



# On using AI methods to carry out SLA research in real-life school contexts

**Detmar Meurers**

University of Tübingen & Leibniz-Institut für Wissensmedien (IWM)

based on collaborative research:  
<http://icall-research.de>

Language and Speech Laboratory, University of the Basque Country  
Micaela Portilla Research Centre, Vitoria-Gasteiz, March 19, 2024



## Overview

- Second Language Acquisition Research:
  - insights from multiple strands of SLA research and some desiderata
  - instructed SLA: from “nice to have” transfer of SLA research results to crucial large-scale data source needed for research on ecologically-valid language learning!
- Digital learning contexts:
  - increasingly widely used in real-life teaching and learning
  - adding AI methods to make digital tools more effective in practice and useful for SLA research
- Scaling up SLA intervention studies using digital means
  - Web-based studies
  - Randomized Controlled Trials in schools



## Second Language Acquisition Research

- long history (??), EuroSLA since 1989/1991, SLA recognized as a distinct discipline for over 20 years (?)
- identified a wide range of linguistic, cognitive, social factors influencing SLA, including:
  - Input Hypothesis, i+1 Hypothesis (?)
  - Noticing Hypothesis (?)
  - Teachability Hypothesis (?)
  - Zone of Proximal Development (?)
  - Output Hypothesis (?)
  - Interaction Hypothesis (??)
  - Cognition Hypothesis (?) in Task-Based Learning
  - ...



## Second Language Acquisition Research: Some challenges

- limited operationalization and empirical breadth of some key notions:
  - i+1, developmental sequences, zone of proximal development, . . .
- in real-life learning, linguistic, cognitive, and social factors are simultaneously involved
  - ?: “SLA is a **multidimensional** phenomenon, involving (at least) biological, neurological, social, psychological, affective, and personal variables plus [. . .] the effect of instruction.”
  - ?: important to study **interactions** between individual differences, treatments, structures
  - But the reliable identification of interaction effects require a lot of data!





## Second Language Acquisition Research: Obtaining rich data at scale

- How can we obtain more data on the learning process and product given a range of factors?
- 34 million children in secondary schools in Europe are learning English as L2 and 20 million children are learning more than one foreign language (Eurostat 2020/21)
  - relatively understudied population in SLA research
  - legal and practical issues make it difficult to stage interventions and collect data at scale
- digital learning contexts offer new opportunities for collecting data



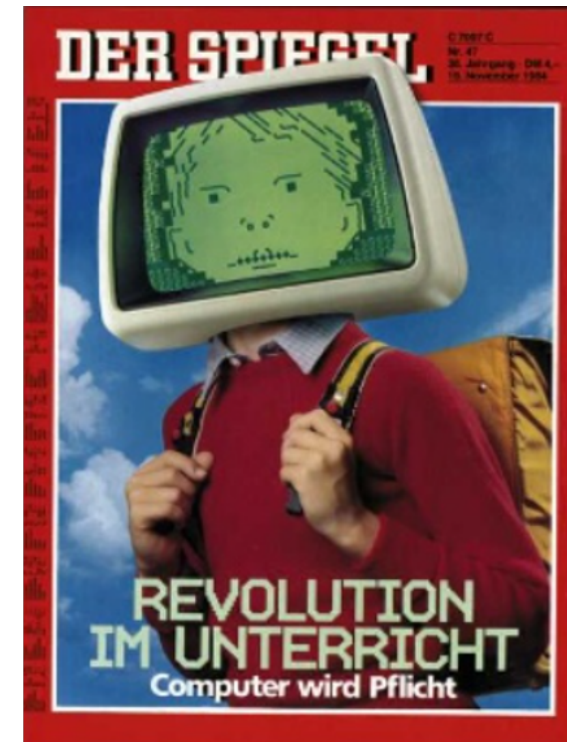
## Digital Learning Contexts

- Schools going digital is a common topic in public discourse, e.g.:

*Computers in all schools, all students at the computers – this is the program the ministers of education want to realize quickly.*

[Spiegel No. 47 / 18.11.1984]

- More recent game changers:
  - widespread use of mobile digital devices (smartphones) by children
  - Corona pandemic required systematic use of digital channels
  - AI methods support development of tools linked to SLA concepts





## Digital learning contexts: from digital media to adaptive, interactive tools

- Traditionally, computers used in education encode and exchange digital information to
  - increase motivation through **authentic multimedia material**
  - support **communication** with native speakers (using text, audio, video)
  - **mechanically practice** vocabulary and grammar (without modeling the learner or providing feedback)
- To obtain **interactive, adaptive** tools, one needs to add **AI methods** that can
  - analyze and generate **language** (using computational linguistic methods)
  - model **learners** and their development towards the curricular **learning goals**
  - analyze and adaptively select or generate **learning activities**
  - Intelligent Computer-Assisted Language Learning (ICALL)
- ⇒ Explore ICALL tools linked to SLA concepts to
  - effectively support learners and teachers
  - research SLA hypotheses in real-life contexts



## Key Factors: **Input and $i+1$**

- **Input Hypothesis (?)**

- access to comprehensible input at  $i+1$  is essential
- input should be “one step more complex” than the interlanguage of the learner

⇒ ICALL tools can help us identify linguistic complexity to search for such  $i+1$  input:

- SyB System (<http://complexity.schule>, ?)
- FLAIR System (<http://flair.schule>, ?)

# SyB: Syntactic Benchmark (<http://complexity.schule>, ?)

## My first day at Hogwarts

This morning I woke up at 8 o'clock, then I went at breakfast. After breakfast I took my backpack and went with my parents to King's Cross by car. There I went in the red Hogwarts express, said good-bye to my Mum and the train has started. After 2 hours we had arrived there. Hagrid has received us. Then we went to the boats and over the sea to Hogwarts. In Hogwarts Professor has bringed us in the Great Hall. Hogwarts is so big. There we are to be sorted in the 4 houses by sorting hat. There are f4 houses, Griffindor, Huffelpuff, Ravenclaw and Slitherin. Nobody wanted to Slitherin because there were the dark Wizards. So I was sorted to Gryffindor. I was so happy. My friends Jonathan and Denny are Hufflepuffs. After sorting, we had eaten so much. I have heard that the house elves had maked the lunch. After lunch, Professor Dumbledore had said a lot of things with the forrest and other things. Then the trust student, it was James Sirius, the son of Harry Potter has bringed us to the Griffindor leasure room and to the dormitorys. I share my room with the son of Newt and Lunas son. Yet I lie on my bed and think about playing Quidditch and the teachers. Good bye diary book.

Challenge

Analyze



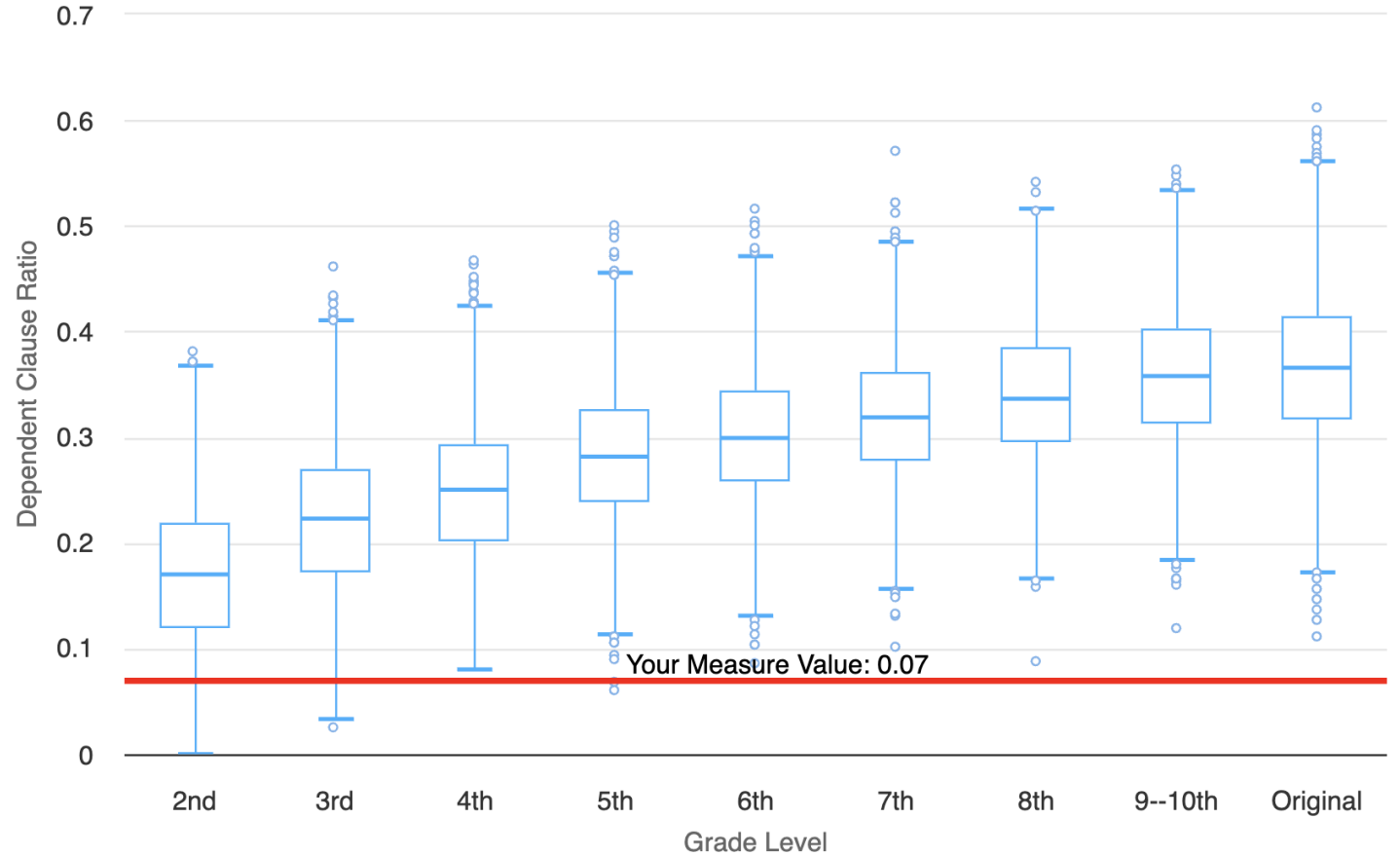
This text is used to scale your proficiency on the target levels. It will be analyzed automatically to identify the aspect of your language that needs to be further improved.

Syntactic Measure:

Dependent Clause Ratio ▼

Challenge

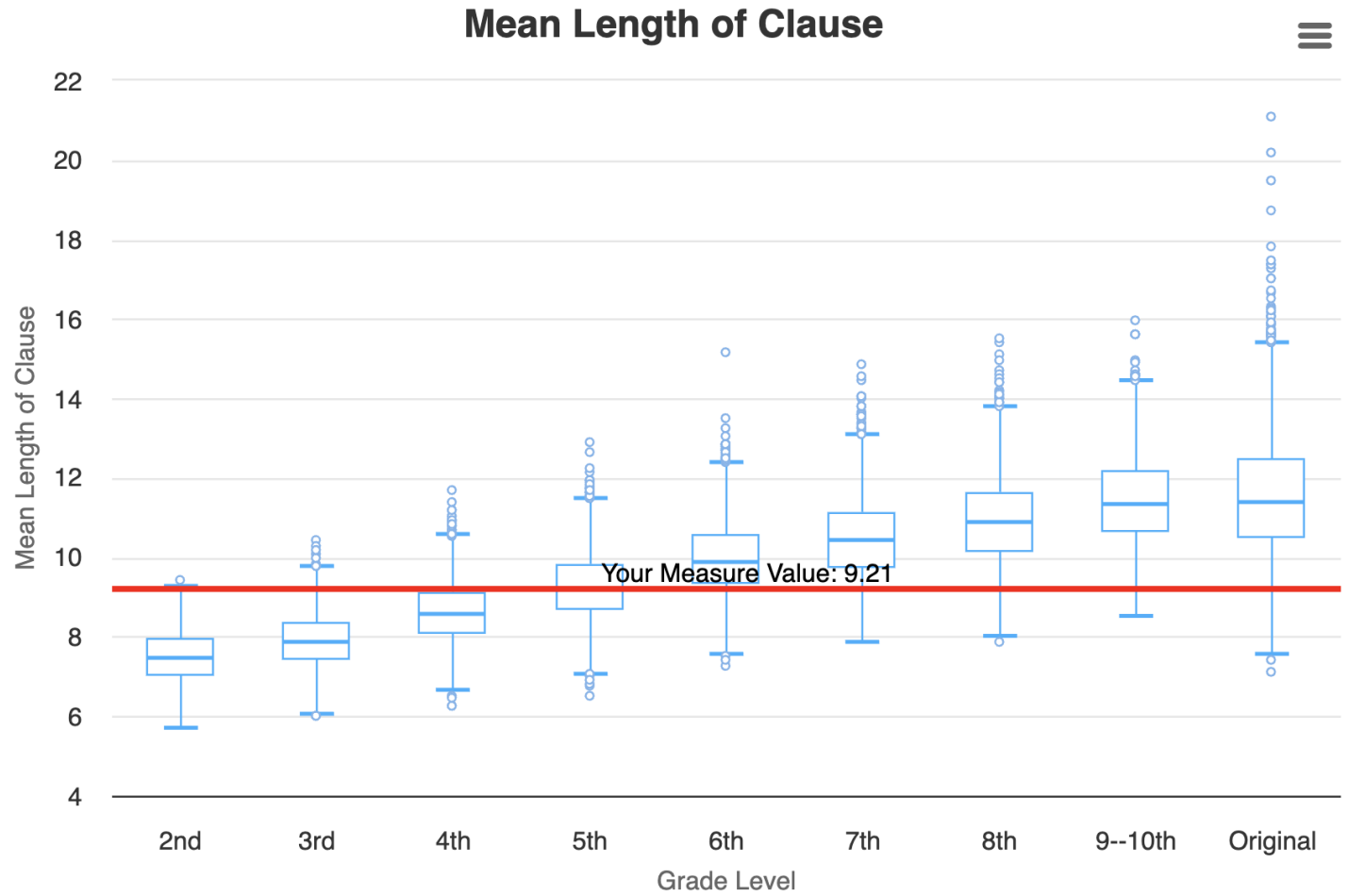
### Dependent Clause Ratio



Syntactic Measure:

Mean Length of Clause

Challenge



All Grade Levels ▼

Challenge Level



### Middle-class Latinos "step it up a notch" as communities thrive

Target Measure: 10.19

When Rick Rodriguez Sr. moved into a three-bedroom home in Downey, California, in the mid-1980s, a neighbor interrupted his yard work with a question: "You're not going to be one of those guys that parks in the front yard and lets chickens run around in the front yard, are you?" Rodriguez, 54, one o...

Grade Level: 8th



### 11 of 12 defendants in Atlanta schools case found guilty

Target Measure: 10.05

ATLANTA ? After considering nearly five months of testimony, a Fulton County jury convicted all but one of the dozen former Atlanta teachers and administrators on trial in the largest test-cheating scandal in the nation. On Wednesday afternoon, 10 former teachers and school administrators were handcuffed...

Grade Level: Original



### Rude political candidates conflict with school anti-bullying rules

Target Measure: 9.27

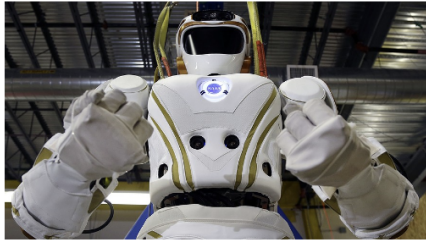
BUFFALO, N.Y. ? Ryan Lysek rose to become vice president of his fifth-grade class at Lorraine Academy in Buffalo, New York. The sitting veep got bounced for saying things that went against the school's anti-bullying rules. So the 10-year-old is a little puzzled that candidates running to lead the co...

Grade Level: 8th



All Grade Levels

Challenge Level



### NASA's Valkyrie robots set the table for human life on Mars

Target Measure: 12.40

LOWELL, Mass. ? Four sister robots built by NASA could be pioneers in the colonization of Mars, part of an advance construction team that sets up a habitat for more fragile human explorers. But first they're finding new homes on Earth and engineers to hone their skills. The space agency has kept on...

Grade Level: Original



### L.A. subway work burps up a bonanza of prehistoric swag

Target Measure: 12.51

LOS ANGELES ? Seventy feet below Wilshire Boulevard, subway construction crews were hard at work. Fresh air roaring from giant ventilation pipes partly covered up the sickly sweet smell of petroleum. Amid the clatter of jackhammers and the whine of a mini-excavator, paleontologist Kim Scott scouted ...

Grade Level: 9--10th



### Don?t count on dance class to give your kid a workout, study warns

Target Measure: 12.73

Only 8 percent of kids enrolled in after-school dance programs got enough exercise during class to meet federal guidelines for moderate to vigorous physical activity, a new study finds. Even worse, only 6 percent of adolescents got the recommended 30 minutes of moderate to vigorous exercise during t...

Grade Level: Original



## From research prototype to a tool usable in practice

- Exclusive focus on specific linguistic complexity aspect is too academic for real-life use.
  - How about supporting selection of material that is
    - (i) **rich in developmentally proximal language**
      - **Teachers** specify general proficiency level and pedagogically-focused language means.
    - (ii) **motivating in terms of content**
      - **Learners** search for texts that fit their individual interests.
- ⇒ FLAIR Search Engine (<http://flair.schule>, ?)

# FLAIR Search Engine (<http://flair.schule>, ?)



FLAIR



## Search



Click on the search icon below and type in a query. FLAIR will fetch the top results from the Bing Search Engine.

## Configure



Configure the settings: text (difficulty, length) and language (the passive, wh- questions, academic vocabulary, ...). You can export the settings to apply them to all further searches. FLAIR will re-rank the documents



Enter a query

climate change |site:www.bbc.com

English

50 Results

50 Results (0 Filtered)

VISUALIZE ↗

SHARE SEARCH SETUP ↗

**Text Characteristics:** ☰

Length:

Prefer shorter texts.

Levels:

- ✓ A1-A2 0 / 50
- ✓ B1-B2 34 / 50
- ✓ C1-C2 16 / 50

**Constructions:** ✓

- ▼ Sentences ↻
- ▼ Parts of Speech ↻

**Language Use:** 📄

Academic Vocabulary ✎ ↻

# 'climate change site:www.bbc.com'

- 1 **What is climate change? A really simple guide - BBC News** ⋮

<https://www.bbc.com/news/science-environment-24021772>

→ Climate change is a shift in those average conditions. The rapid climate change we are now seeing is caused by humans using oil, gas and coal for their homes, factories and transport. When...
- 2 **A brief history of climate change - BBC News** ⋮

<https://www.bbc.com/news/science-environment-15874560>

→ Climate change hardly registers on the agenda, which centres on issues such as chemical pollution, atomic bomb testing and whaling. The United Nations Environment Programme (Unep) is formed as a ...
- 3 **Climate change: IPCC report warns of 'irreversible' impacts ... - ...** ⋮

<https://www.bbc.com/news/science-environment-60525591>

→ The Intergovernmental Panel on Climate Change says that humans and nature are being pushed beyond their abilities to adapt. Over 40% of the world's population are "highly vulnerable" to...
- 4 **Climate change: 12 years to save the planet? Make that 18 mo...** ⋮

<https://www.bbc.com/news/science-environment-48964736>

→ Prince Charles has stressed how important the next 12 months are in tackling climate change One of the understated headlines in last year's IPCC report was that global emissions of carbon dioxide...
- 5 **Climate change: Young people very worried - survey - BBC News** ⋮

<https://www.bbc.com/news/world-58549373>



▼ Sentences ↻

▼ Parts of Speech ↻

▼ Verbs ↻

▼ Verb Forms ↻

▼ Tenses ↻

▼ Aspect ↻

▼ Time ↻

▼ Voice ↻

▼ Phrasal ↻

✓ Phrasal verbs ⓘ 48/50



▼ Modal ↻

▼ Transitive ↻

▼ Imperative ↻

# 'climate change site:www.bbc.com'

1

The law that could make climate change illegal - BBC Future

<https://www.bbc.com/future/article/20200706-the-law-that-could-make-climate-change-illegal>

Climate change is a global problem – if it is not tackled everywhere, it will affect everyone. The modern world is also incredibly intertwined: products – and resultant emissions – made in one...



2

Climate change: US formally withdraws from Paris agreement

<https://www.bbc.com/news/science-environment-54797743>

After a three-year delay, the US has become the first nation in the world to formally withdraw from the Paris climate agreement. President Trump announced the move in June 2017, but UN regulations ...



3

Climate change: Can an enormous seaweed farm help curb it?

<https://www.bbc.com/news/science-environment-63200589>

He's confident his Seafields floating farm will draw sufficient CO2 from the air to moderate the effects of climate change, while also earning its backers carbon credits. At 55,000 sq km (21,200 ...



4

Plant-based diet can fight climate change - UN - BBC News

<https://www.bbc.com/news/science-environment-49238749>

Climate change poses a threat to the security of our food supply. Rising temperatures, increased rain and more extreme weather events will all have an impact on crops and livestock.



5

The climate films shaping society - BBC Future

<https://www.bbc.com/future/article/20221021-how-climate-change-in-film-shape-society>

## The law that could make climate chan... ✕

B1-B2

149 Sentence(s)

2802 Word(s)

2020. People are frustrated, but several governments have come and gone since the goal was set. "Don't blame us," the current government says. "We didn't take the decisions that led us here."

The short-term cycles of government can be a real problem for climate change. Even if climate goals are **laid down** in law, there can often be few concrete measures to stop a succession of governments from taking decisions that collectively **end up** with them being missed.

But a new and ambitious climate law recently passed in Denmark tries to find a way around this problem, and some of the other common pitfalls of climate laws. It makes Denmark one of a small number of countries beginning to provide new blueprints of how government can genuinely tackle climate change. Its law could **turn out** to be one of the closest things yet to a law that would make climate change – or at least the lack of effort to stop it – genuinely illegal.

You might also like:



Construction	Count	Weight
Verbs > Phrasal > Phrasal...	14	(5)

Verbs > Phrasal > Phrasal...

ALL CONSTRUCTIONS

Export document

Include text formatting





## Facilitating SLA research using such ICALL approaches

- Linguistic complexity (?) & alignment research (?)
- Do language learners show alignment with increasingly complex (“i + 1”) language?
- (i) ? : analyzed alignment in continuation writing (data by ?)
  - ⇒ 403 of 575 linguistic complexity measures show alignment
- (ii) ? : ICALL continuation writing study
  - 112 Chinese learners of English
  - worked on sequence of ten increasingly complex texts, with four different challenge groups (MLTU)
  - ⇒ Learners in low and middle challenge group showed more alignment than high challenge group.
  - ⇒ There is alignment, but no clear evidence for learning.
- Some future directions:
  - What constitutes + 1 in the different dimensions of linguistic complexity?
  - When does alignment lead to lasting learning effects?



## Key Factors: **Noticing** and **Focus-on-Form**

- Input alone only results in **Basic Varieties** (?).
  - Some attention to forms crucial: **Noticing** Hypothesis (?)
  - Foreign language learners need a **Focus-on-Form** (??).
- increase salience (?)
- ⇒ ICALL tools can support automated Input Enhancement (IE):
- ⇒ Visual: Highlighting of target forms on **user-selected** web pages (??)
  - ⇒ Functional: Generation of questions on sentences containing target forms (?)



# Visual Input Enhancement example



Africa

Americas

Asia-Pacific

Europe

Middle East

South Asia

**UK**

England

Northern Ireland

Scotland

Wales

UK Politics

Education

Magazine

**Business**

**Health**

**Science &  
Environment**

**Technology**

**Entertainment**

E-mail this to a friend

Printable version

## Cows also 'have regional accents'

**Cows have regional accents like humans, language specialists have suggested.**

They decided to examine the issue after dairy farmers noticed their cows had slightly different moos, depending on which herd they came from.

John Wells, Professor of Phonetics at the University of London, said regional twangs had been seen before in birds.

The farmers in Somerset who noticed the phenomenon said it may have been the result of the close bond between them and their animals.

Farmer Lloyd Green, from Glastonbury, said: "I spend a lot of time with my ones and they definitely moo with a Somerset drawl.



Cows moo with a regional twang



Listen

**Cow moo recordings**

### SEE ALSO

- ▶ 'Accent' confirms unique species  
15 Aug 06 | Highlands and Islands
- ▶ Brain bug changes woman's accent  
10 Jul 06 | Staffordshire
- ▶ What makes you local?  
18 Feb 05 | Magazine

### RELATED INTERNET LINKS

- ▶ University of London phonetics department

The BBC is not responsible for the content of external internet sites

### TOP UK STORIES

- ▶ Major manhunt for Afghan soldier
- ▶ Unemployment dips to 2.47 million
- ▶ PM condemns sympathy for Moat



| News feeds

### MOST POPULAR STORIES NOW

MOST SHARED

MOST READ

1

BBC News



# Visual Input Enhancement example: making prepositions salient



Africa

Americas

Asia-Pacific

Europe

Middle East

South Asia

**UK**

England

Northern Ireland

Scotland

Wales

UK Politics

Education

Magazine

**Business**

**Health**

**Science &**

**Environment**

**Technology**

**Entertainment**

E-mail this **to** a friend

Printable version

## Cows also 'have regional accents'

**Cows have regional accents like humans, language specialists have suggested.**

They decided to examine the issue **after** dairy farmers noticed their cows had slightly different moos, depending **on** which herd they came **from**.

John Wells, Professor **of** Phonetics **at** the University **of** London, said regional twangs had been seen before **in** birds.

The farmers **in** Somerset who noticed the phenomenon said it may have been the result **of** the close bond **between** them and their animals.

Farmer Lloyd Green, **from** Glastonbury, said: "I spend a lot **of** time **with** my ones and they definitely moo **with** a Somerset drawl.



Cows moo **with** a regional twang

Listen **Cow moo recordings**

### SEE ALSO

- ▶ 'Accent' confirms unique species  
15 Aug 06 | Highlands and Islands
- ▶ Brain bug changes woman's accent  
10 Jul 06 | Staffordshire
- ▶ What makes you local?  
18 Feb 05 | Magazine

### RELATED INTERNET LINKS

- ▶ University **of** London phonetics department

The BBC is not responsible **for** the content **of** external internet sites

### TOP UK STORIES

- ▶ Warnings **before** Potters Bar crash
- ▶ Gaza ship Britons 'to head home'
- ▶ Walcott left out **of** England squad

| News feeds

### MOST POPULAR STORIES NOW

MOST SHARED

MOST READ

1 Doubt cast **on** Israel raid



## Facilitating SLA research using such ICALL approaches




- (i) ?: exploratory study using ICALL to support noticing of determiners
- (ii) ?: Study targeting the acquisition of English phrasal verbs
  - phrasal verbs are frequent and important for interpretation, but notoriously difficult (→ avoidance)
  - 127 participants (advanced L2 English, L1 German) read 40 texts in a two week span
  - randomly assigned to two conditions: meaning-focused and form-focused
  - form-focused group saw phrasal verb visually highlighted and particle as multiple choice item

First read the article, then click the button at the end of the article to move on to the questionnaire.

RETIREMENT NEWS | Mon Aug 15, 2016 | 9:34am EDT



# Are you saving too much for your kids' college?



By Chris Taylor | NEW YORK





NEW YORK Parents these days are expected to **pull off** a financial Mission: Impossible. Cover the monthly bills, **pay** around    debts, help elderly parents, save for retirement and for kids' college costs, all with incomes that may have been flat for years.

Facing such a demanding feat, here's some advice you may not often hear: When it comes to your kids' college costs, maybe you are doing too much.

To wit, 42 percent of parents are actually losing sleep over college costs, up from 28 percent just two years ago, according to new data from the Parents, Kids & Money survey by Baltimore-based money managers T. Rowe Price.

Of parents surveyed, 57 percent are willing to **take**   at least \$25,000 of college debt on behalf of their kids, and 19 percent are willing to borrow \$100,000 or more.

More parents (58 percent) report having college-savings   for their kids, rather than retirement savings for themselves (54 percent).

"Parents are more stressed than ever about college   feel guilty about not being able to help more, and many are willing to **take**   huge debts," says Marty Allenbaugh, a senior marketer for T. Rowe Price.



## Facilitating SLA research using such ICALL approaches

- (i) ? : exploratory study using ICALL to support noticing of determiners
- (ii) ? : Study targeting the acquisition of English phrasal verbs
  - phrasal verbs are frequent and important for interpretation, but notoriously difficult (→ avoidance)
  - 127 participants (advanced L2 English, L1 German) read 40 texts in a two week span
  - randomly assigned to two conditions: meaning-focused and form-focused
  - form-focused group saw phrasal verb visually highlighted and particle as multiple choice item

ICALL setup integrated assessment of working memory (?):

- OSpan (?), but using Klingon (?) to reduce cheating

⇒ **interaction effect** between **working memory** and **form-focused instruction**

- ⇒ more benefit from attention to form for learners with higher working memory capacity
  - WM assists simultaneous processing of form, meaning and use of language forms (?)
  - confirms relevance and feasibility of investigating interaction effects (?)



## Key Factors: **Practice, Feedback, ZPD**

- Skill Acquisition Theory (?)
  - Teaching provides declarative knowledge, then **practice** is needed for automated skills.
  - Goal: fluent ability that does not bind attention
- Support learners in their individual **Zone of Proximal Development** (?)
  - scaffolded feedback while working on an activity: **micro-adaptivity**
  - adaptive selection of learning materials/activities: **macro-adaptivity**

Very challenging for teachers in practice: lack of time, diagnostics, adaptive materials

- ⇒ ICALL tools can adaptively support individualized practice (?)
- (i) ? : ICALL dialog system Sascha to practice English question formation
  - (ii) Intelligent Tutoring System FeedBook (??)



## Facilitating SLA research using such ICALL approaches

- **?: English question acquisition**
  - research context: developmental sequences proposed by ?
  - research question: effectiveness of recasts in spoken and written mode
- The ICALL system Sascha developed by Ken Petersen supports dialog interaction for information gap, story sequencing, and spot the difference activities.





08:32

Is the bird on his  
shoulder?





## Facilitating SLA research using such ICALL approaches

- **?**: supporting acquisition of questions in English
    - research context: developmental sequences proposed by ?
    - research question: effectiveness of recasts in spoken and written mode
  - The ICALL system Sascha developed by Ken Petersen supports dialog interaction for information gap, story sequencing, and spot the difference activities.
  - Study design:
    - 56 ESL at public high school, Washington DC, mostly Spanish L1 (13 novice, 43 intermediate)
    - three groups: human-computer (ICALL), human-human, control
    - intervention: three times 30 minutes interactions with Sascha system or human interlocutor
- ⇒ Result: ICALL users showed development along expected sequences, parallel to human-human oral interaction, both better than control.





# From printed workbook to AI-based FeedBook

## Grammar check: Problems

Everyone has got problems. What could these people do differently?

0. Gillian is sad. Her mother never has any time for her.

*If Mrs Collins had more time for Gillian, Gillian wouldn't be so sad.*

1. Mrs Collins feels bad. She should listen more to Gillian.

*If she listens more to Gillian, she feels better.*

2. Gwynn is very disappointed. Gillian doesn't like Wildings School as much as I

*If Gillian like Wilding School as much as I*

**AUSGANGS-  
PUNKT**

**2** Welcome to Wales

**ZIEL**

## CYP 2 Grammar check: Problems

Everyone has got problems. What could these people do differently? Use conditional clauses in your answers.

0. Gillian is sad. Her mother never has any time for her.

*If Mrs. Collins had more time for Gillian, Gillian wouldn't be so sad.* ✓ ?

1. Mrs Collins feels bad. She should listen more to Gillian.

*If she listens more to Gillian, she feels better.*

2. Gwynn is very disappointed. Gillian doesn't like Wilding

3. George and Rajiv feel bad because they don't have a pres

Feedback für "If she listens more to Gillian, she..."

With conditional clauses (type 2), we use the simple past in the if-clause, not the simple present.

Hilfreich?

Ja  Nein

OK

# FeedBook: Feedback on language forms

## B1 Off to Greece again

Mr Lambraki is checking flights to Greece. Read the information he has found on the two airlines and use the adjectives below to compare them.

• LiF8R: Comparison of adjectives

*expensive (ticket) · early (departure) · attractive (shopping on board) · good (choice of food offered on board) · healthy (food and drinks) · suitable (airport) · cheap (tickets for shuttle bus) · friendly (service on board) · easy (online booking)*

Midair	Air-Con
<ul style="list-style-type: none"><li>• London – Athens from 39 pounds</li><li>• departure 7.00 am</li><li>• non-stop</li><li>• small choice of duty free articles for shopping on board</li><li>• low-calorie and vegetarian food available<sup>1</sup></li><li>• from Gatwick only 28 miles from London</li><li>• tickets for shuttle bus are 10 euros</li></ul>	<ul style="list-style-type: none"><li>• London – Athens from 57 pounds</li><li>• departure 12.15 pm</li><li>• via Berlin</li><li>• all international brands for shopping on board</li><li>• snacks: crisps and chocolate bars</li><li>• from Stansted only 40 miles from London</li><li>• tickets for shuttle bus are 10 euros</li></ul>

1.

*The tickets at Air-Con are expensiver than at Midair.*



2.



# FeedBook: Feedback on language forms

## B1 Off to Greece again

Mr Lambraki is checking flights to Greece. Read the information he has found on the two airlines and use the adjectives below to compare them.

• LiF8R: Comparison of adjectives

*expensive (ticket) · early (departure) · attractive (shopping on board) · good (choice of food offered on board) · healthy (food and drinks) · suitable (airport) · cheap (tickets for shuttle bus) · friendly (service on board) · easy (online booking)*

Midair	Air-Con
<ul style="list-style-type: none"><li>• London – Athens from 39 pounds</li><li>• departure 7.00 am</li><li>• non-stop</li><li>• small choice of duty free articles for shopping on board</li><li>• low-calorie and vegetarian food available<sup>1</sup></li><li>• from Gatwick only 28 miles from London</li><li>• tickets for shuttle bus are 10 euros</li></ul>	<ul style="list-style-type: none"><li>• London – Athens from 57 pounds</li><li>• departure 12.15 pm</li><li>• via Berlin</li><li>• all international brands for shopping on board</li><li>• snacks: crisps and chocolate bars</li><li>• from Stansted only 40 miles from London</li><li>• tickets for shuttle bus are 10 euros</li></ul>

Feedback für "The tickets at Air-Con are expensiv..."

When an adjective has three or more syllables, we form the **comparative** with 'more' and the **superlative** with 'most'.



Hilfreich?

Ja  Nein

OK

1.

*The tickets at Air-Con are expensiver than at Midair.*

2.

# FeedBook: Feedback on language meaning and forms

## B1 Gillian's diary

Read Gillian's diary entry and complete these sentences.

<p>Friday 23rd September</p> <p>We'll drive to the north coast tomorrow and have a look at two boarding schools with Gwynn. His sister went to Wildings and he says it would be great for me. If they had a football team, it wouldn't be so bad, but it's all so girly-girly with horses and ballet dancing and everything, yuk! I don't want to go to the school in Llandysul either. It still feels like Gwynn and Mum just want me to go to boarding school because of the new baby. Miss my pals like crazy, miss London and my old school. If my friends were here, boarding school would actually be fun. Being the new girl at school without any friends will be horrible. ☹️ And it's all Gwynn's fault! The village where we live now is the worst. 20 minutes to the nearest supermarket. If there was a shopping</p>	<p>centre, I could at least go shopping. But there's nothing, no shops, no cinema, no nothing ... only sheep!</p> <p>My room is really nice and big though and we have a fab garden which is great for playing football. If I made some friends in the village, we could have a great time there. I met Gruffudd, the boy from next door, this afternoon. He seems nice. He started talking to me in Welsh and I couldn't understand ANYTHING. He then spoke English and told me he plays rugby. Well, it's not football but I might have to learn to like it. They all love rugby here.</p> <p>Aargh, if I had some credit on my phone, I could call Caroline. Hope I get some pocket money tomorrow.</p>
---	--

1. Gwynn thinks Wildings School would be great for Gillian because

*it is great*



# FeedBook: Feedback on language meaning and forms

## B1 Gillian's diary

Read Gillian's diary entry and complete these sentences.

Friday 23rd September

We'll drive to the north coast tomorrow and have a look at two boarding schools with Gwynn. His sister went to Wildings and he says it would be great for me. If they had a football team, it wouldn't be so bad, but it's all so girly-girly with horses and ballet dancing and everything, yuk! I don't want to go to the school in Llandysul either. It still feels like Gwynn and Mum just want me to go to boarding school because of the new baby. Miss my pals like crazy, miss London and my old school. If my friends were here, boarding school would actually be fun. Being the new girl at school without any friends will be horrible. ☹️ And it's all Gwynn's fault! The village where we live now is the worst. 20 minutes to the nearest supermarket. If there was a shopping

centre, I could at least go shopping. But there's nothing, no shops, no cinema, no nothing ... only sheep!

My room is really nice and big though and we have a fab garden which is great for playing football. If I made some friends in the village, we could have a great time there. I met Gruffudd, the boy from next door, this afternoon. He seems nice. He started talking to me in Welsh and I couldn't understand

Feedback für "it is great"

There seems to be important information missing in your answer. Please have a look at the highlighted passage in the text.



Hilfreich?

Ja  Nein

OK

1. Gwynn thinks Wildings School would be great for Gillian because

*it is great*

# FeedBook: Feedback on language meaning and forms

## B 1 Gillian's diary

Read Gillian's diary entry and complete these sentences.

Friday 23rd September

We'll drive to the north coast tomorrow and have a look at two boarding schools with Gwynn. His sister went to Wildings and he says it would be great for me. If they had a football team, it wouldn't be so bad, but it's all so girly-girly with horses and ballet dancing and everything, yuk! I don't want to go to the school in Llandysul either. It still feels like Gwynn and Mum just want me to go to boarding school because of the new baby. Miss my pals like crazy, miss London and my old school. If my friends were here, boarding school would actually be fun. Being the new girl at school without any friends will be horrible. 😞 And it's all Gwynn's fault! The village where we live now is the worst. 20 minutes to the nearest supermarket. If there was a shopping

centre, I could at least go shopping. But there's nothing, no shops, no cinema, no nothing ... only sheep!

My room is really nice and big though and we have a fab garden which is great for playing football. If I made some friends in the village, we could have a great time there. I met Gruffudd, the boy from next door, this afternoon. He seems nice. He started talking to me in Welsh and I couldn't understand

Feedback für "his sister goes there"

We are talking about something that happened in the past. Please use the simple past, not the simple present.



Hilfreich?

OK

Ja  Nein

1. Gwynn thinks Wildings School would be great for Gillian because

*his sister goes there*

# FeedBook: Feedback on language meaning and forms

## B1 Gillian's diary

Read Gillian's diary entry and complete these sentences.

<p>Friday 23rd September</p> <p>We'll drive to the north coast tomorrow and have a look at two boarding schools with Gwynn. His sister went to Wildings and he says it would be great for me. If they had a football team, it wouldn't be so bad, but it's all so girly-girly with horses and ballet dancing and everything, yuk! I don't want to go to the school in Llandysul either. It still feels like Gwynn and Mum just want me to go to boarding school because of the new baby. Miss my pals like crazy, miss London and my old school. If my friends were here, boarding school would actually be fun. Being the new girl at school without any friends will be horrible. ☹️ And it's all Gwynn's fault! The village where we live now is the worst. 20 minutes to the nearest supermarket. If there was a shopping</p>	<p>centre, I could at least go shopping. But there's nothing, no shops, no cinema, no nothing ... only sheep!</p> <p>My room is really nice and big though and we have a fab garden which is great for playing football. If I made some friends in the village, we could have a great time there. I met Gruffudd, the boy from next door, this afternoon. He seems nice. He started talking to me in Welsh and I couldn't understand ANYTHING. He then spoke English and told me he plays rugby. Well, it's not football but I might have to learn to like it. They all love rugby here.</p> <p>Aargh, if I had some credit on my phone, I could call Caroline. Hope I get some pocket money tomorrow.</p>
---	--

1. Gwynn thinks Wildings School would be great for Gillian because

*his sister went there*



## Facilitating SLA research using such ICALL approaches

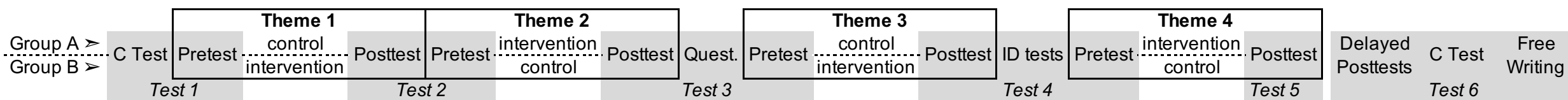
- The FeedBook covers all of the pedagogical language targets of the 7th grade English curriculum in Germany → can support full-year studies
  - 188 metalinguistic feedback types formulated by teachers (on tenses, comparatives, relative & reflexive pronouns, gerunds, passives, conditionals, (in)direct speech).
- Research question: Does immediate scaffolded feedback on form during homework improve learning of the targeted language means? (?)
  - Subjects: Ten regular English classes in 7th grade academic track schools (Gymnasium), including a CLIL class, a private school, an all-boys class, and teachers of different generations
  - Setup: Regular teaching, but FeedBook as workbook.





## FeedBook as a platform for randomized field trials

- How can a system be fully embedded so that it supports regular teaching and support a randomized, controlled study?
- ⇒ everyone uses the FeedBook as workbook (avoids temporary multimedia effect) and receives positive feedback and feedback on meaning, orthography, and default feedback
- ⇒ within-class randomization: who sees specific feedback on which grammar topics
- Overall study design:

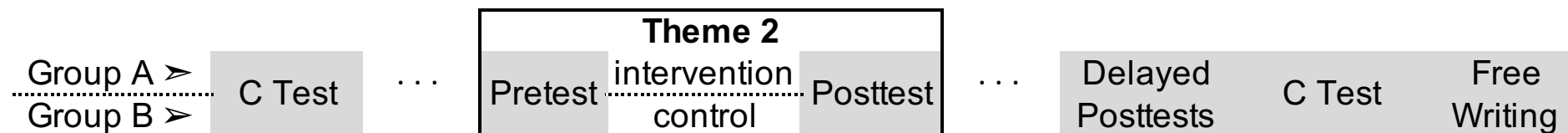


- Each pre-/posttest targets the grammar topics of one Theme.



## Zooming in on specific results

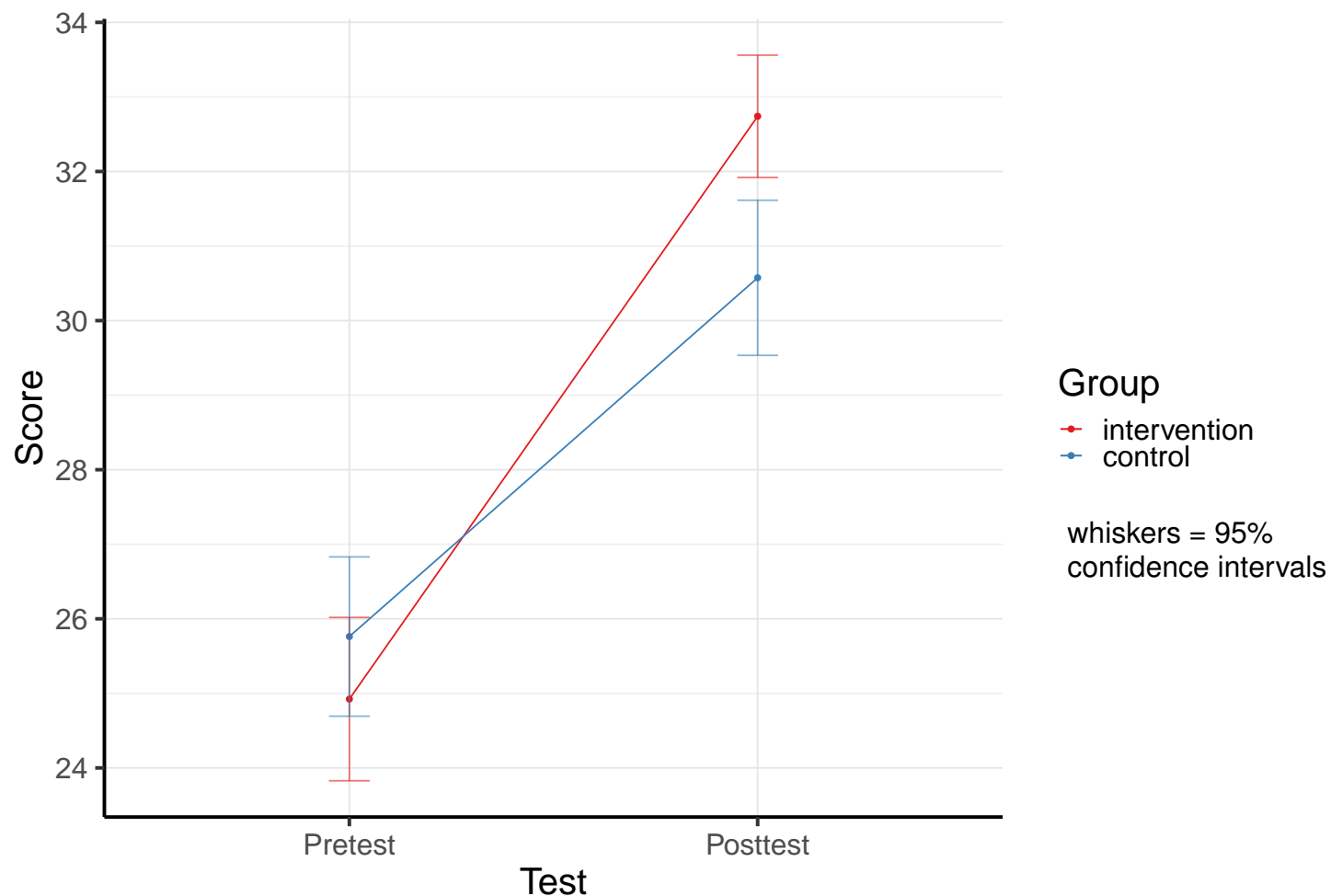
- Analysis of Theme 2 data (?):



- Phenomena covered in Theme 2: comparatives, conditional clauses, relative clauses
- 205 students completed pre- and posttest for Theme 2.



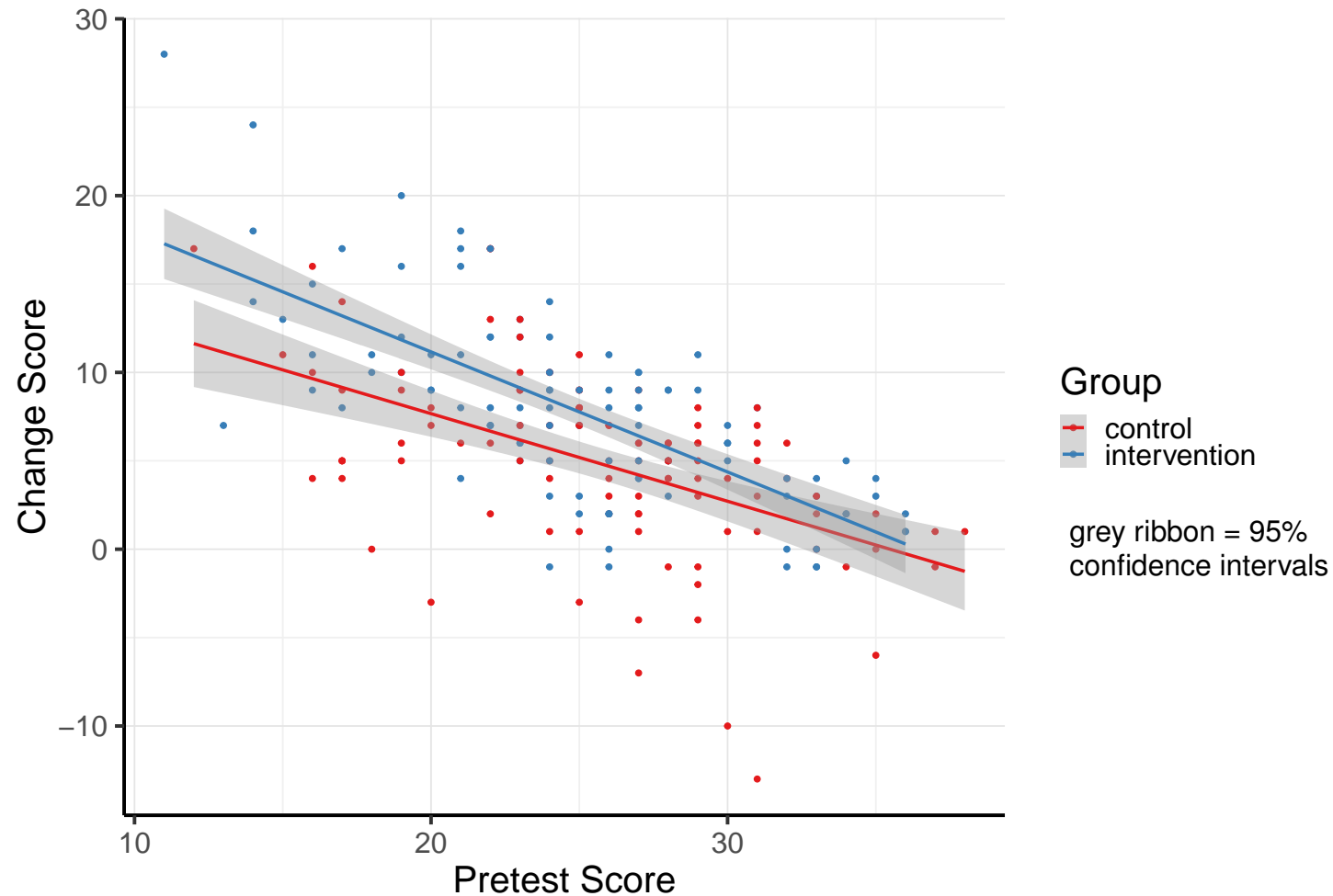
## Results on effectiveness of scaffolded feedback: pre-/posttest scores



- Intervention group improved significantly more than control (p < 0.0001, Welsh two sample t-test):
  - 7.82 for intervention group
  - 4.81 for control group
- intervention group learned 62% more than control group
- Effect size: Cohen's d = 0.56



## Results: pretest & group predicting change score



- “Worse” students improved more
- Possibly a ceiling effect of measuring instrument (max. score: 40)



## Results: mixed effects logistic regression

- Is impact of feedback detectable independent of learner, item, class?
- Predict log odds of the binary outcome of each gap in the tests.
  - Fixed effects: test (pre/post), group (intervention/control) & their interaction
  - Random intercepts: test items, learners, teachers (=classes)

- Results:

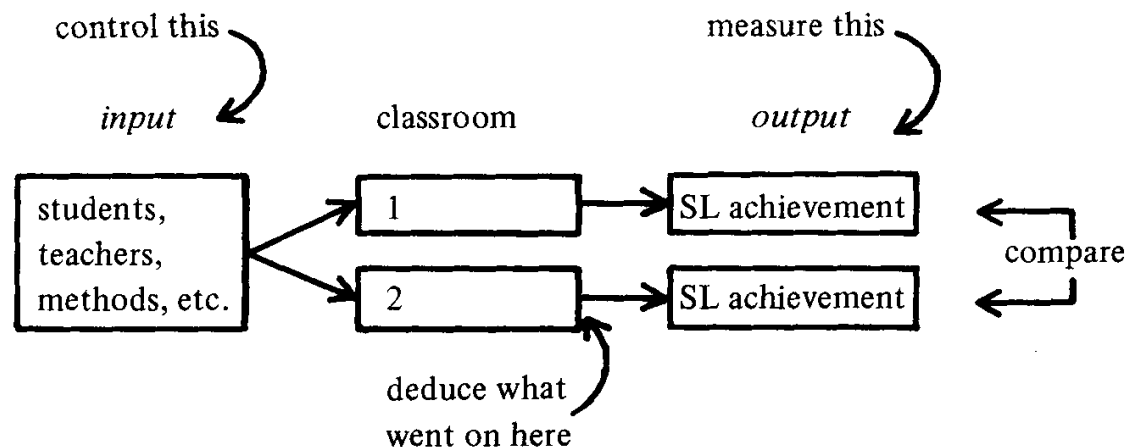
	Estimate	Std. Error
(Intercept) = <i>pretest control</i>	0.73***	(0.15)
TestPosttest	0.68***	(0.05)
GroupIntervention	-0.07	(0.09)
TestPosttest:GroupIntervention	0.43***	(0.08)
Var: Learner (Intercept)	0.30	
Var: Item (Intercept)	0.52	
Var: Teacher (Intercept)	0.05	

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$



## FeedBook as a platform for randomized field trials II

- Full integration into the regular school context = rely only on the state curriculum
  - Single requirement on teacher: assign at least two exercises for each language focus in curriculum
- Black box problem pointed out already by ?:

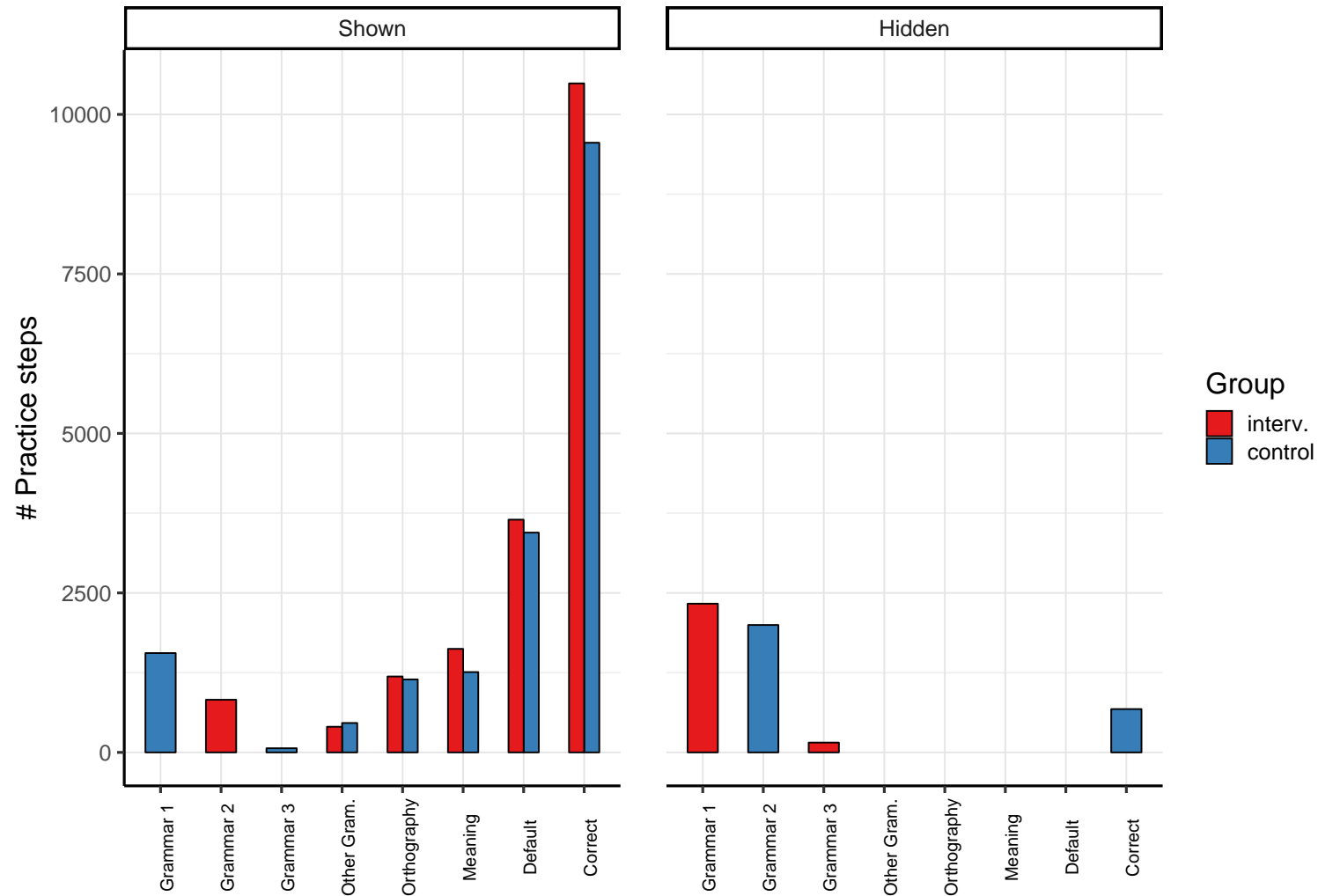


Problem: Loss of control resulting from scaling up to real-life school context.

⇒ Learning analytics using system log data shows us what the students actually did!



# Who saw which type of feedback?





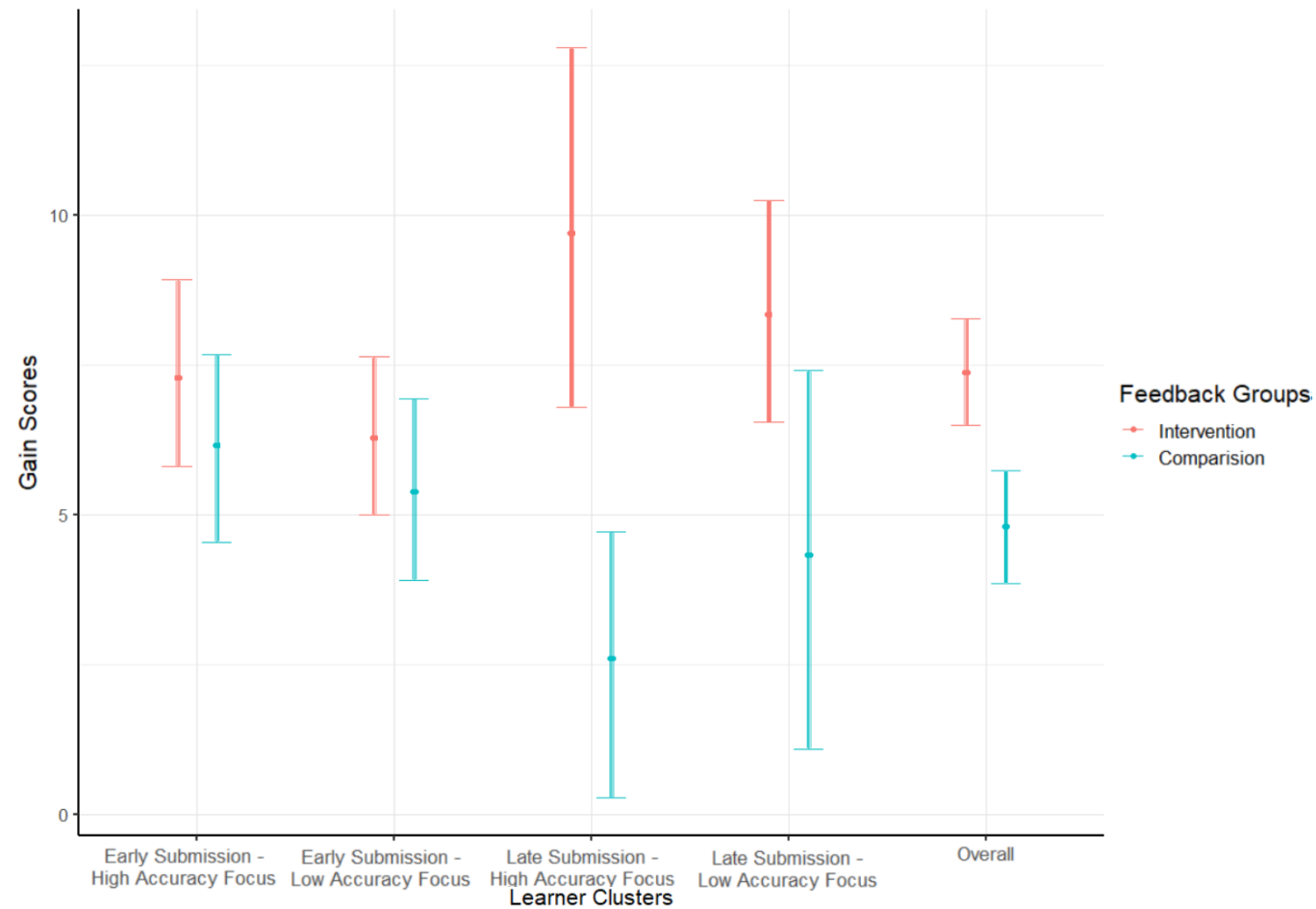


## Learning analytics: For whom is micro-adaptivity effective?

- How are learning gains and interaction patterns linked? (?)
- ⇒ Clustering identifies four groups of students, based on:
  - +/- accuracy focus of student  
How many of the items were filled out correctly, not left empty, answered correctly at first try?
  - +/- submission time of student relative to peers
- ⇒ Scaffolded feedback has the biggest effect for students who
  - systematically attempt to solve the exercises correctly
  - submit later than their peers



# Who benefits most from the specific feedback?





## Learning analytics complements but does not replace learning product data

- Does the effect of practice of specific language forms transfer to open, functional language production? (?)

- Writing topic chosen so that practiced language means are relevant:

*Write a text about your holidays. Please include the following aspects:*

- *Compare two of your holiday trips (weather, duration, ...),*
- *describe your next holiday trip, and*
- *outline what you would do if you could spend 1000€ during your next holiday.*

- Automatic identification of practiced language forms in the learner writing

⇒ The score on the form-specific delayed posttest is a significant predictor of the number of uses of those forms in the free writing!

- But the effect is driven only by *comparatives* due to challenge to determine when something should count as a relative or conditional clause. → acquisition criterion?



## Learning products as Big Data for SLA research

- System use in real life contexts also facilitates large-scale collection of learner product data.
  - EFCamDat corpus based on Englishtown system: 1.2 million writings by 175,000 learners
    - individual variation and role of L1 in morpheme acquisition order ??
    - task-effects on linguistic complexity (??)
- Opportunities arising from “Big Data” in SLA (?)



# Integration of individual practice & teacher-orchestrated task-based class?

- Organize exercises so they empower students to successfully participate in functional tasks.
  - improves acceptance of practice as pre-task activities in a task-based curriculum
  - fosters intrinsic motivation and self-awareness of ability for students

comparatives (one or two syllables) 1	comparatives (one or two syllables) 1 - more practice 1	comparatives (three or more syllables) 1
comparatives (three or more syllables) 1 - more practice 1	comparatives (mixed) 1	comparatives (mixed) 1 - more practice 1
comparatives (mixed) 2	comparatives (mixed) 2 - more practice 1	comparatives (mixed) 3



**CYCLE 2: BOARDING SCHOOL LIFE**  
GOAL: WRITE RULES FOR YOUR PERFECT BOARDING SCHOOL!

SECTIONS: Grammar - Conditional Clauses type 2 Grammar - Comparatives / Superlatives Words and Phrases

Legend

COMPARATIVES (ONE OR TWO SYLLABLES)	1 <sup>st</sup>	2	2	1	MORE PRACTICE
COMPARATIVES (THREE OR MORE SYLLABLES)	2 <sup>nd</sup>	5			CHALLENGE ME
COMPARATIVES (MIXED)	3A <sup>th</sup>	5			MORE PRACTICE
	3B <sup>th</sup>	1	3		MORE PRACTICE
	3C <sup>th</sup>	1	1	3	MORE PRACTICE
	3D <sup>th</sup>	3			MORE PRACTICE
	3E				PRACTICE
SUPERLATIVES (ONE OR TWO SYLLABLES)	4				PRACTICE
SUPERLATIVES (THREE OR MORE SYLLABLES)	5				PRACTICE
SUPERLATIVES (MIXED)	6A				PRACTICE

# 1. Make final task explicit

## CYCLE 2: BOARDING SCHOOL LIFE

GOAL WRITE RULES FOR YOUR PERFECT BOARDING SCHOOL!



SECTIONS: GRAMMAR - CONDITIONAL CLAUSES TYPE 2 GRAMMAR - COMPARATIVES / SUPERLATIVES WORDS AND PHRASES

Legend

COMPARATIVES (ONE OR TWO SYLLABLES)	1	2 2 1	MORE PRACTICE
COMPARATIVES (THREE OR MORE SYLLABLES)	2	5	CHALLENGE ME
COMPARATIVES (MIXED)	3A	5	MORE PRACTICE
	3B	1 3	MORE PRACTICE
	3C	1 1 3	MORE PRACTICE
	3D	3 2	MORE PRACTICE
	3E		PRACTICE
SUPERLATIVES (ONE OR TWO SYLLABLES)	4		PRACTICE
SUPERLATIVES (THREE OR MORE SYLLABLES)	5		PRACTICE
SUPERLATIVES (MIXED)	6A		PRACTICE

## 2. Organize practice by task-essential language means

### CYCLE 2: BOARDING SCHOOL LIFE

GOAL WRITE RULES FOR YOUR PERFECT BOARDING SCHOOL!



SECTIONS: GRAMMAR - CONDITIONAL CLAUSES TYPE 2 GRAMMAR - COMPARATIVES / SUPERLATIVES WORDS AND PHRASES

Legend

COMPARATIVES (ONE OR TWO SYLLABLES)	1	2 2 1	MORE PRACTICE
COMPARATIVES (THREE OR MORE SYLLABLES)	2	5	CHALLENGE ME
COMPARATIVES (MIXED)	3A	5	MORE PRACTICE
	3B	1 3	MORE PRACTICE
	3C	1 1 3	MORE PRACTICE
	3D	3 2	MORE PRACTICE
	3E		PRACTICE
	4		PRACTICE
SUPERLATIVES (ONE OR TWO SYLLABLES)	5		PRACTICE
SUPERLATIVES (THREE OR MORE SYLLABLES)	6A		PRACTICE
SUPERLATIVES (MIXED)			PRACTICE



# 3. Incremental activity complexity

## CYCLE 2: BOARDING SCHOOL LIFE

GOAL: WRITE RULES FOR YOUR PERFECT BOARDING SCHOOL!



SECTIONS: GRAMMAR - CONDITIONAL CLAUSES TYPE 2 GRAMMAR - COMPARATIVES / SUPERLATIVES WORDS AND PHRASES

Legend

COMPARATIVES (ONE OR TWO SYLLABLES)	1	2 2 1	MORE PRACTICE
COMPARATIVES (THREE OR MORE SYLLABLES)	2	5	CHALLENGE ME
COMPARATIVES (MIXED)	3A	5	MORE PRACTICE
	3B	1 3	MORE PRACTICE
	3C	1 1 3	MORE PRACTICE
	3D	3 2	MORE PRACTICE
	3E		PRACTICE
SUPERLATIVES (ONE OR TWO SYLLABLES)	4		PRACTICE
SUPERLATIVES (THREE OR MORE SYLLABLES)	5		PRACTICE
SUPERLATIVES (MIXED)	6A		PRACTICE

zunehmende Schwierigkeit



# 4. Feedback on success relative to support received

## CYCLE 2: BOARDING SCHOOL LIFE

GOAL WRITE RULES FOR YOUR PERFECT BOARDING SCHOOL!



SECTIONS: GRAMMAR - CONDITIONAL CLAUSES TYPE 2 GRAMMAR - COMPARATIVES / SUPERLATIVES WORDS AND PHRASES

Legend

COMPARATIVES (ONE OR TWO SYLLABLES)	1	2 2 1	MORE PRACTICE
COMPARATIVES (THREE OR MORE SYLLABLES)	2	5	CHALLENGE ME
COMPARATIVES (MIXED)	3A	5	MORE PRACTICE
	3B	1 3	MORE PRACTICE
	3C	1 1 3	MORE PRACTICE
	3D	3 2	MORE PRACTICE
	3E		PRACTICE
SUPERLATIVES (ONE OR TWO SYLLABLES)	4		PRACTICE
SUPERLATIVES (THREE OR MORE SYLLABLES)	5		PRACTICE
SUPERLATIVES (MIXED)	6A		PRACTICE

Correct at first try  
Correct after feedback  
Incorrect or missing

# 5. Feedback on acquisition criterion

## CYCLE 2: BOARDING SCHOOL LIFE

GOAL WRITE RULES FOR YOUR PERFECT BOARDING SCHOOL!



SECTIONS: GRAMMAR - CONDITIONAL CLAUSES TYPE 2 GRAMMAR - COMPARATIVES / SUPERLATIVES WORDS AND PHRASES

Legend



COMPARATIVES (ONE OR TWO SYLLABLES)	1	2 2 1	MORE PRACTICE
COMPARATIVES (THREE OR MORE SYLLABLES)	2	5	CHALLENGE ME
COMPARATIVES (MIXED)	3A	5	MORE PRACTICE
	3B	1 3	MORE PRACTICE
	3C	1 1 3	MORE PRACTICE
	3D	3 2	MORE PRACTICE
	3E		PRACTICE
SUPERLATIVES (ONE OR TWO SYLLABLES)	4		PRACTICE
SUPERLATIVES (THREE OR MORE SYLLABLES)	5		PRACTICE
SUPERLATIVES (MIXED)	6A		PRACTICE

“Ready-to-Go-ness”:

- tackled all difficulty levels
- 60% correct at first try for most complex
- Trophies “collect dust” to model forgetting and require revision or use

# 7. Selection of next activity via language means to be practiced

## CYCLE 2: BOARDING SCHOOL LIFE

GOAL WRITE RULES FOR YOUR PERFECT BOARDING SCHOOL!



SECTIONS: GRAMMAR - CONDITIONAL CLAUSES TYPE 2 GRAMMAR - COMPARATIVES / SUPERLATIVES WORDS AND PHRASES

Legend

COMPARATIVES (ONE OR TWO SYLLABLES)	1	2 2 1
COMPARATIVES (THREE OR MORE SYLLABLES)	2	5
COMPARATIVES (MIXED)	3A	5
	3B	1 3
	3C	1 1 3
	3D	3 2
	3E	
SUPERLATIVES (ONE OR TWO SYLLABLES)	4	
SUPERLATIVES (THREE OR MORE SYLLABLES)	5	
SUPERLATIVES (MIXED)	6A	

MORE PRACTICE

CHALLENGE ME

MORE PRACTICE

MORE PRACTICE

MORE PRACTICE

MORE PRACTICE

MORE PRACTICE

PRACTICE

PRACTICE

PRACTICE

PRACTICE



## First results on Interact4School RCT using task-oriented FeedBook

- 847 students from 36 classes (English 7th grade high school)
- broad range of analyses in preparation, incl. classroom videography by partners at Univ. of Lüneburg: Torben Schmidt, Diana Pili-Moss, Carolyn Blume
- Focus here: 618 students in FeedBook condition (7 schools, 24 classes)
- ⇒ Analysis of learning success (pretest/posttest) shows significantly higher learning gains, when comparing new dashboard version to original FeedBook (Parrisius et al. submitted)
  - student questionnaire data also confirm perceived helpfulness of student dashboard
- ⇒ Interestingly, motivational feedback through avatar was detrimental after initial phase.



## Next steps in randomized controlled field trials

- First study: scaffolded feedback (?)
- Second study: task-orientation with criterial and motivational feedback (?)
- Third study: individually adaptive activity sequencing integrating ambulatory assessment of working memory (<http://digbindiff.de>)
- Next study: Support an interface to teacher-orchestrated classroom, requiring teacher dashboard and teacher training in SLA and pedagogy (<http://ai2teach.de>)
  - requires further scaling up to have enough power for testing variables at teacher-level
- Related research: Facilitating spoken language interactive dialogues: AISLA Project (Xiaobin Chen)



## Summary

- Digital tools using AI methods can help realize mechanisms established by SLA research in educational practice
  - improve real-life language teaching and learning
  - support further refinement of SLA concepts and hypotheses in authentic, ecologically-valid contexts
- This opens up possibilities for conducting SLA research in real-life settings:
  - web-based intervention studies supporting scalable analysis of interaction effects
  - randomized controlled field studies in authentic school setting, supporting analysis of product and process data (learning analytics)
- Pursuing these opportunities requires interdisciplinary collaboration on
  - SLA concepts and hypotheses to be refined and tested
  - AI methods to analyze and generate language, model learners, activities and curricular learning goals
  - joint analysis of large-scale process and product data





## References I

- Alexopoulou, T., D. Meurers & A. Murakami (2022). Big Data in SLA: advances in methodology and analysis. In N. Ziegler & M. Gonzalez-Lloret (eds.), *Routledge Handbook of Second Language Acquisition and Technology*, Routledge. URL <http://purl.org/dm/papers/Alexopoulou.Murakami.Meurers-22.pdf>.
- Alexopoulou, T., M. Michel, A. Murakami & D. Meurers (2017). Task Effects on Linguistic Complexity and Accuracy: A Large-Scale Learner Corpus Analysis Employing Natural Language Processing Techniques. *Language Learning* 67, 181–209. URL <https://doi.org/10.1111/lang.12232>.
- Aljaafreh, A. L. & J. P. Lantolf (1994). Negative feedback as regulation and second language learning in the zone of proximal development. *The Modern Language Journal* 78(4), 465–483.
- Chen, X. (2019). Automatic analysis of linguistic complexity and its application in language learning research. Ph.D. thesis, Universität Tübingen.
- Chen, X. & D. Meurers (2017). Challenging Learners in Their Individual Zone of Proximal Development Using Pedagogic Developmental Benchmarks of Syntactic Complexity. In *Proceedings of the Joint 6th Workshop on NLP for Computer Assisted Language Learning and 2nd Workshop on NLP for Research on Language Acquisition at NoDaLiDa 2017*. Gothenburg, Sweden: ACL, Linköping Electronic Conference Proceedings 134, pp. 8–17. URL <http://aclweb.org/anthology/W17-0302.pdf>.
- Chen, X. & D. Meurers (2019). Linking text readability and learner proficiency using linguistic complexity feature vector distance. *Computer-Assisted Language Learning* 32(4), 418–447. URL <https://doi.org/10.1080/09588221.2018.1527358>.  
<https://doi.org/10.1080/09588221.2018.1527358>.



## References II

- Chen, X., D. Meurers & P. Rebuschat (2022). ICALL offering individually adaptive input: Effects of complex input on L2 development. *Language Learning & Technology* 26(1). URL <https://hdl.handle.net/10125/73496>.
- Chinkina, M. & D. Meurers (2016). Linguistically-Aware Information Retrieval: Providing Input Enrichment for Second Language Learners. In *Proceedings of the 11th Workshop on Innovative Use of NLP for Building Educational Applications (BEA)*. San Diego, CA: ACL, pp. 188–198. URL <http://aclweb.org/anthology/W16-0521.pdf>.
- Chinkina, M. & D. Meurers (2017). Question Generation for Language Learning: From ensuring texts are read to supporting learning. In *Proceedings of the 12th Workshop on Innovative Use of NLP for Building Educational Applications (BEA)*. Copenhagen, Denmark, pp. 334–344. URL <http://aclweb.org/anthology/W17-5038.pdf>.
- Corder, S. P. (1967). The Significance of Learner's Errors. *International Review of Applied Linguistics in Language Teaching* 5(4), 161–170.
- De Kuthy, K. & D. Meurers (2022). Extending experimental research on the effectiveness of an Intelligent Tutoring System. A corpus study of authentic ESL student essays. In *Learner Corpus Research Conference. Book of Abstracts*. Padua, Italy.
- DeKeyser, R. M. (2005). What Makes Learning Second-Language Grammar Difficult? A Review of Issues. *Language Learning* 55(S1), 1–25.
- DeKeyser, R. M. (2012). Interactions Between Individual Differences, Treatments, and Structures in SLA. *Language Learning* 62, 189–200.
- Hicks, K. L., J. L. Foster & R. W. Engle (2016). Measuring working memory capacity on the web with the Online Working Memory Lab (the OWL). *Journal of Applied Research in Memory and Cognition* 5, 478–489.



## References III

- Holz, H., Z. Weiss, O. Brehm & D. Meurers (2018). COAST - Customizable Online Syllable Enhancement in Texts. A flexible framework for automatically enhancing reading materials. In *Proceedings of the Thirteenth Workshop on Innovative Use of NLP for Building Educational Applications*. New Orleans, Louisiana: Association for Computational Linguistics, pp. 89–100. URL <https://aclanthology.org/W18-0509>.
- Hui, B., B. Rudzewitz & D. Meurers (2023). Learning Processes in Interactive CALL systems: Linking Automatic Feedback, System Logs, and Learning Outcomes. *Language Learning and Technology* 27(1), 1–23. URL <https://hdl.handle.net/10125/73527>.
- Kim, Y. & M. Michel (2023). Linguistic alignment in second language acquisition: A methodological review. *System* p. 103007.
- Klein, W. & C. Perdue (1997). The Basic Variety (or: Couldn't natural languages be much simpler?). *Second language research* 13(4), 301–347.
- Krashen, S. D. (1985). *The input hypothesis: Issues and implications*. New York: Longman.
- Larsen-Freeman, D. (2000). Second Language Acquisition and Applied Linguistics. *Annual Review of Applied Linguistics* 20, 165–181.
- Lightbown, P. M. (1998). The importance of timing in focus on form. In C. Doughty & J. Williams (eds.), *Focus on Form in Classroom Second Language Acquisition*, Cambridge: Cambridge Univ. Press, pp. 177–196.
- Long, M. H. (1980a). Input, interaction, and second language acquisition. Ph.D. thesis, University of California, Los Angeles.
- Long, M. H. (1980b). Inside the “black box”: Methodological issues in classroom research on language learning. *Language Learning* 30(1), 1–42.



## References IV

- Long, M. H. (1991). Focus on form: A design feature in language teaching methodology. In K. De Bot, C. Kramsch & R. Ginsberg (eds.), *Foreign language research in cross-cultural perspective*, Amsterdam: John Benjamins, pp. 39–52.
- Meurers, D., K. De Kuthy, V. Möller, F. Nuxoll, B. Rudzewitz & R. Ziai (2018). Digitale Differenzierung benötigt Informationen zu Sprache, Aufgabe und Lerner. Zur Generierung von individuellem Feedback in einem interaktiven Arbeitsheft. *FLuL – Fremdsprachen Lehren und Lernen* 47(2), 64–82. URL <http://purl.org/dm/papers/Meurers.DeKuthy.ea-18.pdf>.
- Meurers, D., K. De Kuthy, F. Nuxoll, B. Rudzewitz & R. Ziai (2019). Scaling up intervention studies to investigate real-life foreign language learning in school. *Annual Review of Applied Linguistics* 39, 161–188.
- Meurers, D., R. Ziai, L. Amaral, A. Boyd, A. Dimitrov, V. Metcalf & N. Ott (2010). Enhancing Authentic Web Pages for Language Learners. In *Proceedings of the 5th Workshop on Innovative Use of NLP for Building Educational Applications (BEA)*. Los Angeles: ACL, pp. 10–18. URL <http://aclweb.org/anthology/W10-1002.pdf>.
- Michel, M., A. Murakami, T. Alexopoulou & D. Meurers (2019). Effects of task type on morphosyntactic complexity across proficiency: Evidence from a large learner corpus of A1 to C2 writings. *Instructed Second Language Acquisition* 3, 124–152. URL <https://doi.org/10.1558/isla.38248>.
- Murakami, A. (2013). Individual Variation and the Role of L1 in the L2 Development of English Grammatical Morphemes: Insights From Learner Corpora. Ph.D. thesis, University of Cambridge.
- Murakami, A. (2016). Modeling Systematicity and Individuality in Nonlinear Second Language Development: The Case of English Grammatical Morphemes. *Language Learning* 6(4), 834–871.



## References V

- Parrisius, C., I. Pieronczyk et al. (2022). Using an intelligent tutoring system within a task-based learning approach in English as a foreign language classes to foster motivation and learning outcome (Interact4School): Pre-registration of the study design. *PsychArchives* .
- Parrisius, C., K. Wendebourg et al. (eingereicht). Effective features of feedback in an intelligent tutoring system. *Language Learning and Technology* .
- Petersen, K. (2010). Implicit Corrective Feedback in Computer-Guided Interaction: Does Mode Matter? Ph.D. thesis, Georgetown University. URL <http://purl.org/net/Petersen-10.pdf>.
- Pica, T. & C. Doughty (1985). The role of group work in classroom second language acquisition. *Studies in second language acquisition* 7(2), 233–248.
- Pienemann, M. (1984). Psychological constraints on the teachability of languages. *Studies in Second Language Acquisition* 6, 186–214. URL <http://www.neiu.edu/~circill/bofman/ling460/psychological.pdf>.
- Pienemann, M. & M. Johnston (1987). Factors influencing the development of language proficiency. In D. Nunan (ed.), *Applying second language acquisition research*, Adelaide: National Curriculum Resource Centre, Adult Migrant Education Program.
- Robinson, P. (2003). The Cognition Hypothesis, Task Design, and Adult Task-Based Language Learning. *Second Language Studies* 21, 45–107.
- Rudzewitz, B., R. Ziai, K. De Kuthy & D. Meurers (2017). Developing a web-based workbook for English supporting the interaction of students and teachers. In *Proceedings of the Joint 6th Workshop on NLP for Computer Assisted Language Learning and 2nd Workshop on NLP for Research on Language Acquisition*. pp. 36–46. URL <http://aclweb.org/anthology/W17-0305.pdf>.



## References VI

- Ruiz, S., X. Chen, P. Rebuschat & D. Meurers (2019). Measuring individual differences in cognitive abilities in the lab and on the web. *PloS one* 14(12), e0226217.
- Ruiz, S., P. Rebuschat & D. Meurers (2021). The effects of working memory and declarative memory on instructed second language vocabulary learning: Insights from intelligent CALL. *Language Teaching Research* 25(4), 510–539.
- Ruiz, S., P. Rebuschat & D. Meurers (2024). Supporting Individualized practice through Intelligent CALL. In Y. Suzuki (ed.), *Practice and automatization in second language research: Perspectives from skill acquisition theory and cognitive psychology*, Routledge, pp. 119–143. URL <https://purl.org/dm/papers/Ruiz.Rebuschat.Meurers-24.pdf>.
- Ruiz Hernández, S. E. (2018). Individual differences and instructed Second Language Acquisition: Insights from Intelligent Computer Assisted Language Learning. Doctoral dissertation, Eberhard-Karls-Universität Tübingen.
- Schmidt, R. (1990). The role of consciousness in second language learning. *Applied Linguistics* 11, 206–226. URL <http://appliedjournals.org/cgi/reprint/11/2/129.pdf>.
- Schmidt, R. (1995). Consciousness and foreign language learning: A tutorial on the role of attention and awareness in learning. In R. Schmidt (ed.), *Attention and awareness in foreign language learning*, Honolulu, HI: University of Hawaii, pp. 1–63.
- Selinker, L. (1972). Interlanguage. *International Review of Applied Linguistics* 10(3), 209–231.
- Sharwood Smith, M. (1993). Input enhancement in instructed SLA: Theoretical bases. *Studies in Second Language Acquisition* 15, 165–179. URL <https://doi.org/10.1017/s0272263100011943>.
- Swain, M. (2005). The output hypothesis: Theory and research. In E. Hinkel (ed.), *Handbook on research in second language teaching and learning*, Mahwah, NJ: Lawrence Erlbaum Associates, pp. 471–484.





## References VII

- Unsworth, N., R. P. Heitz, J. C. Schrock & R. W. Engle (2005). An automated version of the operation span task. *Behavior Research Methods* 37(3), 498–505.
- Vedder, I., F. Kuiken & M. Michel (2019). Linguistic complexity and instruction in second language acquisition: introduction. *Instructed Second Language Acquisition* 3(2), 119–123. URL <https://journal.equinoxpub.com/ISLA/article/view/13912>.
- Vygotsky, L. S. (1986). *Thought and Language*. Cambridge, MA: MIT Press.
- Wang, C. & M. Wang (2015). Effect of alignment on L2 written production. *Applied Linguistics* 36(5), 503–526.
- Weiss, Z., S. Dittrich & D. Meurers (2018). A Linguistically-Informed Search Engine to Identify Reading Material for Functional Illiteracy Classes. In *Proceedings of the 7th Workshop on Natural Language Processing for Computer-Assisted Language Learning (NLP4CALL)*. URL <https://aclweb.org/anthology/W18-7109.pdf>.
- Williams, J. N. (2012). Working memory and SLA. In P. Robinson, A. Mackey, S. M. Gass & R. Schmidt (eds.), *The Routledge handbook of second language acquisition*, New York: Routledge, pp. 427–441.
- Ziegler, N., D. Meurers, P. Rebuschat, S. Ruiz, J. L. Moreno Vega, M. Chinkina, W. Li & S. Grey (2017). Interdisciplinary research at the intersection of CALL, NLP, and SLA: Methodological implications from an input enhancement project. *Language Learning* 67, 209–231.