ABSTRACT

There are a great variety of theoretical models of cognition whose main purpose is to explain the inner workings of the human brain. Researchers from areas such as neuroscience, psychology, and physiology have proposed these models. Nevertheless, most of these models are based on empirical studies and on experiments with humans, primates, and rodents. In fields such as cognitive informatics and artificial intelligence, these cognitive models may be translated into computational implementations and incorporated into the architectures of intelligent autonomous agents (AAs). Thus, the main assumption in this work is that knowledge in those fields can be used as a design approach contributing to the development of intelligent systems capable of displaying very believable and human-like behaviors. Decision-Making (DM) is one of the most investigated and computationally implemented functions. The literature reports several computational models that enable AAs to make decisions that help achieve their personal goals and needs. However, most models disregard crucial aspects of human decision-making such as other agents’ needs, ethical values, and social norms. In this paper, the authors present a set of criteria and mechanisms proposed to develop a biologically inspired computational model of Moral Decision-Making (MDM). To achieve a process of moral decision-making believable, the authors propose a cognitive function to determine the importance of each criterion based on the mood and emotional state of AAs, the main objective the model is to enable AAs to make decisions based on ethical and moral judgment.

Keywords: Autonomous Agent (AA), Cognitive Models, Computational Cognitive Model, Decision-Making (DM), Human-Like Behaviors, Moral Decision Making (MDM)

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INTRODUCTION

The investigation of cognitive and brain processes, have contributed to the emergence of new research areas such as cognitive computing, cognitive informatics, artificial intelligence friendly, among others (Wang, Y., Widrow, B. C., Zhang, B., Kinsner, W., Sugawara, K., Sun, F., Lu, J., Weise, T., & Zhang, D., 2011; Wallach, W., Allen, C., & Smit, I., 2008). These fields have been focused in an interdisciplinary research that studies the processes of the brain and internal information processing mechanisms, as well as their engineering applications in Artificial Intelligence and Cognitive Computing.

We think that decision-making is one of the most important human cognitive functions. The decision-making process interacts with a variety of other cognitive functions such as vision, attention, planning, and memory, leading to differences in human behavior. Human decision-making can be regarded as a rational process that determines the best way to achieve a goal by choosing and acting in a reasonable way (Canto Pech, H. G., 2010). Wang, Y., and Ruhe, G. (2007) define decision-making as the process of selecting an option among a set of alternatives based on certain criteria. We can find the decision-making in a wide variety of situations, from the choice of a simple act such as moving a finger to the selection of more complex actions such as decisions made by stock exchange shareholders.

The theory of decision-making has been investigated and applied in various fields, including Computer Science, Management Science, Economics, Statistics, Political Science, Psychology, and Neuroscience (Wang et al., 2007; Gold, J. I., & Shadlen, M. N., 2007). In these fields, decision-making has been classified in several categories. For example, simple decision-making deals with situations in which people have only two alternatives, serial decision-making has to do with interactive events and competition, and dynamic decision-making is concerned with situations in which all alternatives and criteria are dependent on the environment and the effect of historical decisions (Wang et al., 2007).

A very complex type of decision-making with a high impact on people’s social relationships is that involving moral dilemmas. This type of decision is known as Moral Decision-Making (MDM), defined as the process of selecting one option among a set of alternatives based on ethical, moral, and religious principles as well as on individuals’ beliefs of right and wrong, feelings, and emotions (Allen, C., Smit, I., & Wallach, W., 2005; Borg, J. S., Hynes, C., Van Horn, J., Grafton, S., & Sinnott-Armstrong, W., 2006; Wagner, S. C., & Sanders, G. L., 2001; Lu, L. C., Rose, G. M., & Blodgett, J. G., 1999). This type of decision-making allows us not be self-interested, for example, in MDM not only think of the gain, also contemplate the not harm others.

MDM has recently become the focus of study in a variety of scientific disciplines. In psychology, experiments have been conducted to determine how people decide when a moral rule intervenes over another (Borg et al., 2006). It has been found that the moral judgment is a complex activity, because it is a skill that many people perform incorrectly. This is partly by some aspects such as cultural differences, differences in the details of their ethical values and mores, among other (Wallach et al., 2008).

In artificial intelligence (AI), this type of decision-making has been investigated as machine morality, machine ethics, roboethics, and friendly AI (Wallach, W., Franklin, S., & Allen, C., 2010). Moreover, computer systems, robots or humanoids capable of making moral judgments are called Artificial Moral Agents (AMAs). However, although the importance of AMAs has been largely discussed elsewhere (Allen et al., 2005; Wallach et al., 2010), researchers in AI have primarily focused on developing intelligent systems capable of performing well defined tasks with a certain degree of autonomy (Wallach et al., 2008). Developing the capacity of moral decision-making in intelligent systems is usually outside the scope of these types of projects.
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