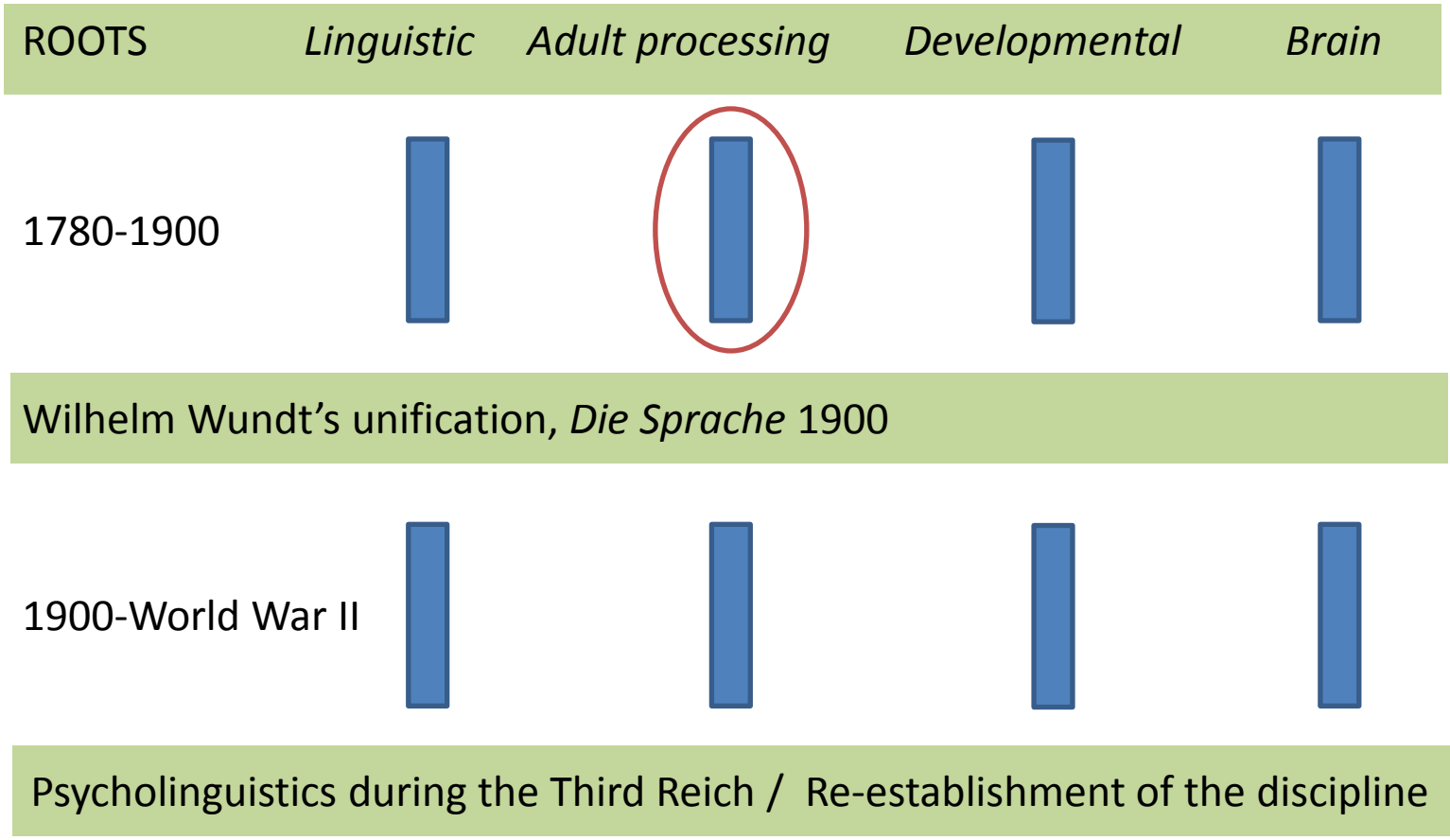
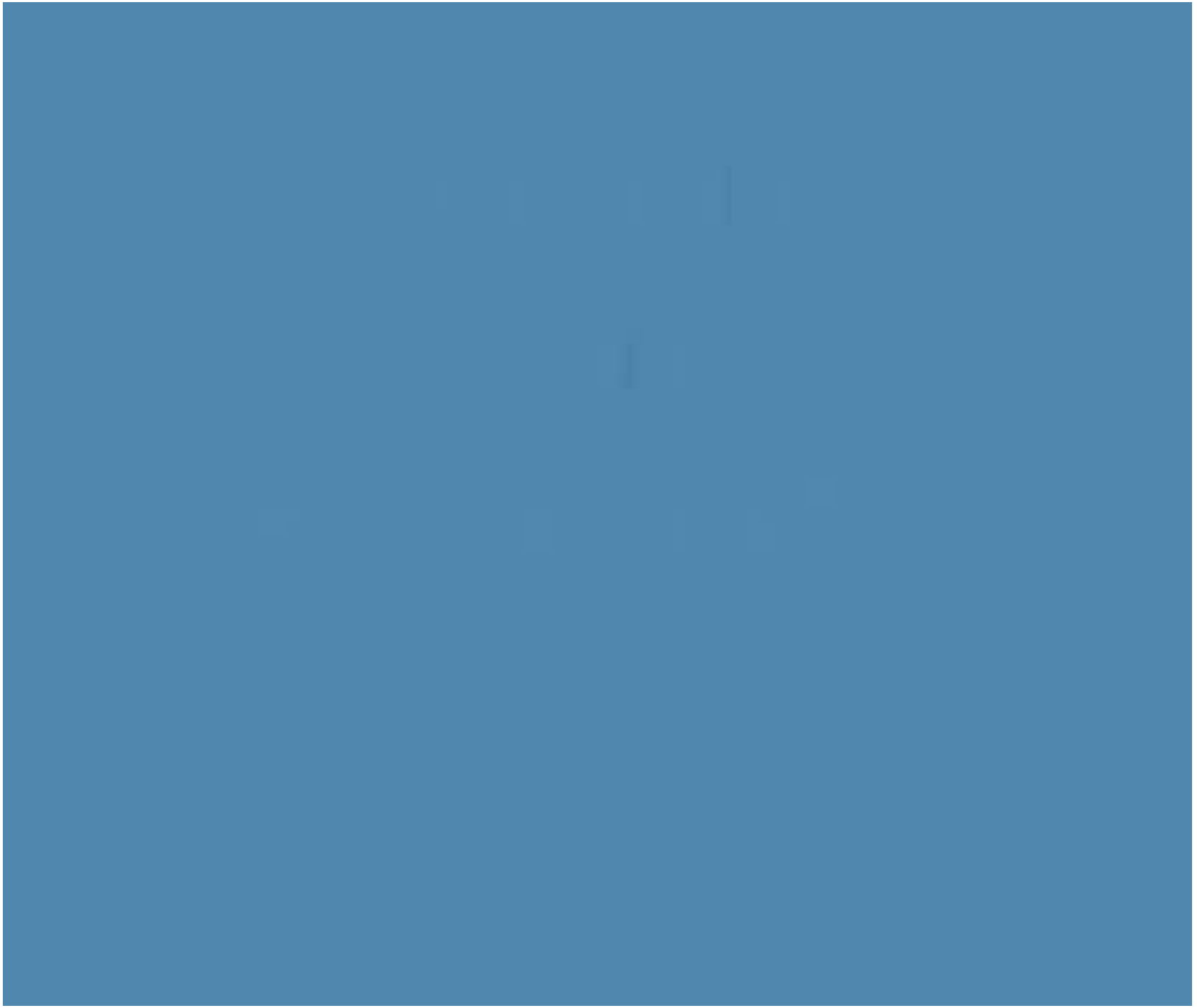
LECTURE 3 19th CENTURY LABORATORY AND SPEECH ERROR STUDIES OF LANGUAGE PROCESSING

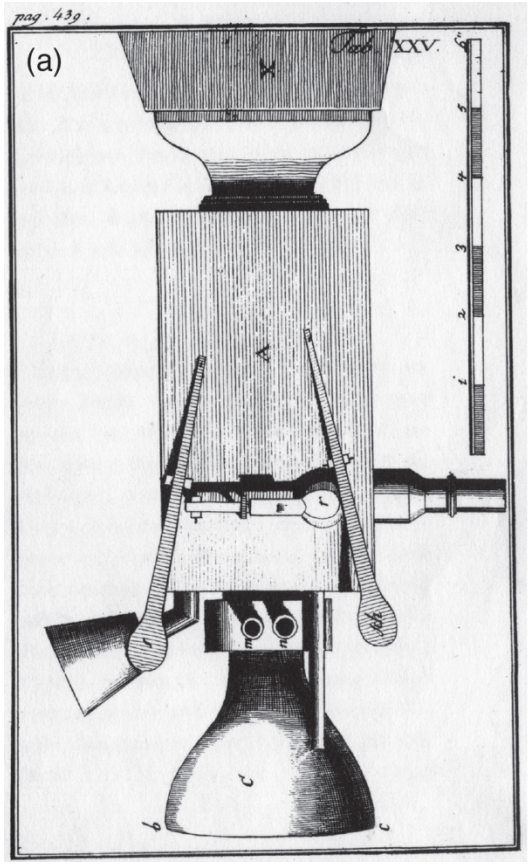


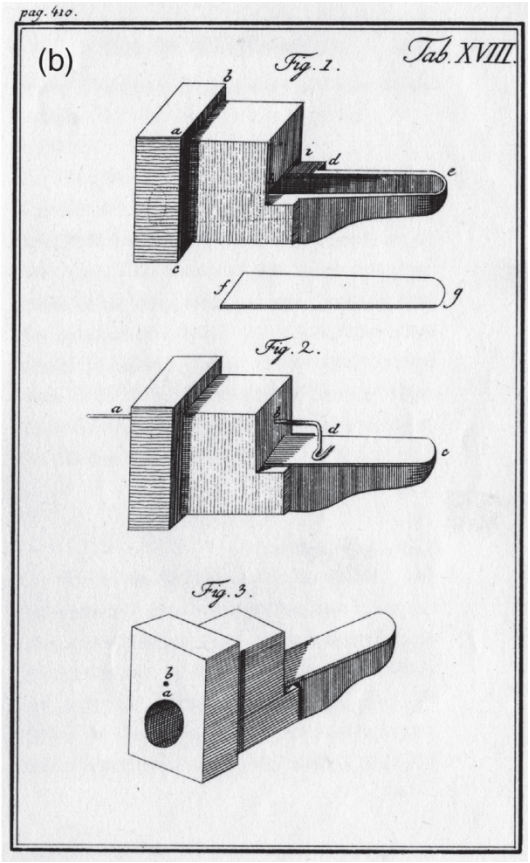
WOLFGANG von KEMPELEN (1734-1804)

Mechanismus der menschliche Sprache nebst der Beschreibung einer sprechenden Machine (1791)



KEMPELEN'S SPEAKING MACHINE (1791)





MAIN NINETEENTH CENTURY CONTRIBUTORS

Franciscus Donders & Johan de Jaager mental chronometry
Francis Galton association
Martin Trautscholdt association
James McKeen Cattell naming, association
Joseph Jastrow association
Benno Erdmann & Raymond Dodge reading
Edmund Huey eye tracking
Hermann Ebbinghaus verbal learning & memory
Benjamin Bourdon habits of speech
Walter Pillsbury (mis)perceiving visual words
Friedrich Kaeding word, syllable, letter frequencies
William Bagley spoken word and sentence perception
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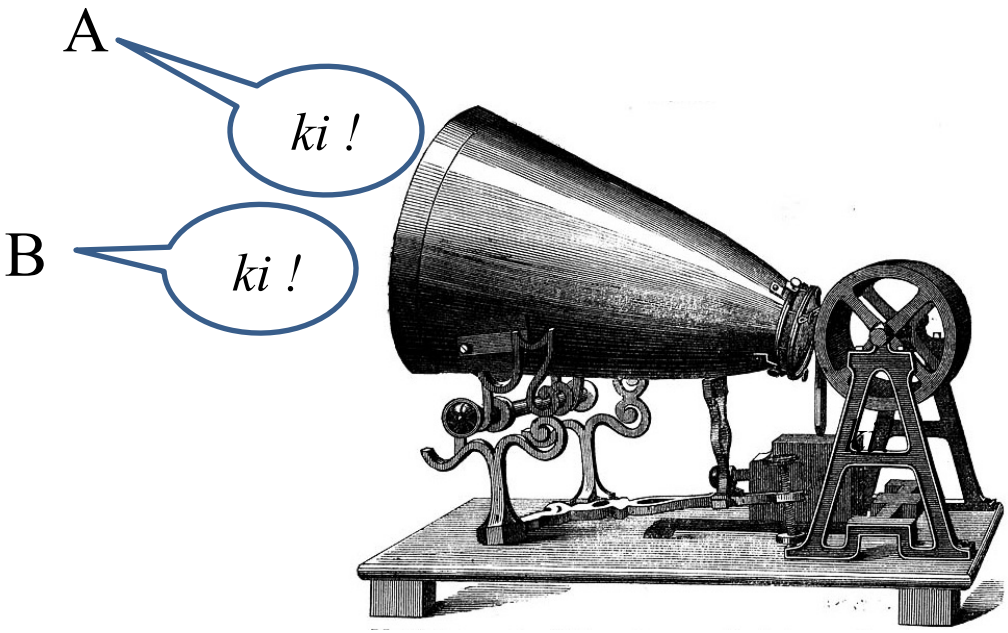
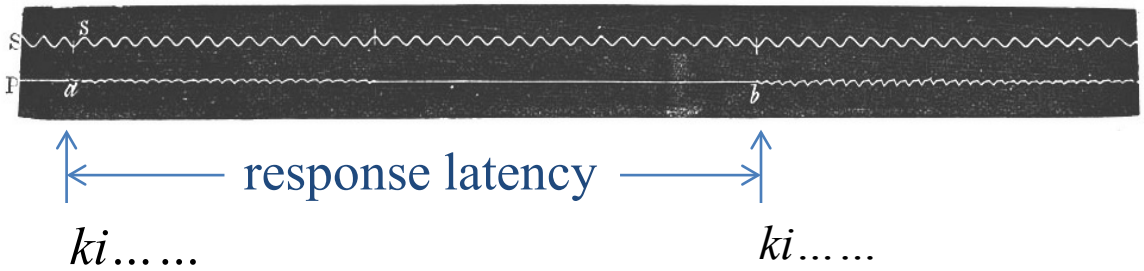
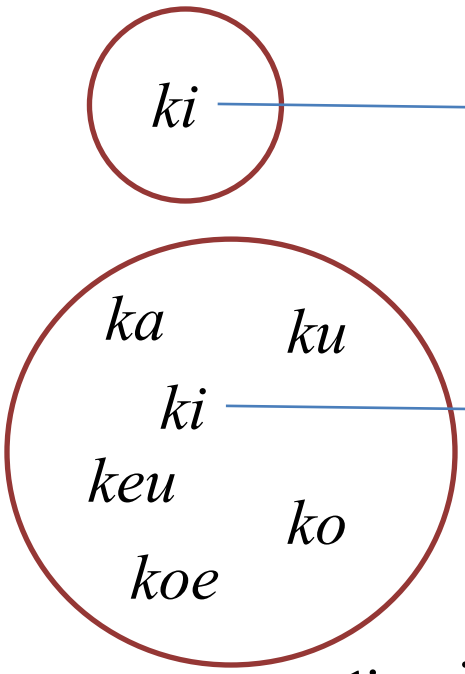
FRANCISCUS DONDERS:
INVENTOR OF MENTAL CHRONOMETRY



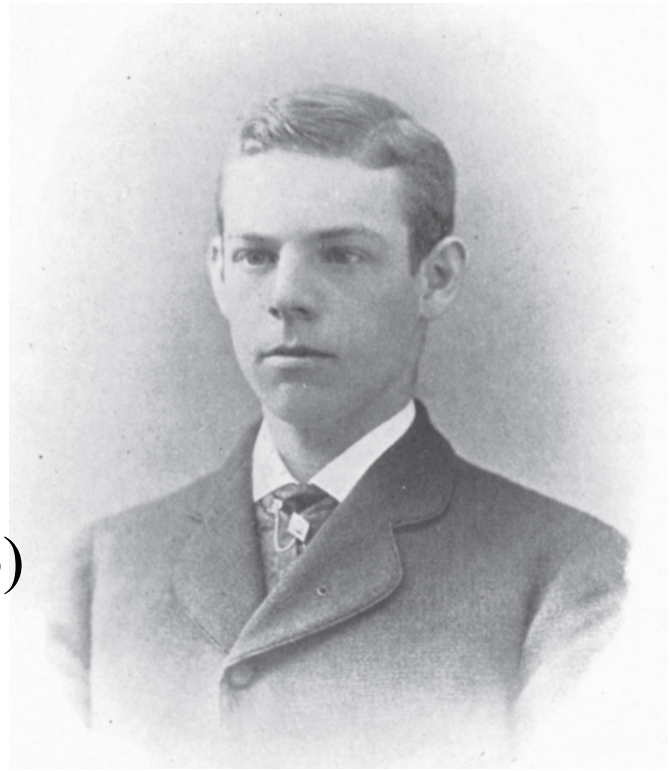


DONDERS' AND DE JAAGER'S SUBTRACTION METHOD



stimuli	response	latency	condition
ki	*ki*	250 ms	"simple"
ka, *ku*, *ki*, *keu*, *ko*, *koe*	*ki*	338 ms	"discrimination"
		---	
discrimination duration →		88 ms	

JAMES McKEEN CATTELL (1860-1944)



The first experimental psycholinguist,

the first American PhD in psychology,

under Wilhelm Wundt's supervision (1886)

JAMES McKEEN CATTELL (1860-1944)

Cattell , J.M. (1886). The time taken up by cerebral operations. Parts 1 & 2. *Mind*, *11*, 220 – 242.

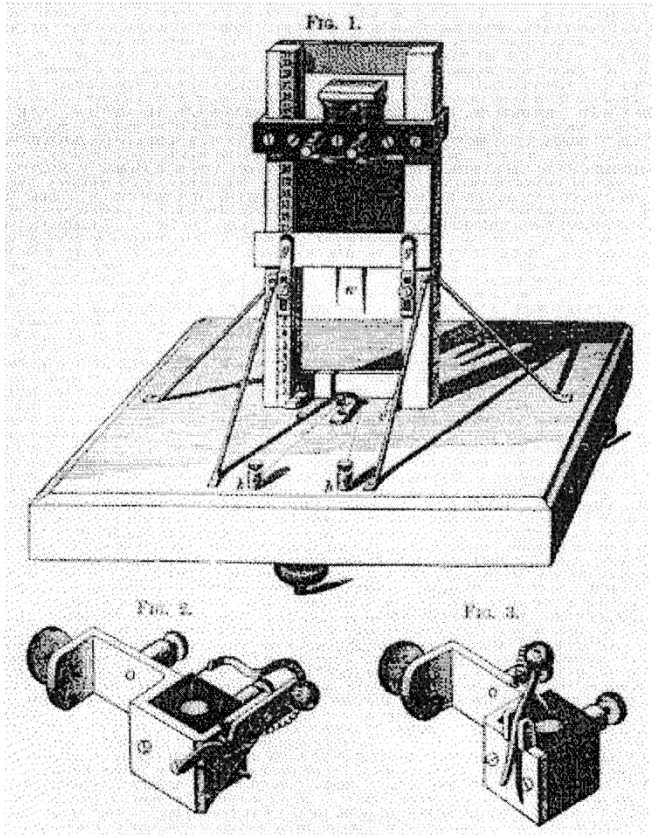
Cattell , J.M. (1886). The time taken up by cerebral operations. Part 3. *Mind*, *11*, 377 – 392 .

Cattell , J.M. (1887). The time taken up by cerebral operations. Part 4. *Mind*, *11*, 524 – 538 .

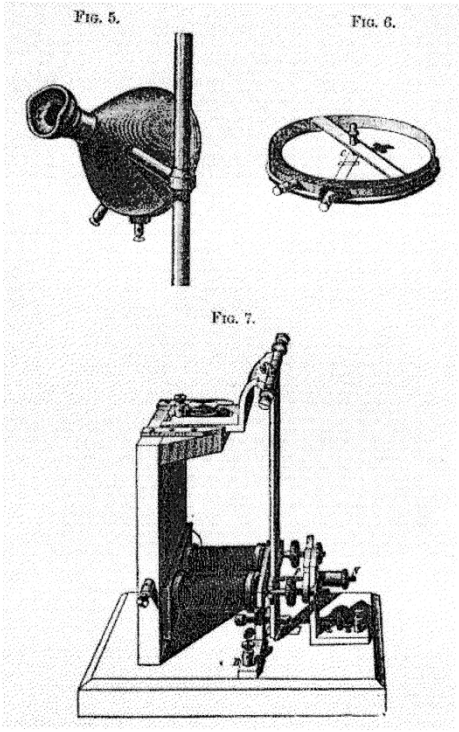
CATTELL'S CHRONOMETRIC EQUIPMENT (1886)

(designed by Cattell and built by Carl Krille)

gravity-chronometer



voice key



CATTELL'S CHRONOMETRIC NAMING TASKS (1886-1887)

letters

short, long words

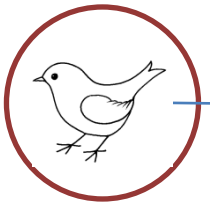
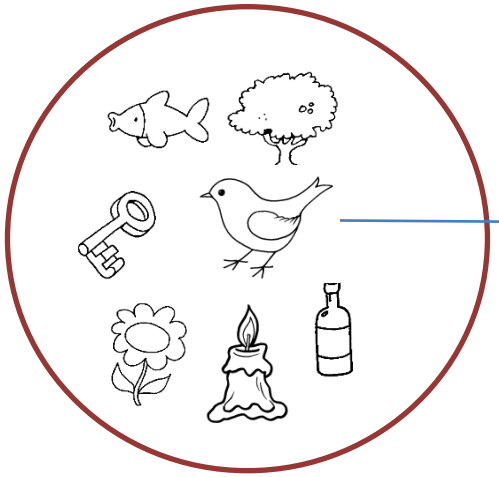
one-, two-, thee-digit numbers

colors

pictures

CATTEL'S CORE MESUREMENTS IN PICTURE NAMING

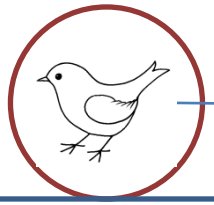
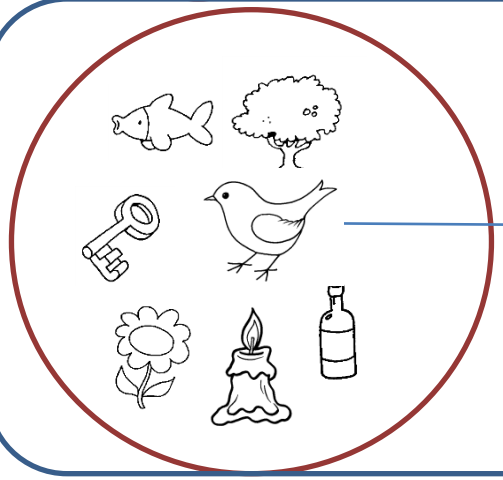
1. Perception duration (= choice duration/identifying the object)

stimuli	response	condition
	*bird*	"simple naming"
	*bird*	"choice/discrimination"

Perception duration = choice duration – simple naming duration
It is 96 σ for Berger, 117 σ for Cattell

CATTEL'S CORE MESUREMENTS IN PICTURE NAMING

1. Perception duration (= choice duration/identifying the object)

stimuli	response	condition
	*bird*	"simple naming"
	*bird*	"choice/discrimination"

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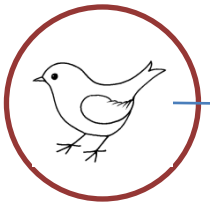
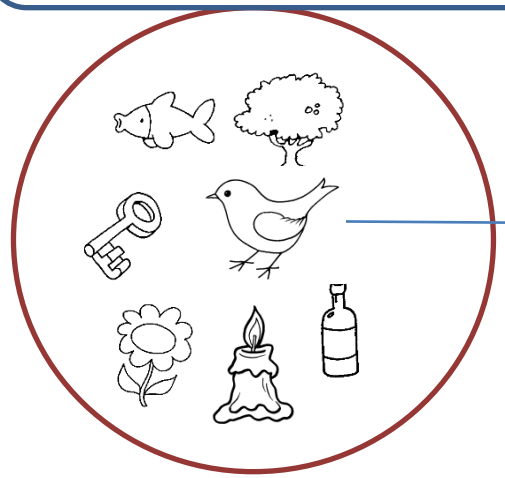
	*bird*	"simple naming"
	*bird*	"choice/discrimination"

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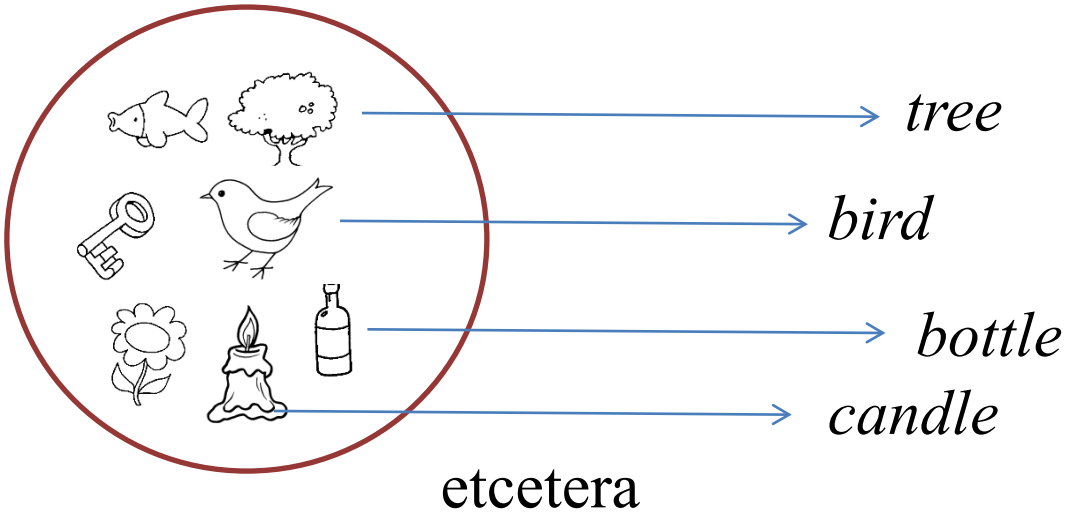
CATTEL'S CORE MESUREMENTS IN PICTURE NAMING

2. Discrimination latency



condition

discrimination

Discrimination latency is 477 σ for Berger and 545 for Cattell

CATTEL'S CORE MESUREMENTS IN PICTURE NAMING

3. Response preparation duration

Response preparation duration =
discrimination latency – perception duration – simple reaction time

For Berger: 477 ms - 96ms - 150ms = 231ms

For Cattell: 545ms - 117ms - 150ms = 278ms

NB Simple reaction time is the latency from presenting a white screen to the subject saying "jetzt". Here Cattell erroneously subtracted 150 ms instead of measured 170 ms.

CATTELL'S SUMMARY TABLE
(stimulus recognition and response selection)

TABLE XL.

	B	C
Reaction-time for Light	150	150
Perception-time for Light	30	50
" " a Colour	90	100
" " a Picture	100	110
" " a Letter	120	120
" " a (short) Word	120	130
Will-time for Colours	280	400
" Pictures	250	280
" Letters	140	170
" Words	100	110

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SOME MORE OBSERVATIONS BY CATTELL

Reading short words is hardly slower than naming letters. Hence, word recognition is not letter by letter.

Naming short words is 40 to 50 ms faster than naming long words.

Colors frequently seen (red, yellow, green, blue black, are named relatively fast.

Native speakers are faster in word identification and word response selection than non-native speakers. This is a way to measure L2 fluency.

CATTELL'S CHRONOMETRIC WORK ON RESTRICTED WORD ASSOCIATION

Cattell , J.M. (1887). Experiments on the association of ideas. *Mind, 12*, 68 – 74

Association times for:	Berger	Cattell
City – capital (*Paris* – "France")	348	264
Translation (*bird* – "Vogel",	240	258
Vogel – "bird")	303	152
Month-season (*January* – "winter")	415	310
Month- next month (*January* –"February")	345	389
Month- previous month (*February*– "January")	832	815
Adding two one-place numbers (*6+3* –"nine")	221	336
Multiplying one-place numbers (*6*×*3* – "eighteen")	389	544
Author-language (*Goethe* – "German")	417	350
Man-calling (*Homer* – "poet")	465	368

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CATTELL'S CHRONOMETRIC WORK ON RESTRICTED WORD ASSOCIATION

Association times for:	Berger	Cattell
Thing-example (*river* – "Rhine")	727	537
Picture-part (*ship* – "sail")	399	447
Name of object-part ("*ship"* – "sail")	578	439
Substantive-property (*sky* – "blue")	436	337
Adjective-substantive (*blue* – "sky")	879	351
Verb-subject (*swim* – "fish")	765	527
Verb-object (*write* –"letter")	654	379

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QUOTES FROM JAMES McKEEN CATTELL

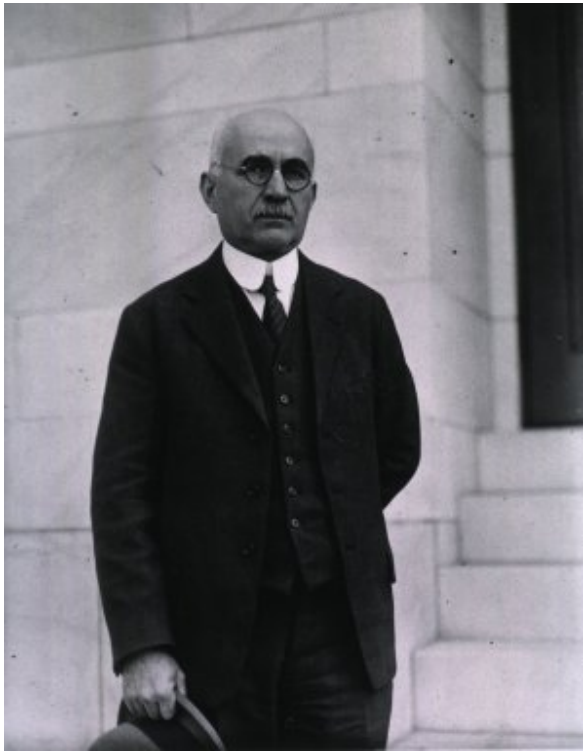
"I think these experiments show that it is possible to apply scientific methods to the investigation of mind. We have determined the times required for those processes which make up a great part of our mental life, and found these times to be constant; they are no more arbitrary, no less dependent on fixed laws than, for example, the velocity of light."

"If in the course of evolution, as is probable, the molecular arrangement of the nervous system becomes more sensitive and delicately balanced, we may suppose that the times taken up by our mental processes become shorter, and we live so much the longer in the same number of years."

"It will therefore be of great interest to make experiments such as these on the lower races, as well as on persons of different age, sex, occupation, &c."

BENNO ERDMANN AND RAYMOND DODGE ON READING

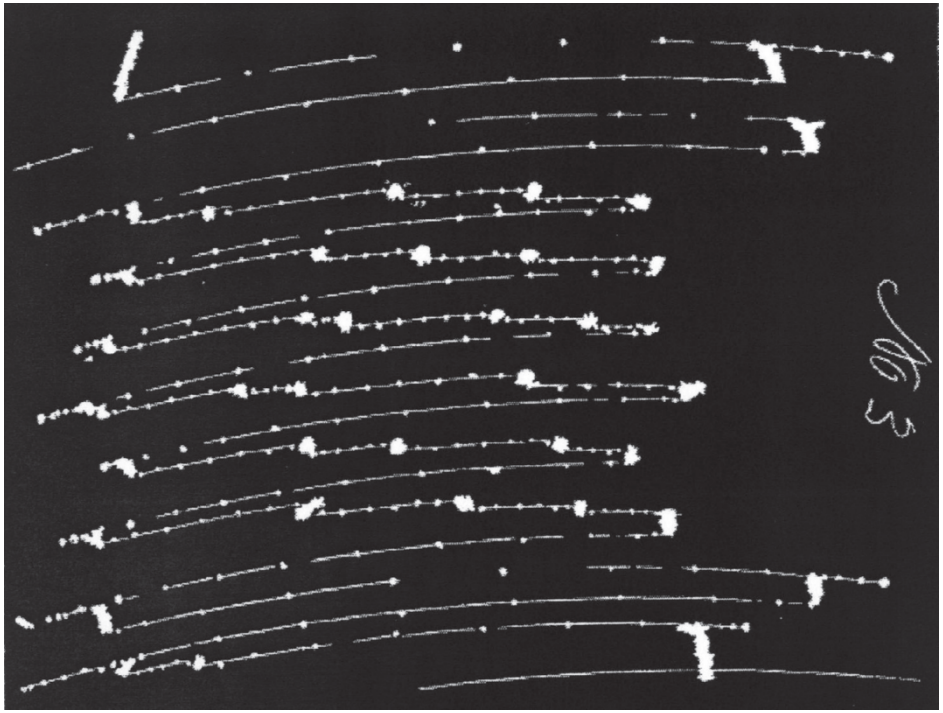
Benno Erdmann (1852-1922)



Raymond Dodge (1871-1942)

Psychologisache Untersuchungen über das Lesen. Auf experimenteller Grundlage. (1898) Halle: Niemeyer.

EDMUND HUEY'S EYE TRACKING DURING READING



Edmund Huey (1870-1913)

SIGMUND EXNER'S COHORT THEORY OF SPOKEN WORD PERCEPTION

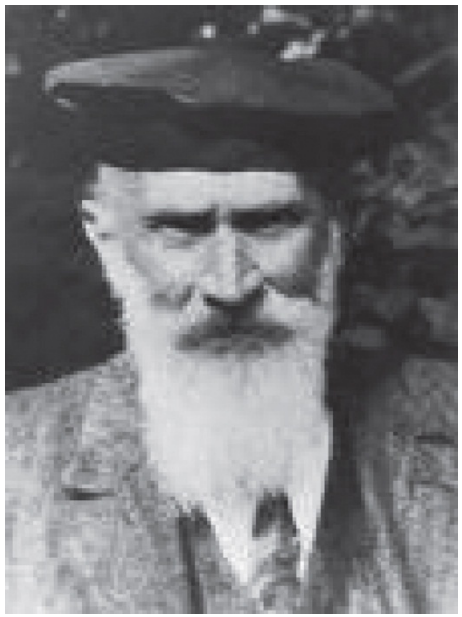
When you for instance hear the sound *K* , with . . . very low intensity the traces are activated which in many earlier cases were simultaneously active with the perception of *K* and which correspond to the images of "Knabe" [*boy*], "Kuh"[*cow*], "Kirsche" [*cherry*], "Kugel" [*ball*], "Kern" [*kernel*], etc. . . . This activation doesn't disappear however with the disappearance of the sound *K* , but continues . . . as a trace for the duration of a number of seconds . . . . If during the existence of this activation . . . also the sound *I* is heard, then a further bit of activation will be received by those traces that are associatively connected to the sound *I.* This should not mean that the image of Fisch [*fish*] is not also activated by the *I* -sound because of its connection to the *I*- sound, but it is obvious that all images whose name begins with *KI* have a remarkable advantage, because they were already activated by the previous *K* -sound. . . . Hence, the image "Kirsche" will be closer to the activation value needed for clear consciousness than the image "Fisch." In addition, it [the *I*- sound] will . . . suppress the vague images "Knabe," "Kuh," "Kugel," "Kern," etc. . . . ["Kirsche"] will however still be at the same activation level with other words beginning with "Ki" . . .. If then the further sound *R* is added, the total activation process of the traces in the brain is narrowed down following the same principle, so that only the traces representing the images "Kirsche" and "Kirche" are activated; the further sound *Sch* then hits a relatively very small number of active brain traces, but it is intensive and it will, during the pause that follows completion of the word, develop itself into the full activation of the image traces of "Kirche." (1894)

WILLIAM BAGLEY: PERCEPTION OF DISTORTED SPEECH

	spoken stimulus	mutilation
b - triple	word initial consonant	
	boy	*oy*
	mid word consonant	
	no***b***ler	*noler*
	word final consonant	
	sta***b***	*sta*

Word triples for all consonants. Many triples for each consonant, with varying vowel contexts. All recorded on Edison phonograph.Task: Word recognition.
Context varied: either word in isolation or after two prime words, such as: “men, fear” → *bra(v)est.*

RUDOLF MERINGER (1859-1931)



Inventor of modern speech error research

Meringer and Mayer (1895). *Versprechen Und Verlesen.*

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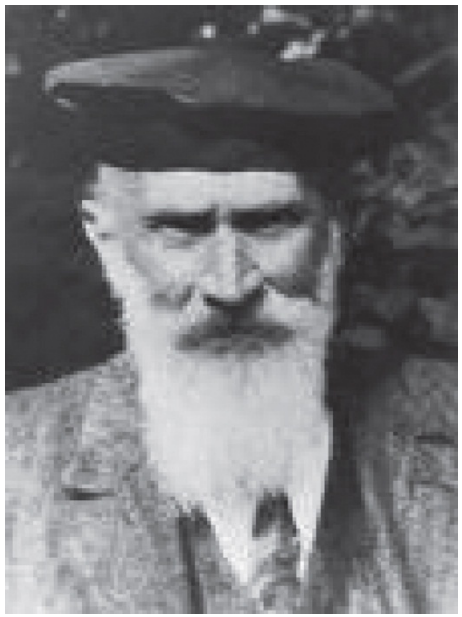

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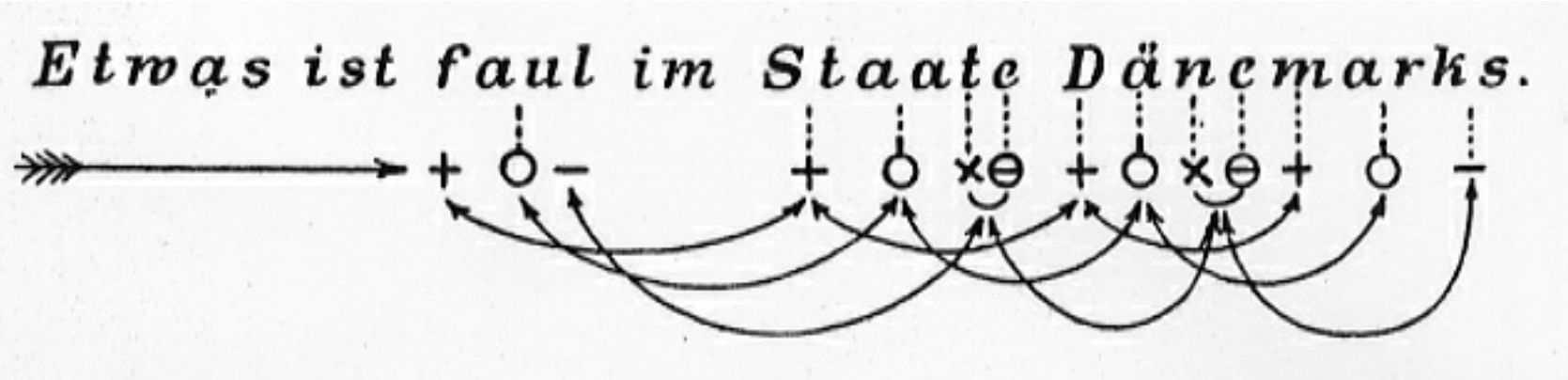
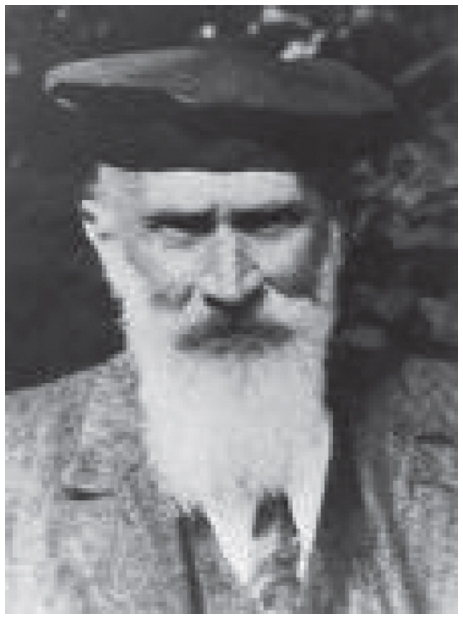
Only attention fails in a speech error, the machine runs without supervisor, is left to its own devices. And what makes speech errors instructive for linguistics, is the circumstance, that the clockwork's cover has been taken off in such moments and a view on the cogs is possible.

POSSIBLE EXCHANGES AND COMPETING SOUNDS FOR EACH POSITION



Etwas ist	f	a u	l	im	St	aa	te	D	ä	ne	m	ar	ks
	st, –	aa, –	te, —		D, f	ä.au	ne, l	m,St	ar,aa	ks,te	—, D	—, ä	–,ne
	D, –	ä, –	ne, —		m, –	ar, –	ks, –	—, f	—, au	—, l	—,st	—,aa	—, te
	m, –	ar, —	ks, —								—, f	—,au	—, l

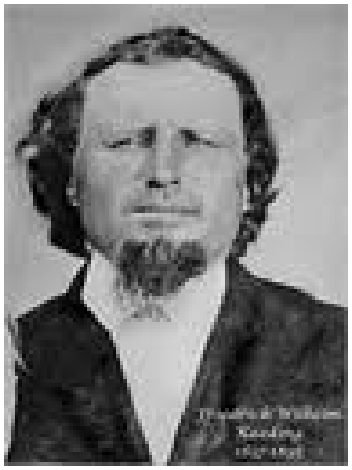
RUDOLF MERINGER (1859-1931)



getting Sigmund Freud his revenge:

"Die täglichen Fehler im Sprechen, Lesen und Handeln." *Wörter und Sachen* (1923), *8*, 122-140.

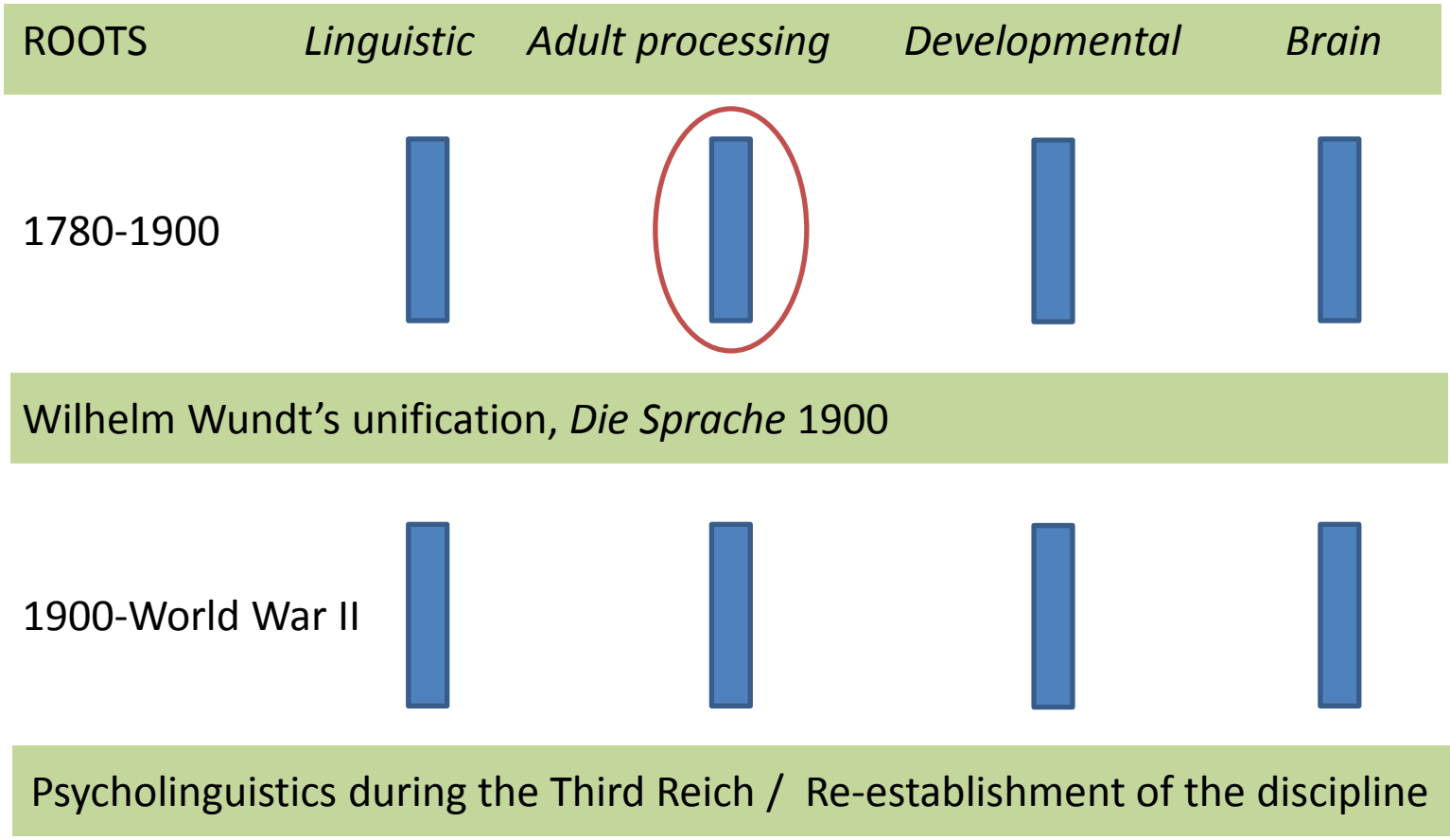
FRIEDRICH WILHELM KAEDING (1843 – 1928)



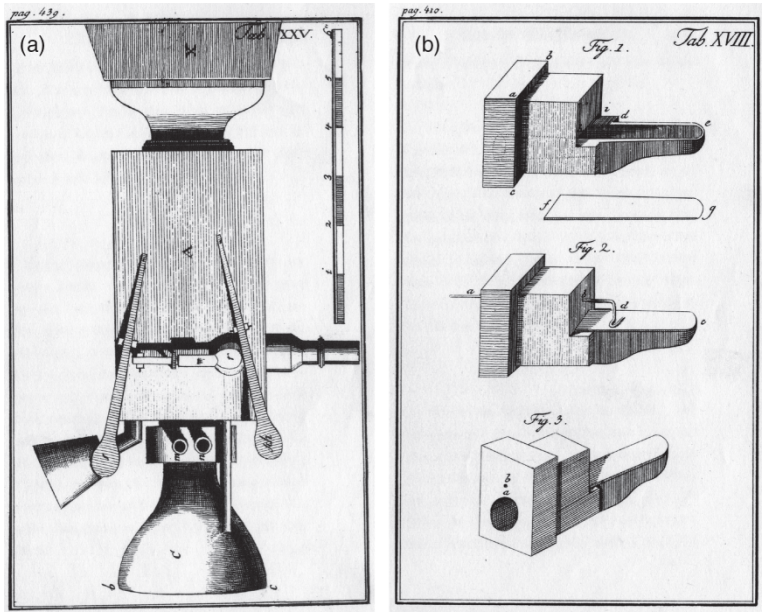
CELEX avant la date. German frequency tables for words, syllables, letters. Based on a 11 million-word text corpus.

Häufigkeitswörterbuchder deutschen Sprache / festgestellt durch einen ArbeitsausschuB der deutschen stenographgiesysteme (1897/98)

LECTURE 3 19th CENTURY LABORATORY AND SPEECH ERROR STUDIES OF LANGUAGE PROCESSING

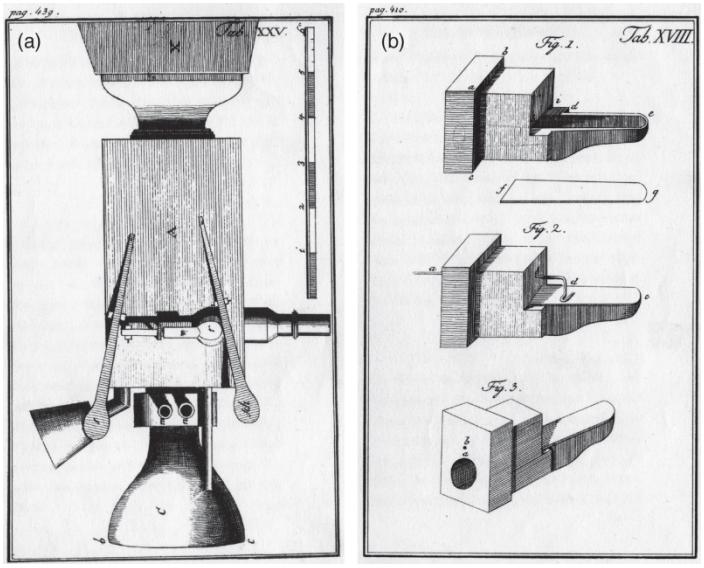


KEMPELEN'S SPEAKING MACHINE (1791)



When the bellow X (only partly displayed) is pressed, the air flows into the wind box A. From there it passes over the reed stop (see (b)), somewhat like a clarinet reed, but made of very thin ivory, setting it to vibrate. The reed stop resides in the opening connecting the wind box to bell C, the soft rubber resonator. Covering this "mouth" by hand produces a particular timbre. This can be varied by moving the hand closer or farther, make it hollow or flat, etc. Different vowels are produced doing this.

KEMPELEN'S SPEAKING MACHINE (1791)



Consonants are produced in several ways. An *f* results from closing all openings and pressing the bellow very hard. A *p* is produced by pressing the bellow, then suddenly removing the hand
from the mouth piece. Here a by-pass pipe (in view) directly connecting the wind box and the "mouth" ensures that pressing the bellow will not push air through the reed stop; its vibration
should not start before the opening of the "mouth." There are levers for producing *sh* and *s*
(in view), which let the air flow out of the wind box through swishing channels (in view, sticking out to the left and the right). The nasals *m* and *n* are produced by opening either one
of two resonators sticking out (to the front) from the "foot" of the mouth piece.

CATTELL'S PICTURE NAMING EXPERIMENTS

	Berger	Cattell
"jetzt" RT to light	178	173
"weiss" only if white, Ø if black	243	273
will time	65	100
picture naming (26 pictures)	474	543
picture perception time	96	117
picture response selection	251	278