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A Universal Moral Grammar (UMG) Ontology

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Abstract

This paper describes an OWL ontology that is a Universal Moral Grammar (UMG). UMG has been hypothesized by students of Chomsky to play the same role in human ethics as Universal Grammar (UG) does in Linguistics. I.e., the UMG describes a moral faculty hypothesized to have a genetic basis. This approach utilizes the modular view of the mind developed by Chomsky and currently utilized by many evolutionary psychology researchers. In this paper I describe the ontology and how it represents ethical choices, rules, scenarios, and systems. This includes representation of choices governed by the golden rule, utilitarianism, and Moral Foundations Theory. The foundation for the model is an Artificial Intelligence model of events, plans, and decisions. This plan model represents what is known as Theory of Mind (TOM). The TOM model is extended to the ethical domain by an analysis of recent research in evolutionary psychology and the representation of 40 different scenarios such as the trolley problem from the philosophical, psychological, and biological literature. The ontology is an example of how semantic technology can be used to provide mathematical rigor to the study of human ethics. This version demonstrates the breadth of the UMG, that it is capable of representing many diverse examples from the literature. However, there are already meaningful results from this version such as a resolution to Hume's Is-Ought problem.

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1. Universal Moral Grammar (UMG)

Discussions related to human morality are often considered to be in the domain of the humanities where rigorous scientific models are considered impossible to construct. As a result concepts are debated even though they are poorly or even incoherently defined. The Universal Moral Grammar (UMG) model described here is an attempt to bring mathematical rigor to the domain of human ethics in the same way that computational linguistics brought rigor to linguistics. The model was created as an OWL ontology in the Protege ontology editor. The ontology is available to the public via the WebProtege server. A link to the ontology as well as other additional material supporting it can be found at: https://tinyurl.com/UMG-Ontology-2018.

The concept of Universal Moral Grammar was first described by Marc Hauser:

I argue that our moral faculty is equipped with a universal moral grammar, a toolkit for building specific moral systems. Once we have acquired our culture's specific moral norms… we judge whether actions are permissible, obligatory, or forbidden, without conscious reasoning and without explicit access to the underlying principles. [1]

This work is the first attempt to develop a formal UMG model. Mikhail [2] describes a UMG using various grammatical representations but his emphasis is on the surface structure of the UMG, i.e., to analyze moral statements as natural language and provide representations of specific English phrases and sentences. This approach is different. I attempt to model the underlying logic that must be part of any UMG. Not to analyze the specific usage of ethical language in English but rather to describe the underlying logic behind ethical statements in any language. To use a linguistic analogy, what Mikhail's work addresses is analogous to a specific grammar for English this ontology is a model of the underlying UMG that is hypothesized to be innate to all humans just as Universal Grammar (UG) is hypothesized to be the foundation for all human natural languages. Note that the term grammar used by Hauser is only to emphasize the analogy with Universal Grammar and does not require a specifically grammatical formalism. Indeed, as Chomsky has said regarding grammars and language: "the original formulations of transformational grammar were set theoretic not graph theoretic: trees are simply a pedagogical aid".[3]

The formal description of a UMG provides a rigorous mathematical foundation to frame ethical analysis. The emphasis of this initial paper is to present the model and demonstrate that it is capable of representing a broad range of the domain of human ethics.

1.1 Ethics as a Science

Topics such as ethics are often thought to be beyond the scope of science by both scientists and philosophers. One of the most well known advocates for this division was Stephen J. Gould. Gould's concept of non-overlapping magisteria partitions subjects such as ethics into the domain of the humanities or religion and off limits to scientific analysis. [4] However, recent disciplines such as evolutionary psychology have challenged this distinction. Tooby and Cosmides argue that ethical analysis should be open to analysis based on evolutionary biology.[5] This new approach to a scientific understanding of individual and societal behavior is often described as a modular approach to cognition. The pioneer of this approach was Noam Chomsky. Chomsky has long argued that any scientific account of language and human psychology in general must be consistent with biology and evolutionary theory.[6]

I also follow Chomsky's paradigm of viewing the mind as a set of functional modules. These modules can be analyzed via formal models without committing to how those models are implemented in physical brain structures. David Marr takes this same approach and divides psychological models into three levels of abstraction: 1) computational theory, 2) representation and algorithms, and 3) hardware (or wetware) implementation.[7] Marr's theory of vision can be used for both computer vision and animal vision. Whereas the computational problem for both (create a 3D model from 2D data) is the same the representation and implementation for computer vs. animal vision are quite different. The UMG ontology is a computational model for the domain of human ethic.

I developed the model in Protege using the Web Ontology Language (OWL) with rules (e.g., to define the logic of various ethical systems) defined using the Semantic Web Rule Language (SWRL). I have developed this initial model to the point that I can represent significant ethical discussions (e.g. abortion) and classic problems from philosophical and psychological research on ethics such as the Trolley problem and scenarios from Haidt's Moral Foundations Theory. I have implemented over 40 ethical choices taken from books by Hauser [1], Fischer [8], and Haidt.[9]

2. The UMG Ontology

Figure 1 shows the highest level view of the classes in the ontology. In order to represent a UMG it was necessary to model agents, events, causality, language, living things, locations, and time. In each case when I have classes that are outside of the moral domain I make them subclasses of the appropriate domain module in the ontology.

The UMG ontology is a formal model for what many in evolutionary psychology call cognitive modules. The modules that were required for the ethics domain are some of the domain modules most often discussed by authors such as Hirshfeld, Kurzban, and Medin [10] [11] [12]. Although many of these authors talk about models of various cognitive modules the UMG ontology is the first attempt to formally model such modules.
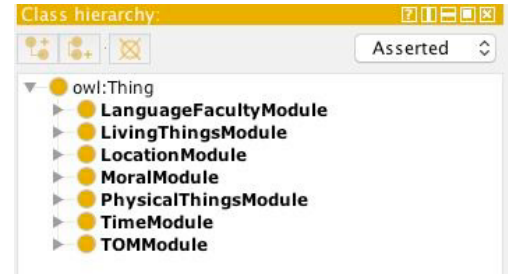

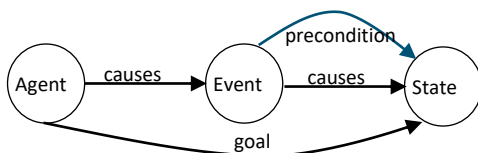Fig. 1. Classes Representing Cognitive Modules

Fig. 2: Agents, Events, & States

The foundation for the UMG is a model of agents and causality shown in Figure 2. An Agent causes an Event which causes a State of the world. All of these classes are subclasses of the theory of mind module (TOMModule).

The causes property is transitive so an Agent that causes an Event also cause the State that results from that Event. Agents have goal states that they construct plans (hierarchical structures of Events) in order to achieve. Events have preconditions: States that must be true in order for the Event to occur. Plans can be generated by starting from a goal state, finding an event that causes the goal state, then examining it's preconditions and finding a task that causes that state and continuing until one finds an event whose precondition is true in the current environment. This is a standard Artificial Intelligence (AI) technique for dynamically developing plans by backward chaining from goals and preconditions. This model was first developed by Newell, Simon, and Miller.[13] [14] In addition the model describes beliefs, desires, and intentions. This is the module described by Leslie and other researchers in evolutionary psychology as a Theory of Mind Module (ToMM).[15] Note that at this point there is no mention of values. This TOM model has been found to exist in children as young as 3-4 months.[15] This is an age that is thought to be before the beginning of moral reasoning. What's more, this type of reasoning about causality and agents is applied even when people view circles and other simple geometric shapes interacting on a computer screen, i.e., causal reasoning can be applied to things that are not animate or considered conscious.

Figure 3 shows how this model is extended with value concepts. I introduce the concept of a MoralSystem, a set of norms that defines values and rules for behavior. This is consistent with philosophical and anthropological approaches and with the developmental approach of Kohlberg where the final stage of moral development is a morality based on a system of universal ethical principles.[16] It is also consistent with Haidt's Moral Foundations Theory (MFT).[9] Even though according to MFT the MoralSystem is subconscious and usually not what the MoralAgent describes as their reasoning about ethical questions, none the less such a system does exist in MFT.

We can classify MoralEvents according to various criteria. Was the event considered a Crime? Was it an act of War or did it violate a Taboo? Does it satisfy the requirements of various MoralSystems for an event considered to be good? For example, does it satisfy the formal definition for an acceptable moral event under utilitarianism or Rawl's theory of justice as fairness?
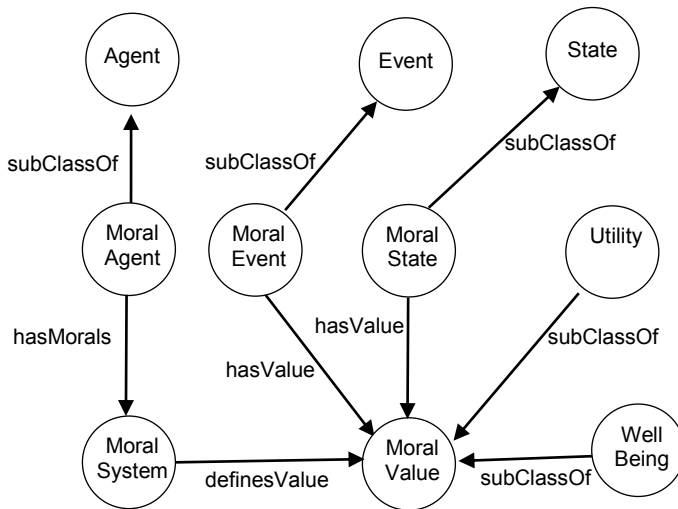
One particularly important type of MoralEvent is a MoralChoice. A MoralChoice has two or more MoralEvents that a MoralAgent must choose from. The selection of the appropriate MoralChoice will be justifiedBy the logic of the agent's MoralSystem. The classes representing a MoralChoice are shown in Figure 4.

In addition to classifying MoralEvents we can use the model to formalize choices between various MoralEvents using different MoralSystems. This is represented by the justifies property that links a MoralChoice to the MoralSystem that justifies it.

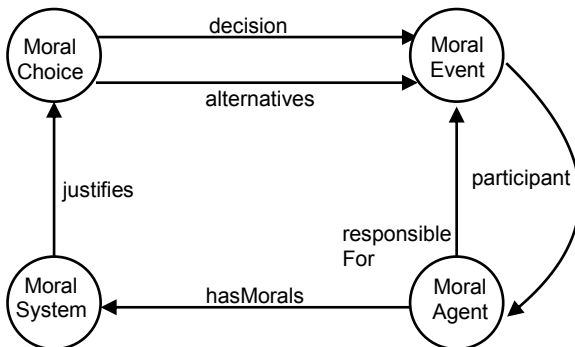Fig. 3. Extending the TOM Model to Create a Value Model

Fig. 4: Moral Choices

The MoralAgent class represents the set of all things that can participateIn or be responsibleFor a MoralEvent. We can model the types of moral judgements humans make of other humans by defining various subsets of the Agent class: Criminals, Victims, etc. One subclass of MoralAgent is GroupAgent. In our use of ethical concepts we not only assign responsibility to individuals. We often hold a group responsible for MoralEvents as well.[17] For example, a Nation that launches an illegal war or a ruling in US law that grants personhood status to corporations. A GroupAgent is a collection of agents that are collectively assigned some moral responsibility or value.

3. Modeling Ethical Issues and Systems

The Ethics Ontology can be used to rigorously define various ethical questions. For example, the question of animal rights can be modelled as different views as to whether animals other than humans should be classified as MoralAgents. Abortion can be modelled as a difference on whether a Fetus is a MoralAgent. Debates about immigration can be modelled as different views on what logical definition to use to classify an individual as a Citizen of a Nation.

The ontology has SWRL rules to define various ethical systems and maxims. These include the Golden Rule, Moral Foundations Theory (MFT), utilitarianism, Kant's Categorical Imperative and justice as fairness. I have also included examples of decisions that are guided by the biological model of kin selection. In each case there are

example agents presented with various choices from the philosophical, biological, and psychological literature such as the trolley problem, choices regarding medical decisions, scenarios from the MFT literature, etc. Each agent utilizes a particular MoralSystem (defined via SWRL rules) and the reasoner infers the correct decision based on the values of the alternative choices and the logic of the MoralSystem.

For example, when a MoralAgent is using the Golden Rule ("do unto others as you would have them do unto you") to resolve a MoralChoice the rules create a hypothetical choice where the responsibleAgent and the recipient (the agent effected by the event who did not cause it) of the choice are swapped. If the agent would accept the decision of this hypothetical rule as just then her decision is considered justified. Space prevents an in depth discussion of specific models. Detailed models from the ontology of ethical issues and all the moral systems described above can be found in an extended version of this paper available at: https://tinyurl.com/UMG-Ontology-2018.

4. The Is-Ought Problem

The UMG provides a resolution to the Is-Ought problem which was first described by David Hume:

In every system of morality, which I have hitherto met with, I have always remarked, that the author proceeds for some time in the ordinary ways of reasoning, and establishes the being of a God, or makes observations concerning human affairs; when all of a sudden I am surprised to find, that instead of the usual copulations of propositions, is, and is not, I meet with no proposition that is not connected with an ought, or an ought not. This change is imperceptible; but is however, of the last consequence. For as this ought, or ought not, expresses some new relation or affirmation, 'tis necessary that it should be observed and explained; and at the same time that a reason should be given; for what seems altogether inconceivable, how this new relation can be a deduction from others, which are entirely different from it. [18]

Hume's argument is an argument about what is a valid logical deduction. If we have a logical model with theorems about the world (is statements) it is not valid to infer conclusions about value, about what a person ought to do without having some logical connection between the is and ought theorems. The UMG resolves this problem by explicitly showing the connection between is theorems and ought theorems. Ethical concepts relate to human values and also are subsets of concepts in the real world. For example anything that happens in time and space is an Event. An event that is given some value by a human becomes a MoralEvent. A MoralAgent is an Agent that participatesIn one or more moral events. All events result in new states of the world. A state that has some value, i.e., some human determines that it is desired or not desired, becomes a MoralState. Figure 3 above illustrates these relations.

These simple definitions resolve the Is-Ought problem. We no longer have an illogical leap from theorems about the world to theorems about value. All that is required is one or more foundational axioms that define what states of the world or events are good (or bad, taboo, etc.). There must be one or more axioms that define the relation between ought theorems and is theorems. The question of course is the nature of these core axioms. It is not possible to prove them by pure reason alone in spite of what many philosophers have claimed, if by reason we mean the standard rules of mathematical logic and proof theory.

If we can not prove them by logic there are two alternatives. The first is to claim that one or more axioms is so intuitively obvious that no rational person could dispute it. The second is to take the approach that all conventional modern mathematical models do and declare some set of axioms as foundational, for example the way modern set theory is founded on the ZFC axioms. [19]

The first approach is often taken by utilitarians such as Bentham[20], Mill, and Harris[21] as well as the majority of modern Anglo-American philosophers. This approach is essentially to accept a common sense definition of morality that is intuitively reasonable to a majority of their readers. As Chomsky points out science and philosophy begin when we decide to go *beyond* common sense definitions and question the ultimate rational justifications that we take for granted in everyday life. [22] This was the starting point for people like Galileo to study motion scientifically

and it should be the starting point for a scientific approach to ethics.

This leaves us with the second option, to take the same approach as mathematics and have some set of foundational axioms that are not proven or demonstrable by empirical evidence because in order to use empirical evidence we first need to have some definition of what counts as evidence and no such definition is possible without at least one foundational axiom about value.

This has consequences for philosophy. This analysis demonstrates that it is logically incoherent to claim any morality is justified on pure reason. This invalidates a significant amount of moral philosophy, perhaps most famously Kant but also a significant amount of modern Anglo-American ethical philosophy. For example, Philippa Foot claims that "no one can act with full practical rationality in the pursuit of a bad end". [23] As with so many philosophers before and after Hume, Foot essentially avoids the Is - Ought problem by appealing to the shared common sense values of her audience.

Another example of a modern philosopher who uses common sense to avoid the Is - Ought problem is Scanlon. According to Scanlon:

"An act is wrong if its performance under the circumstances would be disallowed by any set of principles for the general regulation of behaviour that no one could reasonably reject as a basis for informed, unforced, general agreement." [24]

A logical model of a "set of principles… that no one could reasonably reject" could not be defined in the UMG ontology because the concept of what is "reasonable" is not rigorously defined. Unlike models such as utilitarianism where the formal definition needs to be inferred from the standard definition in the case of Scanlon no such definition is even possible because "reasonable" is vague and dependent on a particular community. What is reasonable for an American academic may often not be reasonable for a European academic or a Muslim cleric.

However, it should be noted that requiring foundational moral axioms is not the same as simply abandoning all hope of having a rational approach to morality and embracing moral relativism. We can look to the history of mathematics for an instructive example. At the end of the 19th century there were attempts by Frege, Russell, and others to ground all of mathematics in logic. This was proven by Gödel to be impossible. Mathematics, the foundation for virtually all of science, itself requires unproven axioms in order to be logically sound. This resulted in Zermelo Fraenkel set theory with the Axiom of Choice (ZFC) which is now the foundation for all of standard mathematics.[19]

The ZFC axioms are not arbitrary or a matter of culture or faith. They are the result of considerable effort to find the smallest set of axioms that could provide the power to ground mathematics and to avoid problems such as Russell's paradox. In the same way I see the UMG ontology as the beginning of a search for the proper ethical axioms that are consistent with the moral intuitions of most humans and also can provide a rigorous foundation to deal in a rational way with the innumerable problems that our modern way of life have brought to the planet. In fact Lex Bayer and John Figdor have recently written a book where they attempt to do just this.[25] Although their approach is less rigorous than mine and intended for a broader audience, their philosophical position is identical to mine in that they acknowledge that the starting point for any system of ethics must be unproven axioms and they attempt to define such axioms consistent with a scientific and humanistic world view.

5. Conclusion

This paper introduced an ontology that is a formal model of a Universal Moral Grammar. This approach is a step toward a scientific approach to ethics. A formal UMG allows us to do more rigorous analysis and to develop rigorous testable theories of human ethics. In this way we can define the boundaries of ethical analysis. We see that any ethical system must start with at least one fundamental unproven ethical axiom that is a statement of what the individual values essentially, not as a means to an end but states of the world that they wish to bring about simply because that is the way they desire the world to be. This is the essential starting point for a true science of ethics. To

realize that just as humans are unique in the animal kingdom in their ability for language they are also unique in defining certain things to inherently have value. As Nietzsche pointed out: A human is a value defining animal.[26]

The work done so far focused on demonstrating that the ontology could represent a broad collection of ethical scenarios and models from the philosophical, psychological, and biological literature. In future work the model will be applied to specific problems such as representing moral guidelines for artificial agents and resolving issues related to the biological foundation for human moral reasoning.

Acknowledgements

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