“Hey Siri, can I learn English by talking to you?”
A meta-analysis of dialogue-based CALL

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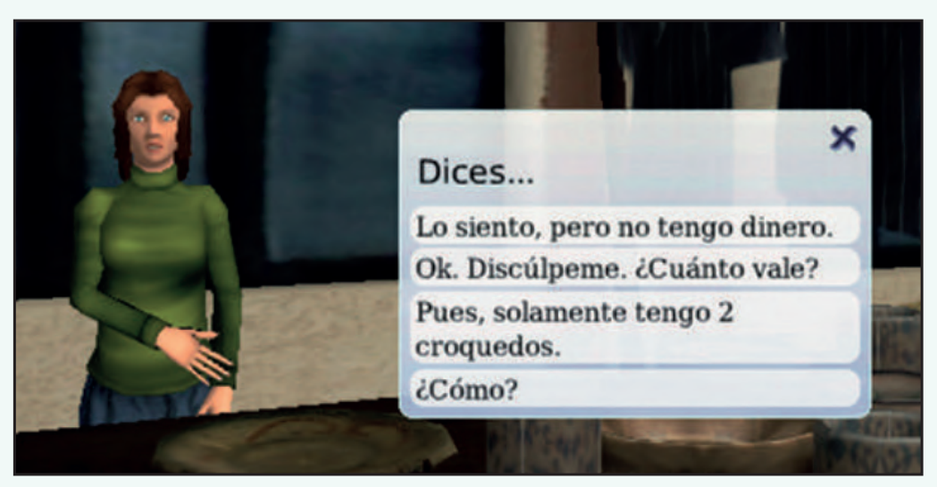
Dialogue-based CALL

Dialogue-based CALL systems involve (Bibauw, François & Desmet, *forthcoming*)

- a **dialogue** (i.e., sequence of conversational turns)
- with an **automated agent** (chatbot, robot, voice assistant, non player character...)
- as a **language learning task** (≠scaffolding).

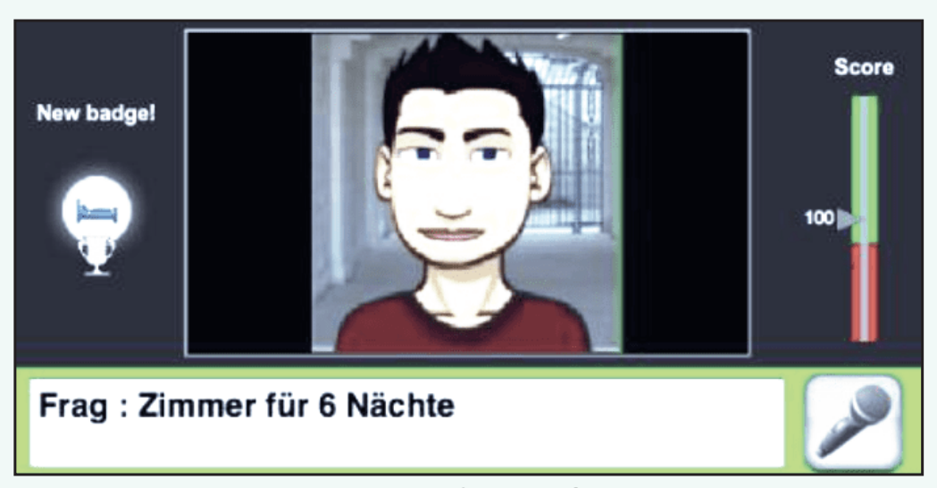
Narrative systems



Dices...
Lo siento, pero no tengo dinero.
Ok. Discúlpeme. ¿Cuánto vale?
Pues, solamente tengo 2 croquedos.
¿Cómo?

Croquelandia (Sykes, 2013)

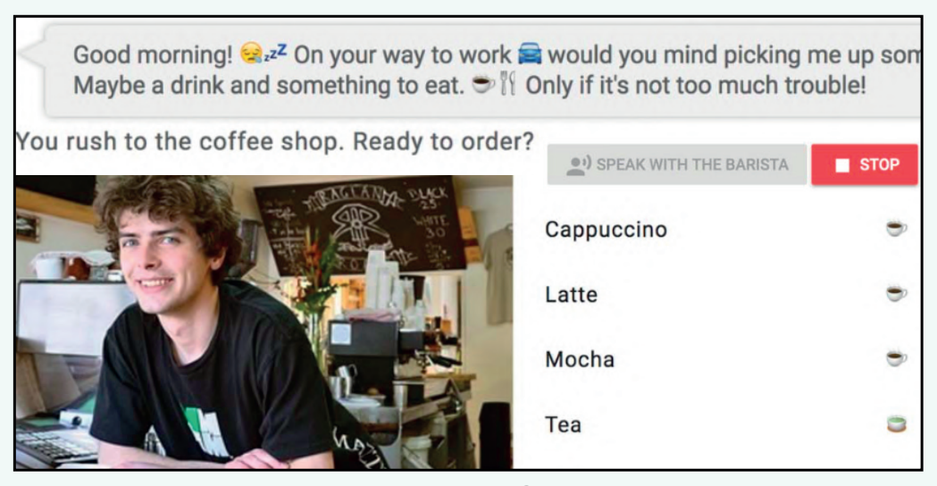
Form-focused systems



Frag : Zimmer für 6 Nächte

CALL-SLIT (Baur *et al*, 2014)

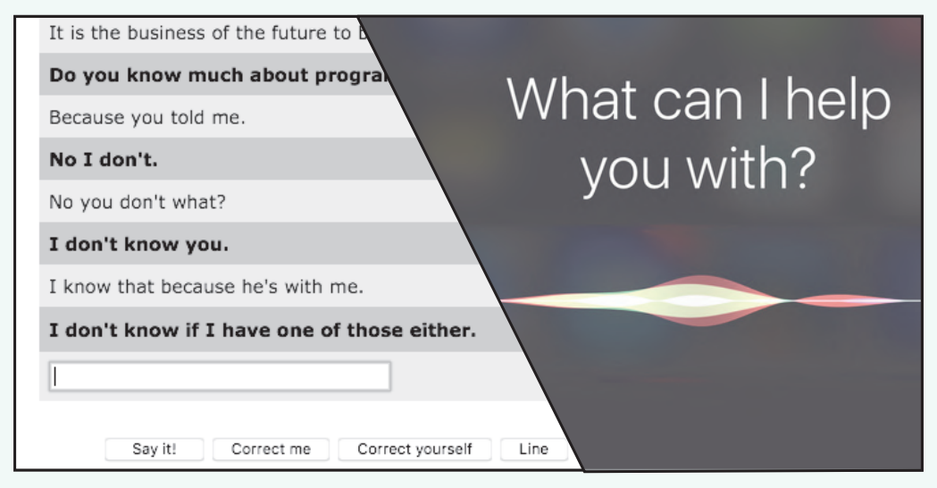
Goal-oriented systems



Good morning! On your way to work would you mind picking me up som
Maybe a drink and something to eat. Only if it's not too much trouble!
You rush to the coffee shop. Ready to order?

HALEF/ETS (Sydorenko *et al*, 2018)

Reactive systems



It is the business of the future to
Do you know much about progra
Because you told me.
No I don't.
No you don't what?
I don't know you.
I know that because he's with me.
I don't know if I have one of those either.

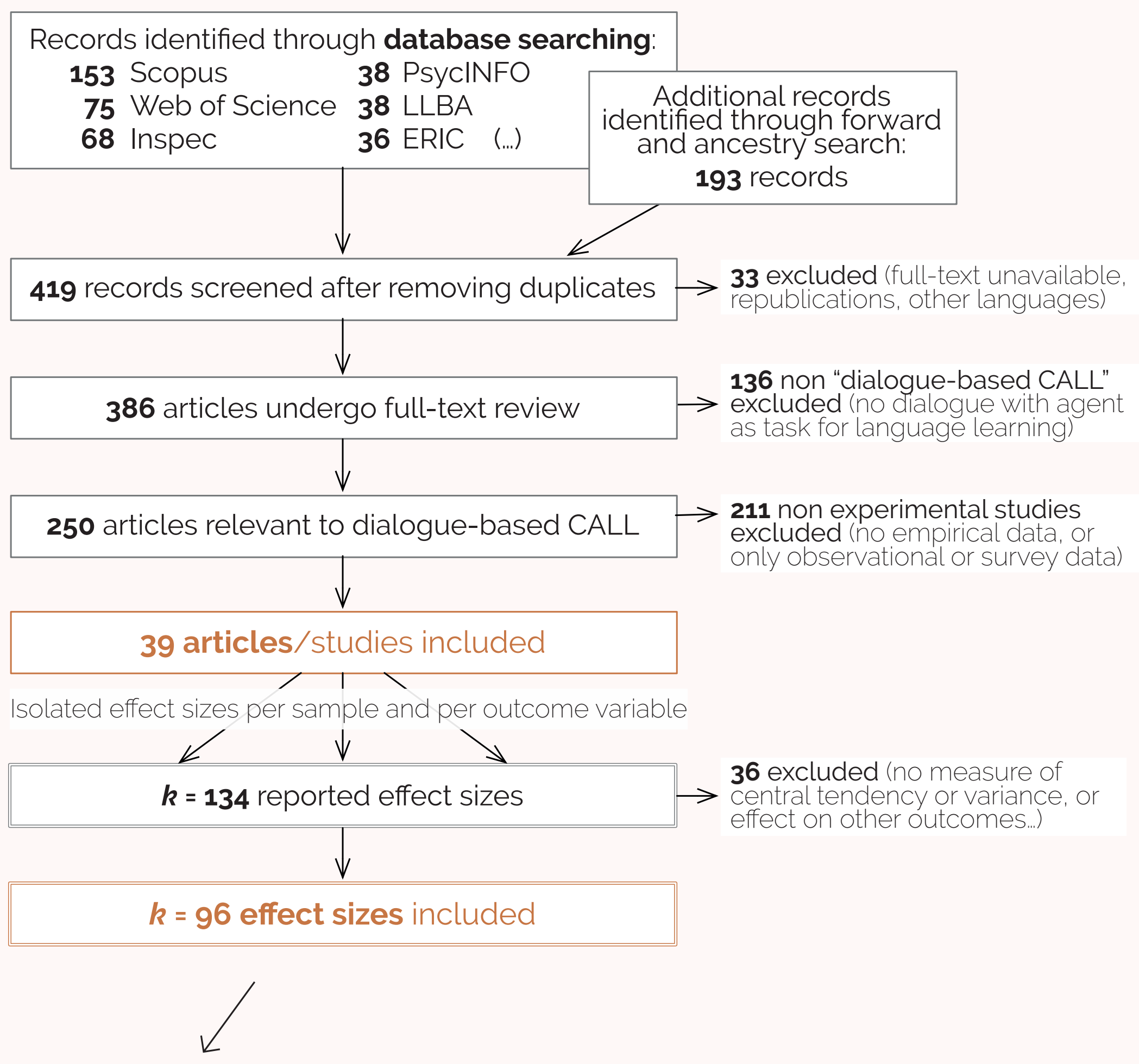
What can I help you with?

Jabberwacky (Fryer *et al*, 2017); *Siri* (Underwood, 2017)

RQ1 How effective is dialogue-based CALL in general for L2 development?

RQ2 How different implementations of dialogue-based CALL, distinguished by characteristics of instructional and system design, compare to each other in terms of effectiveness on diverse language learning outcomes?

Methods



Records identified through **database searching**:
153 Scopus
75 Web of Science
68 Inspec
38 PsycINFO
38 LLBA
36 ERIC (...)

Additional records identified through forward and ancestry search: **193** records

419 records screened after removing duplicates → **33** excluded (full-text unavailable, republications, other languages)

386 articles undergo full-text review → **136** non “dialogue-based CALL” excluded (no dialogue with agent as task for language learning)

250 articles relevant to dialogue-based CALL → **211** non experimental studies excluded (no empirical data, or only observational or survey data)

39 articles/studies included

Isolated effect sizes per sample and per outcome variable

k = **134** reported effect sizes → **36** excluded (no measure of central tendency or variance, or effect on other outcomes...)

k = **96 effect sizes** included

Meta-analysis: statistical summary of studies, aggregat-ing all compatible effects to compute a summary effect.

Multilevel meta-analysis

- every measurement of effect on each outcome variable for each sample is included as a single effect size;
- lack of independence between effects from the same study taken into account by layer of random variation at the study level;
- allows high granularity in study of moderator variables.

(see Van den Noortgate et al 2012)

Level of aggregation	Items/clusters	Remaining variation
Study	$k_{\text{studies}} = 17$	Variation between-studies
Effect size	$k = 96$	Variation between-subjects
Subject	$n = 803$	Random sampling variance

Mixed-effects model:

- random between-studies effect
- random between-subjects effect
- fixed effects for covariates and moderator variables

Standardized Mean Difference (*d*) computed with single raw metric (Morris & DeShon, 2002):

$$d_{\text{PP,raw}} = c(df_{\text{PP}}) \left(\frac{M_{\text{post,E}} - M_{\text{pre,E}}}{SD_{\text{pre,E}}} \right)$$

$$d_{\text{ECPP,raw}} = c(df_{\text{ECPP}}) \left(\frac{M_{\text{post,E}} - M_{\text{pre,E}}}{SD_{\text{pre,E}}} - \frac{M_{\text{post,C}} - M_{\text{pre,C}}}{SD_{\text{pre,C}}} \right)$$

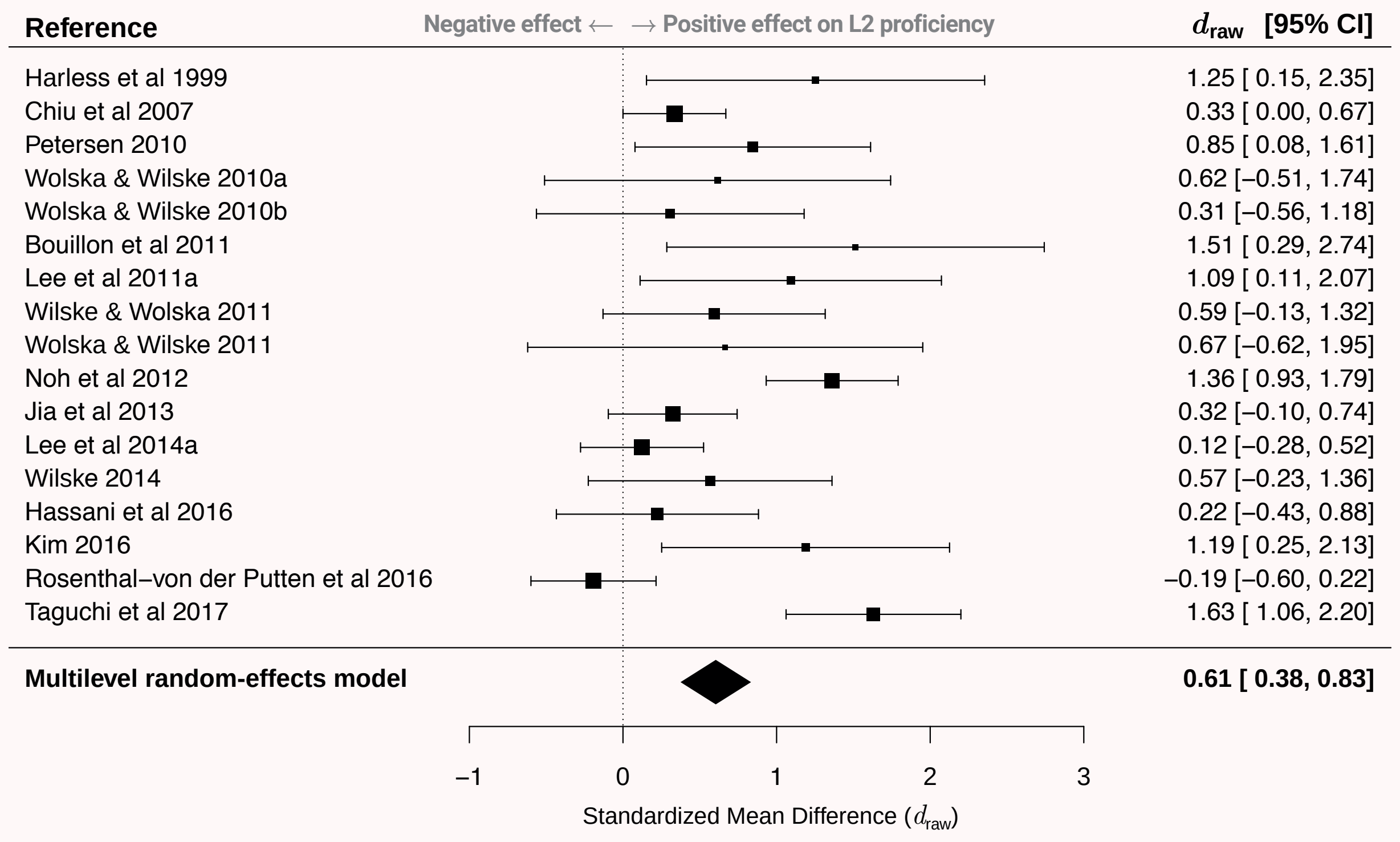
Findings

Medium-high global effect of DBCALL on L2 proficiency:

$$d_{\text{raw}} = .61$$

High **heterogeneity** and limited statistical power in existing studies:

$$Q(df = 95) = 301.3$$



Type	Variable	df	F	p	Values	k	d	SE	CI
Population	L2 proficiency*	4	9.55	.049	intercept		0.69	0.38	[-0.049, 1.436]
					A1	38	0.36	0.21	[-0.056, 0.775]
					A2	89	0.18	0.30	[-0.416, 0.769]
					B1	77	-0.42	0.25	[-0.910, 0.066]
					B2	28	-0.41	0.28	[-0.962, 0.150]
	Context	2	1.03	.599	school	18	0.68	0.23	[0.235, 1.121]**
					university	75	0.54	0.15	[0.259, 0.830]***
					military	3	1.08	0.55	[0.002, 2.160]*
Treatment	Duration*	4	10.29	.036	intercept		0.09	0.20	[-0.300, 0.484]
					+1 hour on task		0.15	0.05	[0.049, 0.256]**
					+1 session		0.31	0.11	[0.094, 0.523]**
					+1 week		-0.19	0.08	[-0.338, -0.037]*
	Type of system	3	1.38	.710	narrative	4	0.31	0.49	[-0.643, 1.261]
					form-focused	15	0.86	0.27	[0.336, 1.392]**
					goal-oriented	71	0.56	0.16	[0.244, 0.877]***
					reactive	6	0.57	0.37	[-0.156, 1.287]
	Type of interaction	2	0.46	.794	goal-oriented	66	0.64	0.14	[0.373, 0.907]***
					open-ended	6	0.56	0.36	[-0.146, 1.276]
					system-guided	4	0.31	0.48	[-0.627, 1.245]
	System modality	1	0.03	.873	spoken	25	0.59	0.17	[0.256, 0.920]***
					written	61	0.63	0.17	[0.293, 0.960]***
	Corrective feedback	2	2.53	.283	explicit	36	0.75	0.16	[0.447, 1.059]***
					implicit	37	0.71	0.15	[0.415, 1.005]***
					none	23	0.37	0.18	[0.013, 0.732]*
Outcome	Test modality	1	1.72	.190	spoken	35	0.74	0.16	[0.427, 1.054]***
					written	61	0.52	0.14	[0.249, 0.799]***
	Matching modality (treatment=test)	1	2.52	.113	true	72	0.68	0.13	[0.428, 0.923]***
					false	24	0.40	0.17	[0.063, 0.745]*
	Outcome type***	2	16.32	<.001	comprehension	4	-0.45	0.33	[-1.095, 0.201]
					production	80	0.76	0.16	[0.453, 1.069]***
					vocabulary	12	0.41	0.25	[-0.083, 0.899]
	Outcome dimension**	6	18.68	.005	holistic proficiency	11	0.76	0.26	[0.263, 1.265]**
					complexity	1	0.68	0.48	[-0.262, 1.614]
					accuracy	49	0.52	0.18	[0.176, 0.871]**
					lexicon	17	0.83	0.23	[0.375, 1.292]***
					fluency	14	0.65	0.23	[0.207, 1.097]**
	Type of test	3	7.75	.051	metaling. judgment	20	0.58	0.20	[0.184, 0.969]**
					selected response	9	0.17	0.23	[-0.280, 0.621]
					constrained resp.	32	0.71	0.18	[0.355, 1.064]***
					free response	35	0.76	0.18	[0.412, 1.109]***
	Temporality of effects	1	0.60	.439	short-term	73	0.62	0.12	[0.388, 0.860]***
					long-term	23	0.52	0.16	[0.202, 0.838]**

Moderator analysis

Differenciated effects across levels: beginners tend to benefit more

Tentative modelization of effects of treatment duration: Time on task + #Session - Time between sessions

Goal/task-oriented interaction seems to provide more learning oppportunities than **open-ended** (e.g., small talk) or **system-guided** interactions

Spoken and written practice seem to have very similar effects

...but effects could be slightly stronger or more visible on speaking

Learning effects are **much stronger on production** outcomes, and could be close to zero regarding an improvement in comprehension

All 4 CALF dimensions seem to benefit from DBCALL, but the effects seem **stronger on vocabulary & fluency** (and possibly complexity)

Effects are higher when tested through free or constrained production tasks than in other types of instruments

15s-Summary

Dialogue-based CALL includes all chatbots, conversational agents, voice assistants, robots and talking NPCs for language learning.

We conducted a **multilevel meta-analysis** on all the effectiveness studies ever conducted on such systems (250 articles initially), collecting **96 effect sizes**.

Innovative statistical formulas and models were implemented to integrate the results.

The **general effect of dialogue-based CALL** practice on L2 proficiency development is **medium-high**, at d_{raw} **= .61**. It is comparable, although logically inferior, to the effect of human-human interaction as measured by other meta-analyses (Mackey & Goo, 2007: d_{raw} = .75).

Insights from the moderator analysis include a differenciated effect **across proficiency levels** (beginners benefit more than advanced learners), and stronger effects on **production tasks**, particularly on **vocabulary and fluency** measures.

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