Heterogeneity in experienced-weighted attraction learning and its relation to cognitive ability

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Abstract

In this article, we apply the experience-weighted attraction (EWA) learning model to examine the learning behavior of a set of 108 subjects, who participated in one of the six series of 15- to 20-person Keynes' beauty contest experiments, held at National Chengchi University in year 2010. Our earlier study (1 citation removed for masked review) has found a positive relation between cognitive ability, measured by a working memory test, and cognitive hierarchy, in the sense of level-k reasoning. Through the analysis of the estimated Markov transition matrix, we further found that the subjects with a higher cognitive ability have a different dynamic behavioral pattern from those with a lower cognitive ability, which indicates the possible effect of cognitive ability on learning. Hence, as a subsequent study, we examine this possibility by directly applying the EWA learning model, which was first applied to the beauty contest experiment data by Camerer and Ho (1999). We consider two different action spaces in terms of granulation: one which has a finer division Camerer and Ho (1999) and hence a large number of choices, and one which has a rather coarse division directly corresponding to the Nagel's classification of reasoning levels (Nagel, 1995). We found that the high cognitive able subjects differ from the low cognitive subjects in the estimated parameters of the EWA models, when one uses the coarse division. Among the five parameters of the model, we are particularly interested in the one which is normally understood as the capability to do counterfactual reasoning or imagination (the parameter δ). We found that δ of the more cognitive able subjects is significantly larger than that of the less cognitive able subjects (0.588 vs. 0.489), and if we further restrict the sample to the tailed 25% subjects, δ is even low to 0.277. However, this relation between cognitive ability and δ disappears when the EWA model is applied to version with finer division. This result may lead to a fundamental question concerning the applicability of (generalized) reinforcement learning to the situation when a large number of many possible choices are presented.

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