The earliest stages of second language learning: A behavioral investigation of long-term memory and age

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Introduction

The study investigates the extent to which declarative and procedural long-term memory predict receptive language development in the earliest stages of L2 exposure in children and adults. Recent cognitive models of L2 learning have capitalized on the distinction between declarative and procedural memory (e.g., Ellis & Wulff, 2015; Hamrick et al., 2018; Paradis, 2009; Ullman, 2016) or declarative and procedural knowledge (e.g., DeKeyser, 2015) to account for patterns of L2 processing and development. Previous studies with adults have found asymmetries in the engagement of the two memory systems depending on amount of L2 practice (e.g., Hamrick, 2015; Morgan-Short et al., 2014), training conditions (e.g., Morgan-Short, 2007), type of linguistic target (e.g., Antoniou et al., 2016), learning context (e.g., Faretta-Stutenberg & Morgan-Short, 2017). Although some L1 studies (e.g., Kidd, 2012) have found a significant effect for procedural memory in child language development, no training studies to date have explored the effects of long-term memory for L2 development in children. The linguistic targets investigated here include aural sentence comprehension (measured during L2 practice), word order and case marking (measured by an aural grammaticality judgment test [GJT] administered at the end of practice).

RQ1: To what extent do declarative and procedural learning ability predict aural comprehension of sentences during L2 practice in children and adults?

RQ2: To what extent do declarative and procedural learning ability predict L2 gains in word order and case marking (as measured by a GJT) in children and adults?

Materials and methods

Forty L1 Italian 9 year olds and 36 adults (*M* = 22; *SD* = 3.7) were incidentally exposed to BrocantoJ (a Japanese-based version of Brocanto2, Morgan-Short, 2007) in the context of a computer board game similar to draughts. After vocabulary training (including 4 tokens names, 4 moves [verbs], 2 adjectives for the tokes' shapes, 2 adverbs [directions], but excluding the case markers) the participants were shown game moves on the computer and simultaneously exposed to the aural sentence stimuli that described them. The exposure (144 sentences) was distributed over six blocks (B) and delivered over three consecutive days (B1, B2-3, B4-6). After each exposure block the participants played a computer game, which consisted in performing novel moves following an aural description (20 sentences per block). The following is an example of a BrocantoJ sentence a participant would hear associated to the game scenario below:

Troise blomi li neimo blomi lu zeima nima
[Round blom NOM square blom ACC horizontally capture]
'The round blomi piece captures the square blomi piece horizontally'

⊠ blomi
⊕ vode
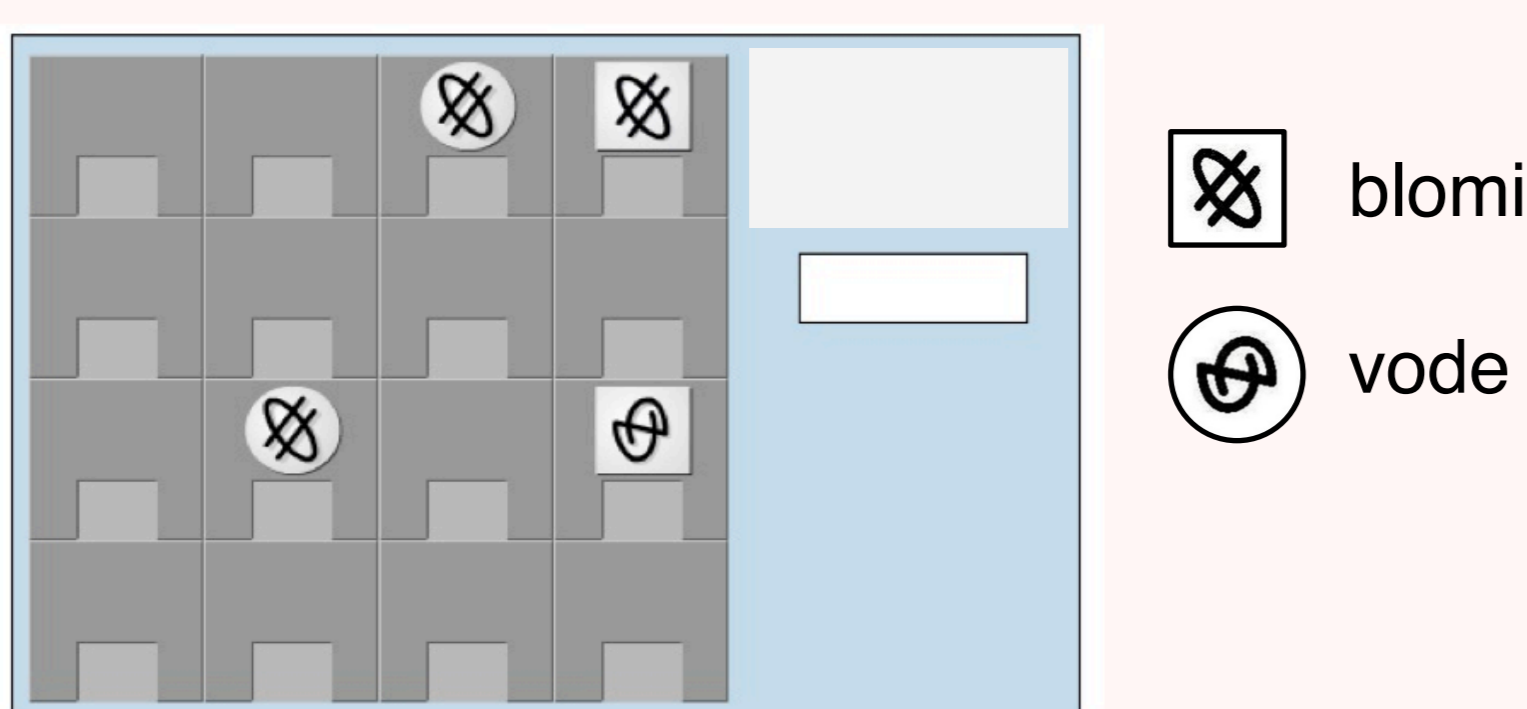
Cognitive and outcome measures:

		Declarative composite score	
Children	Declarative learning ability	Short Story Recall (Vicari, 2007)	Visual-Spatial Recall (Vicari, 2007)
Adults		Short Story Recall (Mapelli et al., 2011)	Rey-Osterrieth Complex Figure (Caffarra et al., 2002)
Children/ Adults	Procedural learning ability	ASRT Task (Hedenius, 2013; Lum et al., 2010) – accuracy score	ASRT Task (Hedenius, 2013; Lum et al., 2010) – RT score
		Procedural composite score	

Trial accuracy in the computer game was used as a measure of sentence comprehension during practice. The aural GJT administered at the end of practice included 28 experimental trials, half of which ungrammatical, probing word order (8 items) and case (6 items).
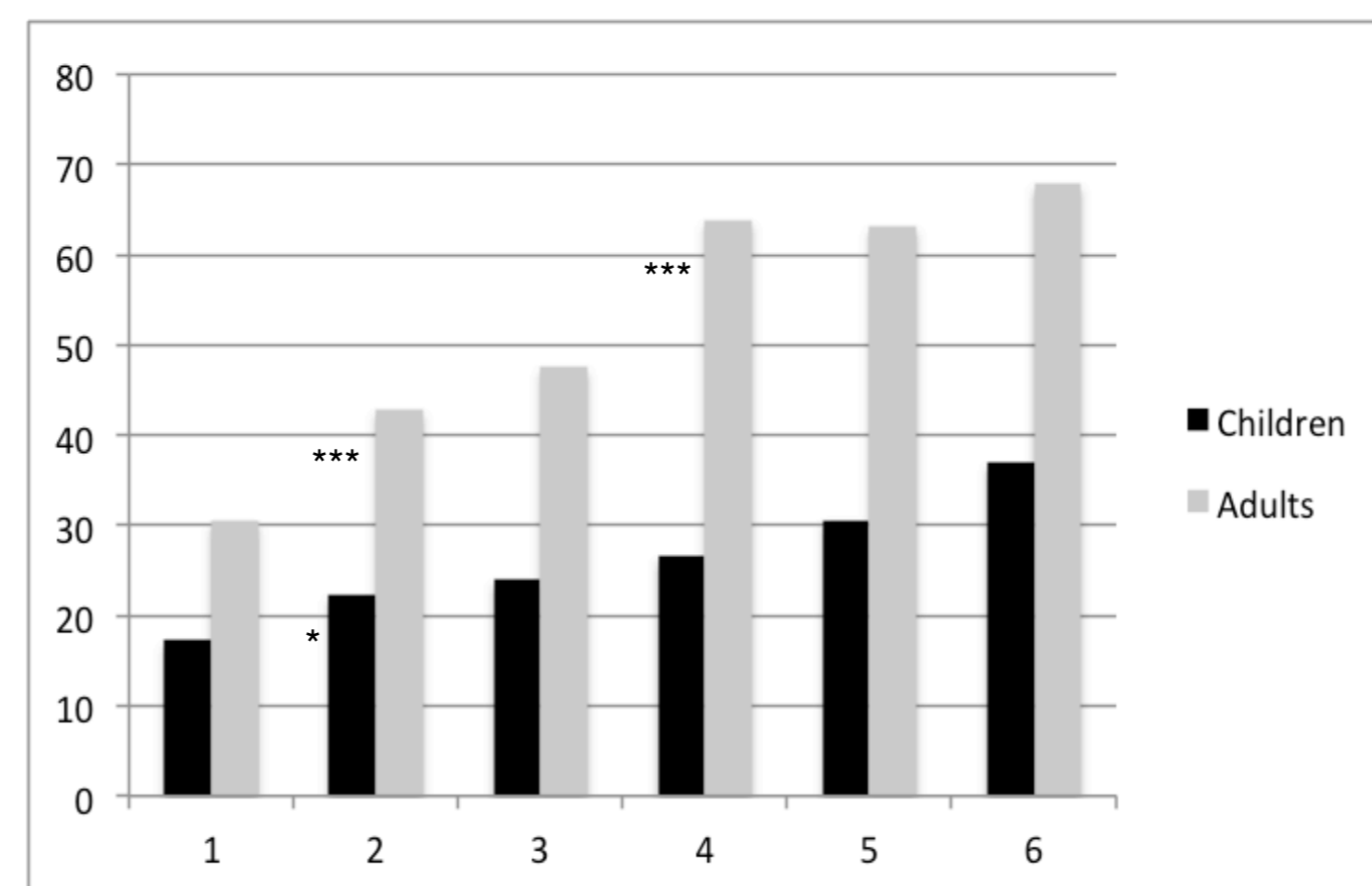
Results

L2 practice

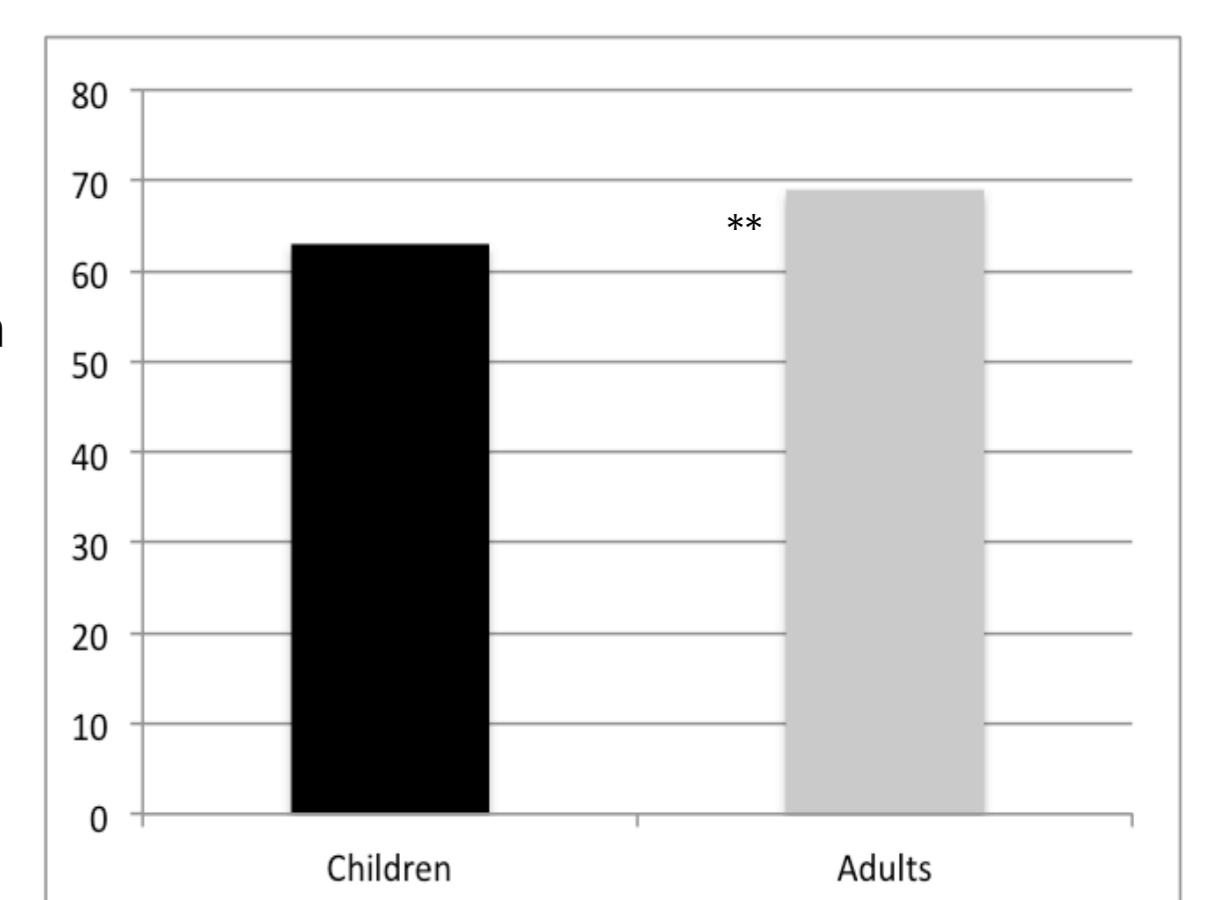*Figure 1.* Child and adult rate of learning during L2 practice (percentage correct per block).

Overall L2 attainment and rate of learning during practice was higher in adults compared to children (*Z* = -24.7, *p* =.000). The stars in Figure 1 indicate significant increments with respect to the preceding block.

The adult advantage in L2 attainment was confirmed in the GJT (*Z* = -2.80, *p* = .005).

GJT

Figure 2. Child and adult L2 attainment in the GJT (percentage correct).
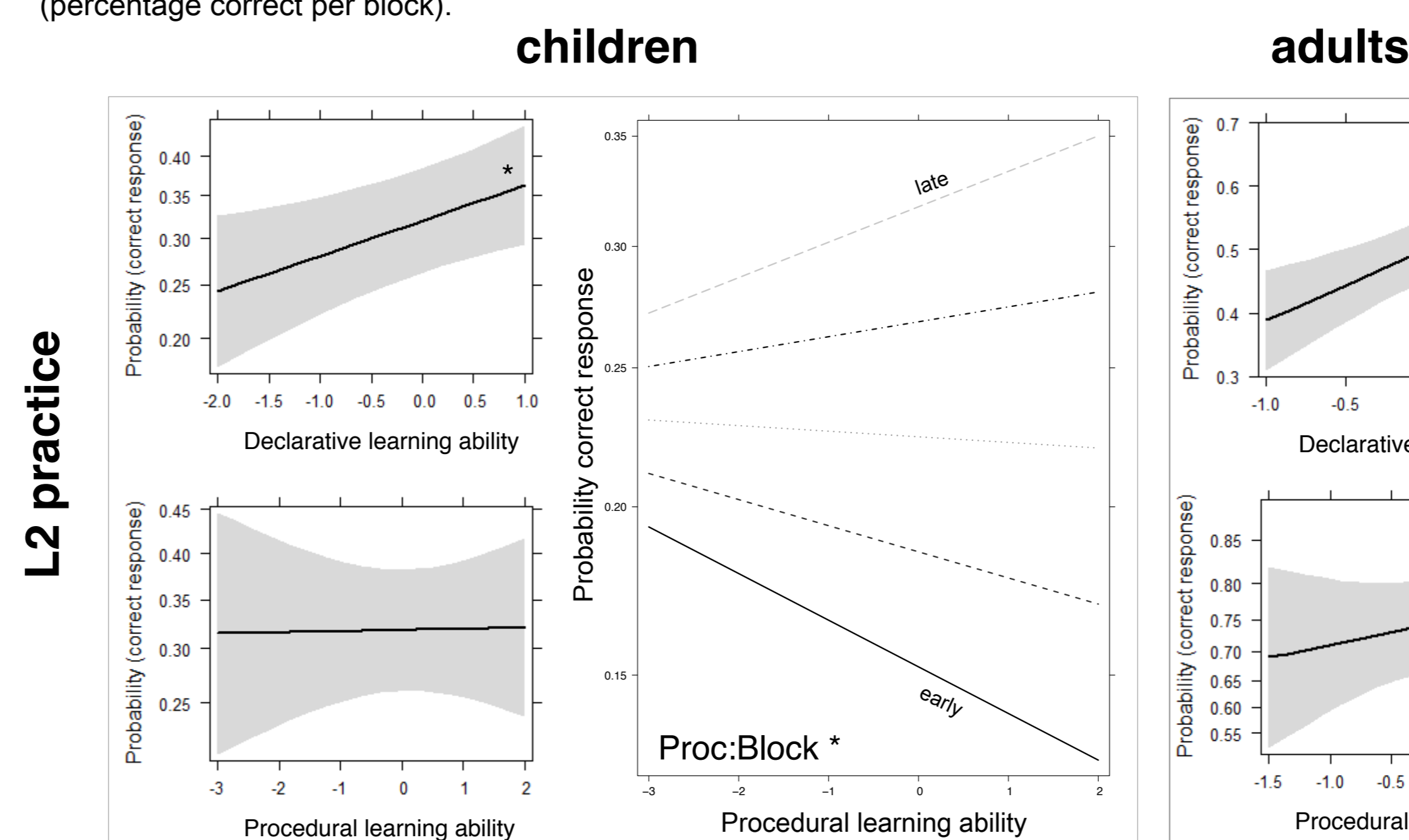
children / adults

Figure 3. Effects of declarative and procedural learning ability in child L2 practice.

Figure 4. Effects of declarative and procedural learning ability in adult L2 practice.

Mixed effects models fitted to the L2 practice data returned a significant effect of declarative learning ability for both children and adults (β = 0.28, *z* = 1.96, *p* < .05; β = 1.07, *z* = 4.68, *p* < .001).

Procedural learning ability was not a significant effect in either group, but in children its effect significantly increased across practice (β = 0.04, *z* = 1.98, *p* < .05).
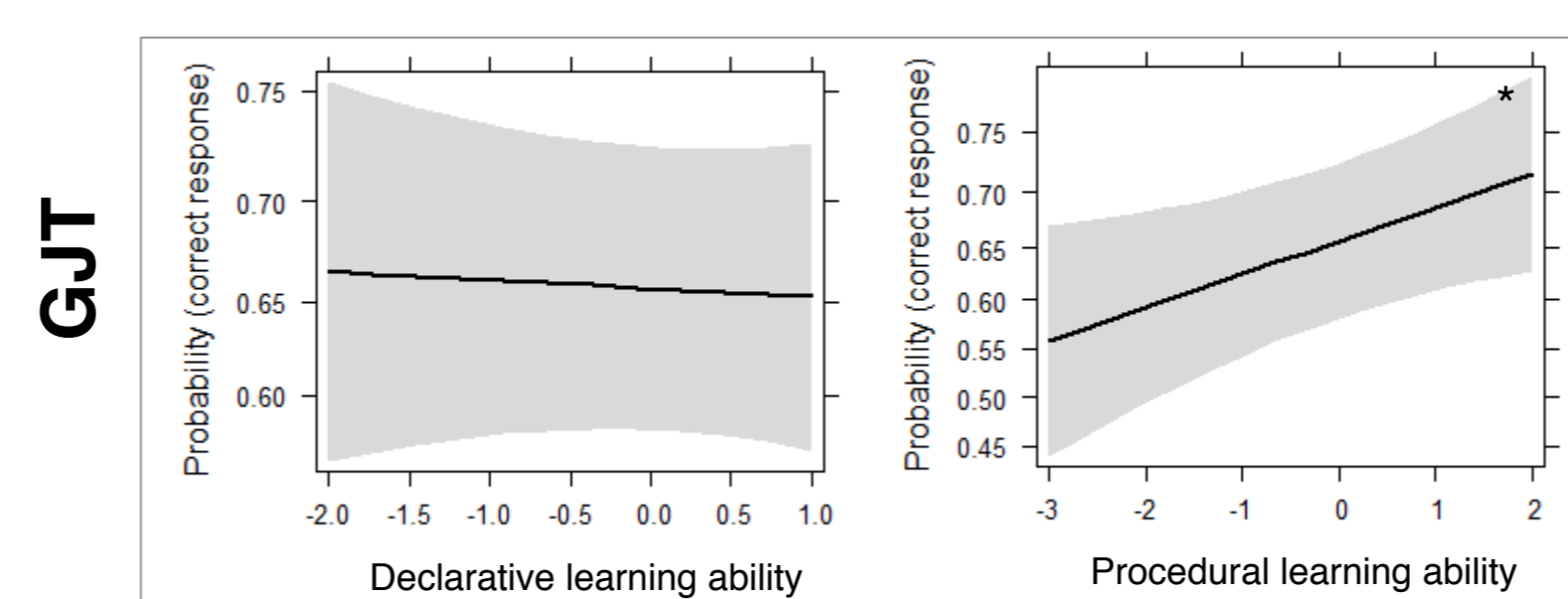

Figure 5. Effects of declarative and procedural learning ability in the child GJT.
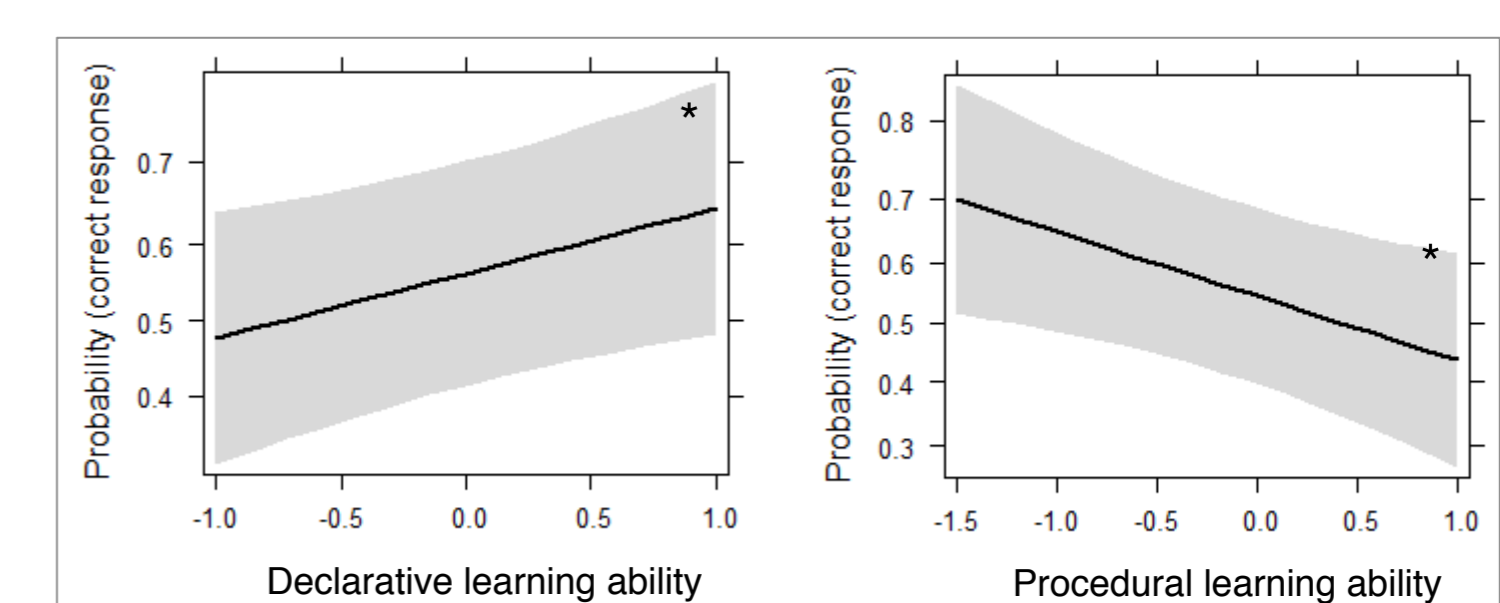

Figure 6. Effects of declarative and procedural learning ability in the adult GJT.

A mixed effects model fitted to the child GJT data returned a nonsignificant effect for declarative learning ability and a significant positive effect for procedural learning ability (β = 0.29, *z* = 2.57, *p* < .05). By contrast, in the case of adults, declarative learning ability was a significant predictor of L2 attainment (β = 0.35, *z* = 2.21, *p* < .05), and the effect of procedural learning ability was negative and significant (β = -0.67, *z* = -2.36, *p* < .05).

Conclusions

(1) Overall, L2 attainment and rate of learning in L2 practice were significantly higher in adults compared to children. Gains were incremental in children, whilst they were consistently significant between sessions in adults.

(2) Adult results support findings in previous studies conducted in similar paradigms but with participants with a different L1. Specifically, they confirm significant effects for declarative learning ability and nonsignificant effects for procedural learning ability in the earliest stages of L2 development, when this is measured via a GJT (e.g., Morgan-Short et al., 2014).

(3) Procedural learning ability appears to have a more prominent role in child early L2 development, compared to adult early L2 development. This was evidenced in the GJT, as well as during L2 practice. These findings complement previous L1 research with children (e.g., Kidd, 2012) extending the role of procedural learning ability to the L2.

(4) Differences between L2 language practice and the GJT emerged with regard to the effect of declarative learning ability. These differences may be due to an effect of type of task.

Selected references

Hamrick, P., Lum, J. A. G., & Ullman, M. T. (2018). Child first language and adult second language are both tied to general-purpose learning systems. *Proceedings of the National Academy of Sciences*, 115(7), 1487–1492.

Kidd, E. (2012). Implicit statistical learning is directly associated with the acquisition of syntax. *Developmental Psychology*, 48(1), 171-184.

Morgan-Short, K., Faretta-Stutenberg, M., Brill-Schuetz, K.A., Carpenter, H. & Wong P.C.M. (2014). Declarative and procedural memory as individual differences in second language acquisition. *Bilingualism: Language and Cognition, 17*, 56-72.

Ullman, M. T. (2016). The declarative/procedural model: A neurobiological model of language learning, knowledge and use. In G. Hickok, & S. A. Small (Eds.), *The neurobiology of language* (pp. 953-968) Elsevier.

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