Rapid Learning of a Novel Language: An Electroencephalographic Investigation

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INTRODUCTION

- Learning can occur at a rapid rate

- Krigolson et al. (2014) demonstrated that learning could occur in as little as one trial

- Learning depends on the detection of prediction errors – when there is a discrepancy between one's expectation and an outcome (Holroyd & Coles, 2002)

- The reward positivity amplitude is theorized to scale to the magnitude of prediction errors (Holroyd et al., 2008)

- Here, we sought to explore whether rapid learning occurred in a complex environment, exemplified by the learning of a novel language

METHODS
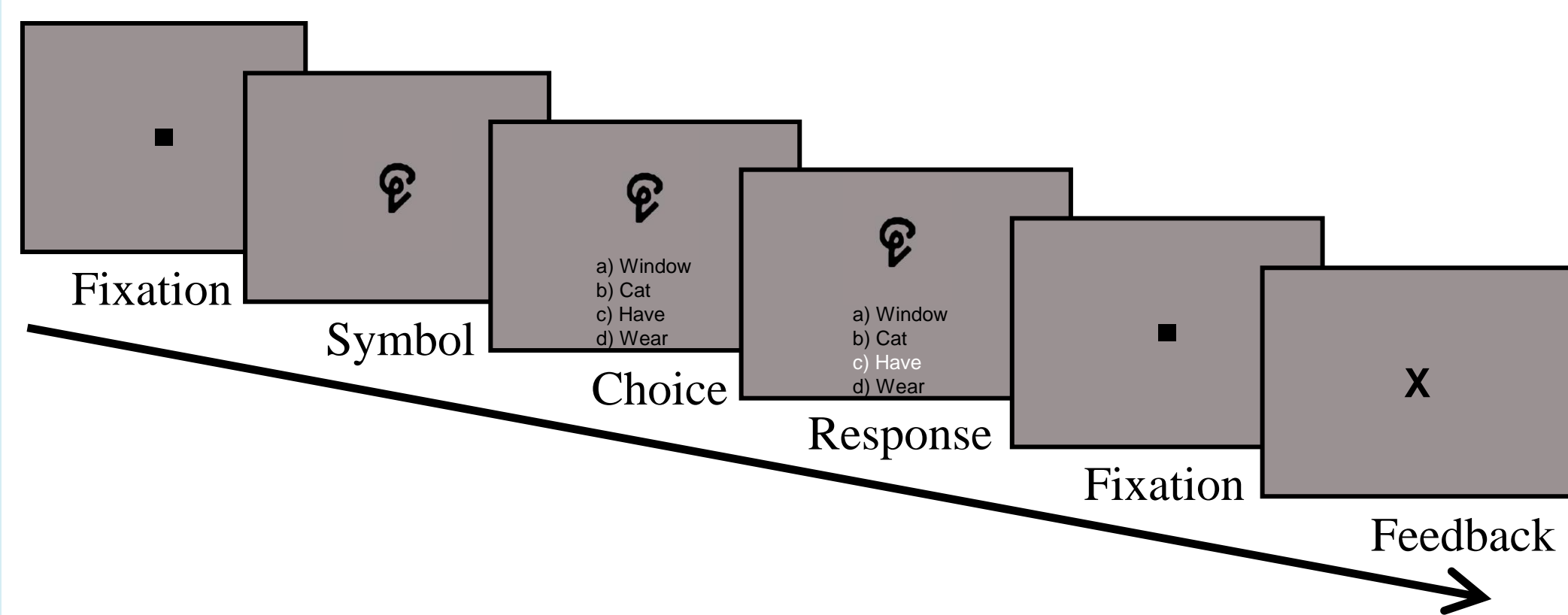
Participants performed a task where they were to learn a novel language

'Symbols' of the novel language represented words

Through trial and error, participants learned to associate each symbol with its meaning

Initially, participants were presented with four different symbols

The symbol pool increased with high block accuracy (>75%), remained constant with low accuracy (<75%), and decreased with subsequent low accuracy (two consecutive blocks <75%)
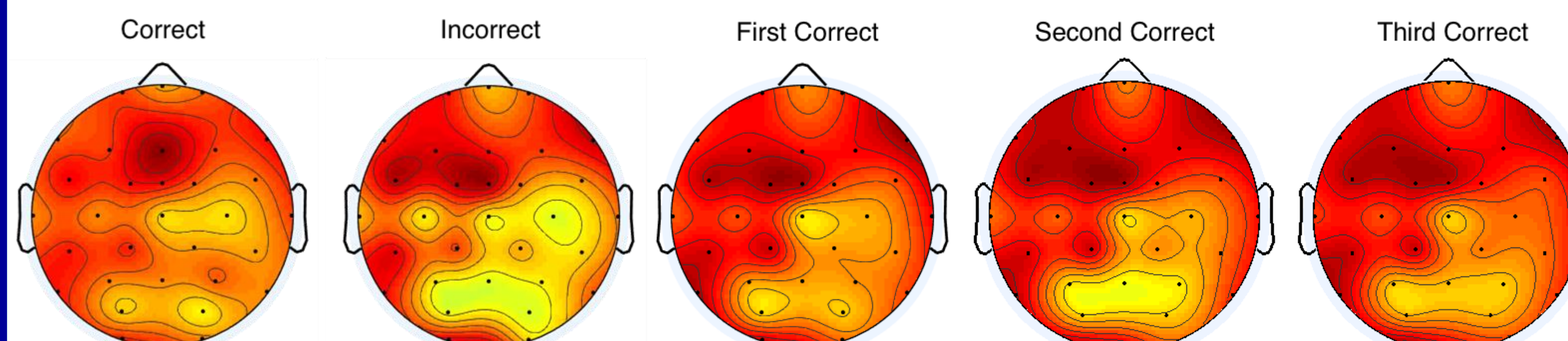
RESULTS

Conditional Waveforms
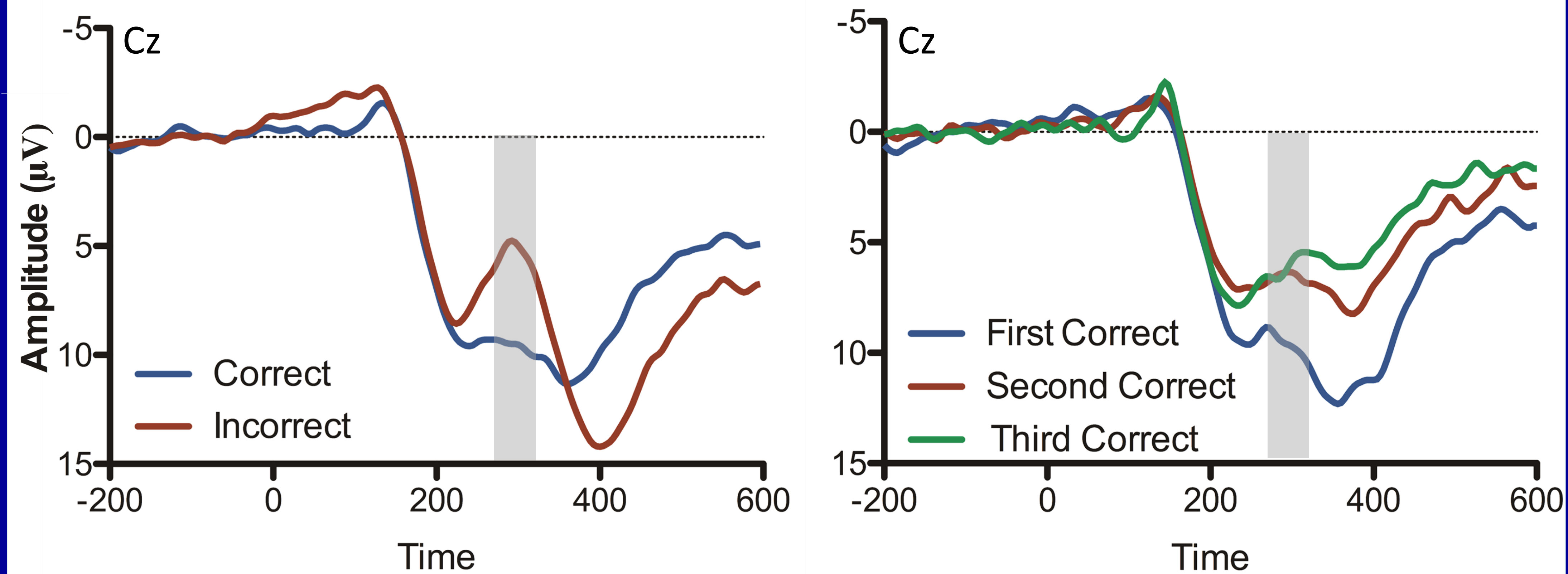
Peak Amplitudes

Topographic Maps

Correct   Incorrect   First Correct   Second Correct   Third Correct
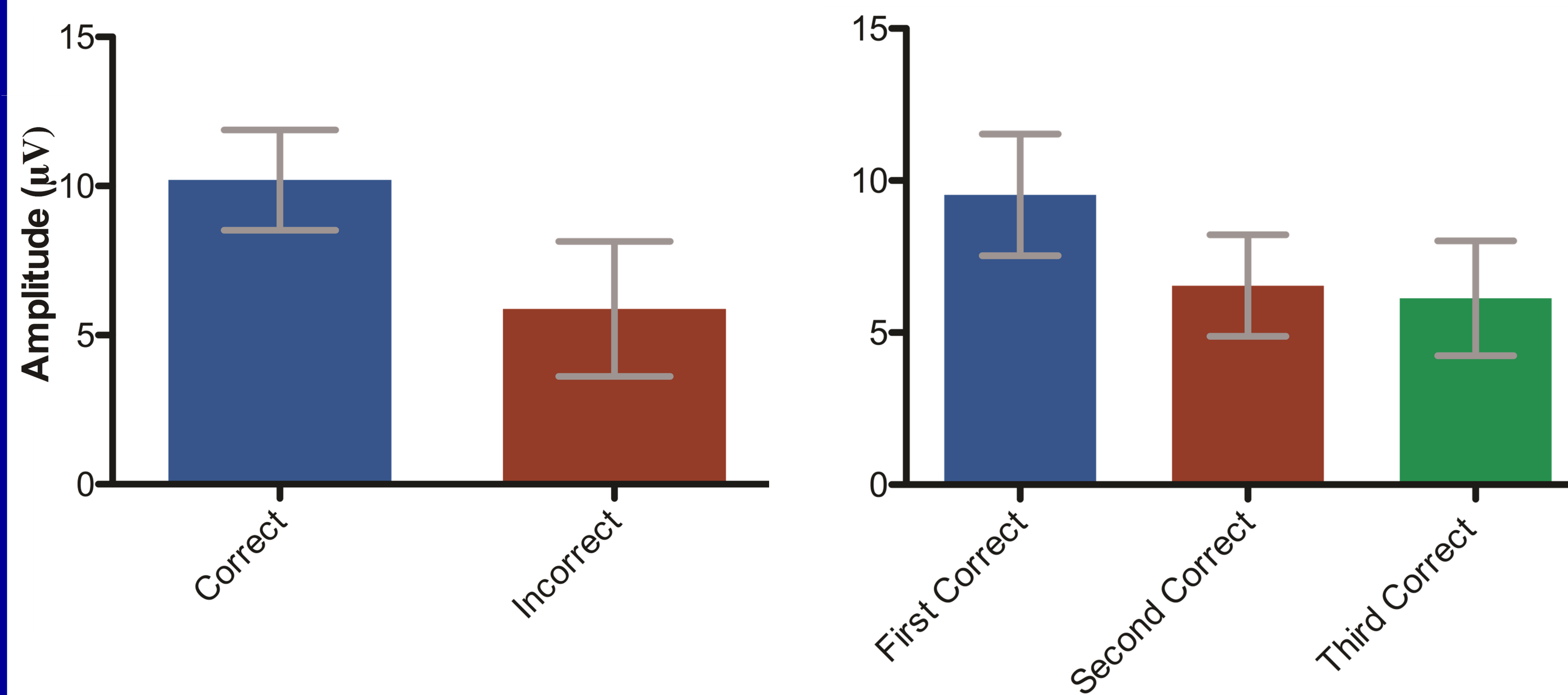
CONCLUSIONS

- As predicted, there was a reward positivity in response to feedback

- Furthermore, the meaning of each symbol was learned rapidly as indicated by the reduced reward prediction error signal on trials proceeding the first stimuli presentation

- This result demonstrated that learning occurred rapidly when learning a novel language. In congruence with Krigolson et al.'s (2014) findings, this indicated that rapid reinforcement learning may occur across contexts

Holroyd, C. B., & Coles, M. G. H. (2002). The neural basis of human error processing: Reinforcement learning, dopamine, and the error-related negativity. Psychological Review, 109(4), 679–709. http://doi.org/10.1037/0033-295X.109.4.679

Holroyd, C. B., Pakzad-Vaezi, K. L., & Krigolson, O. E. (2008). The feedback correct-related positivity: sensitivity of the event-related brain potential to unexpected positive feedback. Psychophysiology, 45(5), 688–697. http://doi.org/10.1111/j.1469-8986.2008.00668.x

Krigolson, O. E., Hassall, C. D., & Handy, T. C. (2014). How we learn to make decisions: Rapid propagation of reinforcement learning prediction errors in humans. Journal of Cognitive Neuroscience, 26(3), 635-644.doi:10.1162/jocn_a_00509

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