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Evolutionary processes and mother-child attachment in intentional change

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Abstract

Behavioral change may occur through evolutionary processes such as running stochastic evolutionary algorithms, with a fitness function to determine a winning solution from many. A science of intentional change will therefore require identification of fitness functions – causal mechanisms of adaptation – that can be acquired only with analytical approaches. Fitness functions may be subject to early-life experiences with parents, which influence some of the very same brain circuits that may mediate behavioral change through interventions.

In social science, intentional change can be broadly defined as behavioral or conceptual changes guided by an intention; that is, conscious determination to act in a certain way. Among all possible behaviors or concepts that constitute a population of solutions for a specific problem, how to select one or a few winning solutions amid complex agent-environment interactions to optimize adaptation is indeed subject to evolution. When evolutionary process is understood as a Darwin machine with operations of variation, selection, and heredity (as Wilson et al. understand it), what can a Darwin machine do for the science of intentional change?

To answer this question, one can look to the artificial intelligence concept of Evolutionary Algorithms (EAs), which are developed to solve optimization and search problems. EAs are composed of algorithms for reproduction, variation generation, and selection procedures, just like Darwin machines. To run EAs, one needs to specify an initial population (i.e., potential solutions to the problems in question) plus the means to select winning solutions that can be inherited with possible recombination or mutation in the next generation. A fitness function is needed in EAs to determine the fitness score, by summing up values across different factors on a common currency to index how close a given solution is to achieving the aims. For example, the best-looking face can be found by running an EA that has a variety of faces that evolve from an initial generation of population to the next by recombining features from the faces selected by humans. Although the solution (the best-looking face) can be found, the fitness function remains unknown.

Therefore, the science of intentional change that depends on evolution processes will require knowledge of the fitness functions. Indeed, Ostrom's eight design principles that were emphasized in Wilson et al. are examples of the knowledge required to formulate a fitness function, which was not obtained through any evolutionary process. If a Darwin machine

cannot operate without fitness function, and the fitness function (e.g., Ostrom's principles) is identified without running the evolutionary algorithm (Darwin machine), then the science of intentional change must focus on the source and properties of the fitness function.

Furthermore, evolutionary theory at its best provides a stochastic approach to study changes, which can be either intentional or unintentional, as opposed to an analytical approach to delineate causal links (mechanistic pathway) that give rise to the changes (intervention). The stochastic and analytical approaches differ in their prediction and explanatory powers. Even when provided with sufficient initial conditions (candidate solutions and the constraints in the environment) and a fitness function, EAs as a stochastic process can provide knowledge of what solution works better than others nondeterministically (therefore with limited explanation power), and the solution cannot be known until computation of numerous iterations is completed (therefore with limited prediction power). On the contrary, an analytical process should be able to predict the outcome and explain the causal links leading to the outcome; for example, applying a hypothesis-testing experiment to test Ostrom's principles with an experiment group versus a control group.

Indeed, multiple aspects of the science of intentional change have been successfully studied in psychology and neuroscience with analytical approaches. One can conceptualize that intentional change involves goal-directed behaviors based on the incentive values of various goals and their related solutions that are encoded and maintained in domain-specific long-term memory systems. Only through analytical approaches were molecular mechanisms of synaptic transmission developed from basic invertebrate neuromuscular preparations (Swain et al. 1991) mammalian brain memory formation and change in hippocampus (Redondo & Morris 2011) and even identified techniques of planting a false memory animals (Ramirez et al. 2013). Brain imaging studies of decision making with multidomain information, a general form of intentional change, have identified the neurocircuits underlying temporal discounting of rewards (Kable & Glimcher 2007) and the common currency of incentive values integrated from social, emotional, and cognitive domains (Ho et al. 2012) – a form of fitness function. In behavioral intervention studies, key mechanisms underlying cognitive behavioral intervention to change an addicted behavior (e.g., smoking) have been identified, such as the self-referential process (Chua et al. 2011; Strecher et al. 2008) and deliberate processing (Ho & Chua 2013).

Notably, a socially inclusive stance, which can manifest in forms of altruism (Swain et al. 2012), in-group identification (Wheeler et al. 2007), and other forms demonstrated in many examples mentioned in Wilson et al., seems to play a key role in promoting positive changes at multiple levels. It may be possible to form a testable hypothesis that recognizing and respecting self and others' perspectives impartially is a central mechanism in promoting intentional behavioral and cultural change. Then, a series of analytical experiments could be carried out to test this hypothesis systematically, as opposed to be randomly conducted to create a sufficiently large population, as prescribed by a Darwin machine.

Interestingly, a hypothesis that one's social "fitness function" can be shaped to be either partial (self-defensive) or impartial (inclusive of others) is consistent with the landmark work in developmental psychology that focuses on parent-infant attachment (Bowlby 1969;

1973). After studying associations between maternal deprivation and juvenile delinquency, John Bowlby postulated his attachment theory based on an innate need to form close affect-laden bonds, primarily between mother and infant. Among studies in brain circuits underlying attachment, for example, Kim and colleagues (2010) showed that mothers who reported higher maternal care in childhood showed larger gray matter volumes and greater functional responses in some of the same brain regions implicated in appropriate responsivity to infant stimuli in human mothers (Swain & Lorberbaum 2008; Swain 2011; Swain et al. 2012; 2014). Thus, by studying the brain basis of the interactive baby-signal/parent-response (Swain et al. 2004) in the parent-infant dyad (Mayes et al. 2005), we may discover candidate brain mechanisms for a psychological fitness function in humans for intentional change.

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