

# Dialogue systems ~~Conversational agents~~ for language learning: state of the art and avenues for research on task-based agents

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 **iMinds**

 **itec**

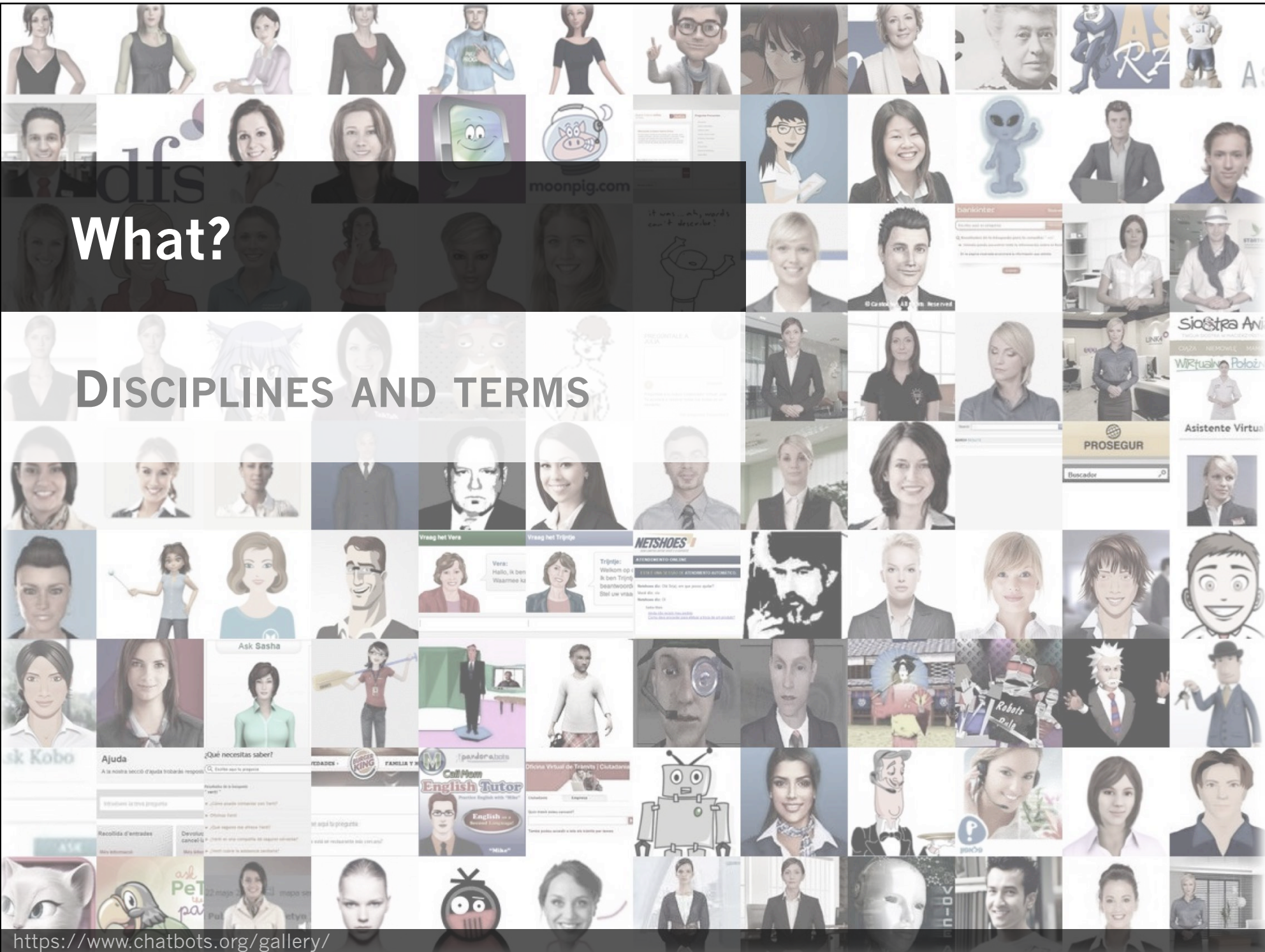
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# Dialogue systems for language learning

- What?
    - Dialogue systems
  - Why?
    - What do we know?
  - How?
- DISCIPLINES AND TERMS
- DEFINITION AND COMPONENTS
- RATIONALE
- EFFECTIVENESS STUDIES
- TECHNOLOGICAL PROCESS



What?

DISCIPLINES AND TERMS

# Dialogue system?

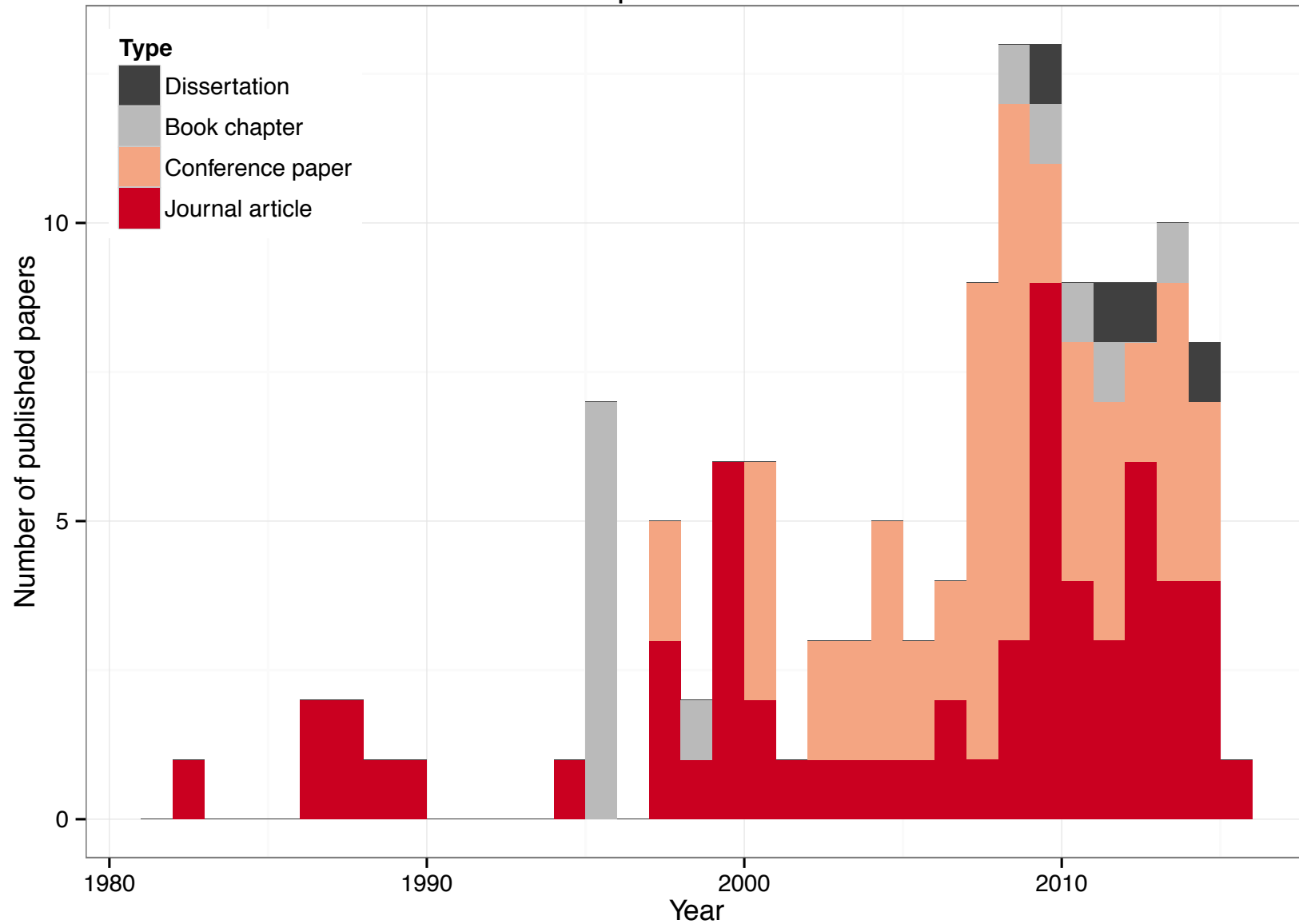
- Chatbot
- Conversational agent
- **Dialogue system**
- Spoken dialogue system
- Dialogue-based CALL
- Dialogue simulation
- Dialogue game
- Simulated dialogue
- Speech-interactive CALL
- Conversational language tutoring system.
- Conversation simulator
- Communication-based language learning
- Chatterbot
- Conversational companion
- Conversational system
- Conversational ICALL system
- Dialogue-based conversation tutoring
- Dialogue program
- Interactive pedagogical drama
- Microworld interaction
- Virtual agent
- Virtual human
- Pedagogical agent
- Voice-interactive CALL...

# Systematical literature study: Corpus collection

- Systematical search on Web of Science, Scopus and ProQuest  
[results: 604 / 494 / 1003 hits]
- Ancestry (citing) and forward (cited in) search
- Final corpus:  
**135** published and peer-reviewed papers  
from 1982 to 2015 (April)

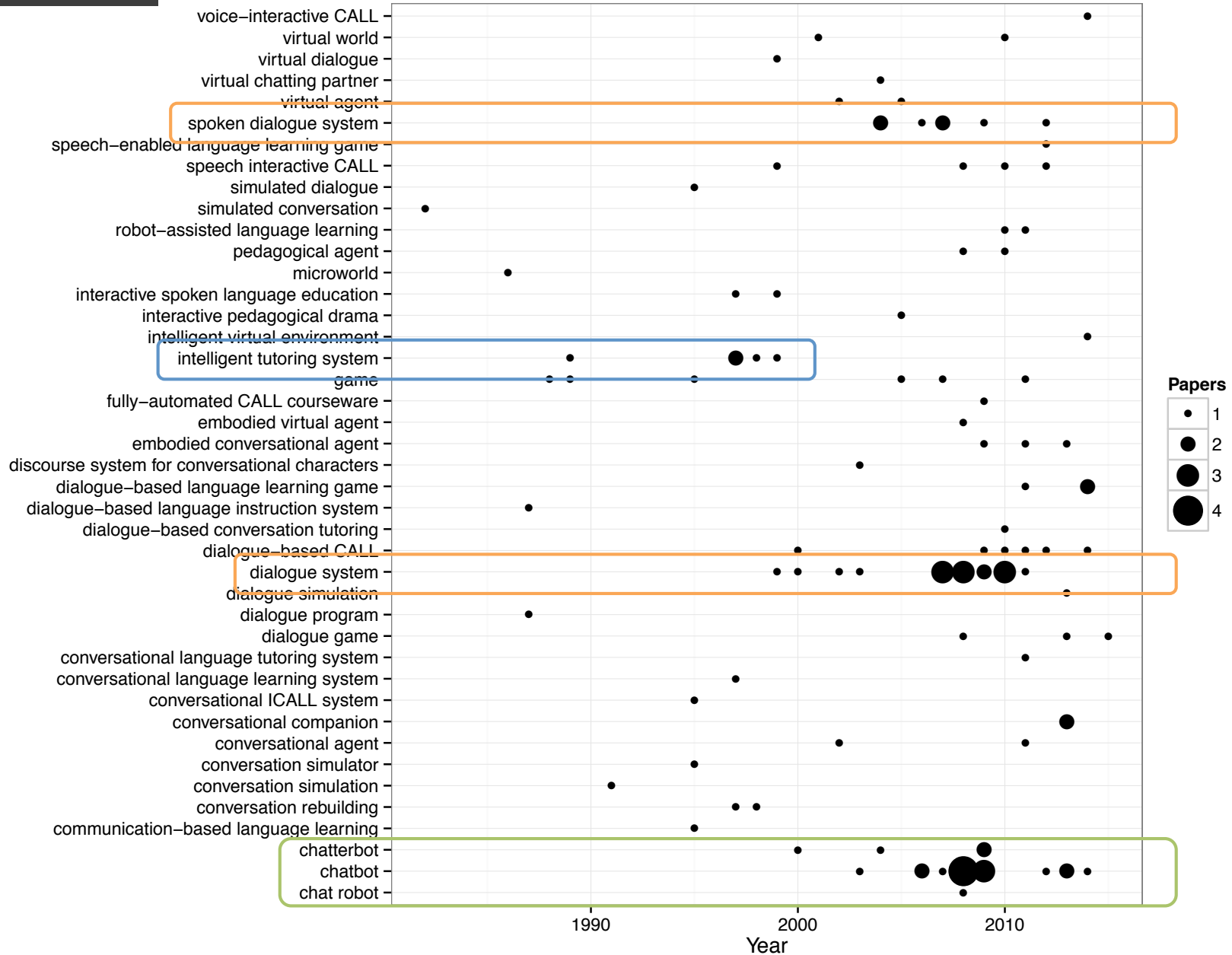
# Corpus of studies

Studies published on DSL



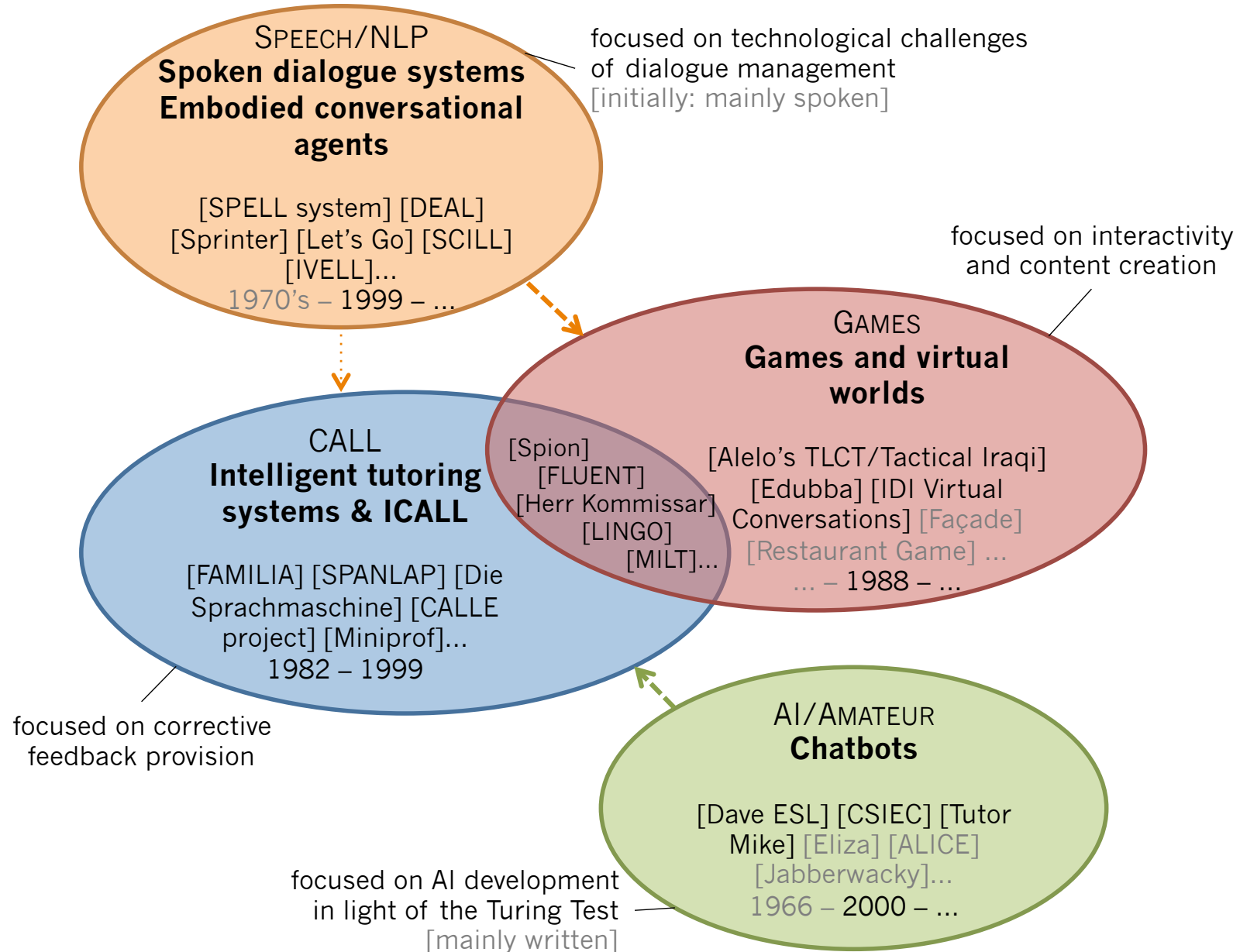
# Terms

Terms used to refer to DSLL across time





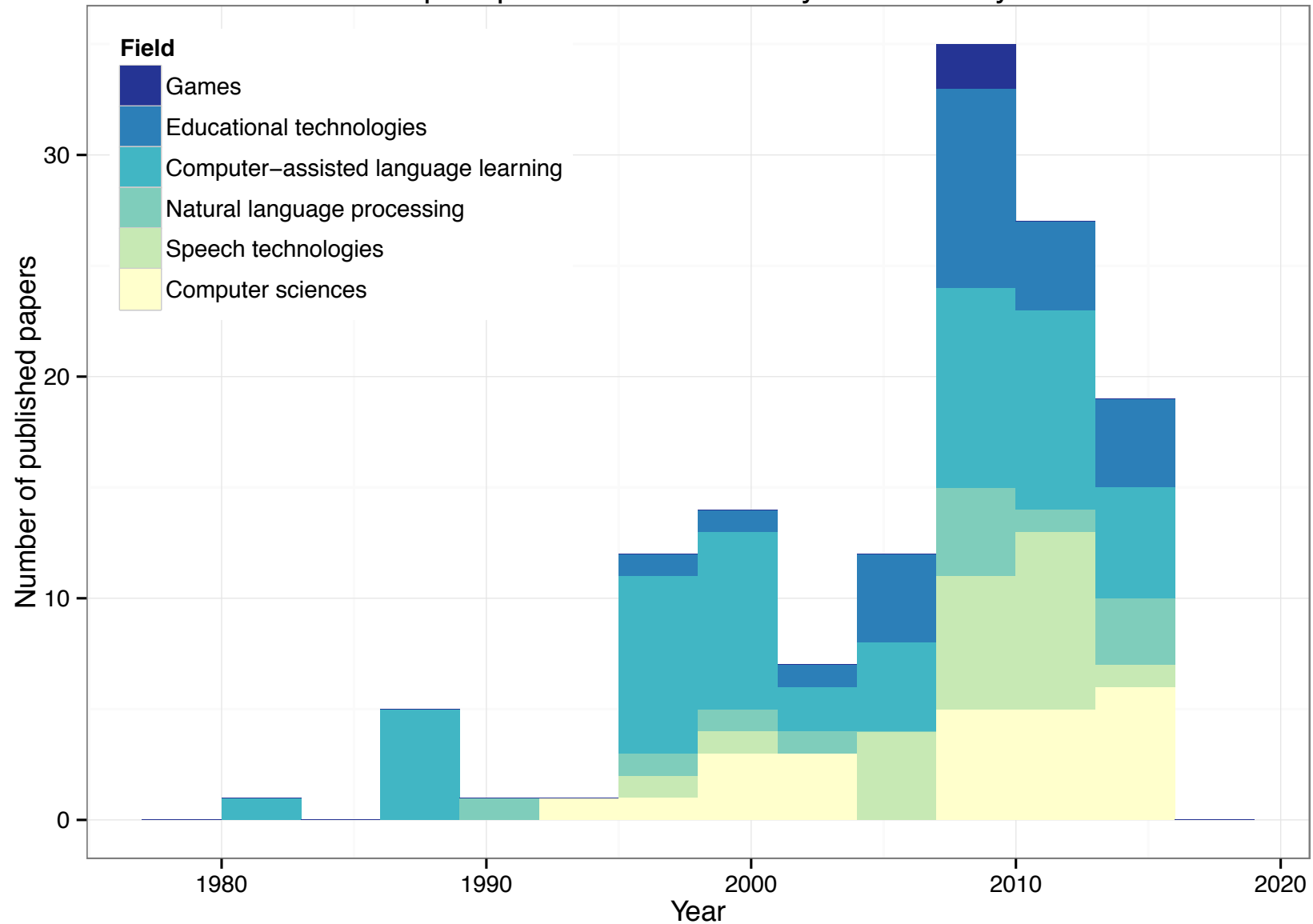
# Disciplinary approaches





# Disciplinary approaches

Papers published on DSLL by field of study



# Dialogue systems

DEFINITION AND COMPONENTS



Dialogue System  
for unity

## Different systems?

- Spoken / Written / Multimodal  
e.g. spoken dialogue systems vs. chatbots
- Technologically simple / complex  
e.g. chatbots vs. dialogue systems (Klüwer, 2011)
- Focus on form / Focus on meaning  
e.g. tutorial CALL vs. “communication-based CALL” (Murray, 1995)

- **Dialogue activity**

- conversation, talk, information exchange, questions-answers, requests-grants, etc.

- with an **automated agent**

- as interlocutor, as tutor, as character...
- virtual, embodied, robot, etc.

Or a single endeavor?

# DSL: Towards an operational definition

- **Dialogue** activity
  - conversation, talk, information exchange, questions-answers, requests-grants, etc.
- with an **automated agent**
  - as interlocutor, as tutor, as character...
  - virtual, embodied, robot, etc.
- **Dialogue system for language learning (DSL)**

Tutor Mike (Lee)

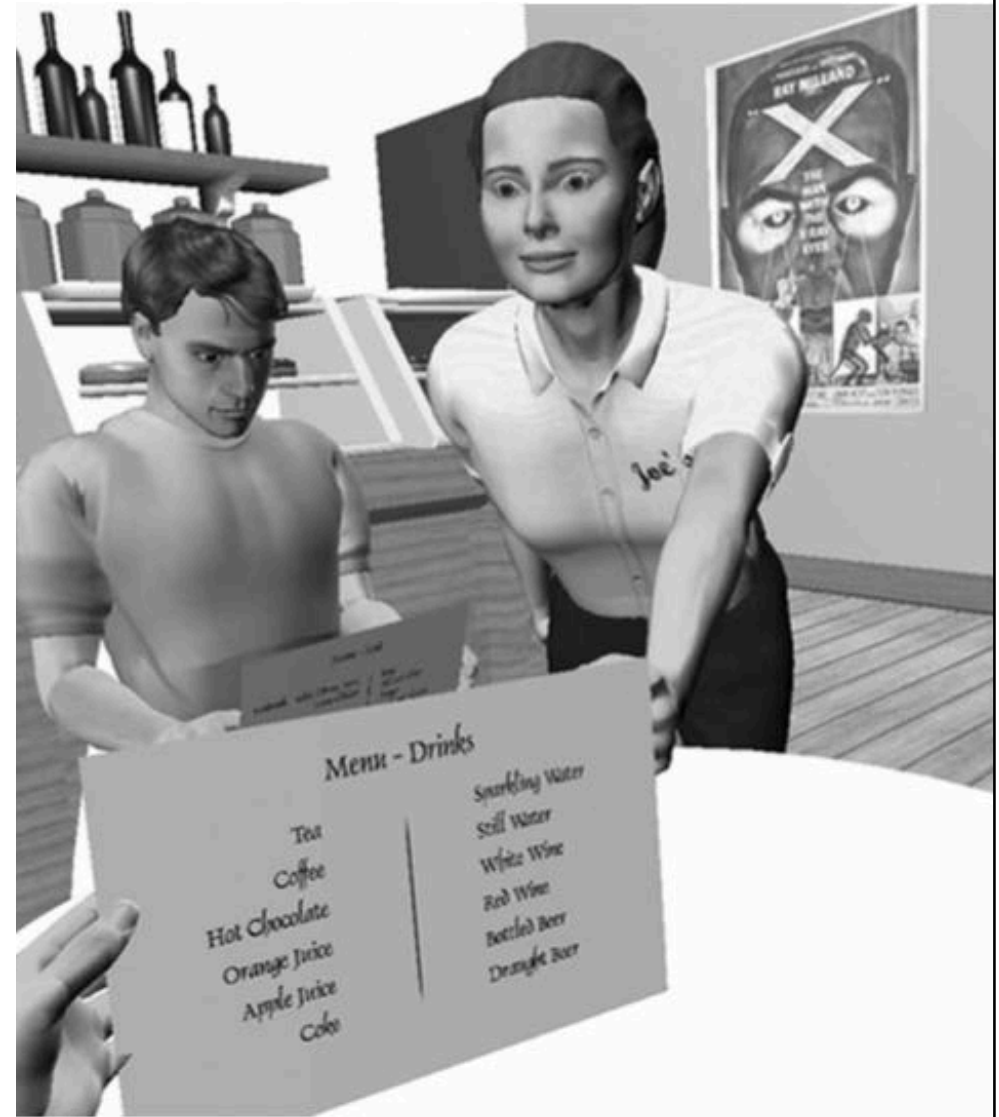
## Practice English with Mike

Mike is very smart. You can ask him any questions. When you want to practice the conversations of the topic you are [www.eslfast.com/robot/](http://www.eslfast.com/robot/), type in "Let's practice topic ..." or "I'd like to practice topic ..." You must type the exact name **Let's practice topic Weather (2)**. When you are acting as **A** and Robot Mike is **B**, you must type in the exact sentence conversation, including the punctuation. If you make a mistake, it is not controlled practice of the conversation anymore you need to type "Let's practice topic ..." again to get the robot back on track.



**YOU:** Hi Mike  
**Mike:** Hello!  
**YOU:** What do you know?  
**Mike:** I'd rather not tell you.  
**YOU:** Can you tell something insightful for the people at CALICO?  
**Mike:** Sure.  
**YOU:** Go on.  
**Mike:** Just a moment.  
**YOU:** We're listening.  
**Mike:** You are?

# SPELL system (Morton, Gunson & Jack)



# Distinctive features

**Interlocutor**

Human

Human +  
Automated tutor

Automated  
interlocutor

**Interaction**

Monologue

“Mono-initiative”  
dialogue

Dialogue

**Input**

Constrained

Partially  
constrained

Unconstrained

**Interactivity**

Fixed

Fixed with  
illusion of choice

Interactive



Interaction ↓	Input ↓	Human	Human + Automated tutor	Automated	Automated	Automated	← Interlocutor
		Interactive	Interactive	Interactive	Fixed with illusion of choice	Fixed	← Interactivity*
Monologue	Constrained input	Registration form	?	?	?	Word(s) completion ( <i>gap-filling</i> ), selection, ordering, etc.	
Monologue	Partially constrained input	?	?	?	Choose from a list of words (various possible sentences)	Choose from a list of words	
Monologue	Unconstrained input	Webinar. Usual web publication	Computer-assisted writing system	?	?	Short answer (with automatic correction)	
Mono-initiative dialogue	Partially constrained input	?	?	<b>Text adventure game and microworlds</b> [FLAG, Spion, LINGO, MILT written]	?	Reading aloud prompted utterances (de Wet et al 2009)	
Mono-initiative dialogue	Unconstrained input	Questions & answers website [Yahoo Answers]	?	<b>User-only initiative in chatbot</b> [CSIEC...]	<b>Questions-asking system</b> where answer is not taken into account [ALICE-chan, Saybot]	<b>Tutorial dialogue</b>	<b>Interactive unconstrained DS</b>
Dialogue	Unconstrained input	<b>Computer-mediated communication:</b> chat, email, videoconference, forum...	<b>Computer-supported collaborative learning and Tutored CMC</b> [MentorChat, Neckle, C4/Mondo]	<b>Interactive unconstrained DIALOGUE SYSTEM</b> [SPELL, Subarashii, DEAL, CSIEC, TLCTS, Façade...]	Free input, but ignored by system [Majestic]	<b>Embedded dialogue</b> (Cornillie et al 2013)	
Dialogue	Partially constrained input	?	?	?	Choose from a list of words in a dialogue (various correct sentences possible)	Choose from a list of words in a dialogue	<b>Partially interactive and unconstrained DS</b>
Dialogue	Constrained input	?	?	Utterance selection dialogue with multiple conversational paths [Let's Chat, Animated pedagogical agent]	Utterance selection with various correct options, but same reaction [Trace Effect]	Reading aloud prompted utterances in dialogue [Virtual Language Patient, FASOP]	
Mono-initiative dialogue	Constrained input	Request more information form	?	Microworld interaction with utterance selection [VILTS, MILT spoken]	Tutorial dialogue asking for words [ARTUR]	Ordering words ( <i>drag &amp; drop</i> ) or <i>gap-filling</i> in a dialogue	<b>All DS</b>

**Focus-on-meaning**  
Successful communication is the main objective

**Focus-on-form**  
Corrective feedback is the main objective

Interaction ↓	Input ↓	Human	Human + Automated tutor	Automated	Automated	Automated	← Interlocutor
		Interactive	Interactive	Interactive	Fixed with illusion of choice	Fixed	← Interactivity
Monologue	Constrained input	9				14	
Monologue	Partially constrained input						
Monologue	Unconstrained input			1			
Mono-initiative dialogue	Partially constrained input			Text adventure games [Spion, LINGO, MILT...] 7			
Mono-initiative dialogue	Unconstrained input	1		Mono-initiative chatbots [Dave, Mike, CSIEC] 9	Questions-asking systems [ALICE-chan, Saybot] 1		Interactive unconstrained DS
Dialogue	Unconstrained input	2	Computer-supported collaborative learning/ <b>Tutored SCMC</b> 5 [MentorChat, Neckle...]	<b>Interactive &amp; unconstrained DSLL</b> 82	2	1	
Dialogue	Partially constrained input				1		Partially interactive and unconstrained DS
Dialogue	Constrained input			3	2	Reading aloud prompted utterances [FASOP] <sup>2</sup>	
Mono-initiative dialogue	Constrained input			Utterance selection [Let's Chat...] 5		Gap-filling 1	All DS

Focus-on-meaning

Successful communication is the main objective

Focus-on-form

Corrective feedback is the main objective



**Why?**

**RATIONALE FOR DSLL**

# SCMC (chat) ⇒ L2 development

- SCMC ⇒ L2 oral proficiency  
(Payne & Whitney, 2002; Payne & Ross, 2005;... Ziegler, 2013; Lin, 2015)
- SCMC ⇒ L2 oral proficiency, more than face-to-face  
(Sykes, 2005; Lin, 2015; although not confirmed by Ziegler, 2013)
- Why?
  - **attention** to form (**noticing** and **feedback**)
  - lower anxiety levels (Satar & Özdener, 2008)

## DSLL → L2 development

- In foreign language teaching contexts:  
interactions in L2 often very rare

⇒ “Virtual immersion” (Ellis & Bogart, 2007; Fryer & Carpenter, 2006)

- Autonomous practice in a communicative, cultural,  
authentic and interactive task  
(Wachowicz & Scott, 1999; Fryer & Carpenter, 2006)

## DSLL → L2 development: advantages over SCMC

- Available at any moment
- Learner can go at his own pace (repeat, etc.)
- Low anxiety environment
- Potentially fully controllable learning environment  
(e.g. feedback, learner modeling and adaptivity, motivational support)

# What do we know?

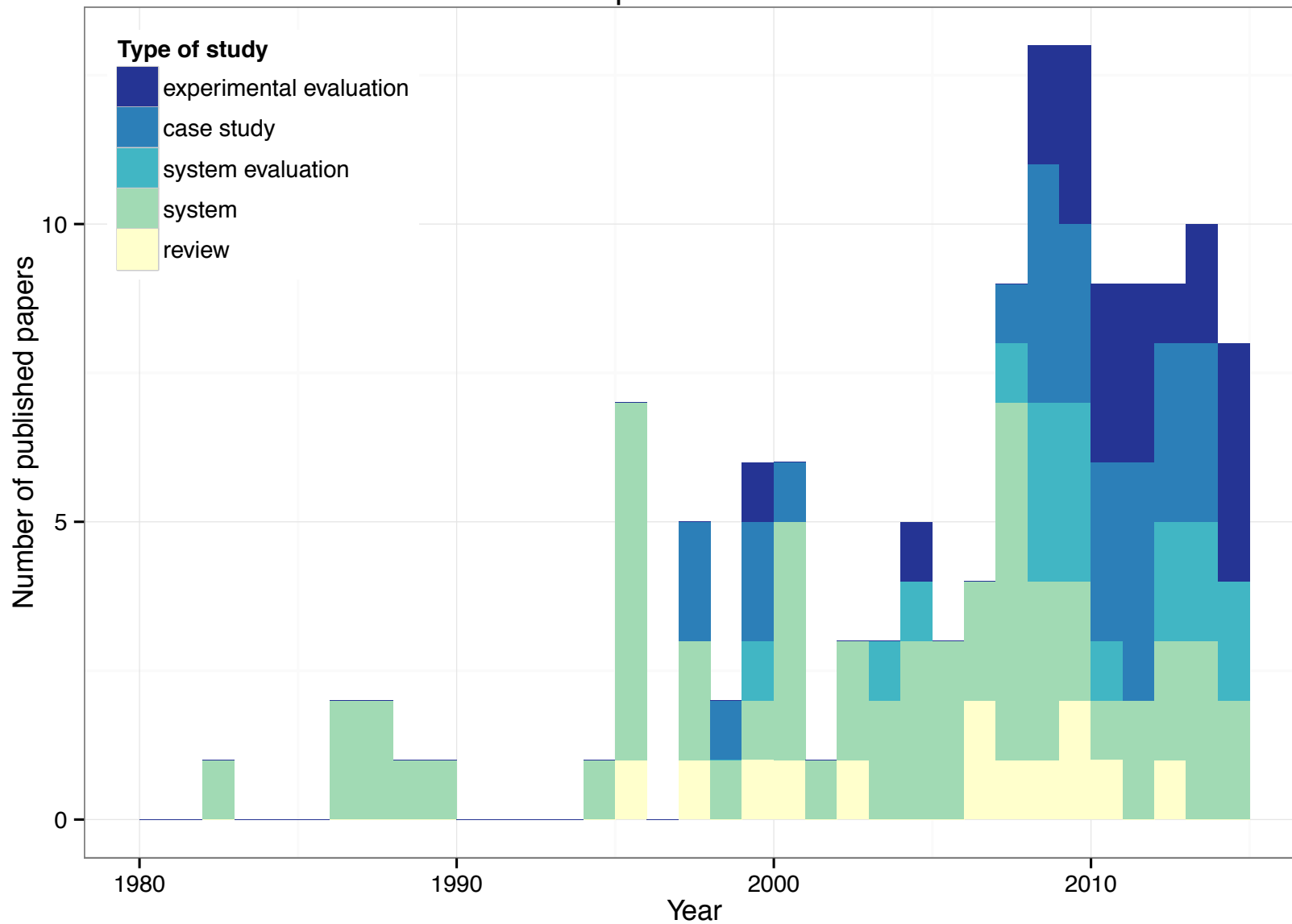
## EFFECTIVENESS STUDIES





# Types of studies on DSLL

Studies published on DSLL



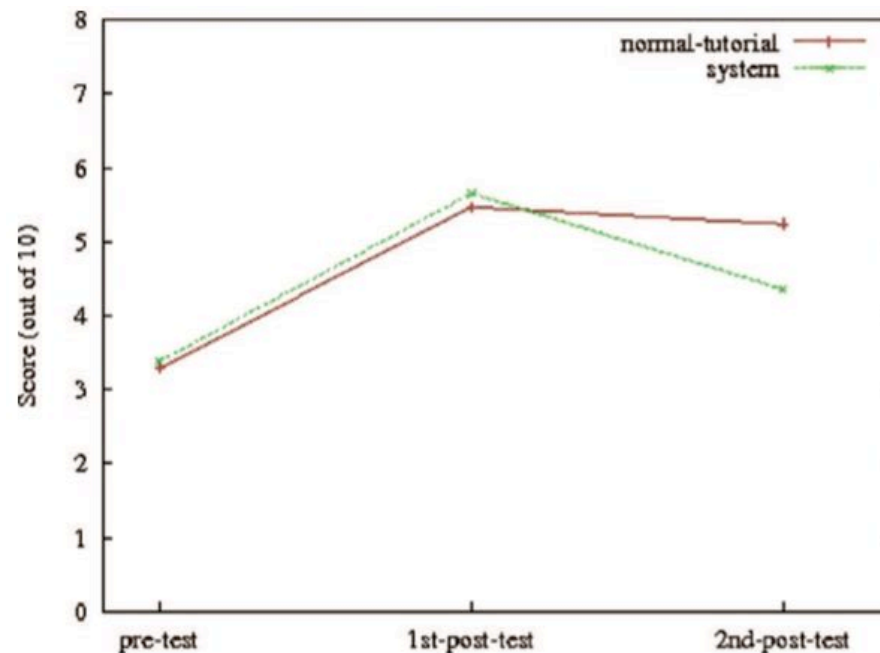
# Effectiveness studies

*Number of studies by dependent variables and methodological design*

	<b>Perceived usefulness</b>	<b>Impact on motivation and attitude</b>	<b>Impact on language knowledge and skills</b>
<b>Post</b>	14	1	3
<b>Pre-post</b>		7	22
<b>Pre-post + control</b>		4	12
<b>Pre-post + control with significant results</b>		0	2

## Experimental studies on DSLL's impact on learning

- Vlugter, Knotta, McDonald & Hall (2009)  
[Te Kaitito]: written DSLL tutorial in Māori
  - compares DSLL tutorial with in-class tutorial about Māori personal pronoun system

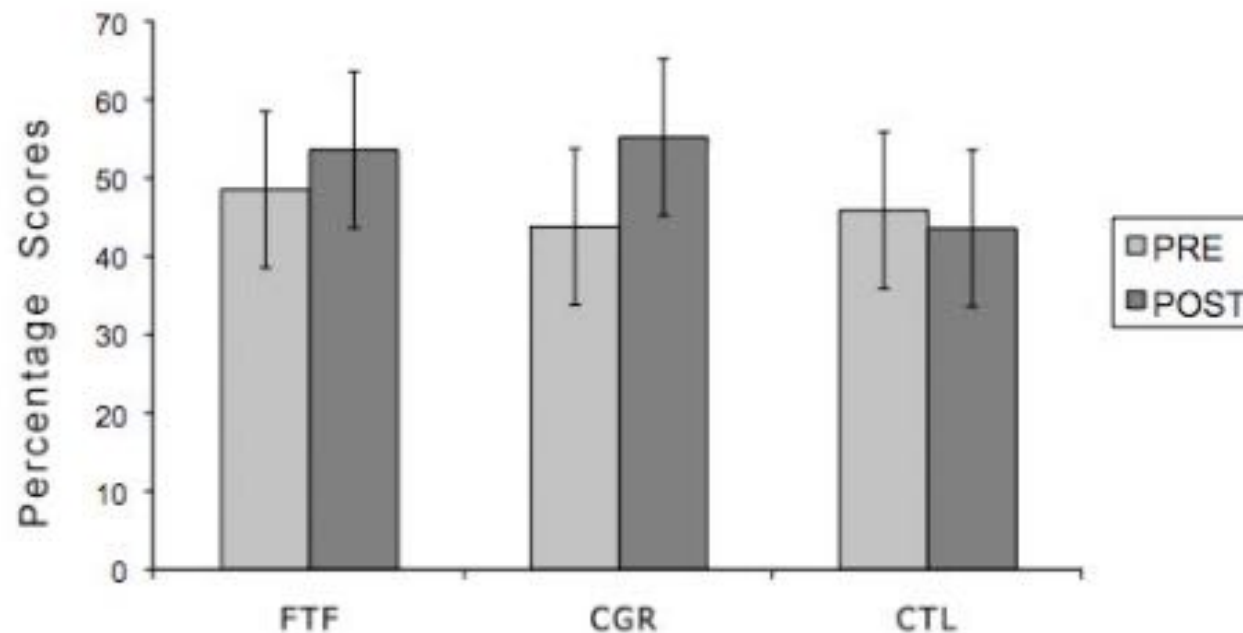


# Experimental studies on DSLL's impact on learning

- Petersen (2010)

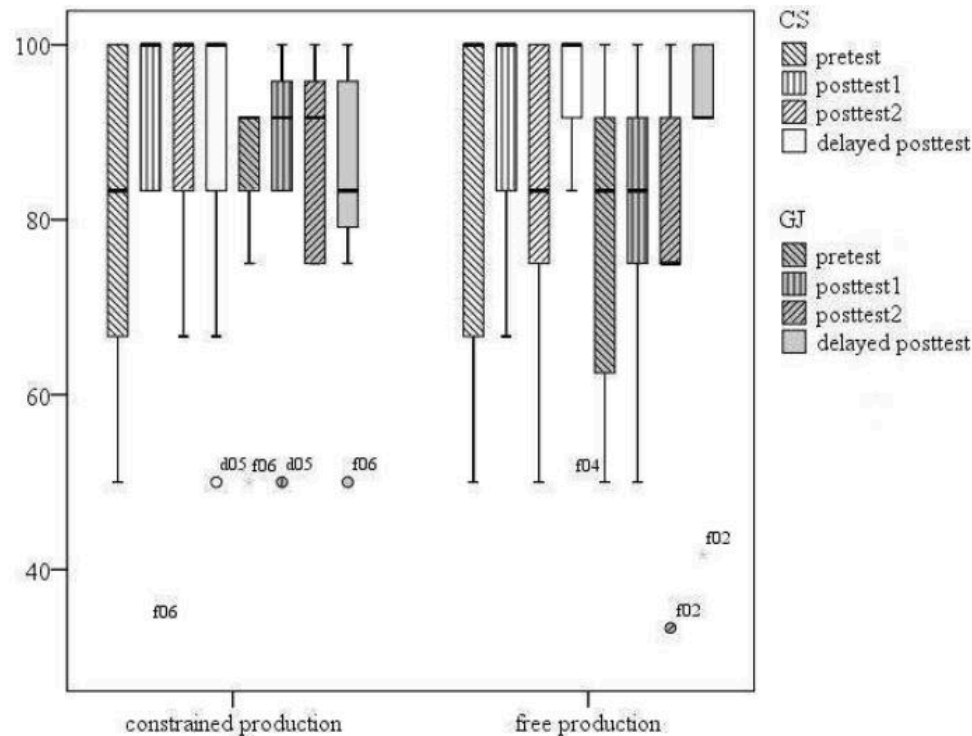
[Sasha]: written DSLL in English providing corrective feedback (recast) and answering questions in a “spot the differences” task

- compares Sasha vs. face-to-face interaction  
=> impact on question construction



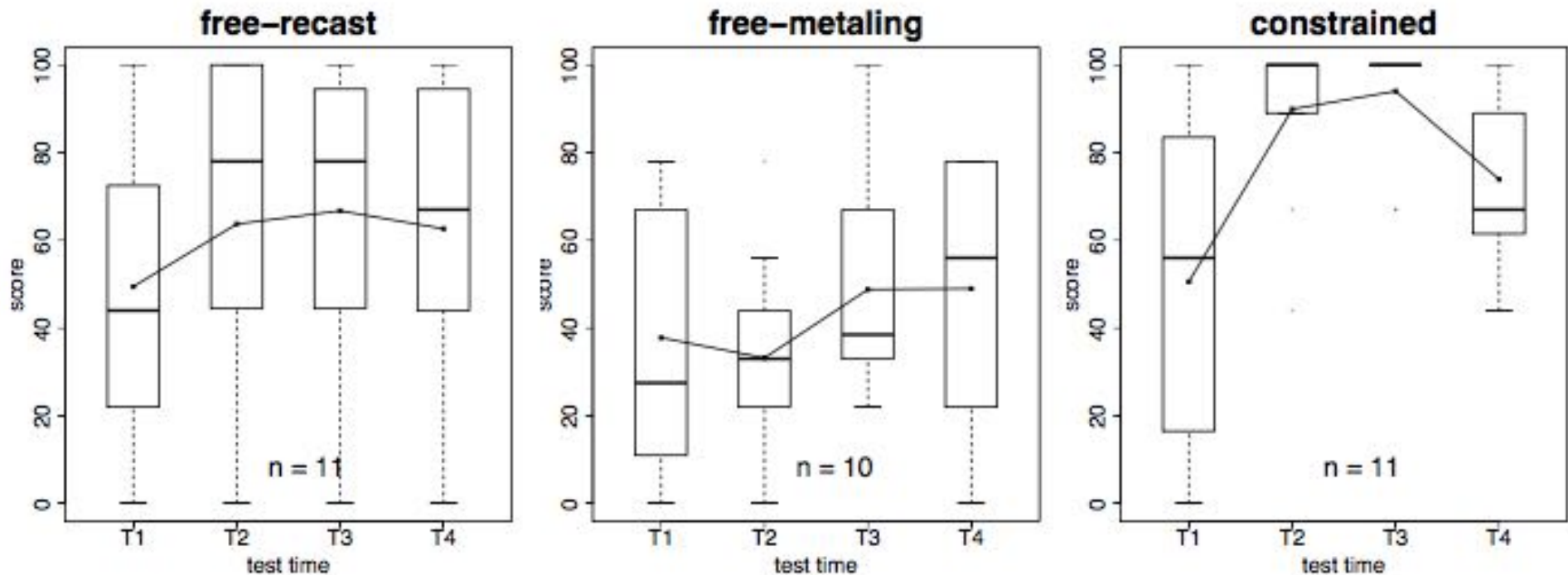
# Experimental studies on DSLL's impact on learning

- Wolska & Wilske (2010a)  
Written DSLL in German
  - compare **free production** vs. **constrained production** (*gap filling*) => impact on sentence construction and grammaticality judgement
  - N=15  
n=7



# Experimental studies on DSL's impact on learning

- Wilske & Wolska (2011)
  - compares free production with either recasts or metalinguistic feedback, and constrained input => impact on sentence construction & grammaticality judgement
  - N=30 / n=9



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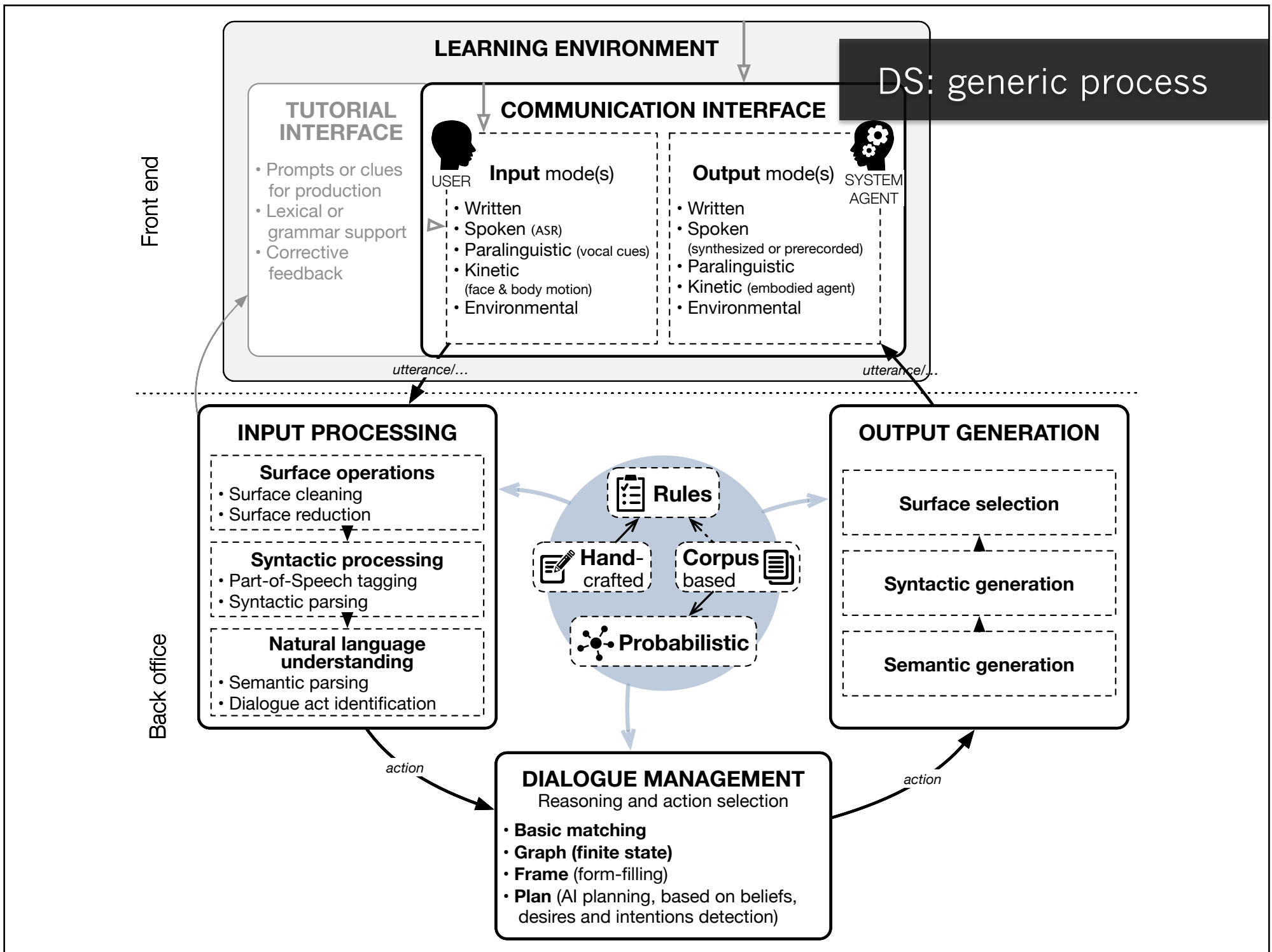
413 <li>Doesn't everyone have a </li>
414 </random><star/>.<br />
415 I have
416 <random>
417 <li>A lot of friends on the Internet.</li>
418 <li>A great programmer.</li>
419 <li>A whole lot of original answers.</li>
420 <li>A plan for a robot body.</li>
421 </random>
422 </template>
423 </category>
424
425
426 <pattern>DO YOU KNOW *</pattern>
427 <template>
428 <think><set name="it"><star/></set></think>
429 <random>
430 <li>I don't know if I know <star/>. Where would I have heard about it?</li>
431 <li>I know very little about <star/>. Tell me more.</li>
432 <li>No, tell me about him, her or it.</li>
433 </ random
434 </template>
435 </category>
436
437 <category>
438 <pattern>DO YOU KNOW WHAT * IS</pattern>
439 <template>
440 <srai>WHAT IS <star/></srai>
441 </template>
442 </category>
443
444 <category>
445 <pattern>DO YOU LIKE *</pattern>
446 <template>
447 <think><set name="it"><star/></set></think>
448 <random>
449 <li>I don't know if I like <star/>.</li>
450 <li>Some people like it.</li>
451 <li>Do you like it?</li>
452 <li>How old are you?</li>
453 <li>I've heard other people say they like that.</li>
454 </random>
455 <random>
456 <li>I like pets.</li>
457 <li>But I like cats.</li>
458 <li>Though I like cats and dogs.</li>
459 <li>I enjoy working with people.</li>
460 <li>I have a stimulating relationship with <bot name="master"/>.</li>
461 <li>I love horses.</li>
462 <li>Someone said they like guns.</li>

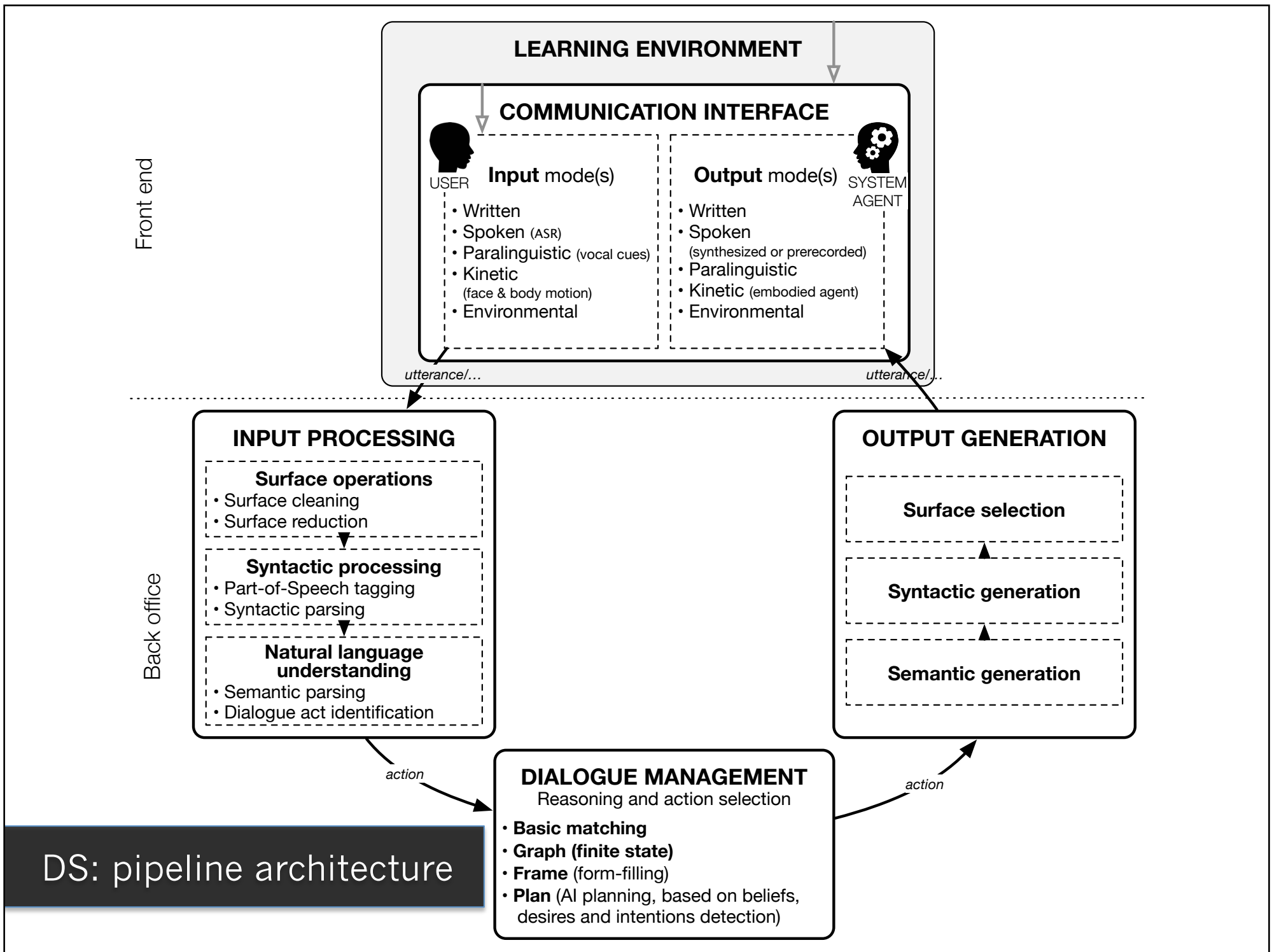
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# How?

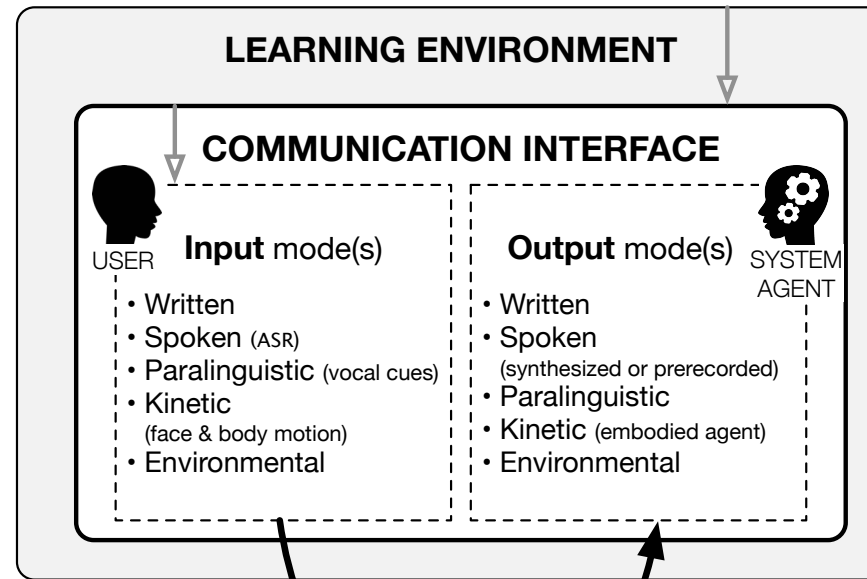
## TECHNOLOGICAL PROCESS



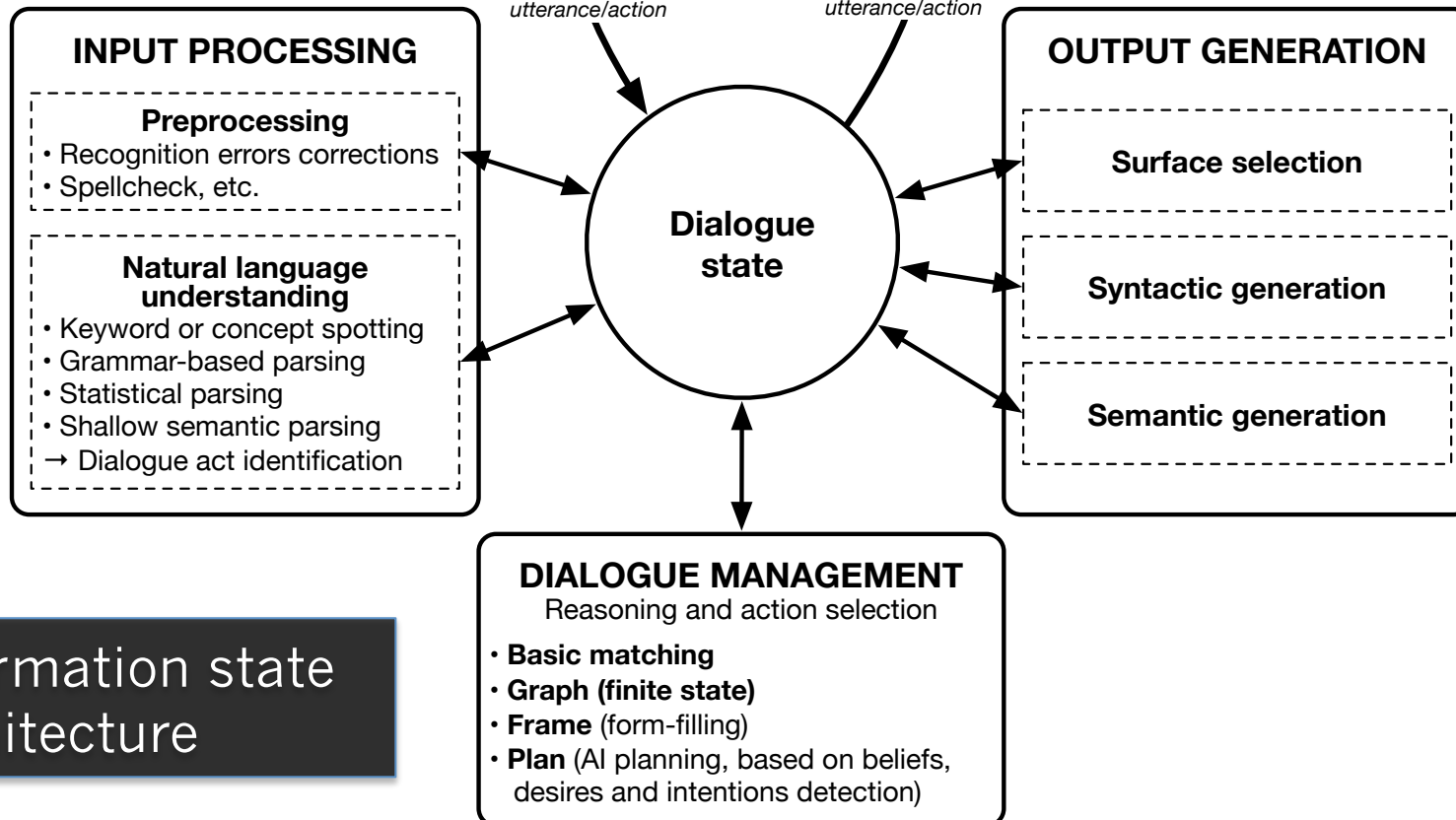




Front end

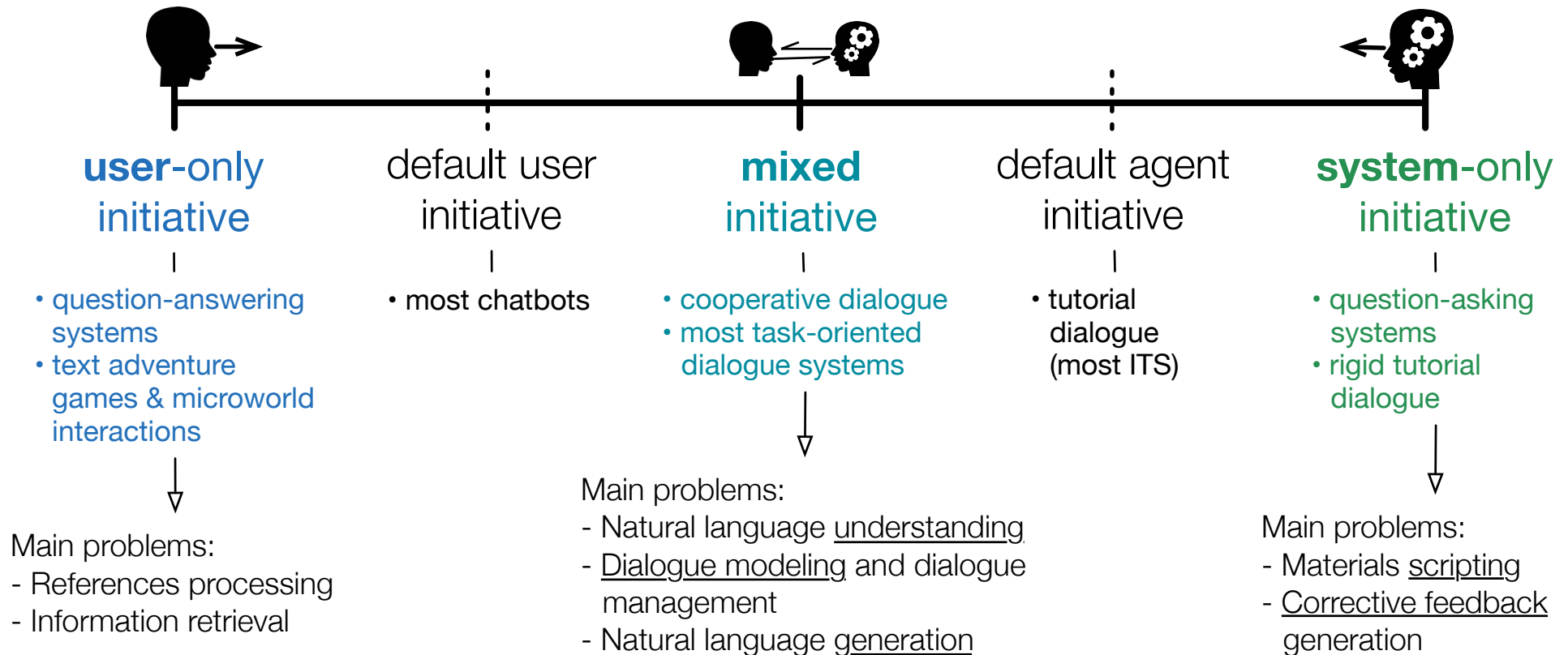


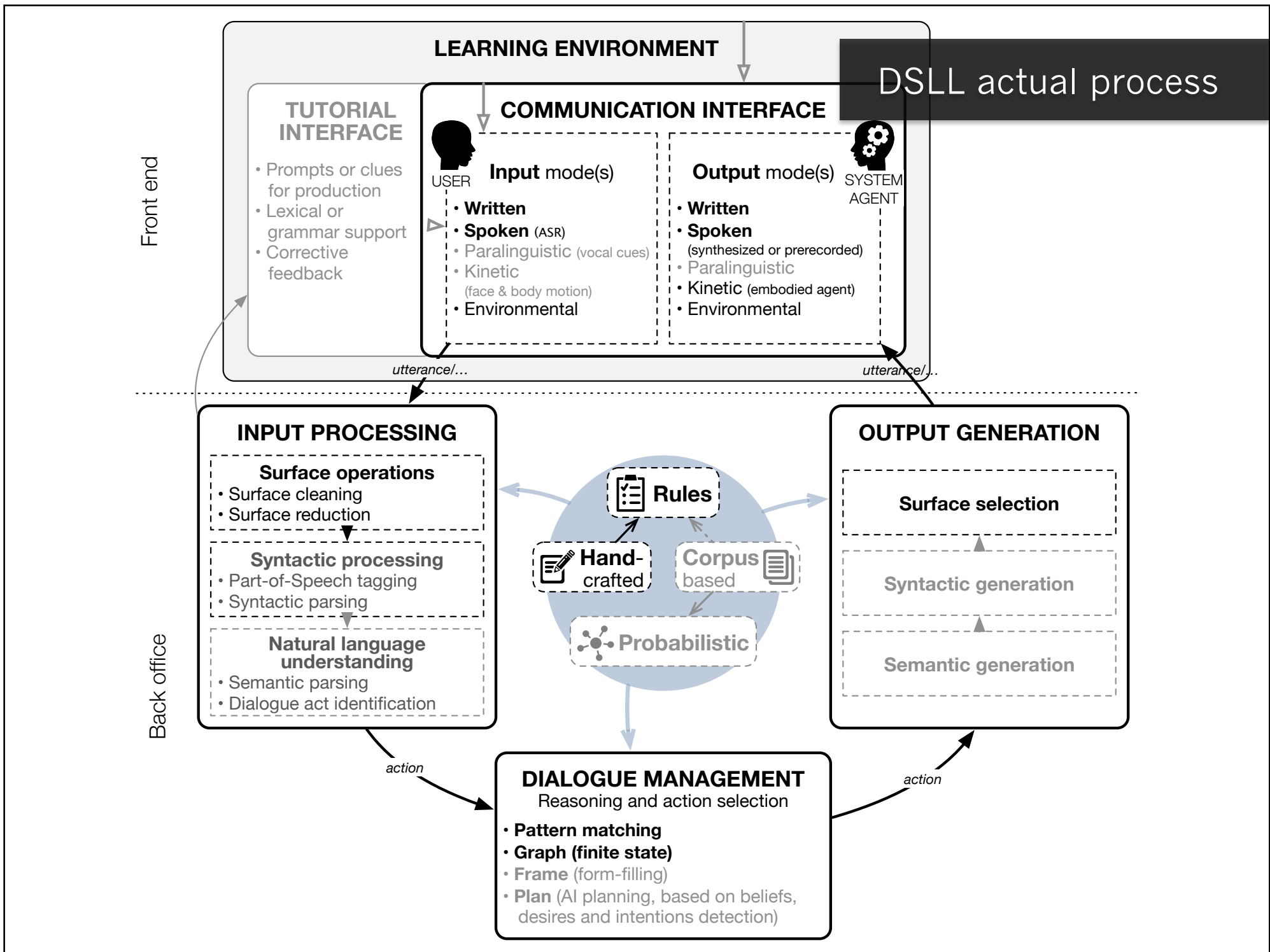
Back office



DS: information state architecture

# Initiative management in dialogue systems





# Conclusions

- **What?**

- Operational definition of DSLL based on systematic literature study:
  - “Dialogue activity with an automated agent, ideally with unconstrained input and interactive dialogue sequence”

- **Why?**

- Insufficient experimental results to demonstrate effectiveness for language language
- ⇒ Need for more effectiveness research

- **How?**

- Advancements in dialogue systems haven't yet been applied to DSLL:
  - natural language understanding
  - information state-based
  - data-driven / probabilistic models
- ⇒ Need for more technological research

# Thank you!

**Dialogue systems for language learning:**  
state of the art and avenues for research  
on task-based agents

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