Jan Hulstijn [http://www.uva.nl/profile/j.h.hulstijn]. Contribution to AILA 2021, in virtual Symposium S016 (taking place on 18 August 2021), entitled "Challenging the state of the art in L2 complexity research", organized by Alex Housen and Magali Paquot.

Complexity research from the perspective of Language as a Complex Adaptive system

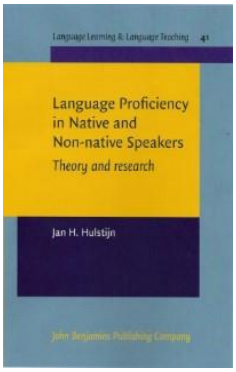
ABSTRACT

This presentation explores whether new life can be brought into L1/L2 complexity research from a combination of two perspectives: (1) the Darwinian perspective of language as a Complex System (Mufwene, Coupé and Pellegrino, 2017; The Five Graces Group, 2009), and (2) the distinction between (i) acquisition of a language in daily oral communication and acquisition of the standard language, used in most written communication. At the same time, the presentation offers an extension to BLC Theory (Hulstijn, 2015, 2019), by specifying the roles of three characteristics of complex systems: (i) unequal frequencies (Zipf-like distributions; Lestrade, 2017), (ii) permanent internal variability, and (iii) a multi-layered neural-network architecture (Diessel, 2019, 2020), in which (i) constructions (with partial productivity; Goldberg, 2019) emerge from words, and (ii) morpho-syntactic patterns emerge from constructions. I hypothesize that, while the arbitrary complexity of the written standard language forms an obstacle for the acquisition of the standard language (for people not so smart or people with little learning opportunities), the natural complexity of the spoken language forms a facilitator (rather than an obstacle): you don't have to be smart to acquire an oral language. The characteristics of natural complexity (in particular internal variability and unequal frequencies), to be observed in both spoken and written language, create a challenge for complexity research, aiming at characterizing complexity differences between levels of language proficiency as well as for language assessment practices. We need to empirically tease apart the variability inherent in all oral and written productions, and the variability that is associated to histories and practices of oral and written language use, in particular reading and writing practices. I will illustrate this with speaking and writing data elicited from native speakers of Dutch who differ in age (18-76 years), level of education, and level of profession.

PRESENTATION

BLC Theory

BLC = Basic Language Cognition, shared by all adult native speakers



2015

Hulstijn (2019). An individual -differences framework for comparing nonnative with native speakers: Perspectives from BLC Theory. *Language Learning*.

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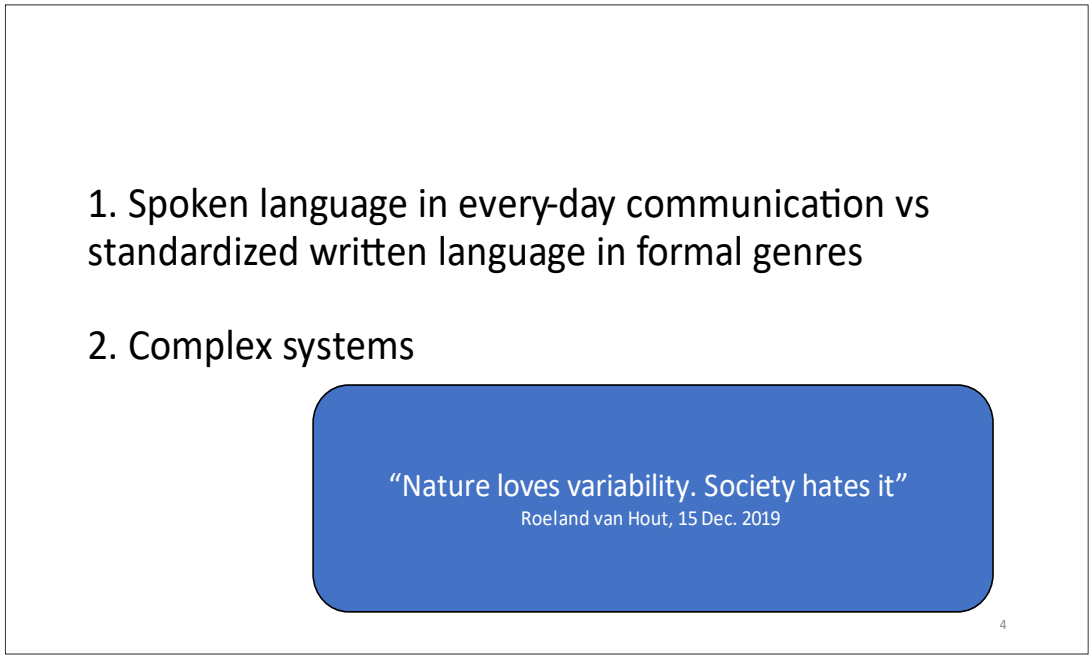
Hello everyone, welcome to my presentation.

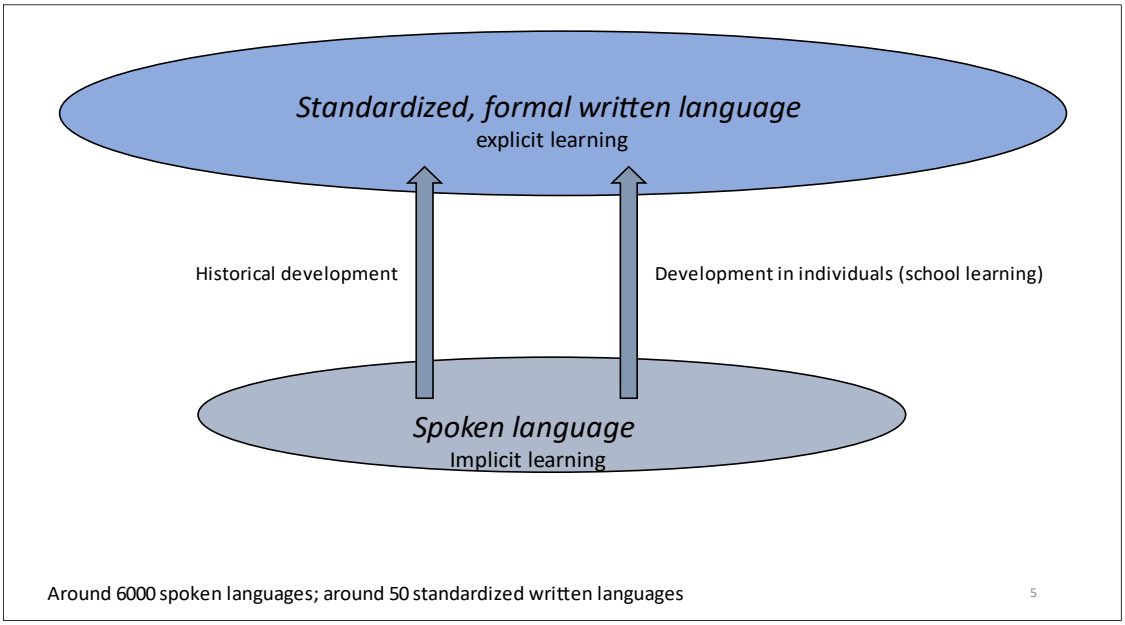
One of my ambitions has always been to explain individual differences in L2 acquisition. This work lead me to investigate individual differences in L1 acquisition. I developed a framework for this, called BLC Theory. In this presentation I incorporate notions of complexity and variability.

In my study of individual differences, I discovered that it would be helpful to take the following two fundamental matters into account:



Spoken language in every-day communication vs standardized written language in formal genres, and the notion of complex systems.

The motto for this presentation could well be “Nature loves variability. Society hates it” as Roeland van Hout said in a presentation not long ago.



Standard languages emerged from spoken languages for the purposes of more sophisticated kinds of communication, through a prolonged process of cultural evolution, including the invention of writing systems.

Children, in the first five years of their lives, through communication only in the oral modality, acquire the most frequent elements and patterns of the language spoken in their community. This is a process of implicit, bottom-up statistical learning, including mechanisms of self-organization in a multi-layered neural network. The acquisition of the spoken language continues well into adulthood.

But when they enter elementary school, children learn to read and write and they begin to learn the standardized written language of their country or region. They are explicitly taught and they explicitly learn a large amount of lexical expressions, lexical-syntactic constructions, and hundreds of do's and don'ts of the standard language, on top of the enormous task of learning the writing system and the orthography of their language.

Only a very small portion of a population can speak and write the standard without errors. Note that only members of this small minority determine tasks and performance criteria in language assessment. Only they decide, arbitrarily, what is correct and wrong.

Complex systems

- Unequal, Zipf-like frequency distributions
- Permanent variability
- Higher-order representations emerge from lower -order representations; fuzziness of linguistic categories

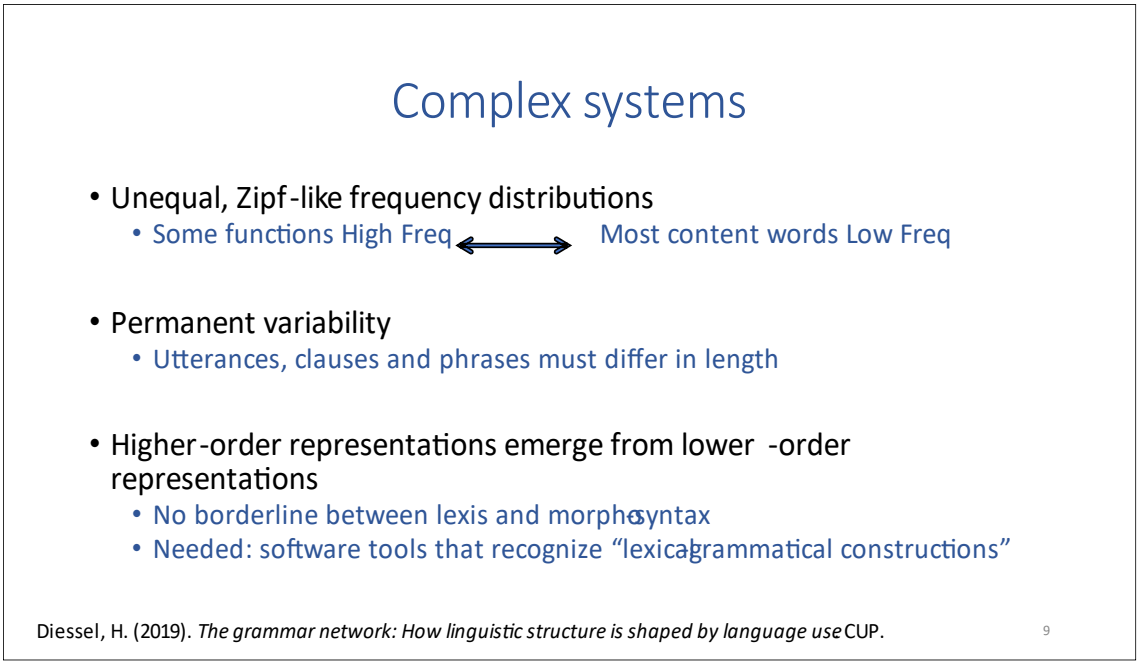
The Five Graces Group (Beckner, C., Blythe, R., Bybee, J., Christiansen, M.H., Croft, W., Ellis, N.C., Holland, J., Ke, J., Larsen-Freeman, D., Schoenemann, T.) (2009). Language is a complex adaptive system. *Language Learning, 59*, Supplement *1*, 1–26.

The authors of this seminal paper in 2009 proposed that languages should be seen as complex adaptive systems, just like Charles Darwin proposed that nature is a complex system. Three characteristics of complex systems are relevant in this presentation:

First, the elements of complex systems manifest themselves in extremely unequal distributions,

Second, complex systems exhibit permanent variability, and

Third, in language learners, higher-order patterns emerge from lower-order elements and patterns. Thus, there is no principled division between syntax and lexis. Let me illustrate this.



When a speaker of an Indo-European language is asked to tell what she did last weekend, she will use some elements relatively frequently, for example articles, a few pronouns, a few prepositions, some conjunctions, auxiliary verbs; and she will use content words only once or twice.

Furthermore, the speaker produces utterances, clauses, and phrases of different length. It is simply impossible to report last weekend's events by producing clauses, each consisting of six words, with each word consisting of two syllables. There is always variability in language production. In addition, when the person is being asked, a few minutes later, to tell us again what she did last weekend, she will do so in a slightly different way: again a manifestation of variability.

Syntactic patterns emerge from lexis and are often constrained by lexis. For example, the verb 'believe' is typically followed by a complement clause ('I believe that she is right'), while the verb 'promise' is typically followed by an infinitival clause ('I promised to do that'). In NLP work it would be wonderful if we had software tools that recognize lexical-grammatical constructions.

Explanations of individual differences

Differences

Control of the standardized written language

Commonalities

Control of the spoken language

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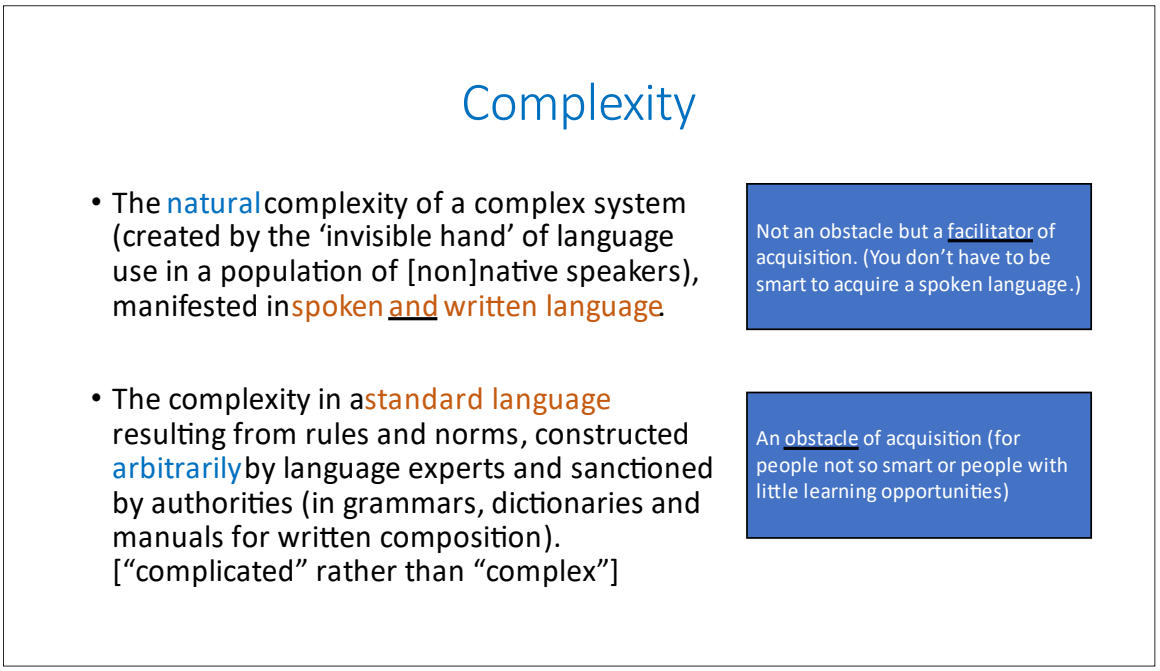
The explanation of individual differences in language acquisition must include, simultaneously, the explanation of commonalities, the elements and features of the language acquired by all native speakers.

For these explanations we have to distinguish two kinds of complexity.

Complexity

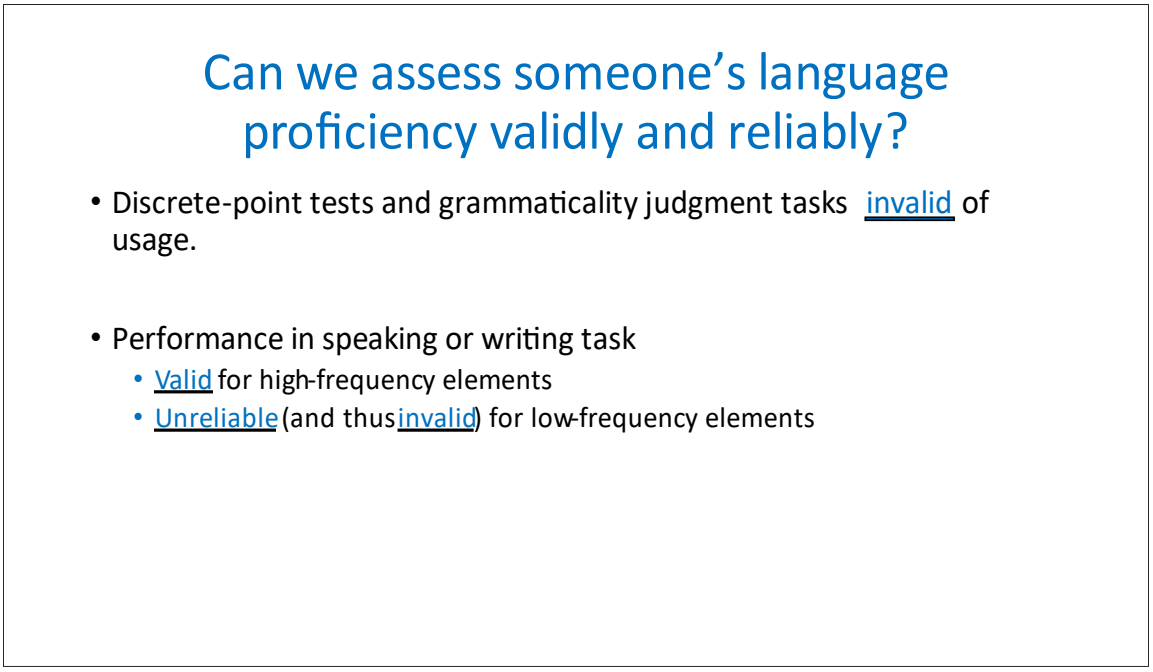
- The natural complexity of a complex system (created by the 'invisible hand' of language use in a population of [non]native speakers), manifested in spoken and written language.
- The complexity in a standard language resulting from rules and norms, constructed arbitrarily by language experts and sanctioned by authorities (in grammars, dictionaries and manuals for written composition). ["complicated" rather than "complex"]

First the natural complexity of language, to be observed in both spoken and written discourse. And second, the arbitrary complexity, salient in formal written language.

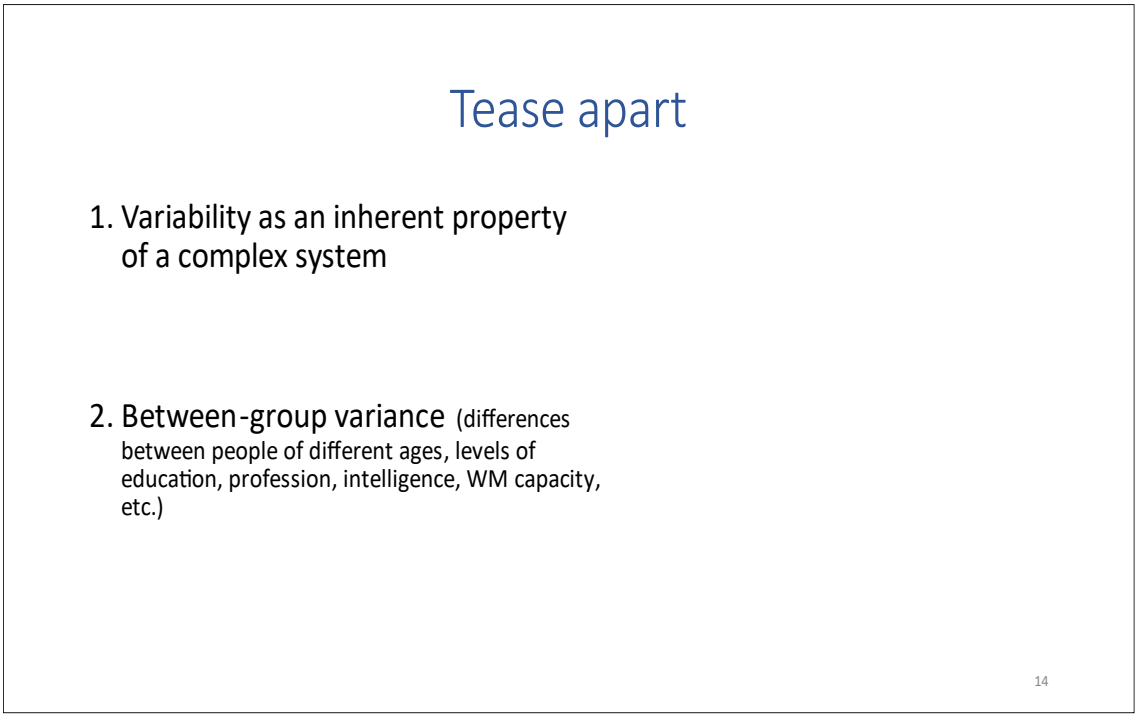


Using this distinction, I claim, that the natural complexity is not an obstacle but a facilitator of acquisition. (You don't have to be smart to acquire a spoken language.) As Padraic Monaghan, a psychologist at Lancaster University, said in a presentation a few years ago: "Variation is not a problem but the solution. Noise is not an accident but it is there by design."

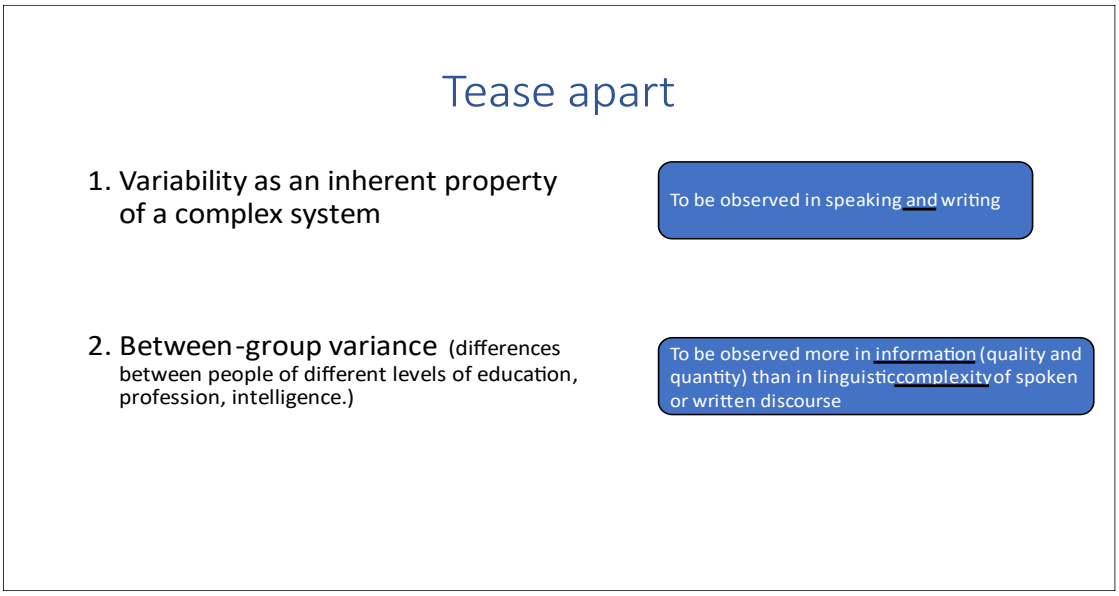
In contrast to this natural complexity, the arbitrary norms of the formal written standard language do form an obstacle of acquisition, in particular for people not so smart or people with little learning opportunities.



The question then arises whether it is at all possible to obtain a complete picture of someone's language proficiency, and, consequently, of the complexity of someone's repertoire. Someone's performance on a discrete-point vocabulary or grammar test or a grammaticality-judgment task is not representative of the lexical and grammatical elements the person uses when asked to perform a speaking or writing task. Given the inherent variability of language production and its unequal frequency distributions, can performance in a speaking or writing task be said to be 'representative' of someone's proficiency? Well, yes and no. In assessing a piece of spoken or written discourse, we can make more or less reliable statements concerning the presence and absence of words, constructions and patterns that occur relatively frequently in large corpora of the elicited genre. But it will be impossible to make a reliable statement about the presence or absence of relatively infrequent constructions.



In assessment, we must tease apart the variability as an inherent property of a complex system from the variance resulting from potentially relevant person attributes, such as age, level of education, profession, intelligence, working-memory capacity.



The first type can be observed in speaking and writing. The second type can be observed more in the quality and quantity of the information provided than in its linguistic complexity.

Spoken

	Nonnatives		Natives		
	B1	B2	Students	Education Low	Education High
Subjects	80	30	33	63	35
Age	20 - 56	21 - 43	18 - 28	18 - 74	18 - 63
Words	40,046	22,531	26,248	44,952	28,482

T-Scan
https://webservices-lst.science.ru.nl

AntConc
http://www.laurenceanthony.net/software/antconc/

Manual counts

De Jong, Steinel, Florijn, Schoonen, & Hulstijn, 2012

Mulder & Hulstijn, 2011

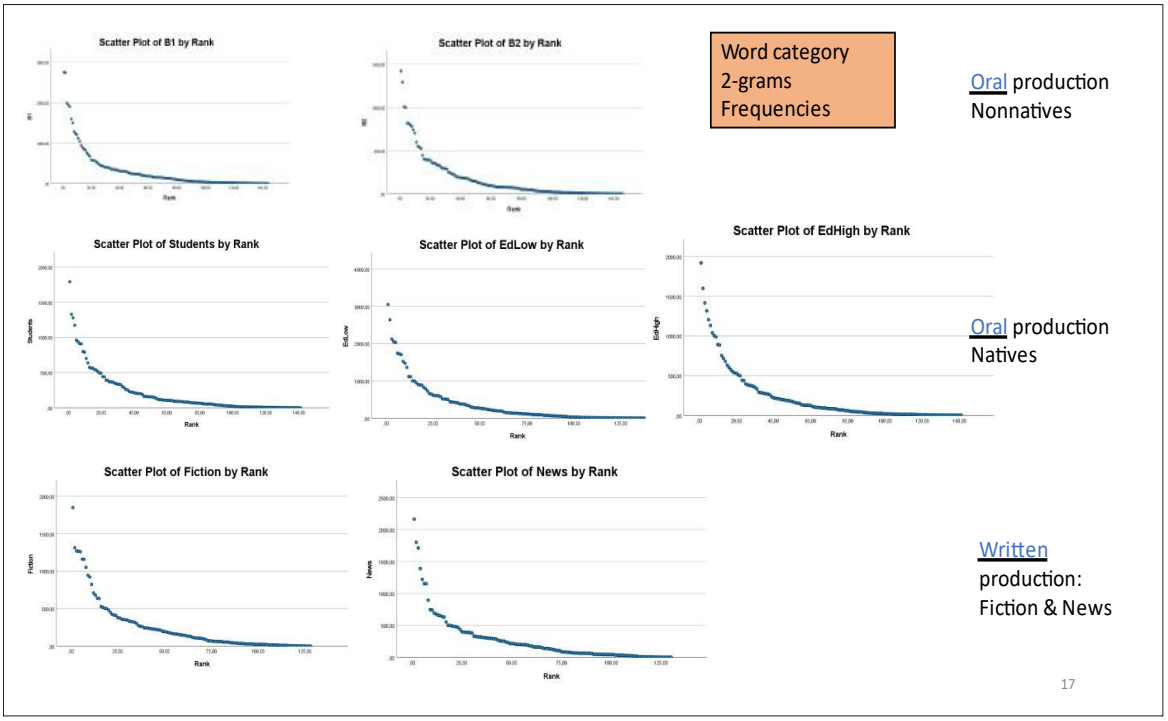
Hulstijn, 2017

Written

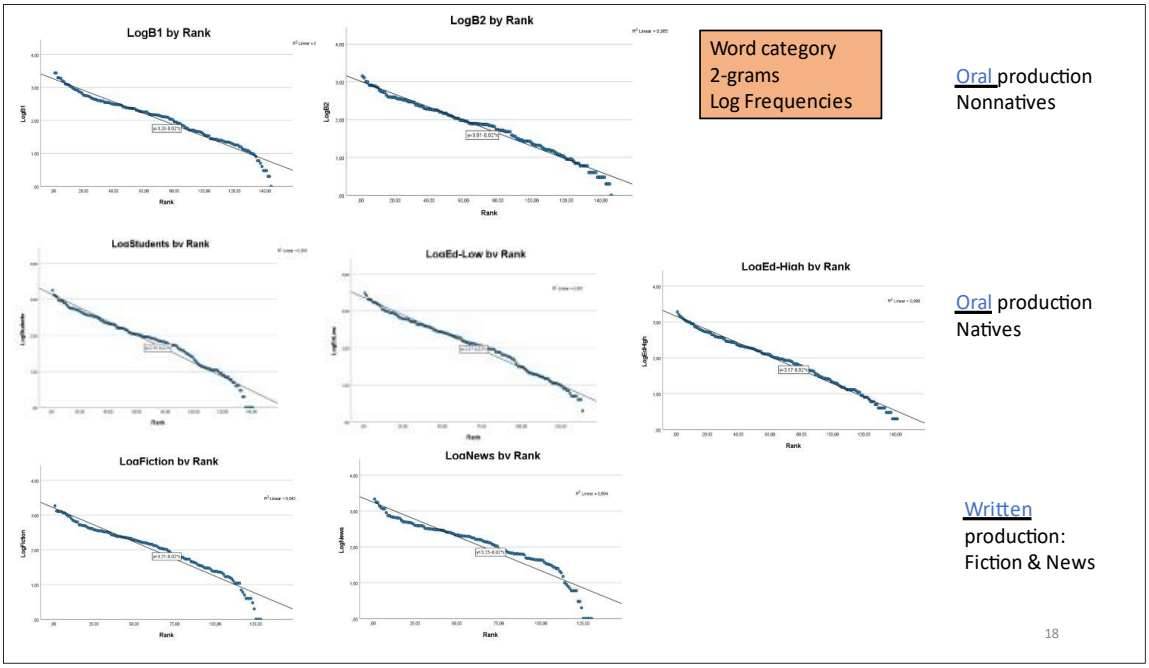
	Education Low	Education High	Fiction	News
Texts	30	25	26	58
Words	14,643	18,200	28,009	29,850

In the little time remaining, let me try to illustrate my points with some of the analyses which I conducted, using spoken and written discourse, elicited for two projects, reported in De Jong et al. (2012), and Mulder & Hulstijn (2011). Participants in these studies all performed the same four speaking tasks, talking about the same four topics.

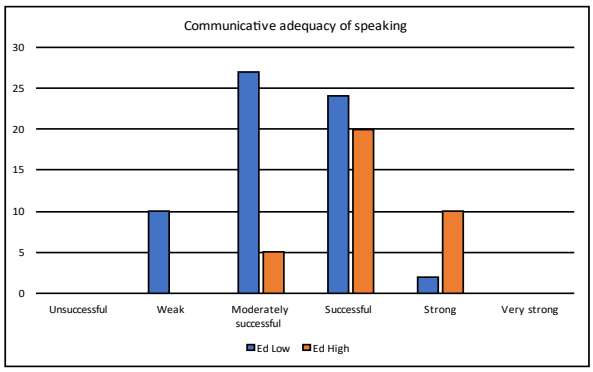
The transcriptions of the spoken discourse were analyzed with two tools. First, T-Scan, an electronic tool for the Dutch language, developed by Dutch linguists. T-Scan includes a syntactic parser, called Alpino, and uses a huge corpus, called SoNaR, for its computations. Second, I used the well-known AntConc concordance program. And third, I conducted manual counts.

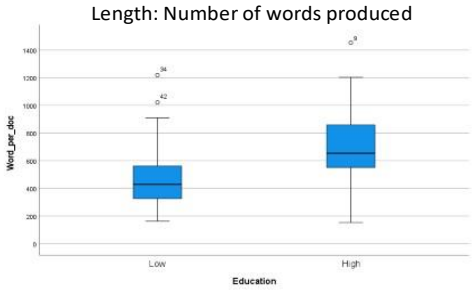


To illustrate the natural complexity, to be observed in almost all spoken and written discourse, let me show the distributions of word-category 2-grams, such as Article plus Noun, or Pronoun plus Verb. As you can see, the raw-frequency curves are highly similar, for nonnatives at the B1 and B2 proficiency levels (at the top row) and natives (in the middle) and for written discourse (on the bottom row).



This similarity can be observed more clearly when the raw frequencies are log-transformed.





Education High (College & University); n = 35
Education Low (all others); n = 63

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Let me now zoom in on the performance of the 98 participants of the Mulder study. These native speakers differed in age from 18 to 76 years, differed in level of profession and level of education. 35 participants held a college or university diploma, while the remaining 63 participants received education at lower levels and for a shorter duration.

The quality and quantity of the information provided in the four speaking tasks was judged by a panel of three raters, using a rating scale. As you can see at the left, the Education High group performed much better than the Education Low group. As you can see in the boxplot on the right, the Education High participants talked longer, producing more words.

	Ed Low	Ed High
Word frequency (log)	5.08	5.05
Coverage Freq 1000	75%	74%
D level	2.1	2.2
MTLD wrd	64.3	67.1
MTLD content wrd	111.5	122.3
Trigram prob forward	-3.19	-3.21
Entropy forward	1.80	1.90

Differences are not significant

No reliable associations between Education (Low vs High) and:
clause length, verb clusters consisting of 3+ verbs, passive voice, *wh*-cleft sentences, center-embedded clauses, fronted subclauses

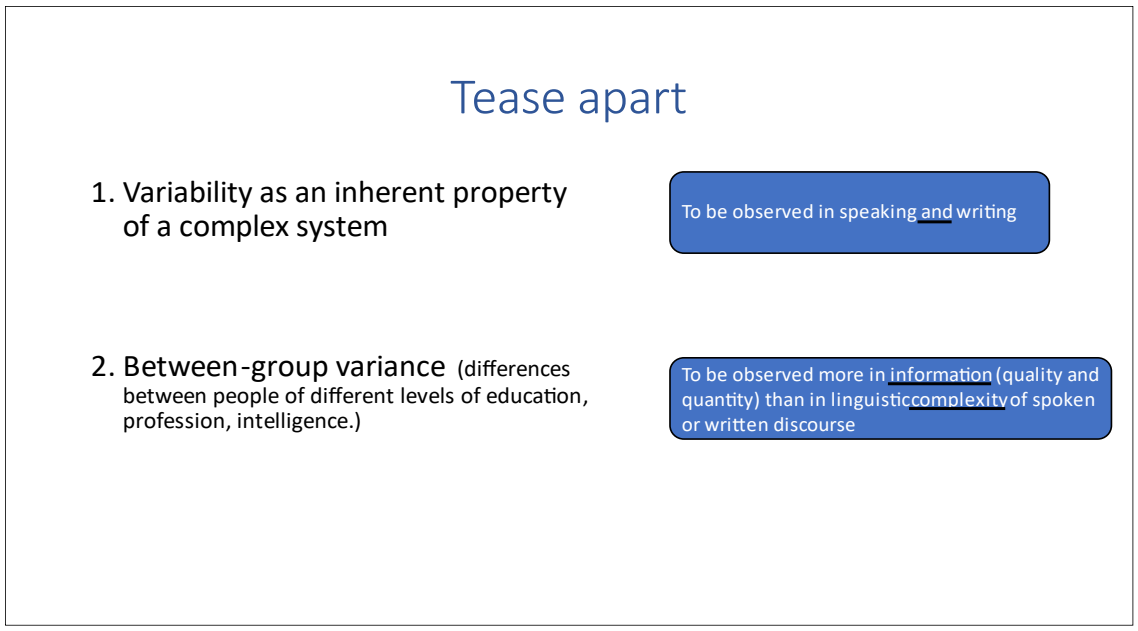
Word-categories (percentages)

	Adj	Conj	Pro	Art	Prep	Adv	Num	N	V	Interj	Names
Ed Low	7.4	7.3	17.1	9.0	11.0	10.8	1.9	15.8	17.9	1.2	0.6
Ed High	7.7	6.6	16.5	9.3	11.2	10.6	1.6	16.0	18.5	1.3	0.6

In contrast with this clear difference, when I compared the Education High and Low groups on indices of linguistic complexity, I did not find significant differences. At the top you see the Mean values of 7 indices produced by T-Scan. The between-group differences were not significant because of the large within-group variance, resulting in overlapping confidence intervals.

In the middle of the slide, it is said that occurrence of some complex syntactic patterns, such as *wh*-cleft sentences, fronted subclauses, verb clusters, and center-embedded clauses was not associated with level of education.

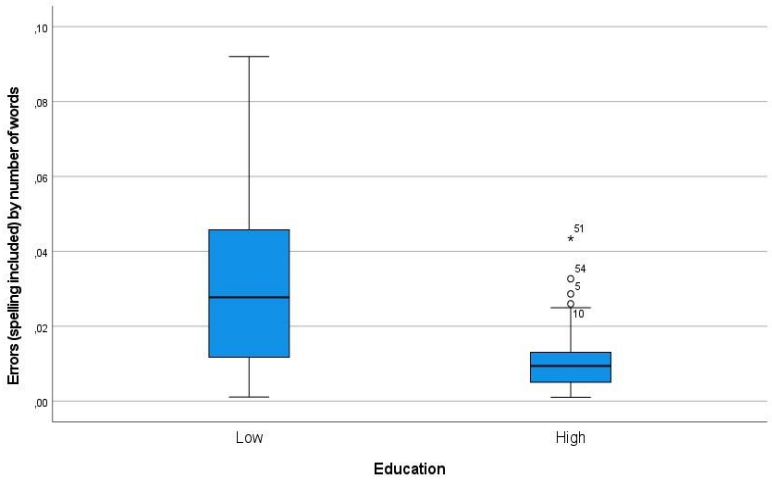
At the bottom, you see word-category percentages. They were not significantly different for the two groups, with one exception, namely the frequency of conjunctions. The subclause density of the High group was indeed significantly higher than in the Low group but the within-group variances were large and the confidence intervals overlapped substantially.



The findings reported, illustrate the claim made earlier.

Finally, let me show one more illustrative observation. Of the 98 participants in the Mulder study, 55 were willing to perform four writing tasks, modelled after the four speaking tasks. Of these 55 individuals, 25 had completed higher education, while 30 people had received less education.

Violations of norms of the standard language (proportions) in written production



Education High (College & University); n = 25
Education Low (all others); n = 30

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When I scored violations of the norms of the standard language, in terms of grammar, lexis, spelling, and punctuation, the association with level of education was substantial, as you can see in this boxplot.

Summary

- Oral every-day communication <-> written, formal communication
  - A spoken language is acquired by every community member (you don't have to smart)
  - Writing in the standardized language is acquired by a minority (you need learning opportunities and being smart helps a lot).
- Natural complex-system complexity <-> arbitrary complexity of the written standard constructed by language experts.
- Individual differences:
  - Small in natural complexity of spoking and written discourse,
  - Large in control of the arbitrary complexity of written discourse,
  - Large in quality and quantity of information provided
- Urgently needed: NLP software capable of recognizing and counting multiword constructions.

This concludes my presentation. I hope I have succeeded in showing that, for the assessment of language proficiency, it is mandatory to distinguish the natural from the arbitrary complexity of language. Thank you.