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Functional and Formal Linguistics
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Feature Distance in Consonantal Slips of the Tongue
Psycholinguistic and Methodological Aspects

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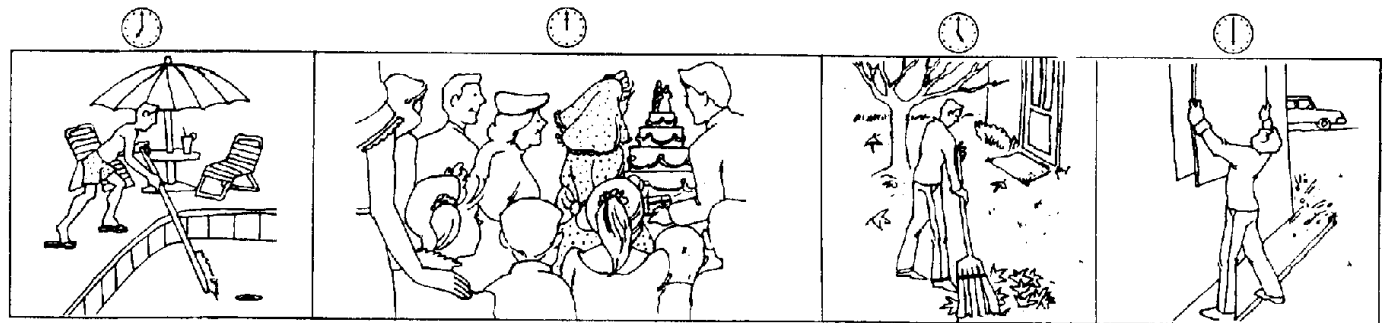
Content

1. Introduction
2. Feature Distance
3. Interaction of Feature Distance and Syllable Distance
4. Summary

1. Introduction

The DFG-Corpus

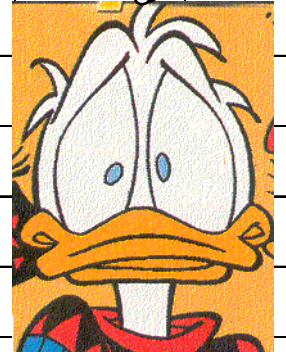
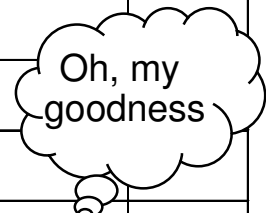
- DFG-Project (Leuninger, LE 596/6-3):
- Language production errors and their repairs in dependence on their modality: German Sign Language vs Spoken German
- Slips of the tongue: $n = 944$
- Slips of the hand: $n = 640$
- Elicitation of slips of the tongue and hand
- Task: Telling picture stories under various stress conditions



- The subjects were video- and/or audiotaped
- objective (bias-free) corpora

Cross Classification Error Type x Entity

slip of the tongue			affected entity						
	N	%	word	phoneme	morpheme	phrase	gramm. feature	semantic feature	other
anticipation	184	19.49	42	95	21		23	2	1
perseveration	214	22.67	57	112	17	1	27		
harmony	48	5.08	3	44	1				
substitution	56	5.93	25	6	11		14		
semantic	156	16.53	121		35				
formal	31	3.28	16	8	7				
sem. + form	3	0.32	3						
blend	188	19.92	38			150			
fusion	1	0.11	1						
exchange	11	1.17	2	5	2		2		
deletion	43	4.56	19	9	13				2
addition	9	0.95	1	6	1				1
sum	944	100	328	285	108	151	66	2	4
%			34.74	30.19	11.44	15.9	6.99	0.21	0.42



Phonological Errors

- Phonological errors ($n = 285 \sim 30.2\%$).
- Words are the most affected entity (35%) followed by phonemes.
- The frequency of phonemes is nearly as high as expected.
- Main focus:
 - Feature distance as a determining factor in phonological errors and
 - Interaction of feature distance and syllable distance in phonological errors

2. Feature Distance

Feature Distance in Consonantal Phonological Errors

☞ Phonological errors

- Data: contextually motivated phonological consonantal errors (n = 172 for the IPA; n = 163 for Kloeke)
- Exclusion: unmotivated formal substitutions, deletions, and additions
- Coding Method:
- IPA and Kloeke (1982)
- Methodological aspect:
We want to find out which among competing feature systems is the most appropriate one to characterize the phonological data.

IPA for Consonants

THE INTERNATIONAL PHONETIC ALPHABET (revised to 1993, updated 1996)

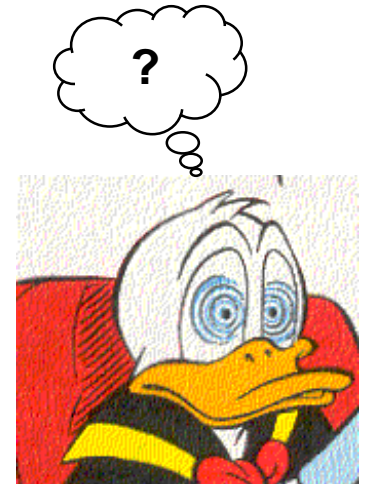
CONSONANTS (PULMONIC)

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k ɡ	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap				ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Where symbols appear in pairs, the one to the right represents a voiced consonant. Shaded areas denote articulations judged impossible.

Some Examples

- Feature types:
 - Place
 - Manner
 - Voice
- Example “Place” inde[m] → i[m]dem
 - anticipation of [m] (lin. translation: by)
 - n → m; alveolar → bilabial
- Example “Manner” nach[d]em dieses erledigt war → nachdem die[d]es ...
 - perseveration of [d] (after this has been done)
 - z → d; fricative → plosive
- Example “Voice” um[g]ekehrt → umgegehrte
 - perseveration of [d] (the other way round)
 - (k → g; -voice → +voice) -

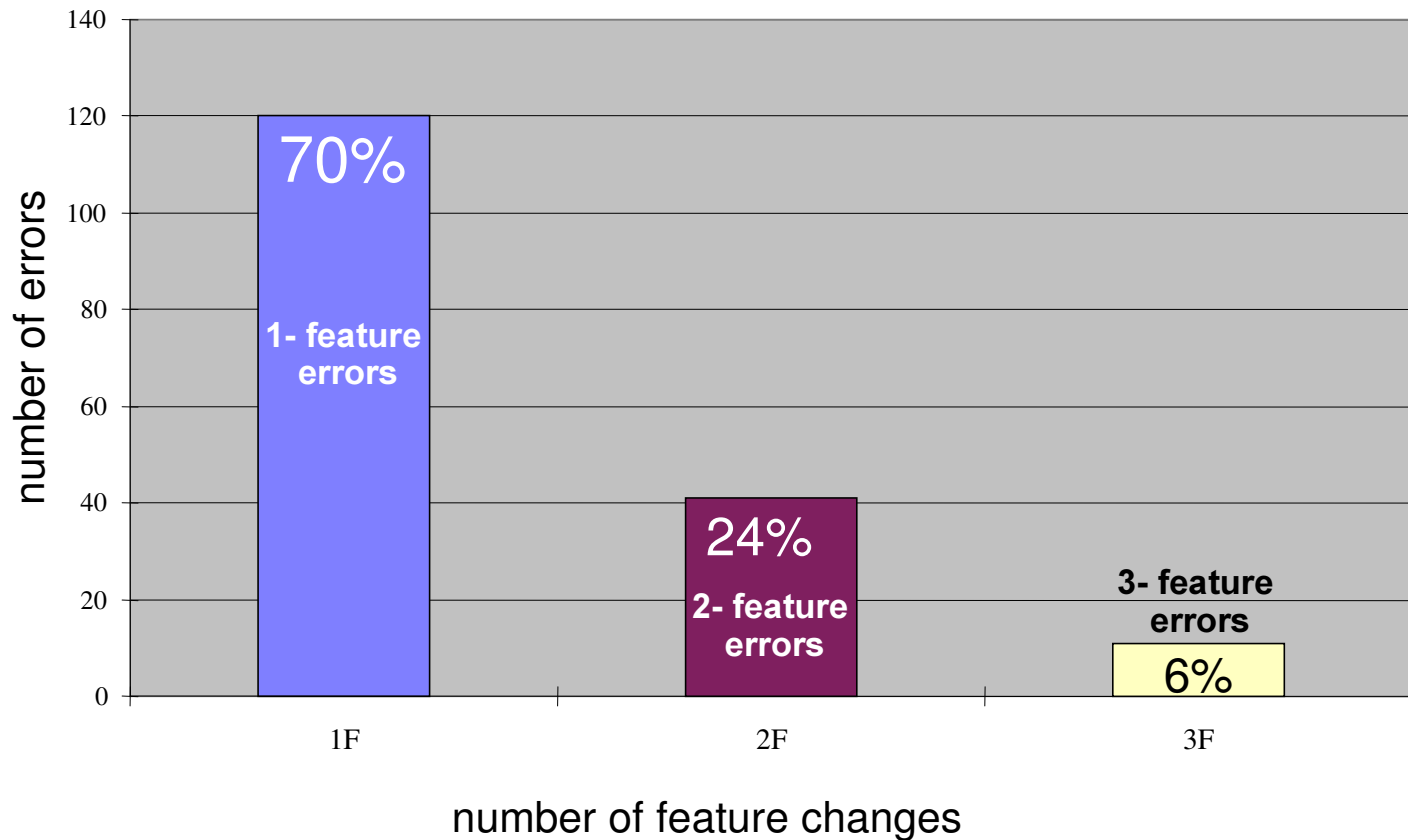


Feature Distance in Consonantal Errors (IPA)

n phon. errors	1 Feature			2 Features			3 Features		
	P	M	V	P	M	V	P	M	V
172	84	20	16	39	29	14	11	11	11
n feature changes	120 (120 errors)			82 (41 errors)			33 (11 errors)		
%	70	16.6	13.3	47.6	35.1	17.1	33.3	33.3	33.3

P: Place M: Manner V: Voice

Feature Distance in Consonantal Errors (IPA)



Affected Features in a Sequence

- The most affected feature is place.
 - Place: 57%
 - Manner: 25.5%
 - Voice: 17.5%
- Why is the place feature mostly affected?
- Some speculations:
 - ➡ The number of subfeatures is decisive for the frequent involvement of place.
 - ➡ Neural representation of the place feature
 - ➡ Underspecification of the place feature:
- The place feature is inserted in dependence on the phonological context.
- Prediction: segments specified for place are supposed to be less affected than those being underspecified.



Place errors

- Especially in the case of one-feature changes, place stands out compared with manner and voice.
- There is a high number of one-feature changes due to frequent $m \leftrightarrow n$ substitutions (33 out of 84 ~ 39%).
- 28 out of 33 $m \leftrightarrow n$ substitutions occur in the coda.
 - ➡ Interaction of place feature and syllable position?
- For example: neben **n** seinen **n(m)** Schuh (next to his shoe)
mit besten **n(m)** Gewissen **n** (with clear conscience)
am U **m(n)** kraut jäten (to be about to weed)
- The remaining 51 place features are distributed nearly equally with regard to onset and coda.

Feature Combination in 2-Feature Errors

	P x M	P x V	M x V
n = 41	27	12	2
	66%	29%	5%

- Also in two-feature changes the place feature is the most affected one.
- Place most likely combines with manner and not with voice.
- Example of a P x M-Interaction: (f → t)
... um an einer Hochzeits**te**i//**f**eier teilzunehmen
... in order to take part in a wedding ceremony

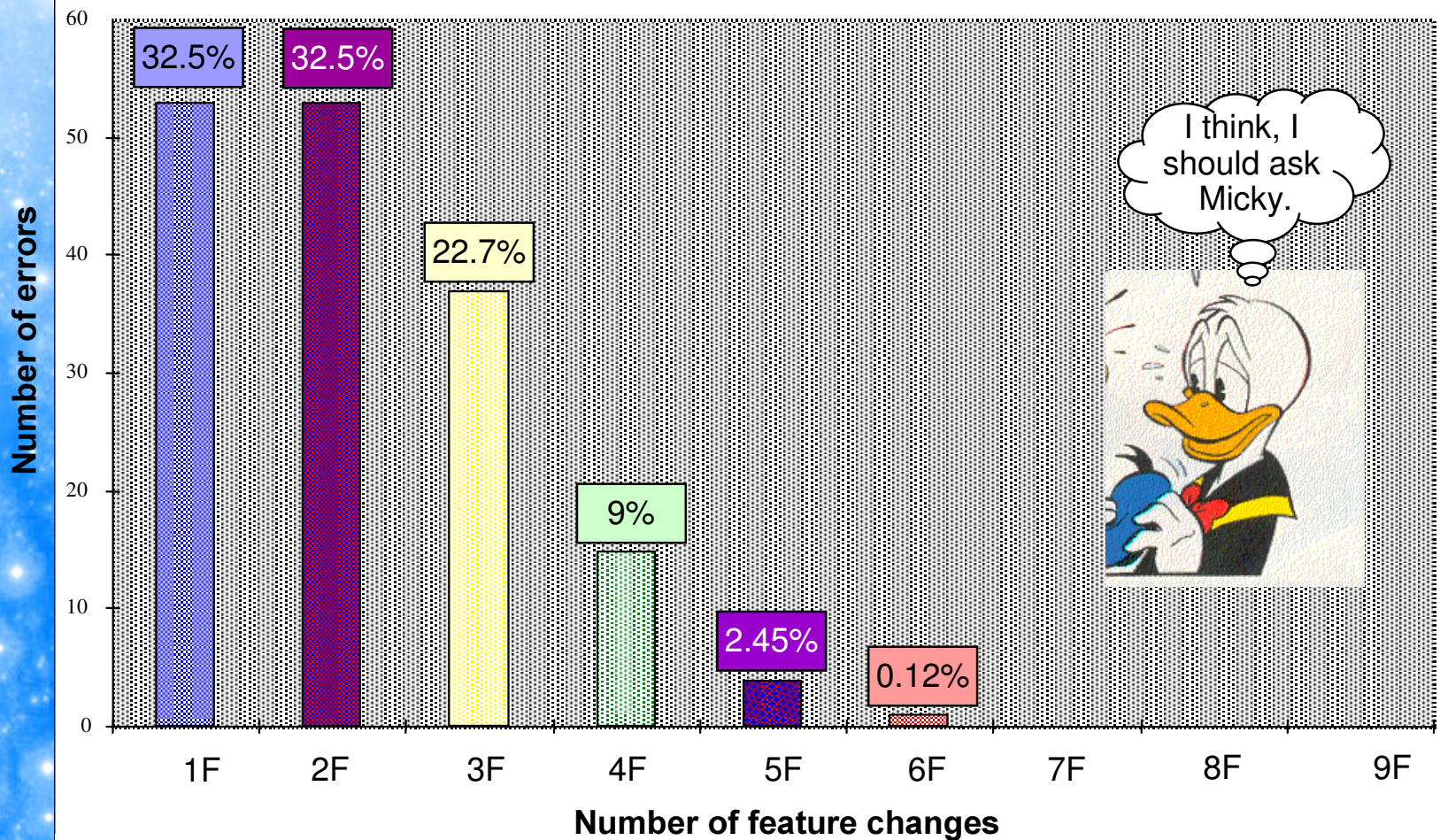
The Kloeke System (1982)

	m	n	ɲ	l	ʀ	p	b	f	v	t	d	s	z	č	y	ʃ	ž	ç	j	k	g	x
cons	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
son	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
back	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+
low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
high	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+
lab	+	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
cor	-	+	-	+	-	-	-	-	-	+	+	+	+	+	+	+	+	-	-	-	-	-
nas	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cont	-	-	-	+	+	-	-	+	+	-	-	+	+	-	-	+	+	+	+	-	-	+
tense	-	-	-	-	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+

[low] is not excluded because both [h] and glottis stop are specified positively for [low].

Both segments are regarded as consonants.

1-9 Feature Changes according to Kloeke



Frequency Distribution of the 9 Kloeke Features

	son	back	low	high	lab	cor	nas	cont	tense
n	15	39	11	54	66	78	12	43	38
%	4.2	11	3	15.2	18.5	22	3.3	12.1	10.7

- cor > labial > high > cont > back > tense > son > nas > low
- There is no dominance of one single feature.

Comparison of the Feature Systems: IPA and Kloeke

IPA

- phonetic
- 3 major features, many subfeatures
- less redundancies
- mainly 1-feature changes
- most affected feature: place
- strongly decreasing graph

Kloeke

- phonological
- 9 binary features
- redundancies (overgeneration)
- equal distribution of 1- and 2-feature errors
- several affected features: coronal > labial >... (both place)
- plateau before decrease

Both systems show the same tendency: the more similar two segments are the more likely they are to be substituted in a speech error.

Feature distance is a main determining factor of contextual phonological errors.

3. Interaction of Feature Distance and Syllable Distance

Interaction of Feature Distance and Syllable Distance (1)

- Is there an interaction between feature distance and syllable distance?
- Hypothesis: With increasing syllable distance between target- and intruder segment, the feature distance is assumed to decrease.
- Analysis of $n = 165$ phonological errors with regard to the distance from 1 to > 8 syllables

	syllable distance	feature distance
n: cases	165	129
average	2.46	1.23

- Example of a 2-syllable distance error (perseveration):
Hochzeitstochter//torte
wedding daughter//cake ← wedding cake

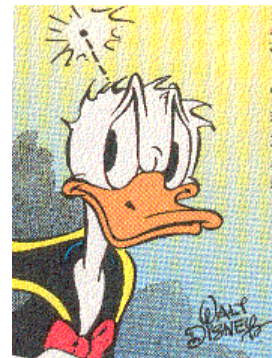
Interaction of Feature Distance and Syllable Distance (2)

- Frequency distribution of errors with regard to the syllable distance:

	1S	2S	3S	4S	5 S	6 S	7 S	8 S	>8 S	n: errors	n: syllables
n	70	48	20	6	6	7	1	3	4	165	406

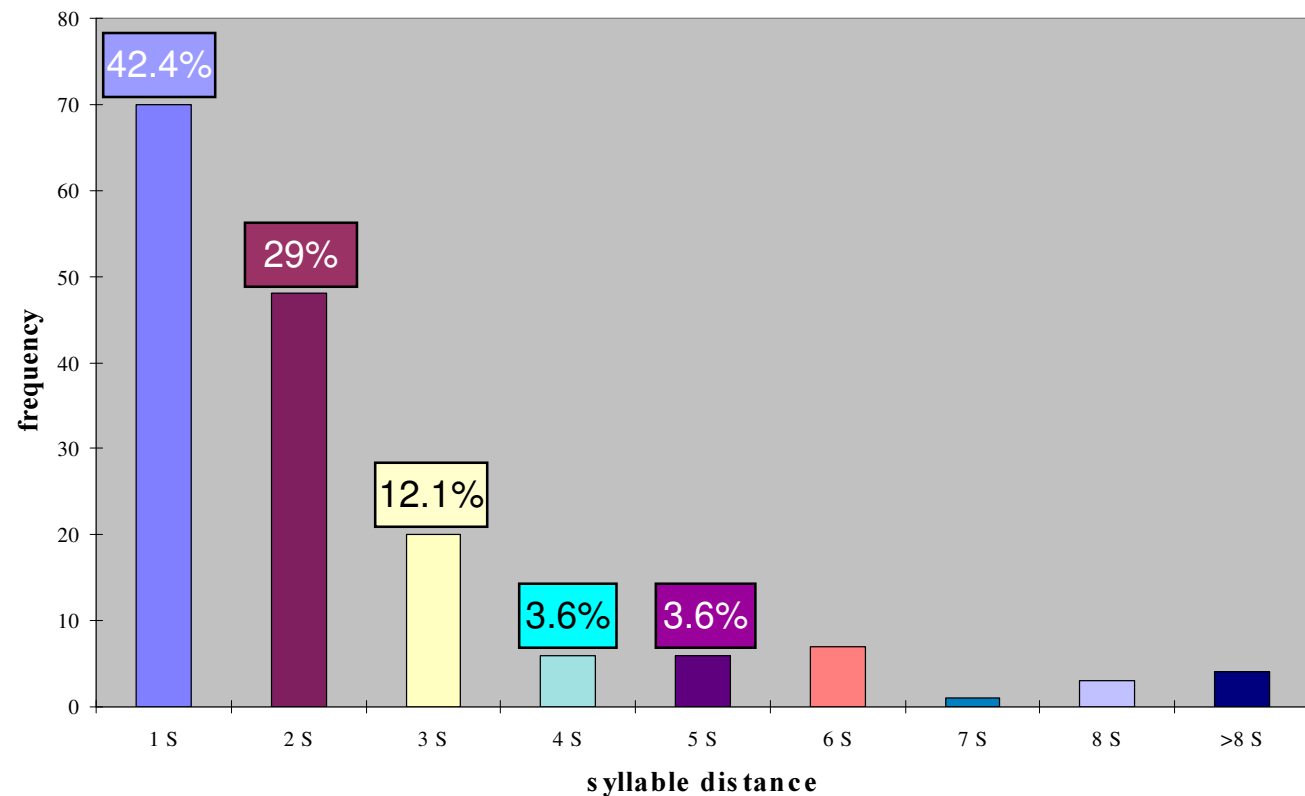
- Result: Most errors are only one syllable away from their intruder segments.

⇒ Contextual phonological errors occur in a small time window.



Interaction of Feature Distance and Syllable Distance (3)

syllable distance in contextual errors



The time window ends at the point where the curve does not continue to fall. ➡ Time window: 1 to 4 syllables

Interaction of Feature Distance and Syllable Distance (4)

- In order to verify our hypothesis regarding the correlation of feature distance and syllable distance, we compared the two factors by computing the quotient:

	1S	2S	3S	4S	5 S	6 S	7 S	8 S	>8 S
Quotient	1.2	1.24	1.3	1.2	1	1.3	1	1.6	1.6

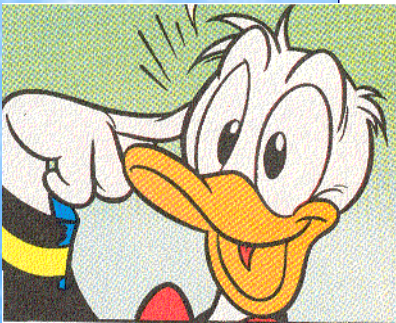
- ➡ There is no interaction between feature distance and syllable distance.
- ➡ The feature distance stays the same despite of increasing feature distance.

4. Summary

Summary

Feature Distance

- Feature distance is a main determining factor of contextual phonological errors.
- For consonantal errors the feature distance for both the IPA and the Kloeke system is very low (appr. 1 in IPA and 2 in Kloeke).
- Similar results apply for vowels.
- Same outcome in German Sign Language: one feature (handshape) is affected mostly.



Syllable Distance

- The measure of syllable distance defines the frame within which phonological processes take place. \Rightarrow time window: 1 to 4 syllables
- Estimation: one syllable lasts \sim 250 ms
- Phonological processes seem to take place within one second.

\Rightarrow These results seem to represent a universal property of phonological processes.