Making of impulsiveness

: what chicks tell us about the logics behind our economic decision making

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Every day, we make some decisions. You may pick up a piece of cigarette to smoke, while you are explicitly told that the delight could lead to lung cancer in the long run. You may save money to pay for post-retirement pension, while you do not know if you will survive long enough to get the payment. Decisions are thus fundamentally irrational, since they inevitably include something that we can never control. We decide because we do not know. In this article, I will show you some studies on decision making in newly hatched domestic chicks, particularly on the hidden reasons for their apparent impulsiveness.

Only the fittest survive, so has been repeatedly argued in biology since Charles Darwin. Evolutionary thinking often obsessively forces us to say that optimality is the rule, and assume that a reliable measure of goodness (or a currency) is uniquely given. By means of such a currency, we may say that this option is $10 good, whereas the other is $11, so I will choose the latter. (…why we can trust the US dollars nowadays, in the daily struggle under the disastrous neoliberalism?) Anyway, the idea of our decisions being controlled by *optimality* principle have long been the norm in the study of animal behaviors since a theoretical biologist Eric L. Charnov has put it more than three decades ago. He applied a simple mathematical analysis to the issue of foraging decisions, and showed that *profitability* is the key. If a forager animal gains “*e*” (for energetic gain) at the expense of “*h*” (for handling time), value of the food item is uniquely given by the ratio “*e*/*h*”. In the world where encounter with food items are largely probabilistic and unpredictable, optimal animals should simply be short-minded, taking only the immediate consequence into account. Best policy is to make the immediate gain the largest. Actually, chicks do this way.

Chicks are highly curious, and peck whatever conspicuous object they find. When a food delivery follows, chicks will promptly learn the association and eagerly peck at the same object thereafter. Assume a red bead was associated with a big food (e.g., 6 grains of millet) and a blue with a small food (1 grain). In choices between red and blue, chicks consistently pecked at the red without a hesitation. The gain “*e*” did matter. What if the big food was delayed and chicks had to wait for the big food by a few second? It depended, and the delay or "*h*" mattered. At the delay of 2 seconds, most chicks avoided the big food and chose the smaller 1 grain alternative. The apparent *impulsiveness* of the chick decisions can be understood reasonably in terms of the profitability-based optimality. As each grain of millet "*e*" is quite small, chicks simply invest a proportionately brief period of time "*h*", so that the ratio "*e*/*h*" is maintained considerably high. Impulsiveness makes sense for such foragers that collect thousands of small food particles to meet the "today's bread". Chicks however have another good reason to be impulsive. It is the sociality.

Food resource is always scarce in the wild. If you do not take it, someone else will come and fetch it away. Optimal decision makers must thus commit *competition*, even in a simple group of chicks. When competitively trained in a group, as Hidetoshi Amita has recently found, these chicks become more impulsive in choices between the immediate 1 grain and the delayed 6. Competition also brought about the risk, but the risk alone failed to cause the impulsive choices. Furthermore, interception of food was not actually required for the development of impulsiveness; chicks watched competitors, and just made it. They are socially predisposed to commit impulsive choices. How then is the chick brain biased?

We often have several good reasons to do a thing. In addition the amount, the immediacy and the competition mentioned so far, certainty (or inverse of risk) and easiness (or inverse of work cost) contributes to the choices. Question is if these fractions of value are integrated to yield a common currency, or otherwise, decision maker switch among several decision frameworks back and forth in each occasion. Brain science data are yet immature for the neural representation of uniquely integrated decision currency, and rather in favor of the *split decision modules*. Experimental surgical deactivation of a brain area (nucleus accumbens) specifically caused impulsive choices in both rats and chicks. Another brain area (arcopallium or prefrontal area in isocortex) leads to a work cost aversion if deactivated. These interconnected brain areas form a web of decision networks, which however do not represent a single value. Rather, the interconnected web could have a dynamics that yields several distinct states, and transitions between these states correspond to each of the decision framework, as has been theoretically pointed out by Ichiro Tsuda in his theory of chaos transitory dynamics. If fully understood, anyway, do chicks tell us all about our decisions?

Clearly, the answer is no. Birds (and any animals as well) differ from us in their cognitive world, and so we are from them, and the difference was evolutionarily shaped through ca. 300 million years of separation since the common ancestry primitive amniotes. It remains an open question to ask what we actually share as common design of brain / mind as suggested in the idea of *core knowledge* proposed by Giorgio Vallortigara. We may otherwise set out to seek for the uniqueness of birds, and that of humans, in biological terms, but the scientific enterprise toward cognitive diversity will ironically necessitate a common platform for comparisons. So long as chicks say something clear about knowledge, decisions and values, their voices (or calls) are still worthy of listening to, as understanding aliens always enriches us.

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