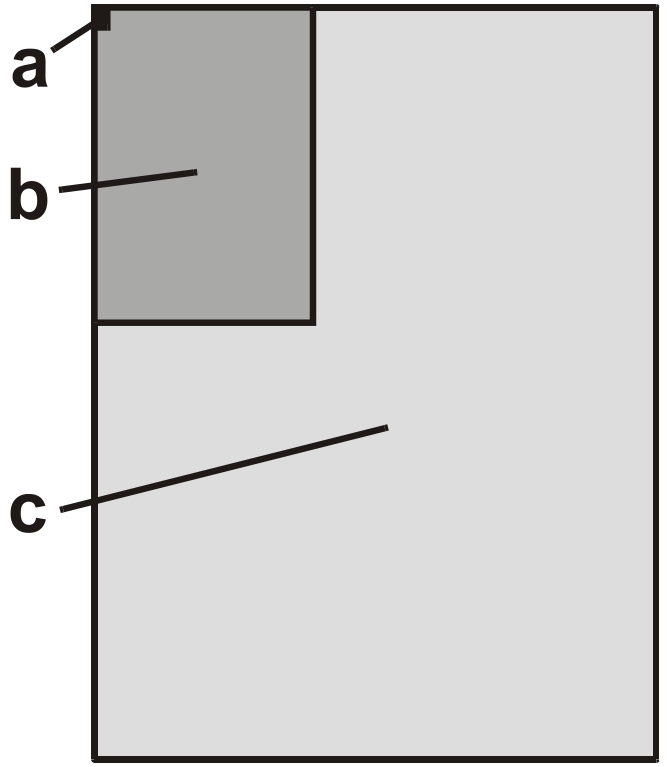
Body region	Minimum distance [mm] for two-point discrimination
Thigh	68
Back	54
Forehead	22
Back of finger	16
Thumb	9
Tip of nose	7
Red lips	4
Finger pulp	2
Tip of tongue	1

Comparison with visual perception

Information density

Area for same amount of information

a) visual
b) tactile dynamic
c) tactile static



Peculiarities of tactile sense

Invariance of haptic perception to position change

Blind persons show higher invariance to positional changes in perception of tactile models than people accustomed to visual perception.

Occultation

… of an object can occur by other object, which is in the line of sight.

When exploring something tactually with the hands however, areas are accessible which are hidden from the eye.

Cf. blind man's buff game (German: Blinde Kuh Spiel)

Peculiarities of the tactile sense

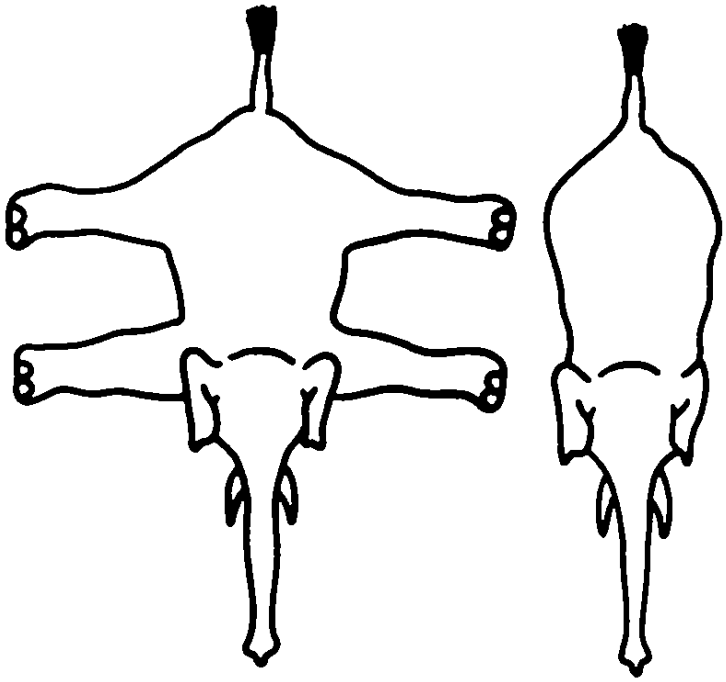
Perspective

The size of an object seems to depend on its distance. With haptic perception the distance of the observer is at maximum the length of the arm. The perceived size is always experienced in direct contact with the object and therefore constant

Shadowing

Results from straight running light rays, for which blind persons have no equivalent in haptic perception

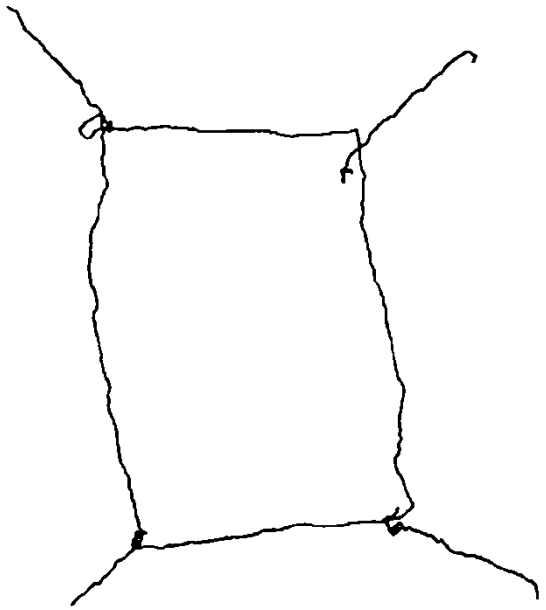
Perspective/model – depending on POV



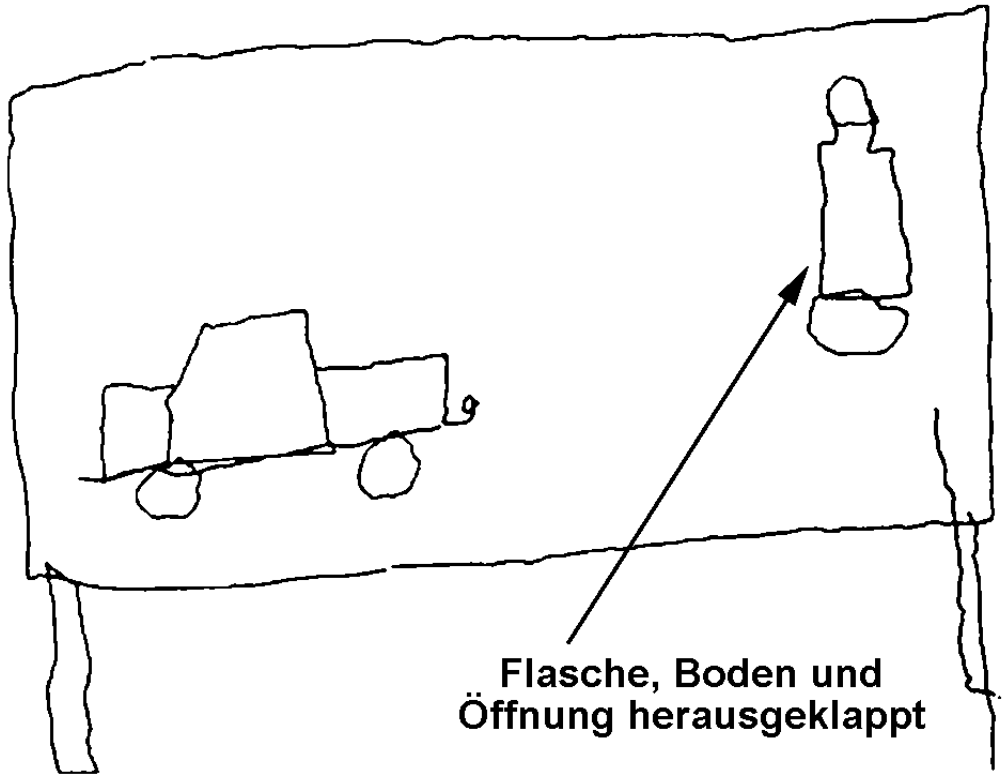
African children and adults (Sambia) argued, that the left image represents an elephant better than the right image

"Advent wreath", drawing of a child of age 5

Perspective/model of blind persons



A table drawn by a blind person

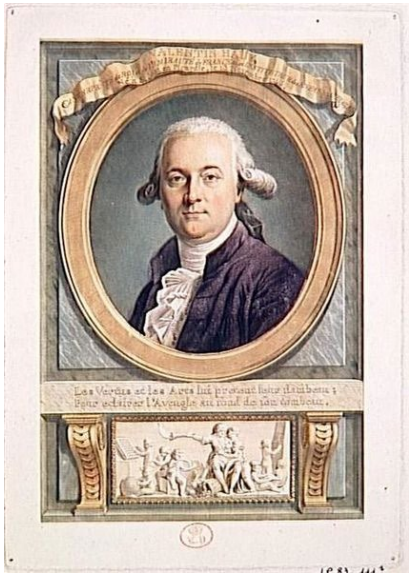


A car and a bottle on a table drawn by blind person, opening and bottom of bottle are "visible"

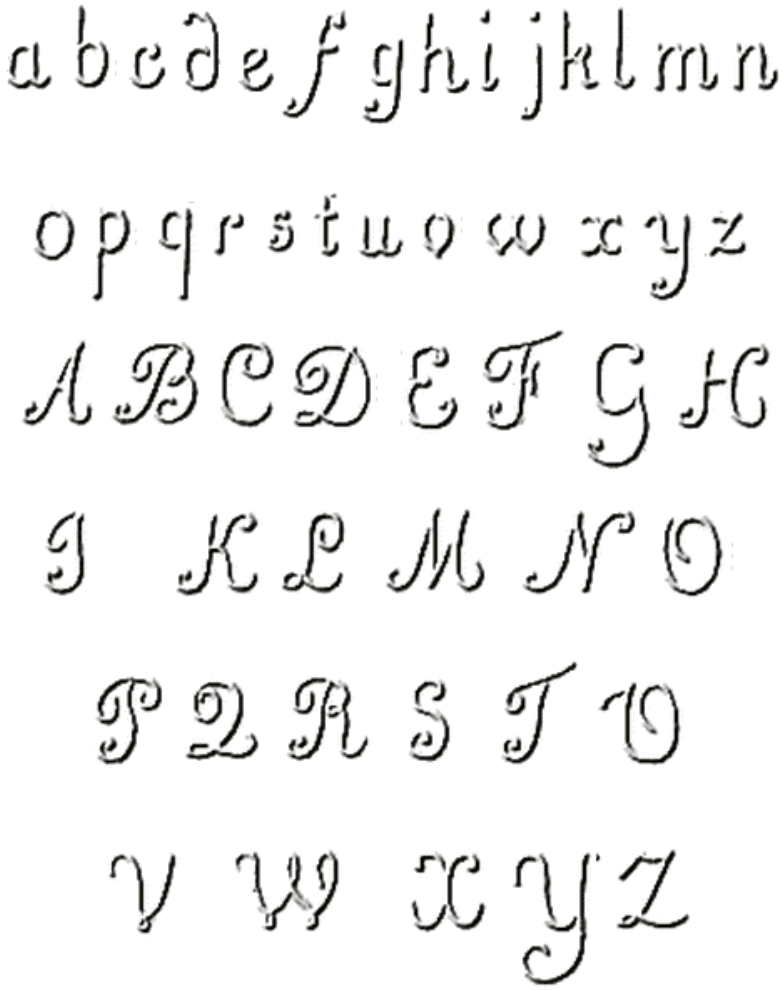
In the beginning in teaching of blind children only **enlarged Latin letters** were used = **relief writing.** These were embossed into moist paper or applied on paper (e.g. 1786 in France by Valentin Haüy).

Valentin Haüy's embossed print letters

Valentin Haüy (1786)

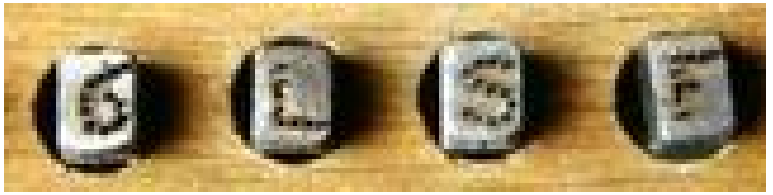


Wikipedia



The **Stachelschrift** (sting/spike writing) was invented 1807 by Johann Wilhelm Klein in Vienna as tactile writing (Relief writing).
It consisted of dotted print of big Latin letters embossed by a „Stachel-Typen-Apparat“ (sting-type apparatus) from the backside into paper.

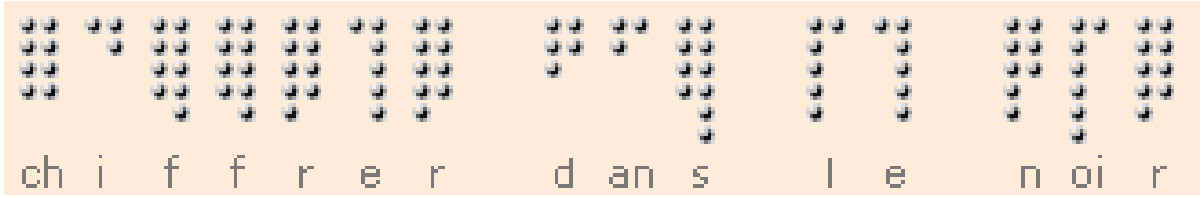

Wikipedia

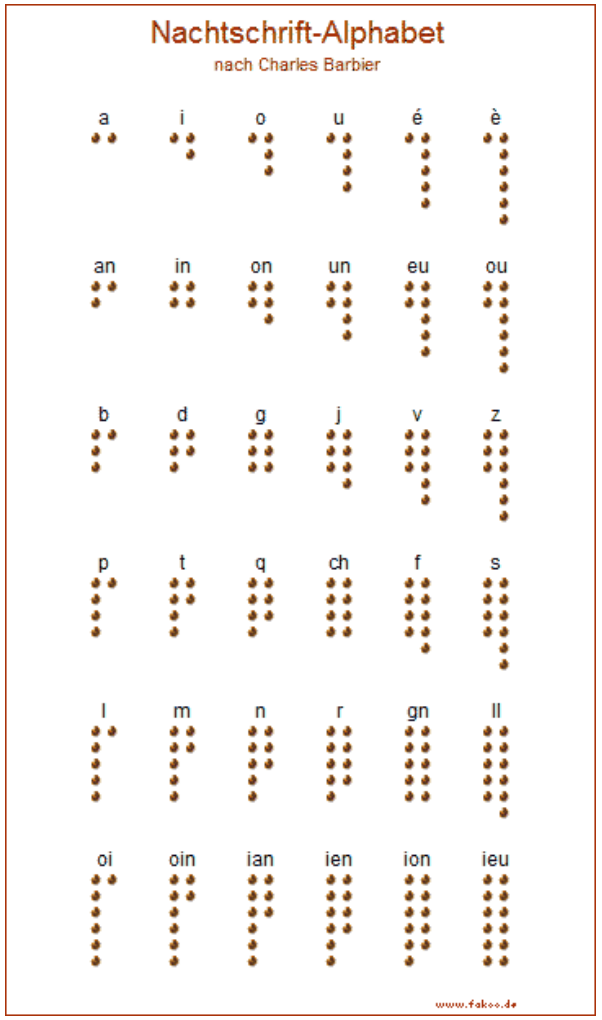


Charles Barbier de la Serre developed a military **„Nachtschrift“** (night writing) with 2 x 6 = 12 dots (dot writing).

Motivation: reading messages during night time without need to use candles or speech.
Was (too) difficult to learn and therefore rarely used.

Wikipedia





Louis Braille (1809-1852)

Fell blind by eye injury
during early childhood and visited
the Paris institute for the blind.
There he met Charles Barbier.

Wikipedia

Looks for method for tactile letters,
which are easy to read and write by blind persons
(without help).

1826 he developed an Alphabet with
2 x 3 = 6 tactile dots.

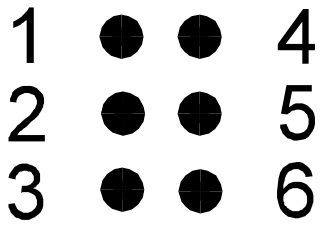
Base form of Braille

Matching the size of the finger pulp and the tactile sense

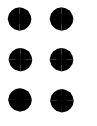
Up to 6 dots in a fixed matrix (3 lines, 2 columns)

Allows for 63 symbols plus 1 space (2^6=64)

Numbering of the 6 dots:

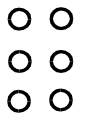


All six dots -> palpable symbol



Alle sechs Punkte gesetzt (tastbar)

no dot -> not palpable space

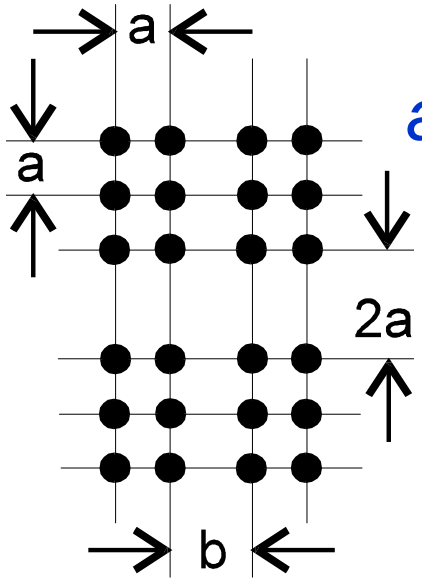


Keiner der sechs Punkte gesetzt (nicht tastbar)

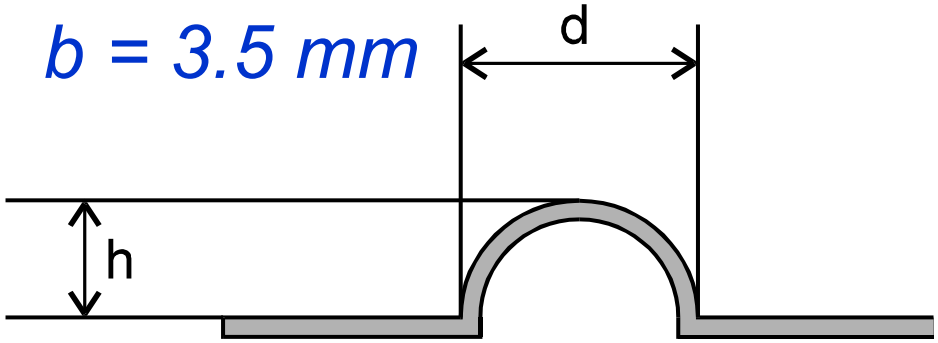
Dimensions of Braille

No mandatory standard

Following dimensions are common => tactile sense



a = 2.5 mm *b = 3.5 mm*

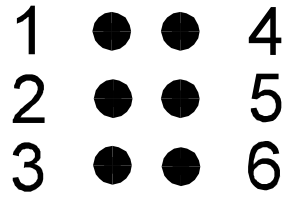


d = 1.5 mm *h = 0.4 ... 0.8 mm*

Differences depending on application

Braille base alphabet

Assignment of characters in strict alphabetic order

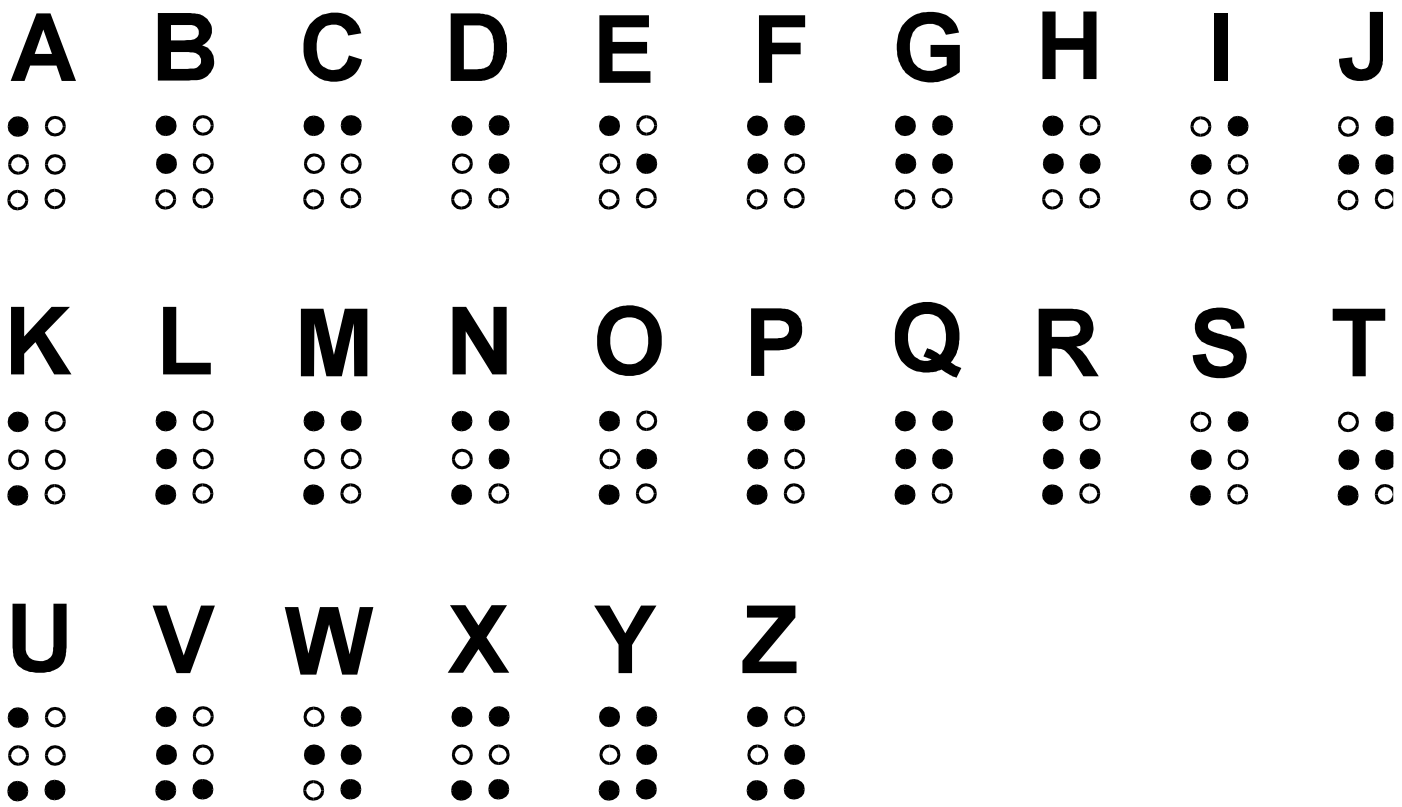


Upper four dots (1,2,4 and 5) for first 10 letters („a“ to „j“)
Of the 15 possible combinations 5 are not used to avoid mistakes.
All characters have to have at least 1 dot in the first column to recognise start of a character reliably.

For the next 10 characters („k“ to „t“) dot 3 is added.

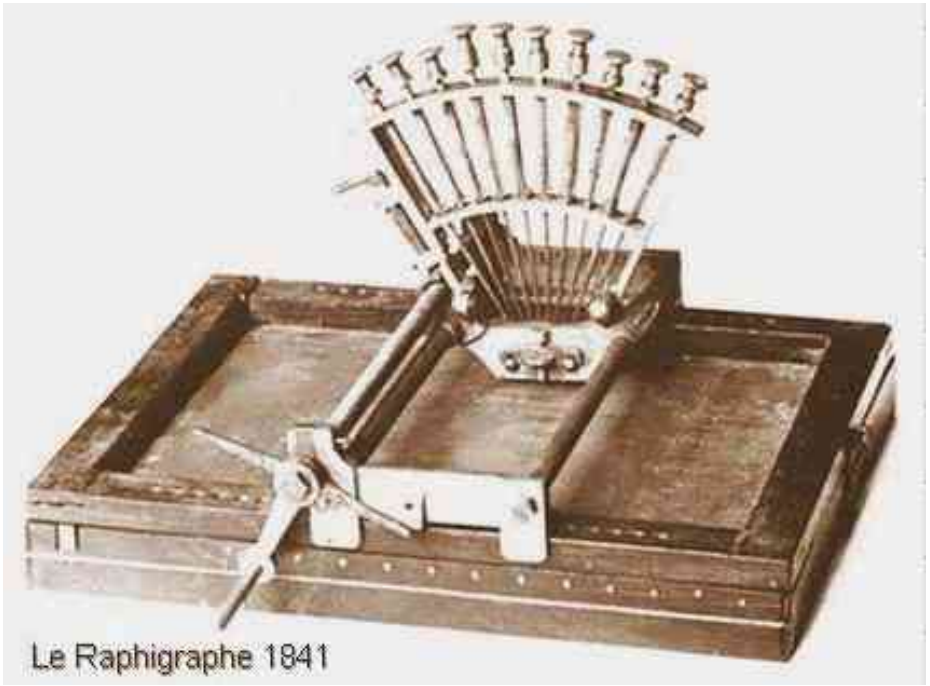
The rest has also dot 6 (exception „w“).
Note: The letter „w“ is not used in French, therefore it was originally not defined by Louis Braille but only added later.

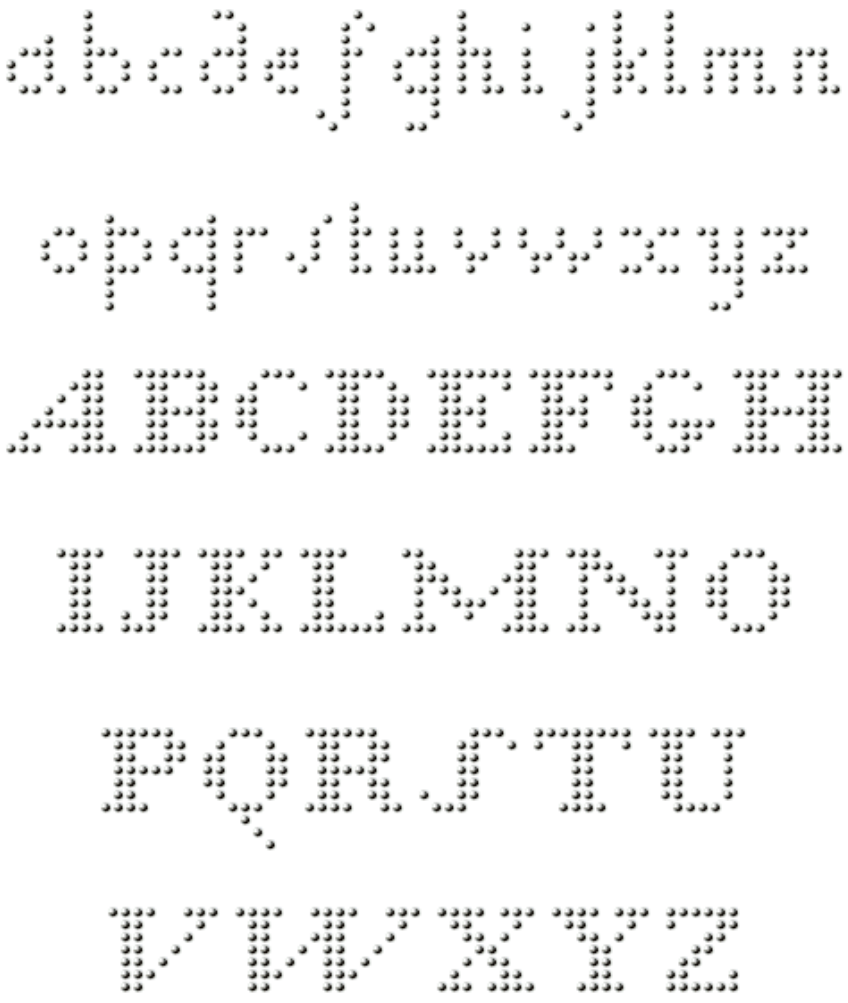
The Braille Alphabet (1826)



1839 Louis Braille introduced his **Raphigraphy** for replication of the black/normal print letters.
By this writing blind persons could write to their relatives which were not able to read Braille.

Typewriter **„Raphigraphe“ (1841)** of **François-Pierre Foucault**


Le Raphigraphe 1841



Other historic tactile script systems

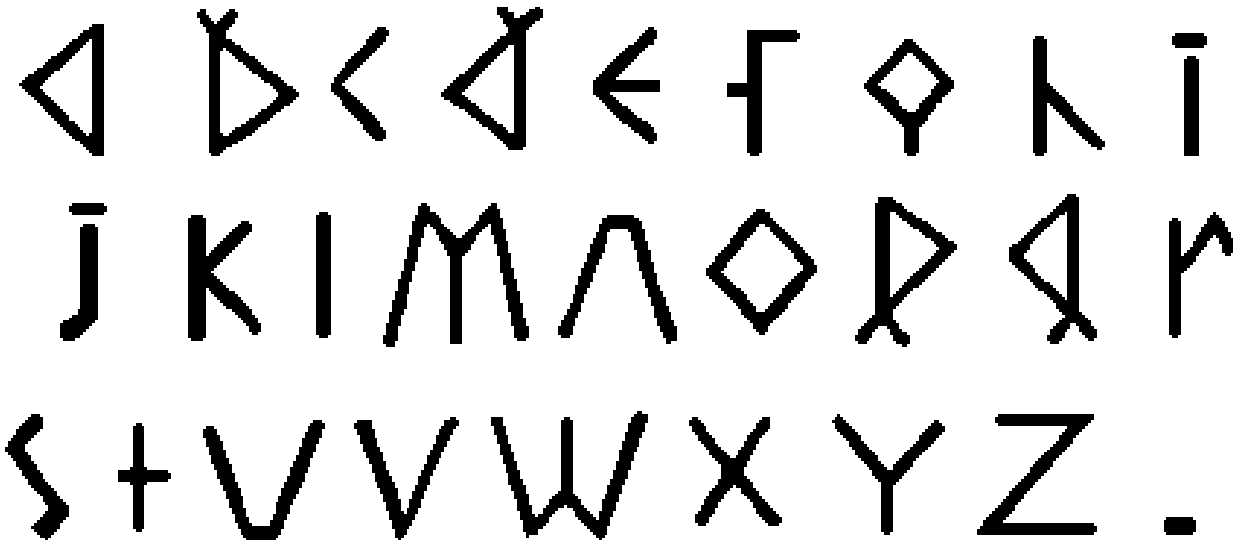
- Did not gain acceptance
- But certain properties and arguments are quite interesting…

Any attempt to introduce a literature for the blind would certainly be ruined by founding it on an arbitrary alphabet. No man can ever expect to feel so much interest in a thing which he must learn before he can understand, as in that which is plain to his ***eyes*** *and to his understanding.*
James Gall

Tactile writing by **James Gall**, **1831**

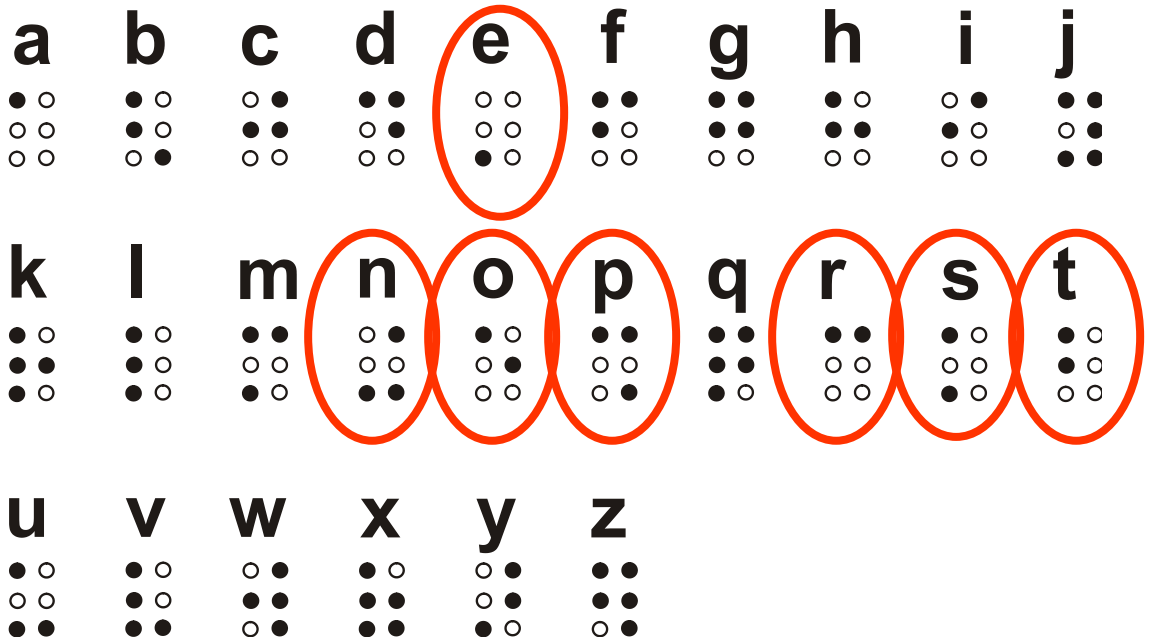
(5 years after L. Braille!)

Purpose: maps readable by blind persons



American Modified Braille **(Joel W. Smith, 1878)**

… is the attempt to optimize (minimize) the number of dots depending on frequency of (English) characters



American Modified Braille

Starting point and motivation:

Louis Braille has based his coding on alphabetical order without consideration of frequency in practical use.

Frequent letters like e.g. „r“ and „t“ are written with 4 dots, less frequent letters like „c“ and „k“ with only 2 dots.

When writing by hand with a stencil this is adversely affecting writing speed .

Joel W. Smith in 1878 in Boston made a re-ordering of the coding:

The characters „e“, „n“, „o“, „p“, „r“, „s“ und „t“ use less dots than the Braille-Alphabet

The advantage in writing speed partially diminished with the occurrence of Braille typewriters around ca. 1950.

New York Point **(William B. Wait, 1872)**

… is a dot writing, which coding considers the frequency of characters and optimizes the needed space.

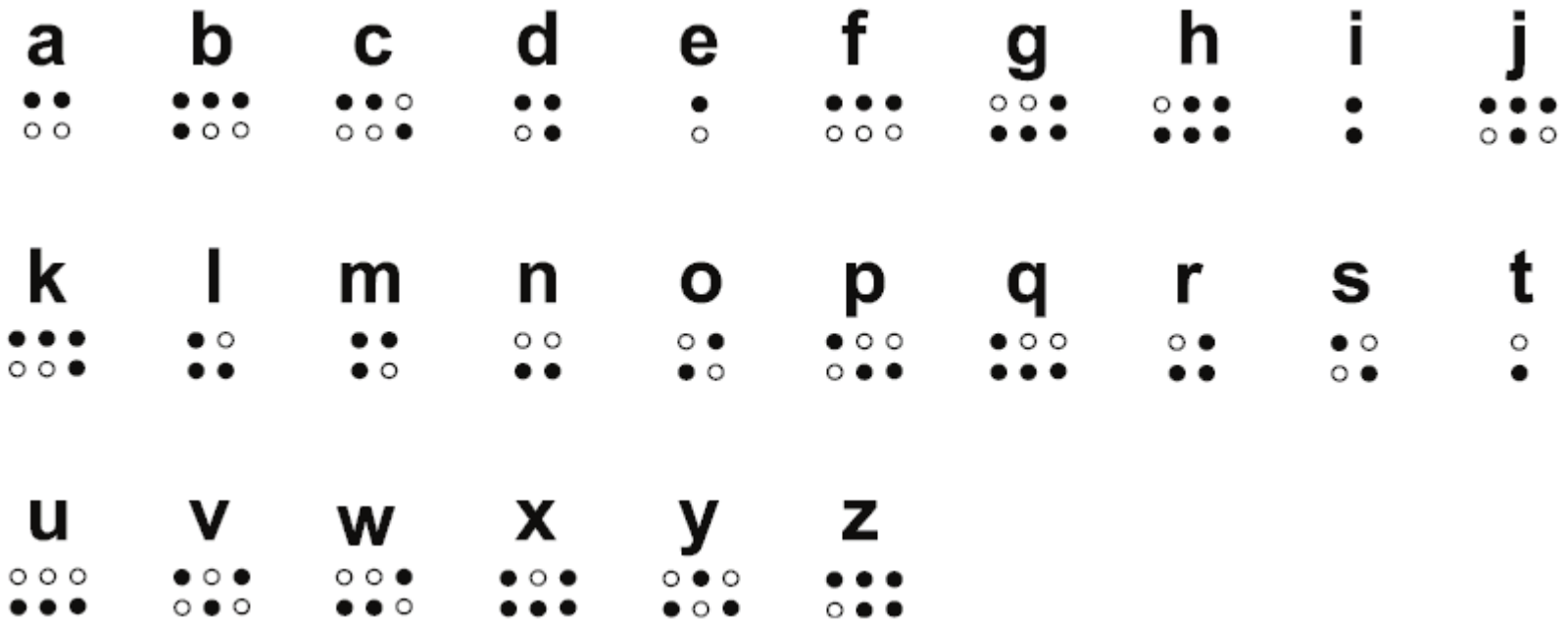
Minimization of necessary dots
Minimization of needed space

Change to a 8-dot scheme:

2 lines and 1 to 4 columns
(Braille: fixed matrix of 3 lines and 2 columns)

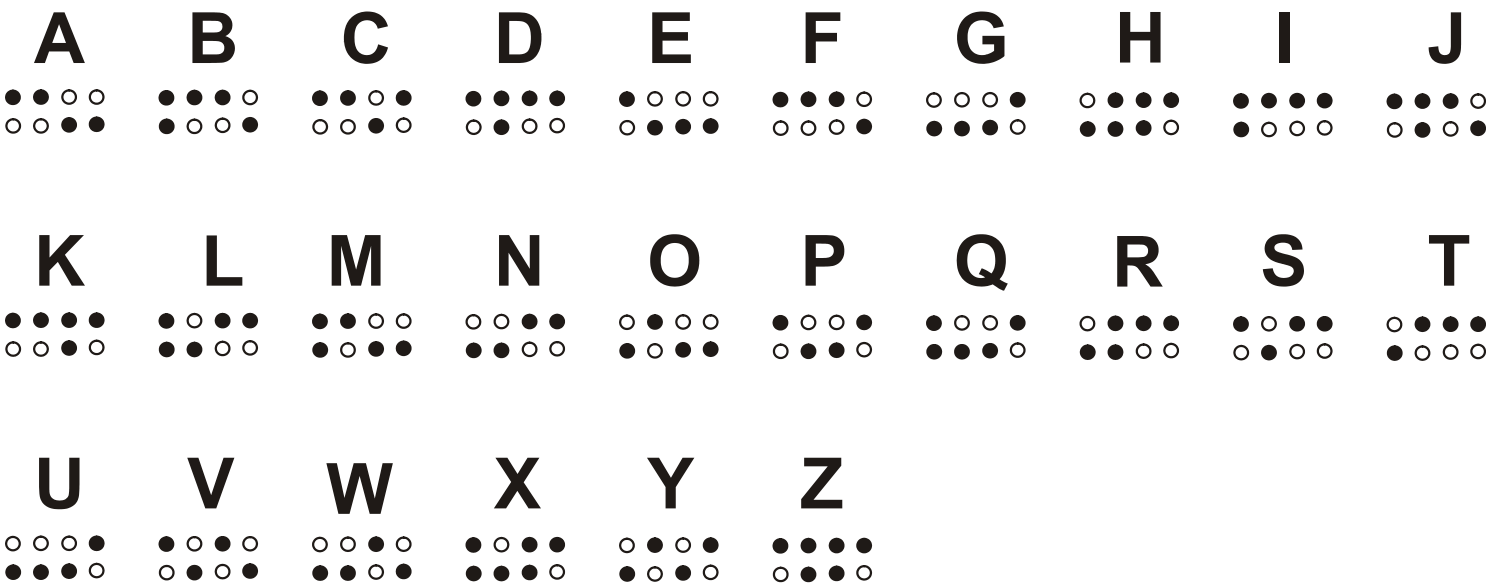
New York Point

- Optimization of needed space and dots
- Complete change to a 8-dot scheme



New York Point

Also allows to represent capital letters



Uptake of Braille

At the end of the 19th century Braille had spread and was used worldwide.

Exception: in the USA there surprisingly long until begin of the 20th century several competing systems existed:

- New York Point
- American Modified Braille
- Braille

This caused blind persons to have to learn several systems over decades, and production of books was complicated.

Only in 1932 Braille was fully established in the USA.

- Specifically: British Grade-2 Braille (using English shortcuts)

Excursus - “The War of the Dots” A Brief History of Braille

Reprinted from Braille Is Beautiful Teacher’s Guide, a publication of the National Federation of the Blind.
https://nfb.org/Images/nfb/Publications/fr/fr28/fr280108.htm

Early attempts to find a usable system of reading and writing for blind children included a system of tying knots on a rope, writing on wax tablets, and the use of carved wooden Roman letters.

1786 Valentin Haüy noticed that letters printed on wet paper were tactually legible on the reverse sides of paper. He devised a system of writing slightly modified letters in reverse on the back of heavy paper, using a metal pen with a rounded tip.

1829 Louis Braille devised and published a code based on a series of embossed dots. The code was based on a raised dot code invented in 1821 by Charles Barbier, an Army artillery officer, who created it because he needed a way to read by touch during night maneuvers. Other systems were simultaneously being developed, and this became known as “The War of the Dots,” which lasted in the United States of America and Great Britain for almost 80 years.

1853 Samuel Howe developed Boston Line Type, an embossed angular modification of Roman letters. Books at the Perkins School used this system for 50 years. Howe remained opposed to the Braille code all his life.

1860 William Wait, Principal of the New York Institute for the Education of the Blind, tried to get schools in Boston and Philadelphia to join him in accepting Braille’s code. They refused, so he developed his own system--New York Point, which resembles Braille characters turned on their side.

1871 New York Point was endorsed and recommended by an association of teachers of the blind, mostly sighted people, for use in the education of blind children.

1900 By this time Boston Line Type started to fade as American schools were using either **New York Point** or **Braille’s code**. Joel Smith developed yet another method, known as **American Braille**.

1909 Helen Keller advocated for the adoption of Braille, distraught by the fact that she had to learn four different embossed codes to have access to printed material, since there was no uniformity in its production.

1932 Standard English Braille was adopted by the United States of America and Great Britain as the uniform method of reproducing printed material--a century after Louis Braille presented his code.

Shortcuts in Braille in English language:

Grade 1 Braille

Every letter is written

Partially used in primary school (as entry point into Braille)

Grade 2 Braille

Uses partially letters for representation of words, e.g. „y“ stands for „you“, „b“ stands for „but“, …

Grade 2 is faster to read than Grade 1 and saves space in books

English books nowadays are typically written in Grade 2 Braille.

Grade 2 is taught regularly in schools.

Grade 3 Braille

Also uses non-standardized abbreviations, only used in private area

Coding of Braille in German language:

Basisschrift/Base

- Every letter usually corresponds to a Braille form
- Only lower case letters
- Numbers indicated by leading number symbol

Vollschrift/Full

- Some syllables / phonemes (ch, sch, …) are assigned special Braille representations

Kurzschrift/Shorthand

- Extensive rules for shortening of sound groups, syllables, words
- Ca. 30…40% savings possible
- Is the usually used Braille version

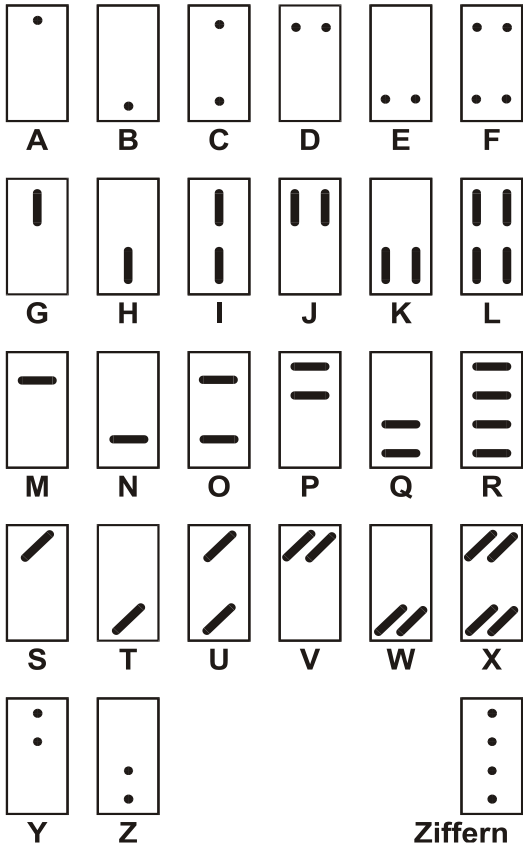
Stenographie/Stenography

- Even more (usually very complex) rules for excessive shortening

Tactile markings after Fishburne (1972)

For blind / visually impaired persons, unable to learn or use Braille (e.g. because of Diabetes)

- Not suited for long texts but
- for marking with labels
- (labelling of food, medicine, clothes
- Every letter on separate tag
- For short notes, e.g. telephone numbers



Fishburne Alphabet (size reduced)

Fishburne embossing mechanism

Upper and lower half embossed separately

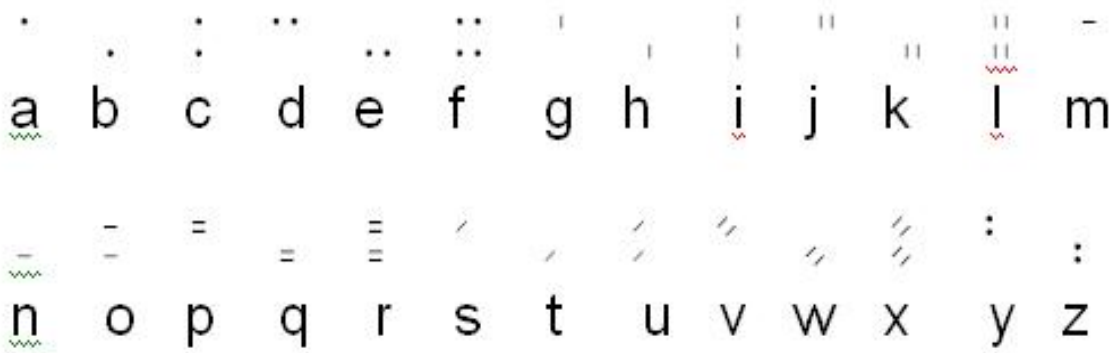
3 letters each per base symbol:

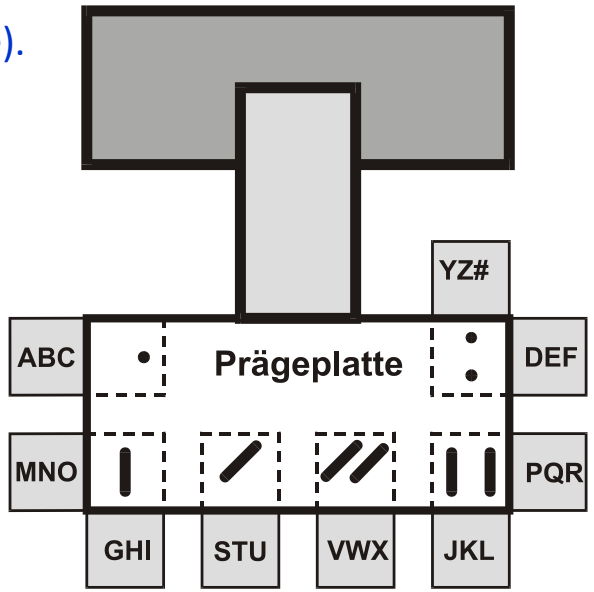
Every dot or dash form can be used either only in the upper, lower or both parts of the tag.

For every 3 letters the same punch form is used.

For labelling tags

Every letter is embossed onto a 1 inch (25.4 mm) long piece of a ½ inch (12.7 mm) wide self-adhesive tape (Dymo® – tape).





Embossing mechanism for Fishburne labels

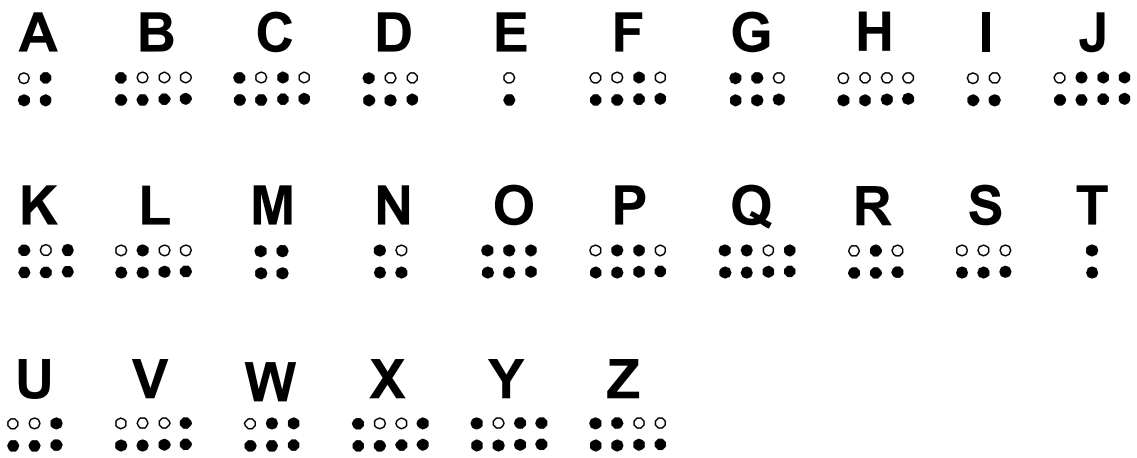
Florian Alphabet (1980s)

Another attempt for access to tactile writing for not Braille trained persons (so far not used much).

Not meant to replace Braille.

Uses the (unchanged) coding of Morse characters

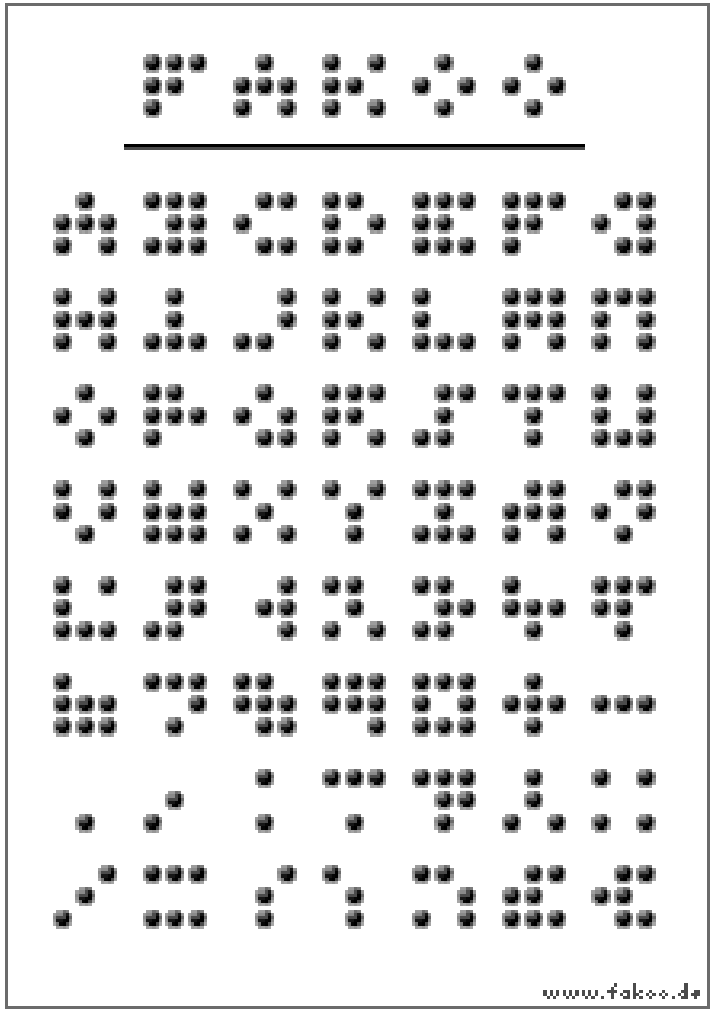
1 dot for „short“, 2 dots (vertical) for „long“



Fakoo-Alphabet

(after Alexander Fakoó, 2008, www.fakoo.de)

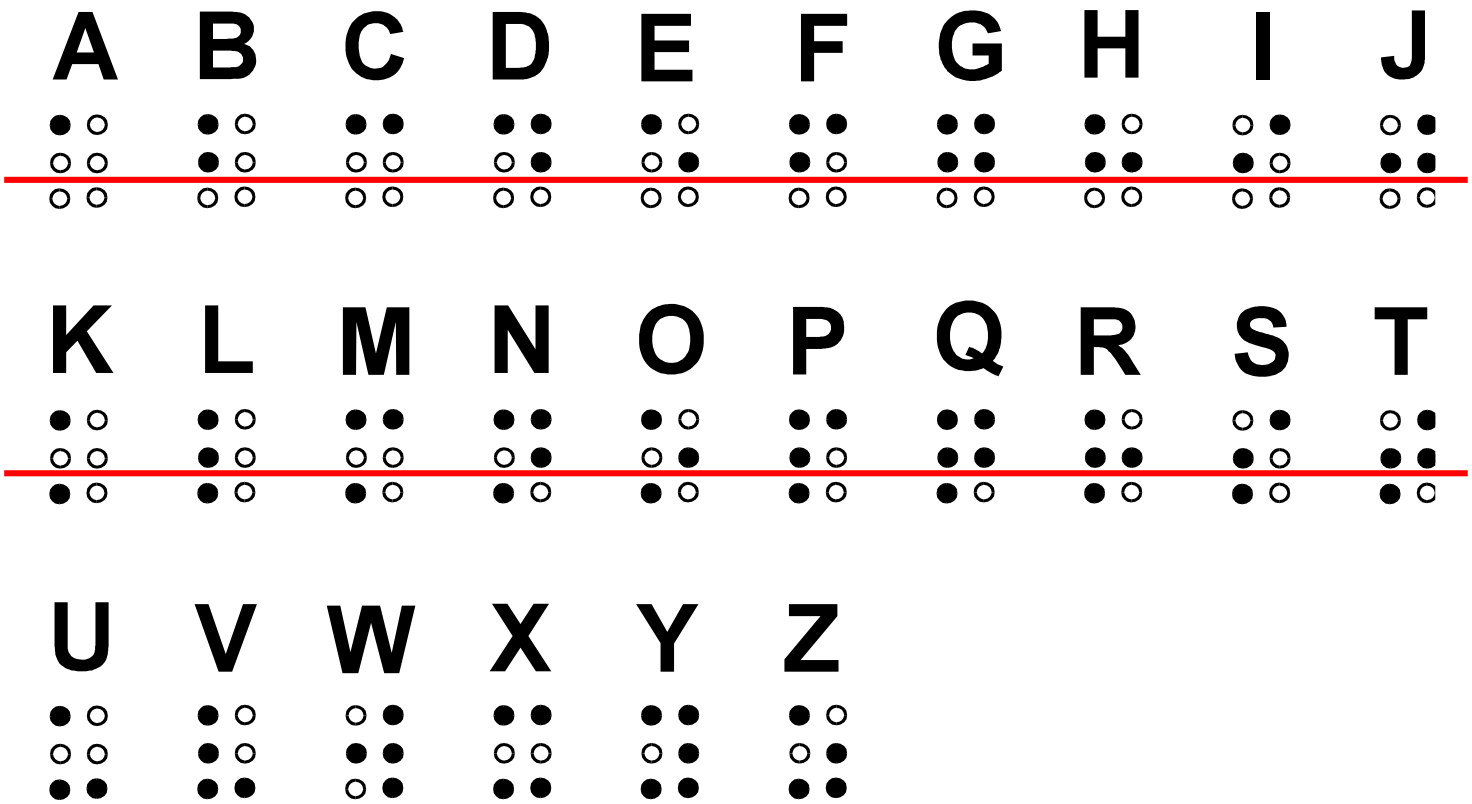
Motivation: create a connection between black print and 6-dot-Braille so that blind, vision impaired and normal sighted persons can communicate better.
Especially in the public area new applications are possible because of better acceptance by normal sighted persons. Fakoo maybe also as alternative for people not able to learn Braille.
The letters in the Fakoo-writing consist of up to 9 dots in a 3x3 grid.
Every Fakoo-character (including space) can be formed by 2 Braille characters.
The letters of the Fakoo-writing can intuitively be perceived both by blind and normal sighted persons, if Latin letters are known



Coding of Braille („braille writing“)

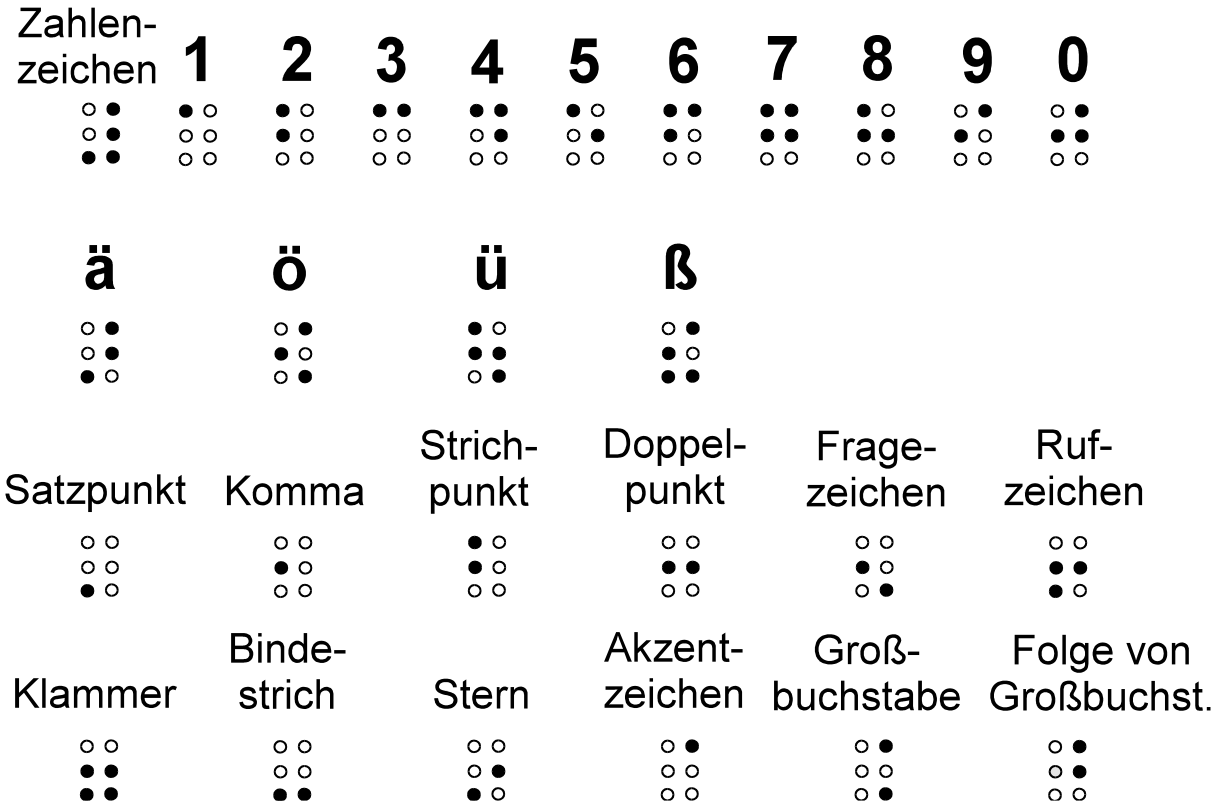
- Despite all weaknesses Braille is now worldwide widely accepted since ca. 1900
- Mostly printed into dry paper
  - This is an advantage over embossing into wet paper (as used for most relief writings)
- „Same sound - same sign“ – principle
- Coding problems:
  - Blackprint allows for unlimited characters, 6-dot Braille is limited to 63 forms. Only by combinations respectively context dependent multiple interpretations of a character more than 63 characters can be represented. Therefore it is common that depending on context and coding system a Braille form can have several meanings.
- Coding system:
  - Since 1998 (Reform of the German Blindenschrift) there are 3 fundamental coding systems: **Basisschrift, Vollschrift and Kurzschrift .**
  - Many more coding systems have been created for special tasks.

The Braille Alphabet



Braille Base Alphabet with extensions

- Indicate numbers, capital letters (single or sequence) by leading special form
- Punctuation or umlaut characters

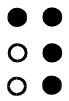
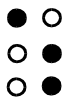
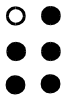
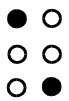


Braille Vollschrift

Lowest form of coding

Some simple, often used character combinations (German: e.g. diphthongs).

Only allowed if real groups, not accidental combinations between word parts

ch	sch	st	au
			

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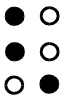
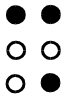
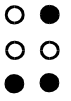
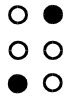
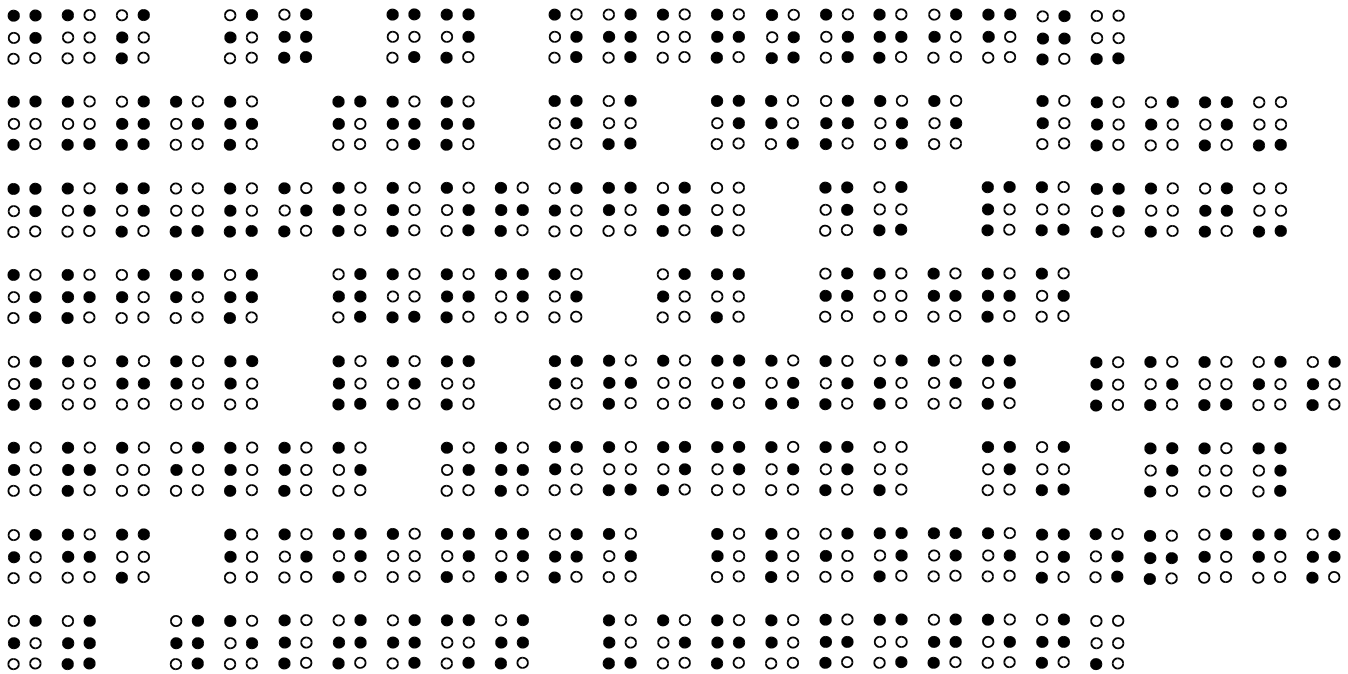
			

Example for German Braille-Vollschrift



Der dargestellte Text lautet: Das ist ein Schwarzschriftmuster für die deutsche Blinden-Vollschrift. Die Punktschrift wurde im Jahre 1826 vom Franzosen Louis Braille erfunden. Die nach ihm benannte Blindenschrift ist weltweit verbreitet.

Braille Kurzschrift / Shorthand

- Goal: Reduce necessary characters (ca. 30%)
  - Faster writing and reading
  - Saving place (Paper weight and volume)
- Shorting of:
  - Sound groups
  - Syllables
  - Words

The Deutsche Kurzschrift (since 1904)

- The rules for shortening are relatively complex in international comparison. There are ambiguities. Revisions since 1972, ongoing struggle for simplification.

Sound group shortenings of German Shorthand

24 shortcuts by single character.

Not allowed in all places of a word.

ach	**ck**	**en**	**ig**	**or**
al	**eh**	**er**	**in**	**ss**
an	**ein**	**es**	**lich**	**te**
ar	**el**	**ge**	**ll**	**un**
be	**em**	**ich**	**mm**	

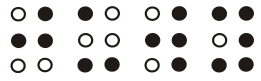
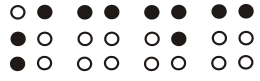
Dabei muss beachtet werden, dass nicht alle Kürzungen an beliebiger Stelle in einem Wort verwendet werden dürfen.

Die Regeln schreiben genau vor, ob eine Verwendung im Anlaut oder Auslaut zulässig ist.

Im Inneren eines Wortes (Inlaut) sind alle Kürzungen statthaft.

Sound group shortening examples

Not allowed in all parts of a word.

Kürzung	Anlaut	Inlaut	Auslaut
el 	Elfe 	Welt 	Juwel 
en 	Ende 	senden 	trennen 
al 	Alpen 	bald 	~~Kanal~~
ll 	~~Lloyd~~	Scholle 	null 
mm 		sammeln 	Lamm 
eh 	~~Ehre~~	Mehl 	~~Reh~~

Shortening of pre- and suffixes

23 shortcuts

Prefixes	Suffixes	
Vorsilben	**Nachsilben**	
aus-	**-ation**	**-ität**
be- *	**-ativ**	**-keit**
ent-	**-falls**	**-mal**
ex-	**-haft**	**-nis**
ge- *	**-heit**	**-sam**
pro-	**-ion**	**-schaft**
ver-	**-ismus**	**-ung**
	-istisch	**-wärts**

*) also used for sound groups

Examples for shortening by pre- and suffixes

Prefix	Example	Suffix	Example
Vorsilbe	Beispiel	Nachsilbe	Beispiel
aus-	Ausrede	**-heit**	Einheit
ent-	entfernen	**-keit**	Einheitlichkeit
ver-	Verband	**-ung**	Forschung

Die Möglichkeit, Kürzungen zu kombinieren und damit in hohem Maße Schriftzeichen einzusparen wird besonders am Beispiel von "Einheitlichkeit" deutlich, das anstelle von 15 Buchstaben der Schwarzschrift mit nur 4 Braille Formen auskommt ("ein"-"heit"-"lich"-"keit").

Word and word stem shortenings (55)

Single form shortenings.

Example:

A single character „d“ means „das“

der	die	das	ein
ist	in	für	ihm

Mit den sogenannten "einformigen Wortkürzungen" gestattet es die deutsche Blindenkurzschrift 55 häufig vorkommende Wörter mit nur einer einzigen Braille Form wiederzugeben

Single form shortenings with leading announcement dot

28 shortenings

Announcement by dot 2 (equals a comma therefore named „Kommakürzungen“)

Example

A single "d" with leading announcement dot means "dürf"

ander	brauch	dürf	hab
könn	richt	soll	woll

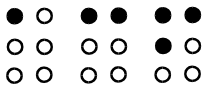
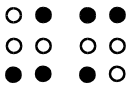
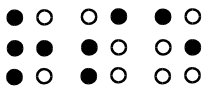
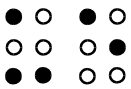
Other single form shortenings (8)

to be followed by suffixes

Einformige Wort(teil)kürzungen vor Endungen

8 Kürzungen für Wortteile, die durch Endungen ergänzt werden müssen.

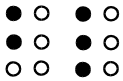
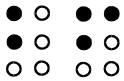
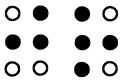
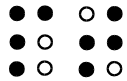
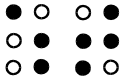
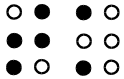
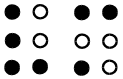
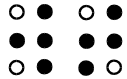
Sonst andere Bedeutung

Kürzung	Beispiel	Kürzung	Beispiel
all.. 	allenfalls 	**dies..** 	diesmal 
selb.. 	derselbe 	**wurd..** 	wurde 

Other, two form shortenings (170)

Zweiformige Wort- und Wortstammkürzungen

- etwa 170 Kürzungen (= größte Gruppe von Wortkürzungen)
- Beispiele

blind 	**Brief** 	**Jahr** 	**Punkt** 
Schrift 	**Technik** 	**vom** 	**weit** 

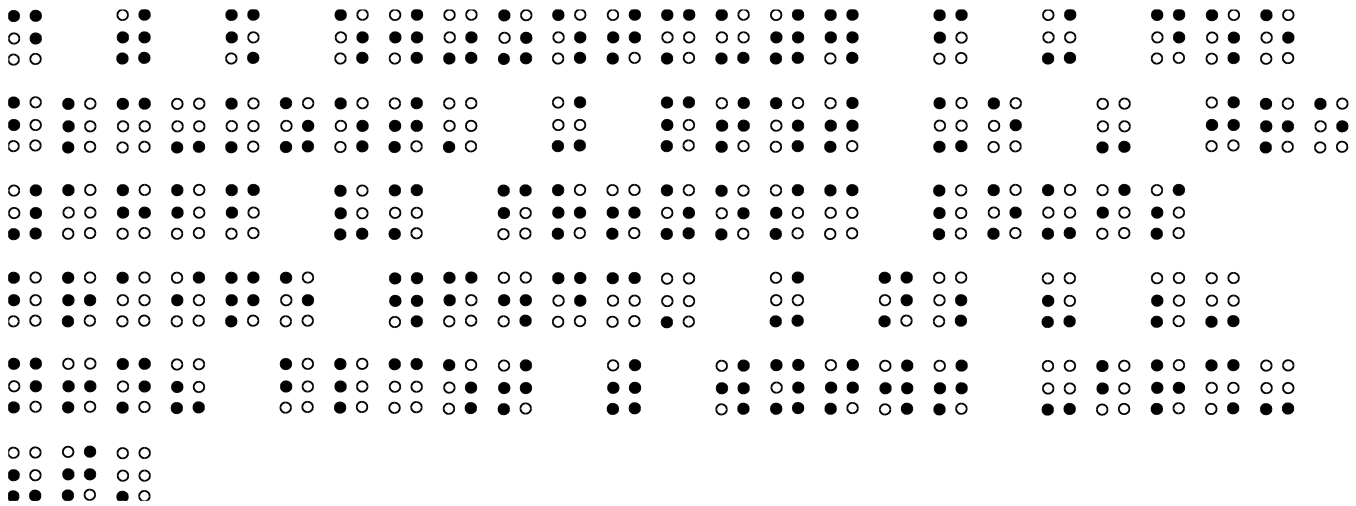
Example of Kurzschrift

(Same text as used in Vollschrift example)

Ca. 30% reduction

Typical reading speed 80 to 150 words/min (6 to 12 characters/sec).

Depends strongly on education and practice of a person.



Der dargestellte Text lautet: Das ist ein Schwarzschriftmuster für die deutsche Blinden-Kurzschrift. Die Punktschrift wurde im Jahre 1826 vom Franzosen Louis Braille erfunden. Die nach ihm benannte Blindenschrift ist weltweit verbreitet.

Braille Stenographie / Stenography additional to Shorthand

Baut auf der Braille Kurzschrift auf, hat wesentlich mehr Kürzungen

Weglassen unwesentlichen Buchstaben / leave out unneccessary characters

Vereinfacht gesagt werden alle Buchstaben (insbesondere Endsilben) eines Wortes weggelassen, sobald das Wort aus den Buchstaben des Wortanfanges bereits bestimmt (oder aus Zusammenhang erkennbar) ist

Die meisten Wörter werden reduziert auf eine Folge von nur 2 bis 3 Buchstaben.

dient als "Notizschrift„ / for taking notes

(in gleicher Weise wie die Schwarzschrift-Stenographie)

Für die Herstellung von Büchern etc. ist sie nicht geeignet.

Individuell angepasst: / individual to writer

Es existieren zwar Grundregeln für die Braille Stenographie, jedoch legt sich jede_r Braille-Stenograph_in ein persönliches, individuelles Kürzungssystem zu.

Notationen:

Für deutsche Sprache meist 6-Punkt aber auch 7- und 8-Punkt Notationen.

In den USA wird mit 6-Punkt Notation gearbeitet.

Hilfsmittel

Früher eigens dafür gebauten Punktschrift-Schreibmaschinen (auf endlos Papierstreifen zwecks Zeiteinsparung).

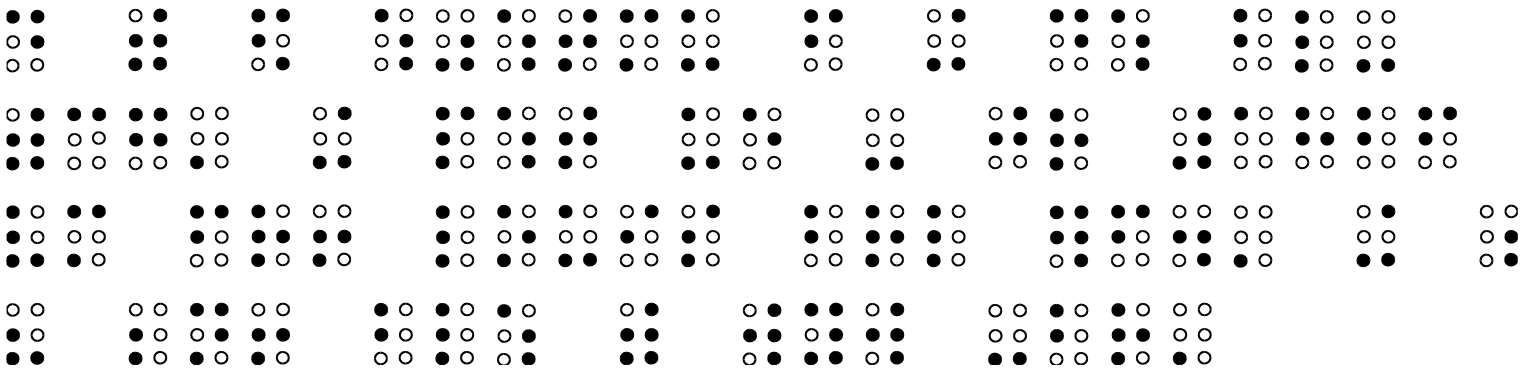
Heute werden hauptsächlich elektronische Braille-Notizgeräte verwendet

Example Braille Stenographie / Stenography

Writing speed

Exam: 150 syllables/min (7 char/s)

Top: 350 syllables/min (16 char/s)



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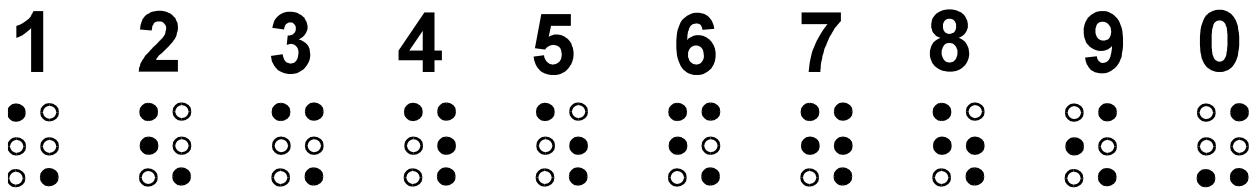
Computer Braille

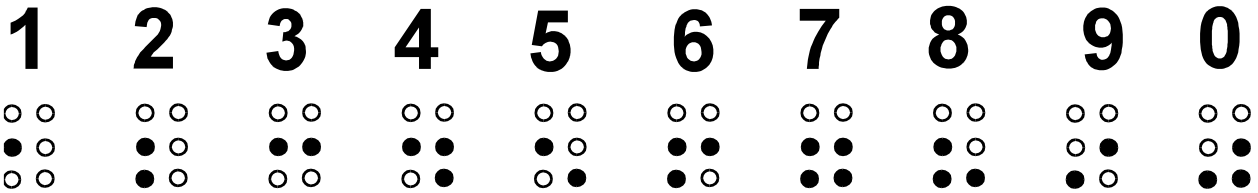
Base coding less suited for computer use

Not character accurate for numbers

=> German number indicator by dot 6



❖ Anglo-American representation by shifting down



8-dot Braille extension (ca. 1980)

Also **„Euro-Braille“, „Computer-Braille“**

Extension of the Braille scheme to 8 dots

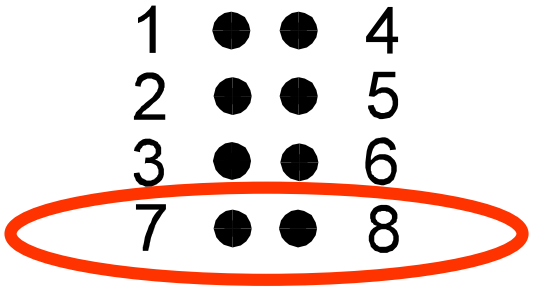
The 2 additional dots (7 and 8) are placed below the usual 6 dot matrix.

255 + 1 characters possible to be represented

Direct representation of upper and lower case characters without additional forms

For coding of control codes for computer use (Ctrl, Alt etc.)

Braille display for computer use (Source: Wikipedia)



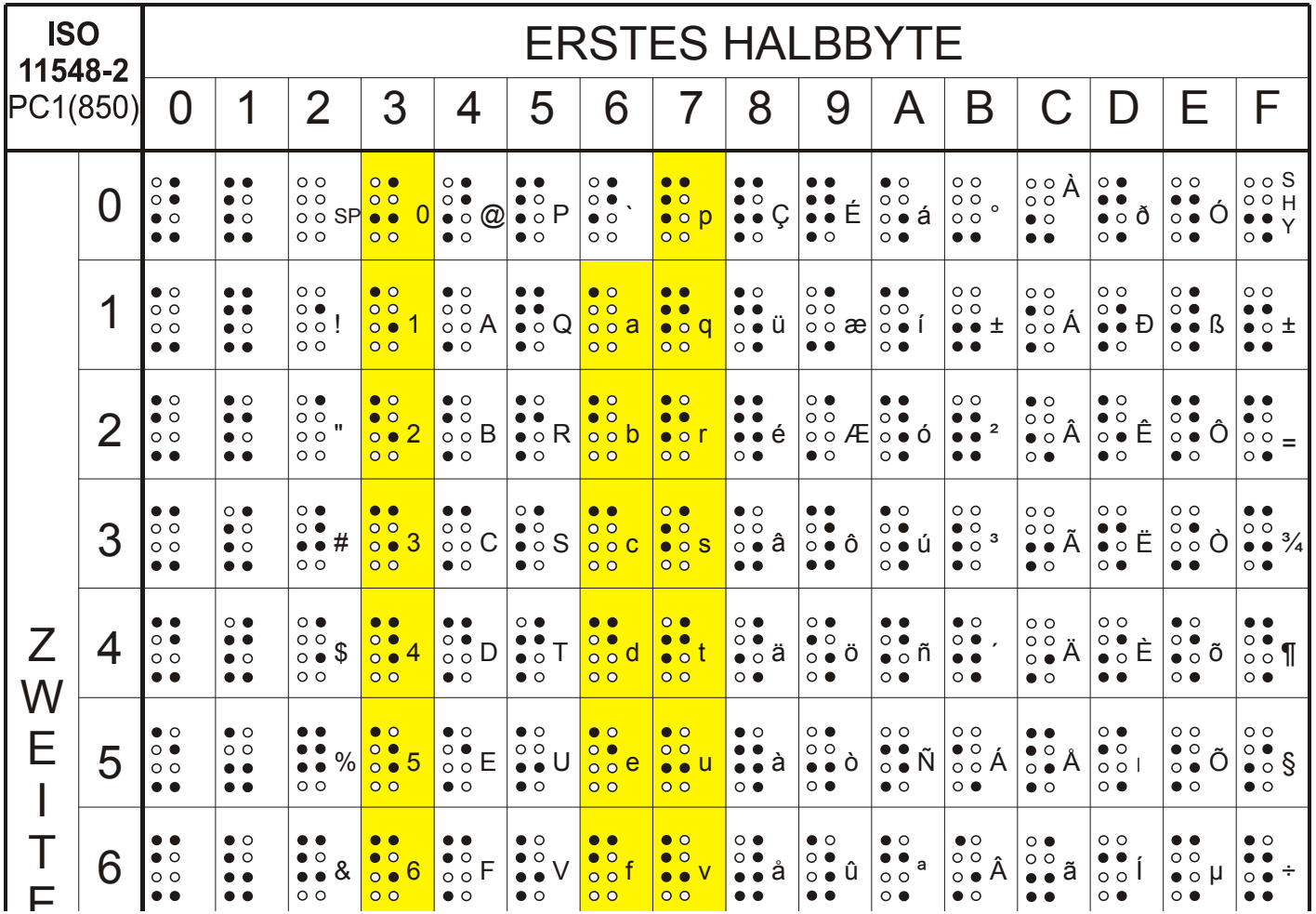
8-dot Braille

ISO standard 11 548-2 assigns all 256 8-dot Braille forms to characters of PC code tables for Latin characters.

Sometimes multiple assignments (ambiguities), Example:

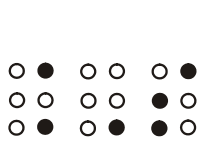
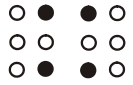
Braille character			Meaning (assigned graphic or control character)				8-bit code		
Identi-fier	Graphic symbol	Dots	Identifier	Graph. symbol or ac-ronym	Rank	Name	Code table	Dez.	Hex.
B124	○ ○ ○ ● ● ○ ● ○	357	SM24	§	0	SECTION SIGN; PARAGRAPH SIGN	3 4	167 245	A7 F5
			SA93	Σ	1	SUMMATION SIGN	5	228	E4
			GS02	Σ	2	GREEK CAPITAL LETTER SIGMA			

ISO 11548-2 coding



Braille Codes for Mathematics

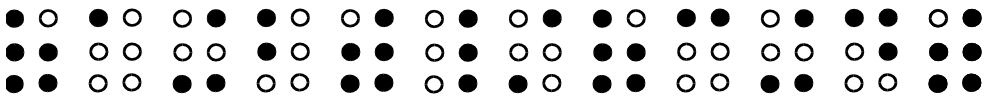
- Several national and local solutions
- Only some gained importance
  - Marburger System (first 1919 for Mathematics, Physics and Chemistry, current: http://www.bskdl.org/mathematik.html)
  - Nemeth Code (1952, 1992 influenced Unified English Braille, a Braille umbrella standard for English speaking countries)
- Examples (Nemeth)

+ 	− 	• 	/ 
√ 	∫ 	∑ 	= 

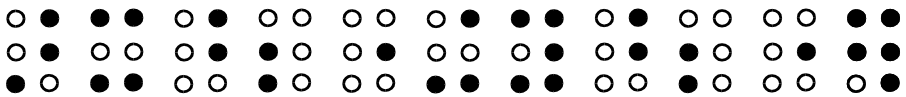
Examples of formulas

$1 + x + y = 0$

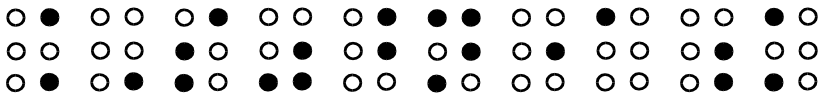
$(a+b)/(c+d)$



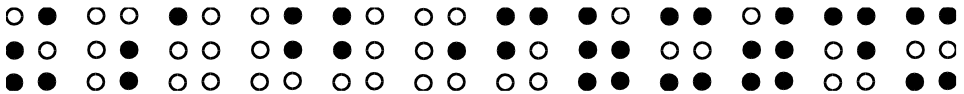
$\sqrt{x^2 + y^2}$



$\sum_{0}^{n} a_k$

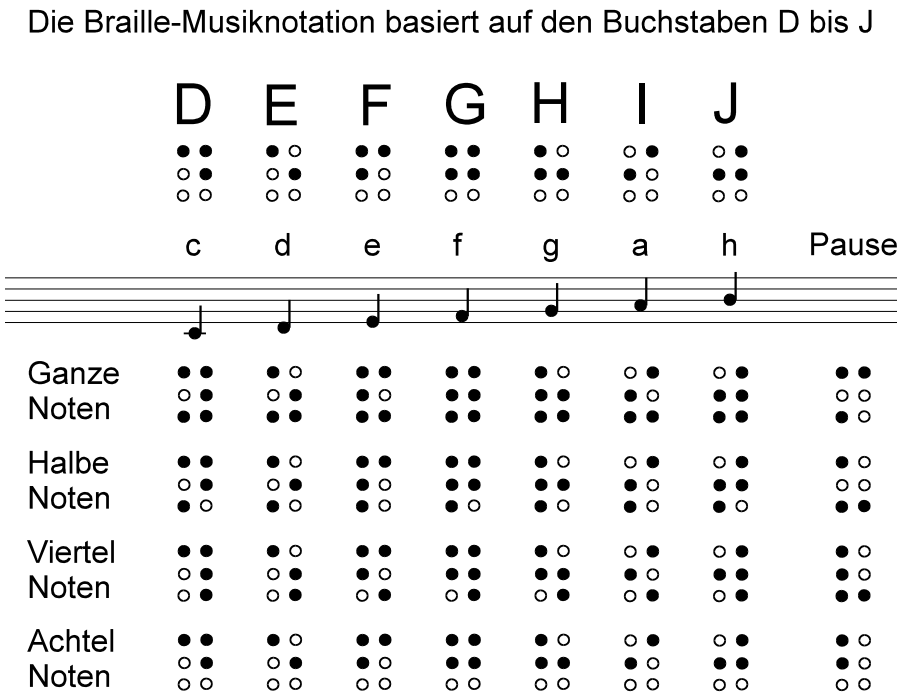


$\int_{a}^{b} f(x)dx$



Music notation

Introduced by L. Braille.
Same forms as used for text.
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.
Overview: http://www.fakoo.de/braille-music.html

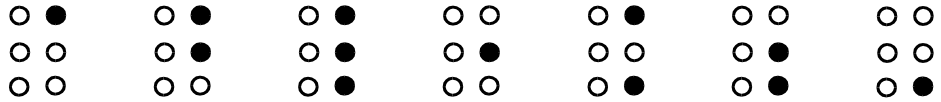


Music – further details

Seven octave indicators

Die Angabe der Oktave erfolgt durch sieben "Oktav-Zeichen"

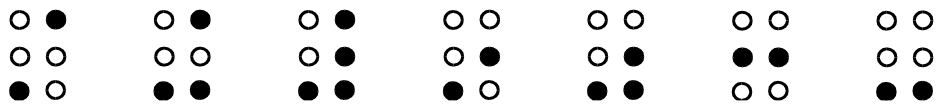
1	2	3	4	5	6	7
Kontra	Groß	Klein	'	''	'''	''''



Chords indicated by relation to base tone

Bei Akkorden wird das Intervall der mitklingenden Töne in Bezug auf den Grundton angegeben

Sekunde	Terz	Quarte	Quinte	Sexte	Septime	Oktave



More Braille codes exist e.g. for:

- Phonetics
- Chemical formulas
- Electrical schematics
- Chess
- Knitting patterns

Overview: http://www.bskdl.org/braillesysteme.html

Have all to be trained to be useable

International Alphabets in 6-dot Braille – national differences

	á	à	é	è	í	ì	ó	ò	ú	ù
Tschechisch										
Französisch										
Ungarisch										
Isländisch										
Italienisch										
Portugiesisch										
Polnisch										
Spanisch										

Die in den verschiedenen Sprachen vorkommenden Akzent- und Sonderzeichen werden durch solche Braille-Codes ausgedrückt, die in der jeweiligen Sprache sonst keine andere Verwendung haben.

Das geschieht nicht in einheitlicher Weise (bzw. kann aufgrund des bei 6-Punktschrift sehr kleinen Zeichenvorrats nicht einheitlich geschehen), siehe Tabelle rechts

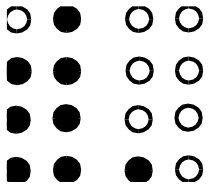
International alphabets for 8-dot Braille

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“,

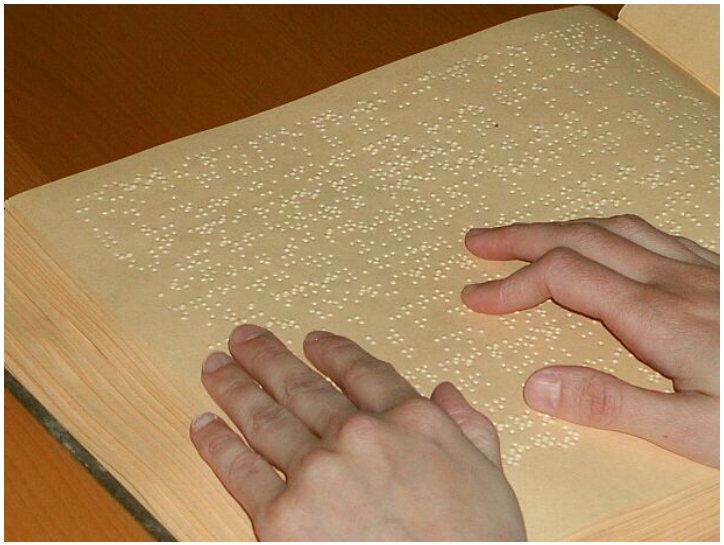
e.g. Latin Alphabet:



Reading Braille

„Die gebräuchlichste Technik ist das beidhändige Lesen, wobei die Zeigefinger die Lesefinger sind: Man legt die Hände so auf das Papier, dass die Arme entspannt liegen und sozusagen aufeinander zu zeigen. […] Die Zeigefinger liegen nun an der Stelle, die gelesen werden soll. Beide Finger beginnen nun mit dem Lesen einer Zeile. Etwa in der Mitte oder nach zwei Dritteln der Reihe beginnt der rechte Zeigefinger, die Zeile alleine zu Ende zu lesen, während der linke schon zum Anfang der nächsten Zeile geht. Hat der rechte Zeigefinger das Ende der Zeile erreicht, beginnt der linke schon, die neue Zeile zu lesen; der rechte kommt dazu, und das Ganze beginnt von vorne.
Leider wird diese Lesetechnik nicht immer trainiert; es gibt viele Menschen, die die Brailleschrift nur mit einem Finger lesen. Experten sind sich aber weitgehend einig, dass die oben beschriebene Technik die effektivste und schnellste ist. Es spricht nichts dagegen, mehr als nur den Zeigefinger zum Lesen einzusetzen; es gibt aber nur wenige, die eine solche Technik wirklich gemeistert haben."
Quelle des Zitates: Norbert Müller, 2000, auf http://www.anderssehen.at/lesen/braille.shtml

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.



Reading Braille

Reading speed: experienced Braille readers achieve ca. **100 words per minute**. This is about **30% to 50% of the reading speed** of normal sighted readers.

There are many blind or severely vision impaired persons who cannot read Braille.

Reasons:

Many people fall blind (e.g. because of diseases) only at an age where learning Braille is already difficult.

Diseases (e.g. Diabetes) often lead to reduced sensitivity of the finger tips.

Therefore: Information in public space should be also available as raised/protruding standard letters or tactile markings/symbols.

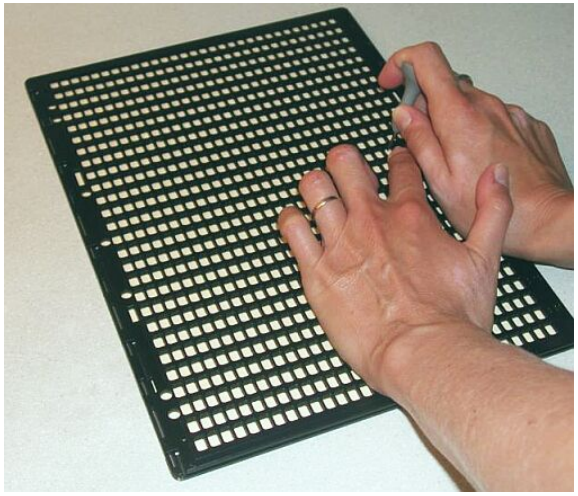
Alternatives are audible information.

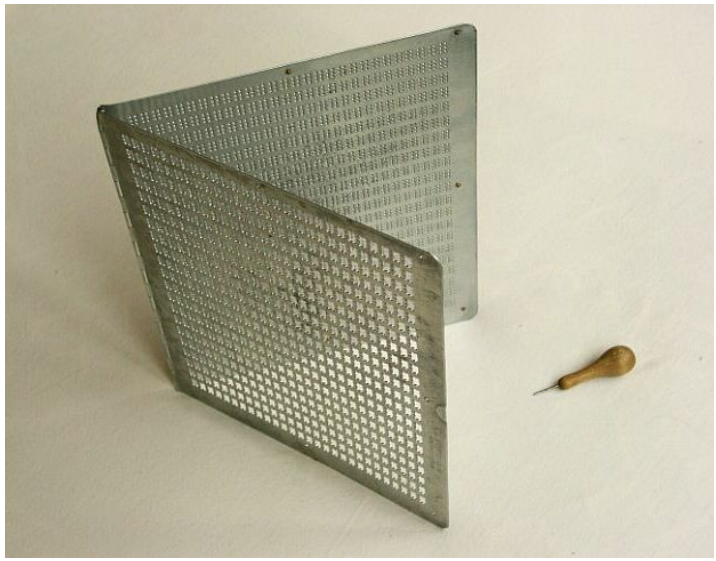
Source: http://www.blindenverband.at/home/wissen/tastkultur/978

Writing Braille

Braille-„stencil“, developed by Louis Braille
Paper is put in between two matrices. The backside has depressions for the 6 dots.

Writing is performed dot-by-dot with a stick which is pressed into the paper guided by the openings in the front stencil.
The writing has to be done in mirrored representation! It is not possible to read the written text while writing to check it, only after taking the paper out and turning it.
This is a practical tool which is available in different sizes for taking quick notes and can be carried along.
(Nowadays maybe more and more replaced by smartphone, computer).
Source: http://www.anderssehen.at/lesen/braille.shtml





Writing Braille

First Braille typewriter of Oskar Picht 1899 (in Germany)

Buttons on typewriter for dots of braille cell are ordered from left to right: 3, 2, 1, 4, 5, 6.
All buttons needed for a cell are pressed simultaneously (synchronous embossing from backside to front),
additionally a space button in the middle.

Big speed advantage over stencil.
advantage: text can be read without removing paper during writing.
Source: http://www.anderssehen.at/lesen/braille.shtml

Picht writer, source: Deutsches Blindenmuseum

Perkins Brailler

Nowadays importance of Braille is decreasing:

New alternatives to Braille:

Speech synthesis and Screenreaders make texts available in audible form.
Texts and books are available in the Internet (can partly replace the expensive production of Braille books)
Hardware required is mainstream
Many Apps

Disadvantage of Braille:

Learning and teaching is tedious, Braille texts are voluminous

Advantages of Braille which get lost:

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..

Braille Literacy

By computer/speech output there are now alternatives available which but also might lower felt necessity or motivation…

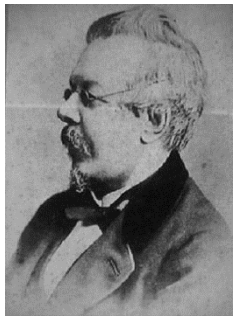
Estimates for Germany (ca. year 2000): of a total of ca. 155.000 blind persons only ca. 30.000 can read Braille. Source: http://www.anderssehen.at/lesen/braille.shtml

In the USA literacy has reduced for blind pupils from ca. 50-60 % (1950s) to ca. 10 % (2014). Also less printed Braille is produced.
Inclusion of blind pupils in regular schools since 1970s was a big progress but unfortunately reduced teaching of Braille. Only among blind persons with occupation the majority has Braille literacy, also higher education correlates with Braille literacy.
Estimates see ca. 10% (of the 1,3 Million) blind persons as able to read Braille.
Source: http://www.nbcnews.com/id/29882719/ns/us_news-life/t/fewer-blind-americans-learning-use-braille

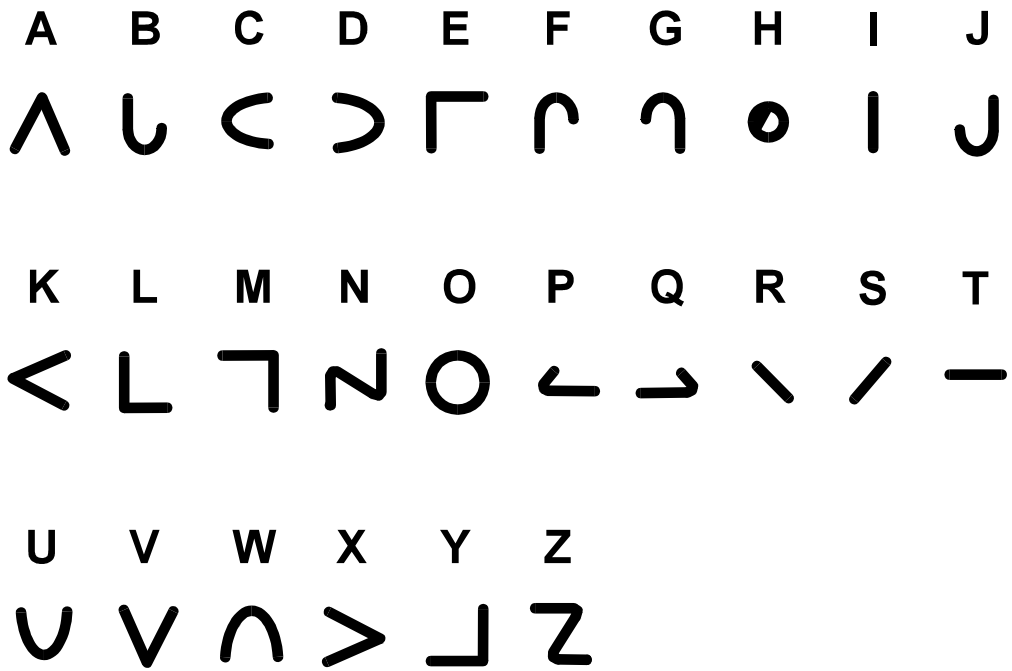
Relief script after W. Moon

created 1845 in UK (ca. 20 years after Braille-Alphabet)

- Symbols similar to Latin characters (→ easier to learn for late blind persons)
- Are embossed into moist paper.



Wikipedia



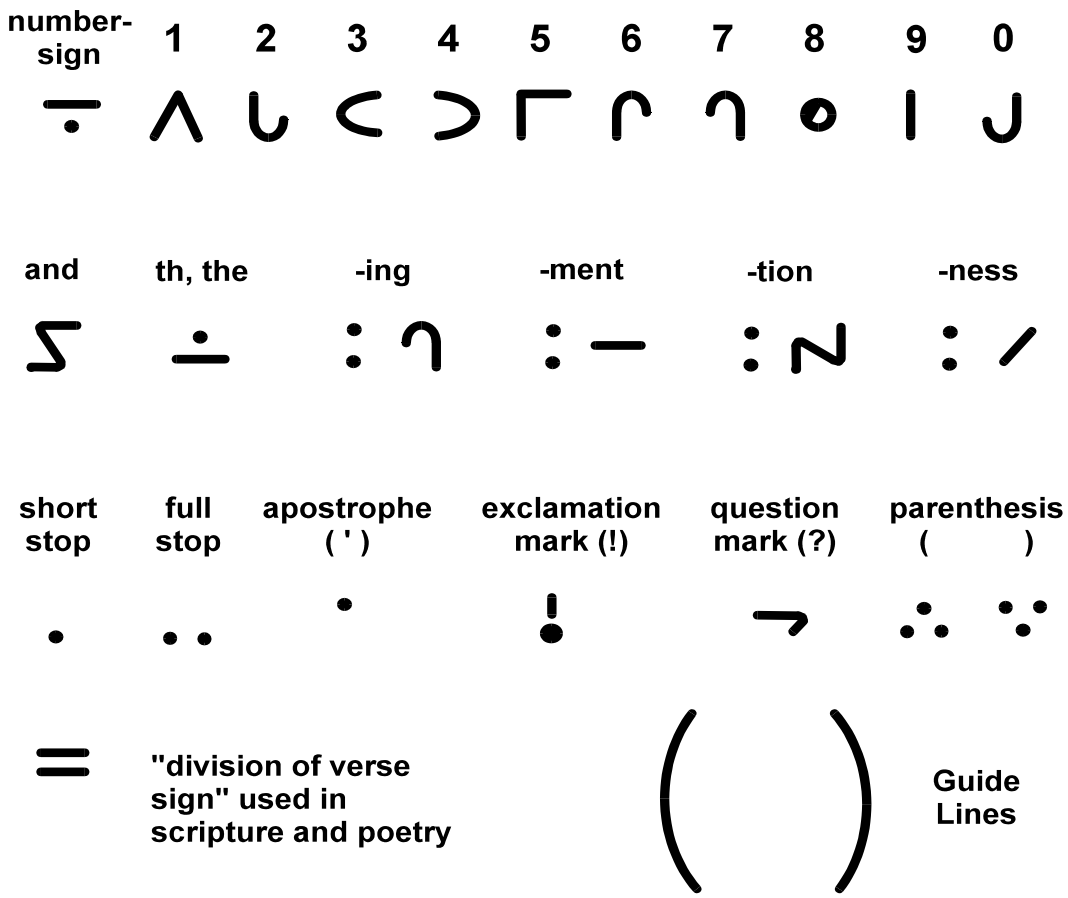
Moon Writing

Advantage

- Similar to normal black print
- Easier for late blind persons

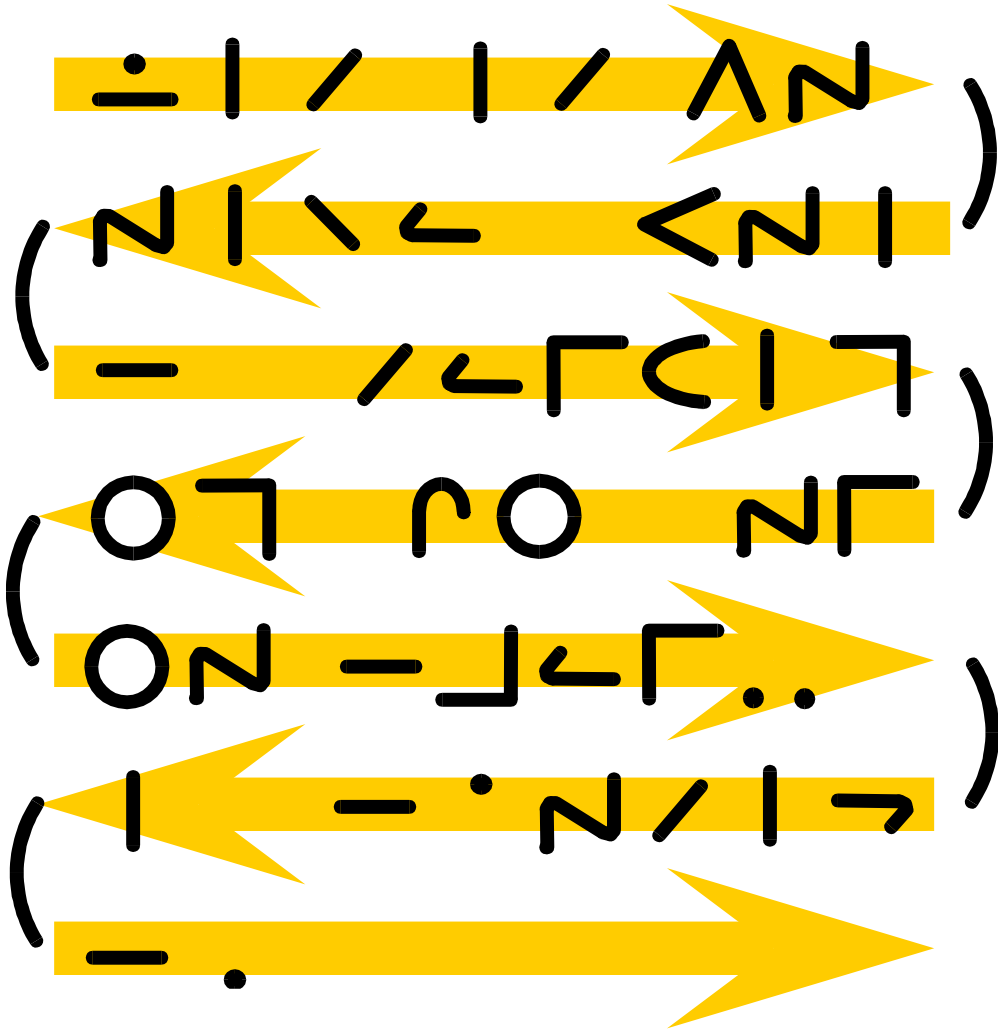
Disadvantage

- Quick reading not possible (the recognition of lines, angles, arcs is difficult for blind persons)
- Difficult to write by hand



Moon script

Originally read in „meanders“ (alternating left-right with right-left 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.

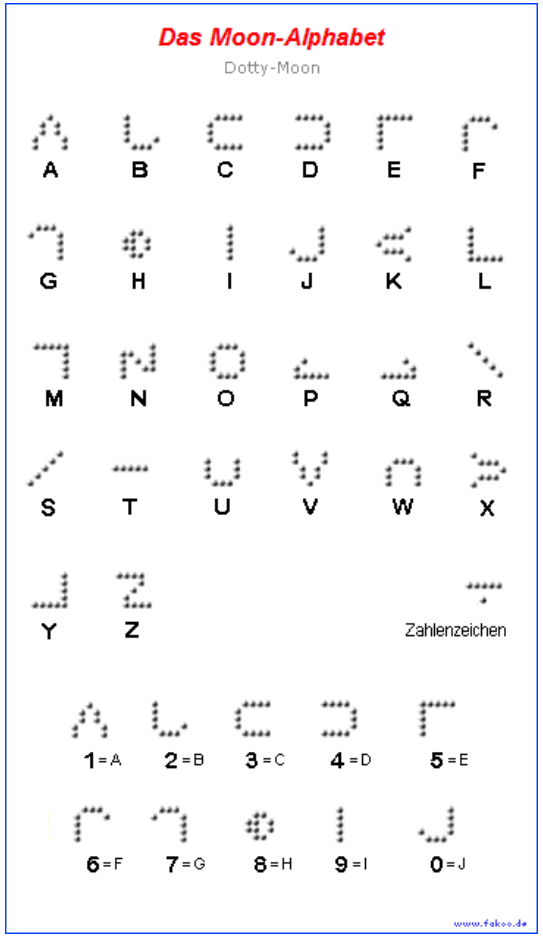


Moon script – usage

Mostly replaced by Braille

- Used only for reading by late blind persons and multiply impaired children in first teaching (only UK and some countries).
- In UK books in Moon script are still available but no longer produced or proposed by the RNIB
  https://www.rnib.org.uk/braille-and-moon-tactile-codes/moon
- In few countries (South America) still used as standard script for the blind.
- Important: there exist no possibilities to read Moon on PCs but printing can be done using Braille printers:
  - *„Dotty Moon“: Moon represented by 5x5 dots still experienced as relief lines.*

http://www.fakoo.de/moon.html



- Many tactile script systems have been developed over time.
- Only Braille has gained wide acceptance and remained in use.
- Braille is read by the finger pulp and fits the sensitivity of it.
- (Only) ca. 10..15 % of the blind persons are able to read Braille.

- Because of the availability of new technologies Braille use is decreasing.

Outlook to Block 3

3. Tactile communication (continued)
   - 3.5 Writing, embossing and printing
   - 3.6 Tactile graphics
   - 3.7 Braille displays
   - 3.8 Braille devices
4. Picture and symbol languages
   - 4.1 Basics
   - 4.2 Bliss