Good at simple, good at complex: proficiency is maintained across elemental and higher-order visual learning tasks in an insect

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In social groups, individuals may exhibit important variations in their abilities to solve different classes of learning problems. The question of whether individuals that are good (or bad) in a particular learning task are equally good (or bad) in other different tasks is relevant as learning proficiency may not be absolute but may vary with the complexity of the problem considered. The honeybee Apis mellifera constitutes an attractive model to address this topic. Bees live in societies exhibiting inter-individual variability and are capable of simple and higher-order problem solving. Here we studied if learning proficiency remains constant across tasks of different complexity in this insect using elemental and non-elemental conditioning protocols. We tested whether performance of individual bees in visual elemental discriminations (e.g. stimulus A rewarded vs. B non-rewarded, or vice versa) correlates with performance in higher-order, conceptual learning tasks (e.g. ‘relationship ‘above of’ rewarded vs. ‘below of’ non-rewarded, or vice versa). While the former imply learning simple links between physical objects, the latter require learning relations between objects independently of their physical properties, and thus represent a higher level of learning complexity. We show that some individuals perform consistently better than others in both task levels, thus suggesting diversity and cognitive specialisation within the hive. As elemental and non-elemental learning tasks typically recruit different circuits and/or structures in the mammalian and insect brain, our results raise the question of whether individuals differing in learning proficiency also differ at the neural level.