

# Might second-language instruction benefit from the view of Language as a Complex Adaptive System?

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Good morning everyone and welcome to my presentation. Let me begin by saying something about myself. I started my career, in 1971, as a Dutch as a second-language instructor. But I also became a researcher, interested in ever more abstract, underlying issues. This presentation begins with such abstract matters. But in the final part I will address matters of language instruction.

## Part One

Metatheoretical frameworks

Three schools in linguistics and psychology

## Part Two

Did the three schools affect L2 instruction?

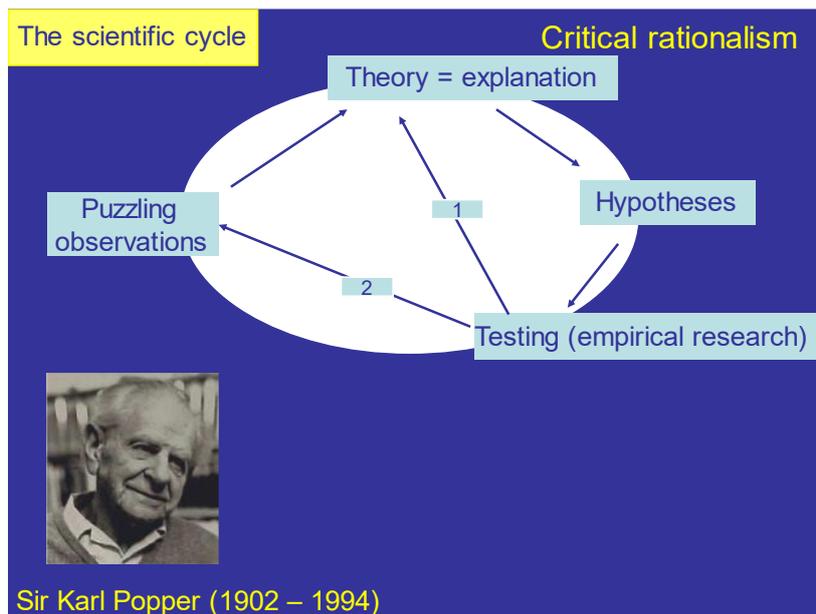
## Part three

What L2 instruction can learn from the framework of Language as a Complex System

In the first part I take you on a journey from Karl Popper, via several intermediate stages to usage-based linguistics and complex systems.

The philosopher Sir Karl Popper argued that the main issue in scientific inquiry is dealing with uncertainty about the truth. Scientific knowledge should be evidence-based but can never be ‘certain’. We cannot prove an empirical claim right but we can try to prove it wrong. This is called falsification. A fruitful theory or hypothesis must be formulated in such a way that it can be falsified. I will return to the falsification criterion shortly.

Popper argued that it is best to start with a problem, in the form of a puzzling observation, a puzzling phenomenon.



Puzzling observations require an explanation (a theory). Falsifiable hypotheses are derived from the theory and subsequently tested empirically. The findings of the empirical investigation may lead, as indicated by arrow 1, to a rejection of the theory (falsification), or the findings are interpreted as support for the theory. The findings may also provide a new understanding of what we believed to be the puzzling phenomena or problem with which we started, indicated by arrow 2.

It is best not to use the word *facts* but rather the term *observations*, to remind ourselves of the need to interpret our findings.

Popper said:

- Explanatory claims should be implausible, the bolder the better, as long as they are falsifiable.
- Knowledge is provisional.
- Theories are tools.

Around sixty years ago, these two scholars



Nobel Prize , 1973



Konrad Lorenz 1903-1989      Niko Tinbergen 1907 -1988

made the distinction between proximate questions (about causation and development) and ultimate questions (concerned with evolution and function).



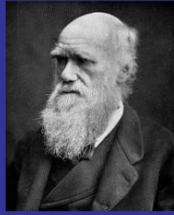
### Etiology

- **Proximate** questions
  - Causation (learning mechanisms)
  - Development (ontogeny)
- **Ultimate** questions
  - Evolution (phylogeny)
  - Function (adaptations)

Tinbergen (1963)

So let us turn to evolution theory. In his evolution theory, Charles Darwin conceived of nature as a Complex Adaptive System, led by his well-known principles, listed on this slide.

## Charles Darwin



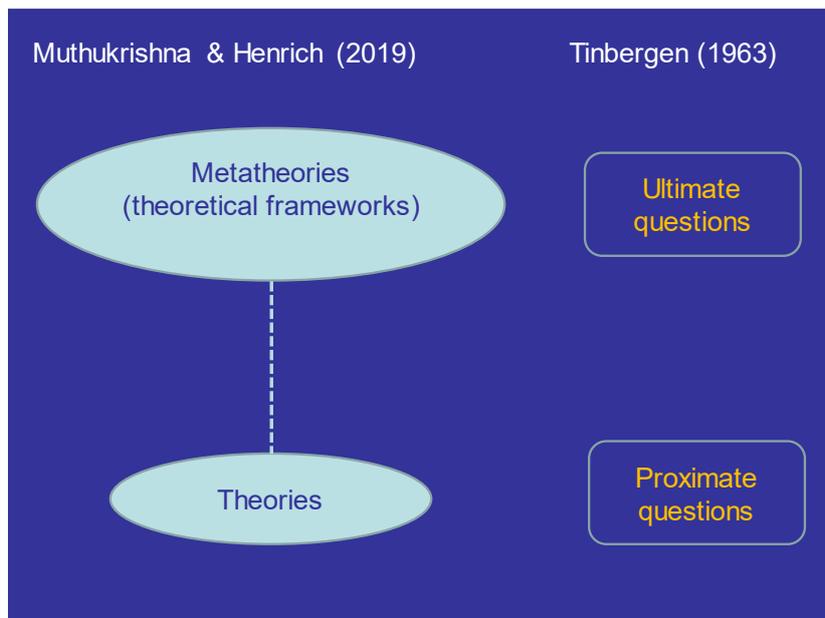
1809 - 1882

### V-S-I-R algorithm

- Variety (V)
- Selection (S) (generalized survival)
- Innovation (I)
- Replication (R)

Darwin's views still stand after 160 years of scientific inquiry. His main views have been supported by a huge amount of empirical research.

We now turn to language. In a recent paper, Muthukrishna & Henrich, argued that a general theory of human language must be evolutionarily plausible.



Evolution theory is a metatheory (also called a theoretical framework). What we demand of a metatheory is that its claims are falsifiable in principle. However, this does not mean that at some point Darwin's claims must and will be falsified. That is why one can say that Darwin's views are falsifiable in principle but were so far not falsified. Here are a few falsifiable statements, taken from a long list,

which I found in a recent book by Van den Bergh (2018). Darwin’s theory would be falsified ...

- if physiologic and behavioral diversity were lacking in any population or species;
- if a species permanently were badly adapted to their environment without becoming extinct;
- if DNA, the physical basis to store and accumulate information, did not exist;
- if the Earth should prove to be too young to permit an evolutionary unfolding of life.

OK. Now let us consider what this means for language and language acquisition.

In linguistics of the last hundred years, one can discern three main periods, associated with three schools of thought, as shown here.

Three schools (paradigms) in linguistics and psychology		
	Linguistics	Psychology
1910 → bottom-up	Structuralism Distributional analysis	Behaviorism Stimulus → Response Learning by imitation and analogy “Shaping” of the desired behavior
Cognitive Revolution 11 September 1956		
1960 → top-down	Generative linguistics Syntax central Poverty of the stimulus Faculty of Language	First-wave cognitive $\Psi$ Boxes-and-arrows cognitive psychology, deterministic perspectives
1985 → bottom-up	Usage-based linguistics Complex system Grammar emerges from Lexis through social interaction	Second-wave cognitive $\Psi$ Neural-network psychology, probabilistic perspectives

In the interest of time, let me immediately go to the third school in linguistics, usage-based linguistics. In the second part of this presentation I will return to these three schools and you will see this slide again.

It is impossible to characterize a whole paradigm in a single slide but these are the features relevant for this talk.

## Usage-based linguistics 1985 →

- Language: complex adaptive system
- Bottom-up learning through social interaction
- Representations emerge from processing
- Network elements more or less strongly connected (gradient)
- Constructions more or less abstract (form – meaning)
- No principled distinction between grammar and lexis

Now, from the view of language as a Complex System, claims can be derived that are falsifiable in principle, because language as a Complex System is a metatheory, in line with evolution theory.

Here are some falsifiable claims of language as a complex system.

- As long as they are being used, languages must change.
- In language users, the mental lexicon and grammar must change.
- In multilinguals, languages must affect one another.
- Grammatical structure emerges implicitly in L1 and L2 acquisition, given sufficient input.
- There is always competition between simplification and complexification.
- Natural languages must exhibit polysemy and ambiguity.

For many years, I thought that usage-based linguistics and Complex Systems were surely to be followed by yet another theoretical framework. I was waiting for yet another paradigm shift.

But I have now come to the conclusion that there will be no next paradigm shift. We will witness new theories under the umbrella of the meta-theory of language as a Complex System. Some of those theories will make contradictory claims

and via a process of falsification some theories will be rejected, exactly in the spirit of Popper's critical rationalism. But of all new theories we must demand that they be in line with the metatheory of language as a Complex System. The essential claims of language as a Complex System are not likely to be falsified. They will simply remain falsifiable in principle.

## PART TWO

I will now turn to the question of whether the three schools just presented did affect L2 instruction. The short answer, as we will see, is: There was very, very little influence.

### L2 instruction before 1960

- **Grammar-Translation method**
  - modelled after the instruction in 'dead' languages, like Latin and (old) Greek.
- **Direct methods**
  - emphasizing understanding and producing oral language (e.g., Berlitz school).

Before the cognitive revolution, the grammar-translation method prevailed in most western countries, with here and there a few advocates of direct methods, emphasizing listening and speaking.

But in the 1950s some educationalists, based in the U.S., developed the so-called audiolingual method, which rested firmly on behaviorist psychology.

	Linguistics	Psychology	1950s
1910 →	Structuralism Distributional analysis	Behaviorism Stimulus → Response Learning by imitation and analogy "Shaping" of the desired behavior	Audiolingual method Grammatical gradation of course material
Cognitive Revolution 11 September 1956			Contrastive Analysis
1960 →	Generative linguistics Syntax central Poverty of the stimulus Faculty of Language	First-wave cognitive $\Psi$ Boxes-and-arrows cognitive psychology, deterministic perspectives	Pattern drills Grammar more important than vocabulary
1985 →	Usage-based linguistics Complex system Grammar emerges from Lexis through social interaction	Second-wave cognitive $\Psi$ Neural-network psychology, probabilistic perspectives	Listening (in the "lab") before reading

When I began to teach Dutch as a second language in 1971, I had to use "Levend Nederlands", a typical audiolingual method with grammatical gradation, listening before reading, and the typical oral pattern drills.

These drills followed the behaviorist claims:

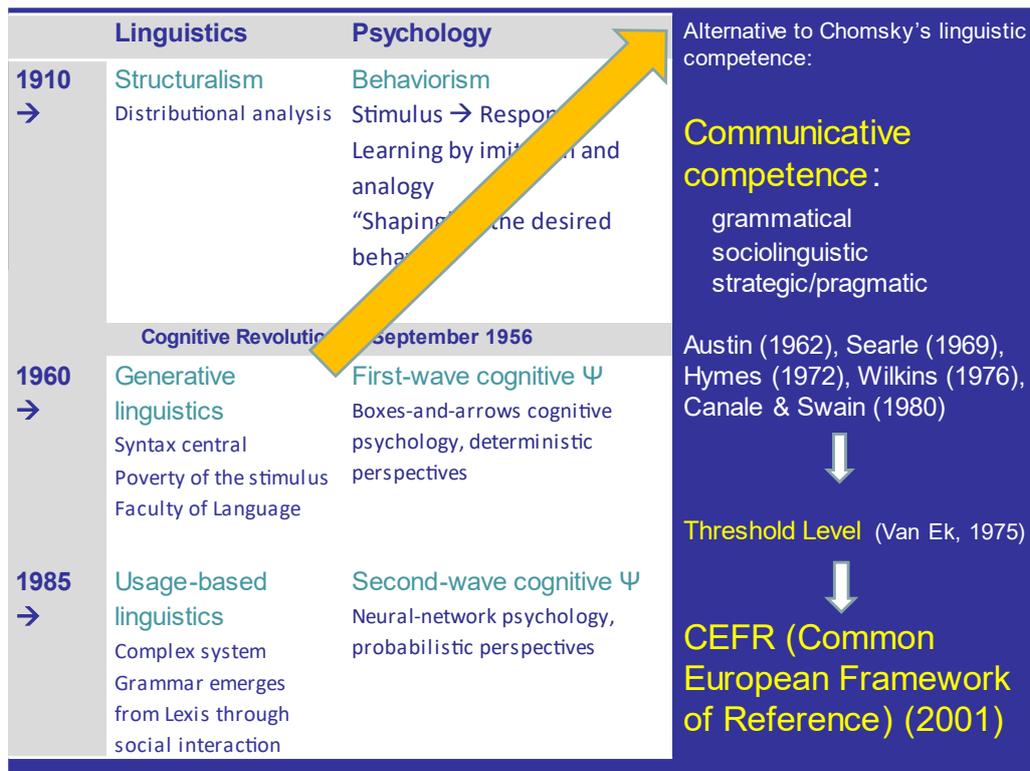
- Habits are strengthened by reinforcement.
- Foreign language habits are formed most effectively by giving the right response, not by making mistakes.
- Language is behavior and behavior can be learned only by inducing the student to behave (Rivers, 1964).

Generative linguistics only indirectly affected L2 instruction because of Chomsky's widely quoted critique of Skinner's behaviorism. Through this critique the audiolingual method soon disappeared from the scene.

	Linguistics	Psychology	
1910 →	Structuralism Distributional analysis	Behaviorism Stimulus → Response Learning by imitation and analogy “Shaping” of the desired behavior	Indirect influence:  1 Critique of Skinner’s behaviorism and thus of audiolingual method (Newark & Reibel, 1968; <i>The Natural Approach</i> , Krashen & Terrell, 1983)  2 “flirting with” explicit teaching of the rules of transformational grammar: impossible to incorporate in L2 teaching materials ( <i>cognitive code-learning theory</i> , Carroll, 1966)
Cognitive Revolution      September 1956			
1960 →	Generative linguistics Syntax central Poverty of the stimulus Faculty of Language	First-wave cognitive Ψ Boxes-and-arrows cognitive psychology, deterministic perspectives	
1985 →	Usage-based linguistics Complex system Grammar emerges from Lexis through social interaction	Second-wave cognitive Ψ Neural-network psychology, probabilistic perspectives	

In the 1970s, a few educationalists tried to use transformational grammar in L2 teaching but it soon became clear that this was pretty pointless.

But then, in the 1970s, an alternative to Chomsky’s grammatical competence was proposed: communicative competence. And this construct turned out to be extremely influential, as you can see here.



It even led to the Common European Framework of Reference. However, this development took place outside mainstream linguistics, which was dominated by generative linguistics for several decades.

Cognitive psychology after the cognitive revolution had an impact on SLA, the scientific inquiry of second language acquisition, with notions of implicit and explicit knowledge and automatization, but it hardly affected practices of L2 instruction.

	Linguistics	Psychology	
1910 →	Structuralism Distributional analysis	Behaviorism Stimulus → Response Learning by imitation and analogy "Shaping" of the desired behavior	Influence on SLA:  Explicit and implicit knowledge  strong interface weak interface no interface  Automatization (of declarative rules)
Cognitive Revolution 11 September 1956			
1960 →	Generative linguistics Syntax central Poverty of the stimulus Faculty of Language	First-wave cognitive $\Psi$ Boxes-and-arrows cognitive psychology, deterministic perspectives	
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And what about usage-based linguistics, neural network psychology and language as a complex system?

	Linguistics	Psychology	
1910 →	Structuralism Distributional analysis	Behaviorism Stimulus → Response Learning by imitation and analogy "Shaping" of the desired behavior	??
Cognitive Revolution 11 September 1956			
1960 →	Generative linguistics Syntax central Poverty of the stimulus Faculty of Language	First-wave cognitive $\Psi$ Boxes-and-arrows cognitive psychology, deterministic perspectives	
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In answering this question I have reached Part Three of this presentation.

PART THREE

What would I have done differently then, in 1971, when I taught Dutch as a second language, had I known then what I know now about usage-based linguistics, psycholinguistics, and complex systems?

Well, I guess I might have taught listening skills and grammar in a different way.

### Part three

What L2 instruction can learn from the framework of Language as a Complex System

1. Listening
2. Grammar

## LISTENING

Let me address instruction of listening skills first. This slide, which I presented earlier, contains the claim that representations emerge from processing.

## Usage-based linguistics

1985 →

- Language: complex adaptive system (CAS)
- Bottom-up learning through social interaction
- **Representations emerge from processing**
- Network elements more or less strongly connected (gradient)
- Constructions more or less abstract (form – meaning)
- No principled distinction between grammar and lexis

This is of utmost importance to L2 instruction. This brings us to the essence of language usage, namely speech processing.

Speech is available only fleetingly. Both the speaker and the hearer have to process speech quickly, on the spot, otherwise communication breaks down.

We can remember (literally) only a few words from what we just said or from what we just heard.

The fleeting character of speech is what Christiansen and Chater, two influential neurolinguists, called “the now-or-never bottleneck”.

## The Now-or-Never bottleneck: A fundamental constraint on language

**Morten H. Christiansen**

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Language learners solve this now-or-never problem by learning to chunk the incoming acoustic input at several levels: phoneme sequences, morpheme sequences, word sequences, grammatical patterns. This learning process is completely input-driven and takes a long time: several years for small children, who receive oral input every day!

## The now-or-never bottleneck: a fundamental constraint on language

Speech is available only fleetingly

- Normal speech rate: 15 phonemes / 6 syllables / 3 words per second
- Auditory trace of a (speech)sound: max 100 ms

Memory for auditory stimuli: max 9 units

Solution: **chunk-and-pass processing** (bottom-up)

Conclusion: Language acquisition is learning to process (rather than inducing a grammar)

Christiansen & Chater, *BBS*, 2016

Thus, language learning is primarily a matter of “learning to process”.

Adolescent and adult L2 learners have to learn to process speech in just the same way as children do. Learning to understand L2 speech comes *before* speaking, reading and writing.

Now, adolescent and adult L2 learners cannot spend so much time learning the language as small children can; nor can they avail themselves from the daily oral discourse at home. And furthermore, when you have already acquired one or several languages, learning to process a new language is affected by interference from the languages already acquired. But fortunately, since the invention of speech recording devices more than 100 years ago, there is a pretty good solution to this problem: On their computers, tablets or smartphones, L2 learners can listen to L2 speech, again and again, in order to learn to process speech as quickly as native speakers do. Word-by-word understanding of speech, spoken by different voices, is THE hallmark of L2 learning. I would now tell my learners that listening only once, or even twice, to a recorded conversation, or watching a soap, does not suffice. You have to listen again and again until you can process the speech stream as quickly and accurately as native speakers do.

Subtitles can help learners in learning to process speech. In an article published in 2003, I proposed that computer software be developed to help learners in trying to understand speech: word-by-word. Together with Arjen Florijn and Jan de Jong we developed a prototype, which we called “123Listen”. There were three modes of listening to a piece of speech:

## 123Listen

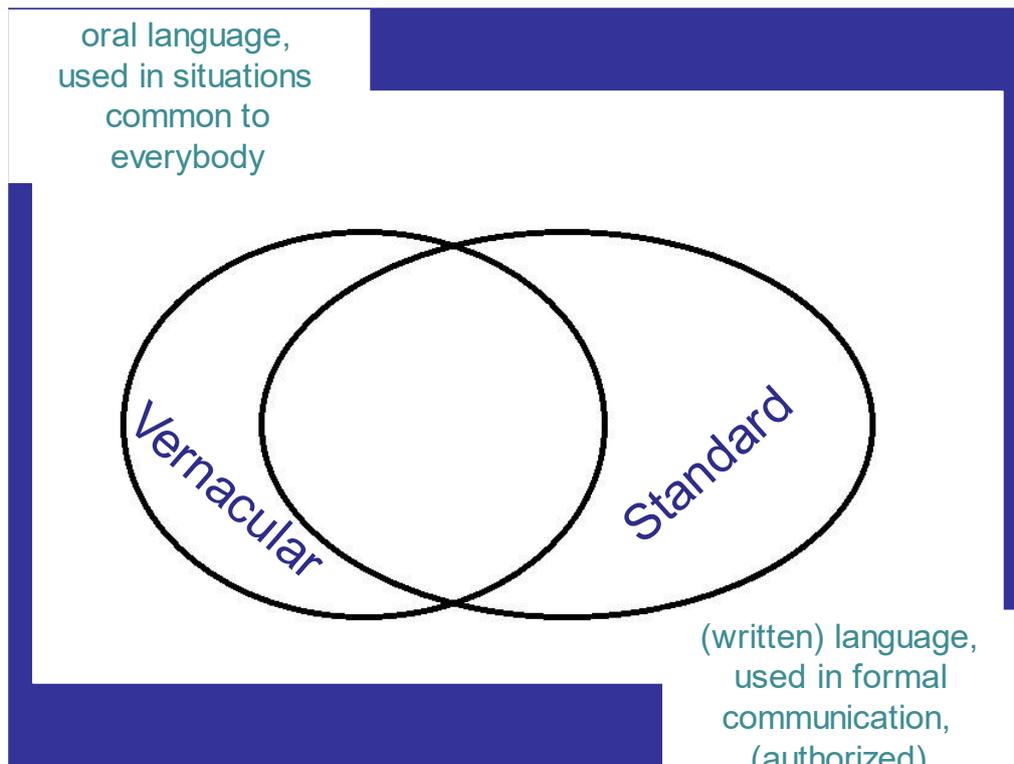
1. Listen and watch without subtitles.
2. Playing each fragment with **delayed** subtitles as often as necessary (by pressing the **Repeat** button).
3. Playing the text fragment-by-fragment with simultaneous subtitles.

Hulstijn ( *Computer Assisted Language Learning* , 2003)

The essence of this technique is formed by the second mode: Learners use their ears first - and use the text only later for feedback. The repeat button makes this technically easy and therefore increases the likelihood that learners will indeed repeat this process as long as necessary for being able to understand every word of what was said. I firmly believe that learners are more likely to perform such a focused rehearsal activity if technology makes this very easy.

## GRAMMAR

All right. Let me turn now to grammar teaching. First, I would tell my students that it is useful to make a distinction between the spoken language of every-day communication, on the one hand and the formal written language on the other hand. I refer to these two varieties with the labels Vernacular and Standard (Pawley & Snyder, 1983).



The vernacular is the core of our repertoire, a natural complex system, evolved over centuries of spontaneous oral language use. This language is shared by all (typical) adolescent and adult native speakers.

The standard language, in contrast, is the product of conventions of do's and don'ts, proposed by language experts and sanctioned by governments.

Then I would tell my students that language production in the vernacular (speaking) is not rule-governed, as Chomsky argued. Instead of rules, I would speak of grammatical patterns. Some of these patterns can be observed very frequently. I would call them typical patterns.

## Grammar of the vernacular

- Language production is **not** rule-governed
- A syntactic pattern (“productivity”) emerges from, and is constrained by lexical items
- Syntactic patterns and lexical items are interconnected in a **single network**
- **Typicality**: syntactic patterns are probabilistic/statistical

For instance, in Dutch,

- the typical place of an adjective is before the noun, not after it. Then I would give some examples.
- The typical main clause has the finite verb in second position.
- The typical subclause begins with a conjunction (such as ‘omdat’) and the finite verb can be found towards the end.

Typical patterns have emerged from centuries of language use. They do not rest on man-made laws or rules.

There are many constructions that do not exhibit this typical main pattern. Such constructions are often used with some typical words: they are “lexically constrained”.

For example, in Dutch (as in English) it is possible to form a conditional subclause that does not contain a conjunction and in which the finite verb is placed at the beginning:

*Mocht u nog vragen hebben, dan kunt u me gerust bellen of mailen.*

*Should you have any question, please feel free to phone or mail me.*

Often, such conditional clauses are used with ‘mocht’ (*should*). Although one can form such clauses with other verbs, the one with ‘mocht’ is typical. The labels ‘often’ and ‘typically’ are synonymous. Typicality is a matter of differences in frequency; large frequency differences are a characteristic of complex systems.

Here is another example, the verb ‘geloven’ is typically followed by complement clauses. But the verb ‘beloven’ is typically followed by an infinitival clause.

*Ik geloof dat ... [I believe that ...]*

*Ik beloof om ... [I promise to ...]*

The upshot of all this is that students acquire grammatical patterns (via vocabulary) through exposure to massive input. So I would tell my students to listen and read as much as they can, right from the beginning of studying their L2. You acquire grammatical patterns of the vernacular bottom up, through input exposure. Hence I endorse *task-based language teaching* (TBLT) and *content and language integrated learning* (CLIL).

In the Standard Language we do follow ‘rules’ if you will, but I would rather speak of ‘conventions’ or ‘prescriptive regulations’ and ‘advice’. This is what children begin to learn in elementary school, continue learning in secondary school and college or university. While all adult native speakers have control of the vernacular, there exist huge differences in control of the standard language. Only a small minority of adult native speakers end up in professions where full control of the standard language is required.

In short, in my Dutch L2 classes, I would speak of “patronen” (patterns), not of “regels” (rules) in the grammar of the vernacular, and of “voorschriften en adviezen” (prescriptions and advices) in the grammar of the formal standard language.

With this I have reached the end of my presentation. I have tried to show how many linguists and psychologists today embrace the ideas of usage-based linguistics, neural networks, and, in particular, complex systems. I have illustrated how these ideas might inform L2 instruction with respect to listening skills (word-by-word understanding) and grammar (acquisition of grammatical-

lexical patterns of the vernacular and learning the prescriptions of the standard language).

The bad news is that acquiring a language (a native language as well as a nonnative language) is a long journey (requiring massive input and much practice) but the good news is that, at least for the acquisition of the vernacular, you don't have to be smart.

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