

RELIGION, IDEOLOGY AND PROSOCIALITY: SIMULATING SECULARISING SOCIETIES

Proposal description

In recent years both religious movements and secular ideologies have been at the forefront of social and political changes. Despite this, ever greater numbers of people living in developed countries such as Poland and Norway, do not identify with any religion and few would claim to identify with nationalist, communist or indeed fascist ideologies. At the same time, numbers of people who see democratic ideals as vital to a good society also appear to be on the wane.

Understanding these changes requires a multidisciplinary approach that combines sociological theories with those from the cognitive sciences. Being able to predict their effects calls for an analytical methodology that is capable of combining those theories, such as is provided by computer modelling methods. The proposed project will use existing theories such as the magical ideology theory developed by the Principal Investigator as the basis for agent-based computer models of social phenomena such as religions and ideologies in order to test those theories against the available sociological data and, ultimately, arrive at an improved understanding of secularising societies and the cognitive and cultural mechanisms that underpin them.

1. CURRENT KNOWLEDGE IN THE FIELD & PRELIMINARY WORK

Existing research provides us with a wealth of basic theories regarding the phenomena under investigation. Given the amount of research that has been carried out, no attempt is made here to provide an exhaustive overview. Instead, the most important, relevant results are presented with an effort to link them to each other and the proposed project.

1.1. Secularisation - data and theory

The phenomenon of secularisation has, historically, been understood in ways that now appear to be profoundly wrong-headed. However, the recent tendency in some social sciences to conclude that it does not exist is not borne out by the data. This data, which in its most convincing iteration includes repeated multi-country surveys of representative samples carried out as part of the World Values survey, the European Values Study and by the Pew Research Center, is clear. Throughout the WEIRD societies (Henrich, Heine, & Norenzayan, 2010) such as in Europe, North America or Japan we find religion on the wane (Bruce, 2011). This is for the most part true whatever measure of religious belief or practice is used. At the same time, the speed and extent of secularisation in these societies varies greatly, with the US having been the major outlier in terms of maintaining unchanging high levels of religiosity, although even that is now changing (David Voas & Chaves, 2016).

Working on the basis of the World Values Survey data, Pippa Norris and Ronald Inglehart have proposed an explanation for this phenomenon in terms of the existential security that members of the secularising societies feel (Norris & Inglehart, 2004). The theory claims that religiosity declines when people feel that their well-being is secure. This explains the relatively high levels of religious belief in the US as an effect of the relative weakness of the social welfare net in that country, with the Scandinavian countries lying at the other extreme with the strongest social welfare systems and lowest levels of religion. This work ties study of the long-term process of secularisation to a phenomenon that has been primarily observed in the short-term. Numerous studies (Jong, Bluemke, & Halberstadt, 2013; Malinowski, 1992; Padgett & Jorgenson, 1982) have shown that increased levels of anxiety are tied to increased assent to supernatural claims and higher levels of ritualised behaviour – both key elements of religions. Existential security theory holds that the same relationship can be observed in the long-term in that permanently lowered levels of anxiety resulting from living in a safe environment can be tied to secularisation.

David Voas, who has mainly analysed data from the European Values Study, has done more (D. Voas, 2008; David Voas & McAndrew, 2012) to identify the fundamental patterns of secularisation that are very much in line with the work of Norris and Inglehart. By comparing subsequent waves of surveys he has been able to show that religiosity remains largely constant in each cohort as it ages and that secularisation is mainly the result of each subsequent cohort being less religious than the previous one. By combining data from a number of different countries he has shown that the process of secularisation follows roughly the same 200-year-long trajectory wherever it occurs.

In light of Voas' conclusions a recent analysis (Pew Research Center, 2018) carried out by the Pew Research Center takes on particular significance. For each of the countries in which they carried out surveys that included questions regarding religiosity they compared the responses of the participants who were over forty years of age with those who were younger. In the case of weekly religious attendance and importance of religion, the difference was the greatest in Poland, and in the case of daily prayer Poland was in second place. Given what Voas showed about the relevance of cohorts to secularisation, this strongly suggests that Poland is the country that is currently secularising most rapidly.

While these results provide a lot of answers to basic questions about secularisation, they also raise a number of further questions. The central issue is what is the connection between the large scale social changes such as secularisation and the cognitive and cultural mechanisms that determine the behaviour of the individual members of those societies. Understanding that connection is vital if we are to be able to answer such questions as: why it is that existential security leads to a fall in religiosity; why do members of secularised societies none-the-less maintain high levels of assent to non-religious magical and superstitious claims; what is the connection between religions and secular ideologies such as nationalism which often see their support co-vary with support for religious claims; how will climate change affect secularisation in the future.

Error management theory, presented by Martie Haselton and David Buss (Haselton & Buss, 2000), is key to understanding how anxiety is connected to secularisation. Haselton and Buss make two key observations: 1) where there is a consistent difference in the costs of different kinds of mistakes, evolutionary pressure will lead to a bias against making the more expensive kind; and 2) in dangerous environments this bias will be greater. These observations are relevant because 1) provides an explanation why people are likely to postulate non-existent entities in their environment and see non-existent causal connections while 2)

explains why there should be a connection between anxiety and supernatural beliefs. Since anxiety is the internal indicator of being in a dangerous environment, it is thereby understandable that anxious individuals are more likely to conceive of supernatural beings and engage in ritualised behaviour. While these considerations are purely individual, there is a further point to be made concerning social learning. Dangerous environments are also ones in which the cost of innovation increases, which means that imitating other members of one's society that have been able to survive becomes a more attractive strategy. This has the effect that cultural traditions are transmitted between generations with greater fidelity. This may, for example, play a significant role in the maintenance of credibility enhancing display traditions or lowering the degree to which people exhibit epistemic vigilance to the source of information.

While this helps to tie individual cognition to the social secularising trend, it does not help to understand how that is connected to non-religious beliefs and to secular ideologies. To do that it is necessary to consider religion as a magical ideology, as proposed by the Principal Investigator (Talmont-Kaminski, 2014). This approach has three essential elements: 1) Religious beliefs and practices are to be considered along with magic (and superstition) in that they are cognitive byproducts resulting from the normal functioning of our cognitive systems under commonly met conditions; 2) Big God religions (Norenzayan, 2013) are ideologies in that they are sets of beliefs and practices whose function is to motivate prosocial behaviour; 3) The prosocial function of ideologies is not connected to their truth, which means that to maintain stability ideologies must minimise the potential impact of counterevidence while providing other cognitively acceptable reasons for believing in them – (Big God) religions are particularly apt to do this, being based upon cognitive byproducts. The resultant picture of religions is that they combine the traits of supernatural belief systems – being cognitive byproducts – with traits of ideologies – motivating prosocial behaviour – where these two elements of the picture mutually support each other, helping to explain why they have been as successful as they have. This provides a fascinating perspective upon secularisation: while the process has fundamentally altered the influence of religions, it has had a seemingly weaker effect upon either nonreligious supernatural beliefs or secular ideologies – both appearing quite influential in a number of secularised societies. It calls for an approach to the study of secularisation that looks at changes to religions in the context of both secular ideologies and nonreligious supernatural beliefs.

1.2. Key modelling results

When studying complex human phenomena, it has become more and more apparent that it is necessary to incorporate individual variations in combination with environmental factors. There is thus the need to account for the interaction between micro-level variables, how individuals take decisions and interact with each other, and macro-level variables, how socio-economic disparity at the society level may affect individuals' behavior. Modeling and Simulation (M&S), and especially agent-based modeling, provide a unique way of linking micro- and macro-level variables. Agent-based models are computer programs that simulate individuals explicitly, along with their environmental factors, life history characteristics, and behavioral strategies. By implementing individuals' behavior and interactions at the micro level, one can observe causal chains, unintended effects, and multilevel feedbacks that produce emergent macro-level phenomena. These models thus offer the possibility of exploring complex social systems and identifying the dynamics leading to specific scenarios emerging from a set of specific conditions. Not surprisingly, these computational tools have been increasingly adopted within the social sciences (Alvarez 2016) as well as humanities (Diallo et al. 2019).

The collaborators assembled in Norway for this project are experts in modeling and simulation, have ample experience in building agent-based models, and have published extensively in this field of research. Several of the models developed by this team have been on topics relevant for the study of religiosity (Gore et al. 2018; Shults et al. 2018a; Shults et al. 2018b; Puga-Gonzalez et al. 2019). Two of these models are relevant for the current proposal. First, the model (Gore et al. 2018) of the role of existential security (Norris & Inglehart, 2004) on the changes of religiosity at the society level was able to reproduce the observed changes of religiosity in several countries by varying the degree of existential security over time. In this model, however, the religious beliefs of agents were based on correlated variables extracted from surveys and their changes based on structural equation models. The cognitive mechanisms and biases governing religious beliefs were thus implied rather than explicitly modeled in the cognitive architecture of agents. For our research purposes, the model cannot be used to understand how cognitive mechanisms and biases may influence religious beliefs (one of the main aims of this project). The second model (Puga-Gonzalez et al. 2019) was built with the purpose of better understanding secularization on the basis of credibility enhancing display (CRED) theory (Henrich, 2009). In this case, the cognitive architecture of agents is more complex in the sense of appreciation of intensity and religious beliefs of agents displaying CRED behavior. These elements however, are limited to the appreciation of CREDs and do not include any cognitive bias related to the predisposition to adopting a belief. The model does not include the effect of the environment on religious beliefs and is not suited to answer our research questions. Furthermore, neither of these models is concerned with beliefs other than religious (such as, magic and superstitions) and studied theories of secularization separately.

2. OBJECTIVES

The project is to provide computer-based models of aspects of secularising societies that will allow researchers to understand the connections between cognitive processes and behaviour at the individual level with society-level phenomena. By combining the individual and social levels in a complex, realistic model, this methodology makes it possible to test hypotheses and make predictions in a way that was previously unavailable to social scientists. It offers a means to rigorously combine the results of empirical studies that range from psychological experiments, through ethnological observations and sociological surveys to economic histories. The results of its application will help to reinforce some of the existing theories but – thanks to proving social scientists with a novel tool – are sure to also reveal relationship that had thus far eluded them.

2.1. Hypotheses

The planned research will be aimed at four hypotheses in part put forward by the PI on the basis of previous empirical work in a number of disciplines and in part coming from existing theoretical approaches. Testing these hypotheses and expanding upon them would constitute a major step forward in our understanding of secularisation.

2.1.1. Fuzzy fidelity

The account of fuzzy fidelity put forward by David Voas helps to spell out some of the details of how secularisation proceeds. What is particularly striking about it is that it seems to suggest that the process looks relatively similar in different societies. Voas suggest that it is a roughly 200-year-long process that is characterised by the appearance, preponderance and then disappearance of individuals exhibiting what Voas calls ‘fuzzy fidelity’, i.e. a loose religiosity that is not necessarily tied to a specific Church or specific theological claims and which typically does not involve anything but minimal religious practice.

Being able to model the beliefs and practices of individuals in simulated societies undergoing secularisation will help to determine the role that beliefs and practices play in perpetuating religion, under what conditions this process fails and why secularisation involves the temporary appearance of fuzzy fidelity. The hypotheses are that it is primarily the practices that maintain religion, that the practices are the first to disappear because they are deemed too costly to continue in what appears to be a secure environment, and that the characteristics of fuzzy fidelity are the result of the failure of practices to be maintained. As can be clearly seen, this account is closely connected to the notion of Credibility Enhancing Displays and the role they play in maintaining religion. Given the connection between religion and both nonreligious supernatural beliefs and secular ideologies, the question is how it is that they respond to a long-term secure environment.

2.1.2. Prosocial equilibrium

The insight that higher levels of anxiety lead to increases in religiosity when taken together with the claim that religions help to maintain societies by motivating prosocial behaviour leads to the idea of a prosocial equilibrium. The hypothesis is that a level of prosocial behaviour can be maintained by religions such that the societies provide sufficient security to lower anxiety and that any disturbance to this equilibrium – such as caused by natural disasters – will lead to a response that will tend to bring the society back to the state of equilibrium between anxiety and religiosity. So, a plague would lead to resurgence in faith which would ensure that people cooperate on improving their lives, which in turn would make these lives more secure and, thereby, weaken the drive to religion.

Secular institutions have changed the picture by permanently improving the quality of life without the need for that improvement to be motivated by religion – one of the elements of the equilibrium has been removed. The resulting disequilibrium provides an explanation for one of the traits of the process of secularisation that Voas has observed – the degree to which the process looks similar across societies. According to this approach secularisation in various societies looks so similar because in all of them religion is in free fall because people’s external motivation for engaging in it has been removed.

The questions include what levels of anxiety are necessary to maintain the equilibrium, how particular kinds of secular institutions affect the equilibrium and why they do not affect secular ideologies and nonreligious supernatural beliefs in quite the same way.

2.1.3. Error management

The PI has sought (Talmont-Kaminski, 2013) to explain the connection between anxiety and religiosity in terms of error management theory. According to this hypothesis, superstitious behaviour (Skinner, 1948) as well as supernatural beliefs can be explained as the result of the false positives generated by human

attempts to comprehend their environment, false positives that become more common when threats require that false negatives be avoided at all costs.

This connection is already being studied by the PI in his current empirical research, which uses online PathGame methodology to determine the conditions under which humans ritualise their behaviour. Initial results show that it is enough to introduce uncertainty for traits of ritualised behaviour to appear spontaneously, with anxiety providing an additional boost. Importantly, such ritualisation of behaviour appears to require no supernatural beliefs, which seems to provide another potential line of evidence toward the claim that – when it comes to religion – practices should be thought of as more fundamental than beliefs. Future extensions of this methodology will look at the conditions under which people playing the Pathgame learn and repeat the ritualised behaviours of others, thereby providing researchers with an understanding of how traditions of ritualised behaviour can form.

The question for the proposed project is how such individual experiences and feelings of anxiety come to form the basis for supernatural belief systems that are shared by all individuals within a society.

2.1.4. Epistemic vigilance

Sperber and coauthors (Sperber et al., 2010) have observed that people make use of two different kinds of information to judge whether what they are told by other members of their society is worth of acceptance. The first focus is on the content of the claims in question, which they call content vigilance. The second focus is on the source from which the claims come, i.e. source vigilance. The distinction is particularly important when it comes to understanding the difference between religion, common sense reasoning and science. The hypothesis is that religious institutions downplay content vigilance while making use of source vigilance to maintain stability while scientific institutions downplay source vigilance while making use of content vigilance to formulate accurate theories about the world. The difference is tied to the previously mentioned fact that the prosocial function of religion is not tied to the truth of religious claims.

This relationship should be capable of being captured using computer modelling methodology, the aim being to show that the different approach to kinds of epistemic vigilance is a result of the different functions.

2.2. Impact

The hypotheses to be examined are all interconnected in that they concern the way in which cognitive processes constitute the basis for maintaining religion. Computer modelling provides a way for tracing the causal pathways from individual beliefs and practices to effects on the social scale. Taken together, the proposed research offers the possibility of arriving at concrete well-supported claims as to how religions are maintained in societies as well as, in the case of secularisation, what are the precise processes by which they fail to be maintained. In particular, the project promises to show how cognitive processes, behaviour and interactions on the individual level lead to social change. By taking into account a range of existing theories regarding the role of religious beliefs and rituals as well as of secular ideologies and nonreligious supernatural beliefs and practices, it should be able to provide a framework for understanding a broad range of social and cognitive phenomena that will be of value to many researchers.

At the same time, by exhibiting how computer models can be used to understand social processes, the project can serve as a paradigmatic example of the use of a novel methodology. As such, its influence upon the social sciences can be both widespread and enduring.

3. WORK PROGRAMME

In order to meet our objectives just outlined, the RIP team will take a multi-disciplinary and mixed-methods approach. The relevant disciplines and scientific theories were introduced briefly above, and the pertinent methods will be outlined below.

3.1. Work Programme including proposed research methods

Our efforts will revolve around four main research questions, arising out of the hypotheses described above. These questions will be:

- **RQ1:** What are the conditions under which – and the mechanisms by which – religiosity, secularity and *fuzzy fidelity* increase (or decrease) in contemporary societies?
- **RQ2:** What are the conditions under which – and the mechanisms by which – contemporary societies are able to achieve and maintain a *prosocial equilibrium*?
- **RQ3:** What are the conditions under which – and the mechanisms by which – the cognitive *error management* system generates beliefs and practices related to magic and religion within contemporary societies?
- **RQ4:** What are the conditions under which – and the mechanisms by which – the cognitive *epistemic vigilance* system generates beliefs and practices related to magic and religion within contemporary societies?

To help us answer these RQs, the research programme will be divided into four different projects which will be carried out in parallel. Each of these projects involves the construction of multi-agent artificial intelligence models (described below), each of which will provide an “artificial society” within which we (and other scientific research teams) can test a wide variety of hypotheses related to religion, ideology and prosociality. Because it is the only methodology through which one can “grow” *macro*-level phenomena (such as polarization at the population level) from *micro*-level behaviors (such as individual reactions to out-group members), the multi-agent artificial intelligence modeling approach is ideal for addressing our RQs.

The construction of computer models follows a similar methodology and therefore it is generally described for all models below. Each model, however, will be tailored according to its specific RQ; how this will be done is specified in the sections allocated to each project.

3.2. General methodology for computer models development

Theory and method are tightly interrelated in research using computer modeling and simulation (CMS) technologies. The aim of CMS is the construction of a computational architecture that captures the key dynamics of a complex adaptive social system requires and enables the clarification and integration of theories about ideology and norms across disciplines in a completely new way. In fact, designing simulation experiments for a computer model is itself a form of “theory-building.”

The development of each computational model and its analysis will be divided into four stages: model 1) conceptualization, 2) programming, 3) calibration and validation, 4) experiments and analysis. Each of these stages requires close collaboration between model developers and subject matter experts throughout the whole process, close collaboration among these actors is key in the obtention of a well-designed model. To this end, frequent meetings will be organized during the three years. These meetings will involve face-to-face seminars in which all members of the research team will gather to conceptualize the model(s). Model conceptualization requires the development of a “causal architecture” that determines how variables impact each other as agents interact over time and move through simulated space. In these meetings, research teams will discuss the information derived from empirical data and statistical analyses in order to identify the variables and parameters that are most relevant for the “causal architecture”. Because the dynamics that shape ideological transformation and norm diffusion are complex, we anticipate the need to develop virtual agents with the appropriate cognitive, emotional, and social-network-interaction capacities (as we have done in some of our other models). Each simulated agent will incorporate cognitive-emotional processes that are constantly in flux, seeking a kind of equilibrium using continuous dynamic modeling of virtual mental processes. This process of equilibration is interrupted whenever an agent must function as learner or exemplar in an interaction with another agent, after which the equilibration process resumes. Simulated agents will also have rules for learning, memory, reproduction, and transmitting cultural traditions, all of which will occur within the spatio-temporal ecological landscape of the artificial society.

Once conceptualized, the model is then programed by the model developers and afterwards it is calibrated and validated. Calibration involves estimating the values or ranges of constants and parameters within which the model will run (e.g. life spans of individuals, education years, etc.). These values will be estimated from empirical datasets (collected by Statistics Poland, and from the Norwegian Centre for Research Data (NSD)), surveys, and from the subject matter expert knowledge. Once satisfactory estimates have been obtained, the model will be run and its ‘outputs’ will go through a reality check, i.e. model validation. The ‘outputs’ of the model may include measurements of factors in a population such as increased prosociality (of the sort that would mitigate the effects of ideological polarization) or decreased magical beliefs (of the sort that contribute to the rejection of climate change science). The validation process will establish the credibility of the model by demonstrating its ability to replicate or resemble the phenomena observed in reality; it will require the comparison between the ‘output’ patterns emerging in the model and those from empirical data. Comparisons will be done at different levels depending on the degree of detail necessary. One can compare whether the model reproduces patterns observed at the society level or zoom-in into more detailed levels, like those observed on specific groups of a given population or even at the individual level.

Once the model is calibrated and validated, experiments will be carried out in the model. These experiments involve sensitivity analysis and/or optimization experiments. Sensitivity analysis involves running

thousands of simulations under different initial values of parameters. These analyses help one to get a good understanding of the causal relationships and links between different processes in the model, leading to a better understanding of the whole system and/or the generation of new hypotheses that can be tested in empirical data. Optimization experiments involve the tweaking of model parameters in order to obtain a specific goal. For instance, to identify ways in which we can ‘grow’ phenomena such as a peaceful prosocial equilibrium in contexts characterized by strong ideological differences.

By demonstrating and testing the interrelations among a wide variety of factors, CMS can promote both clarity within (and empirical constraint over) cognitive and cultural theories dealing with the dynamics of religiosity, secularism, ideology, and prosocial attitudes and behaviors. This means that the RIP project will effectively produce *new theories* about these dynamics as a result of the collaboration between computer modelers, public policy professionals, and scholars from the humanities and social sciences. The artifact of this theoretical generativity – the models themselves – can then be used to develop *new experiments* in artificial societies that could never be carried out in the real world (due to ethical concerns or limited time and resources).

Further, research on the topics this proposal address have sometimes been adversely affected by the academic division between the humanities and the natural sciences, as well as other sub-divisions within the social sciences. We plan to transgress these boundaries in the construction of these models as we work across disciplines in order to construct more comprehensive theoretical frameworks that can incorporate the relevant micro- *and* macro-level variables.

3.3. Detailed methodology for development of individual models

What follows is a brief description of our tentative plans for constructing the four computational models designed to help us answer the four research questions above. New cognitive architectures will be constructed and ASAP will be expanded and adapted as described below in order to address the new RQs.

3.3.1. Fuzzy Fidelity Model

This model is oriented towards answering the RQ1, with it we expect to run optimization experiments to discover the conditions under which – and the mechanisms by which – fuzzy fidelity (in contrast to religiosity and secularity) at the population level (dependent variable) is incremented or decremented.

Empirical data analysis - This stage will be done during months 1-3. An empirical analysis similar to the one performed in the study by Voas (D. Voas, 2008) will be carried on with data of the new wave of the European Values Study (EVS). These data will be released during fall of 2019 and thus will be already available by the start of the project. The main goal of this analysis is to replicate Voas’ findings and will serve as the basis for the conceptualization, calibration and validation of the agent-based model that will be developed in this project.

Model development - All modelling stages will be done during months 4-15. This model will be adapted from an earlier artificial society analytics platform (ASAP) constructed by members of the research team in Norway (Shults et al., 2018). The model will reproduce the characterized dynamics of secular religious and fuzzy fidelity individuals. Although the details will depend on the outcome of working sessions with

subject-matter experts and other stakeholders, we expect that the relationships among variables in the *fuzzy fidelity* model will look something like Figure 1.

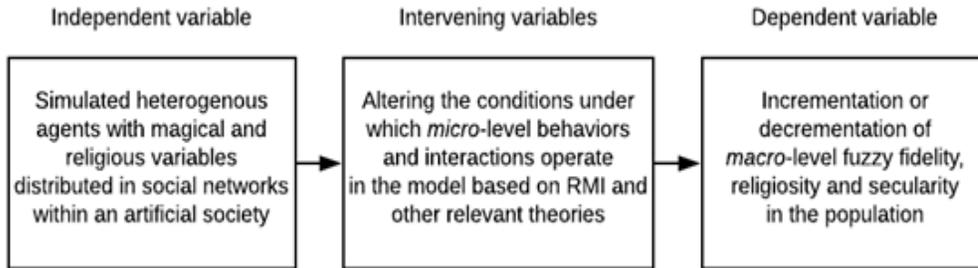


Figure 1

The agent architectures and interaction rules will be informed by our empirical analysis and hermeneutical insights on findings from disciplines such as moral psychology, cognitive science, philosophical ethics and the history of religions. Building agents and artificial societies with higher levels of realism will require massive surveys of the relevant literature on ideological polarization and extensive input from experts during the actual construction and validation of the model. The causal architecture of the model will be informed by theories such as Religiosity as Magical Ideology (RMI) and credibility-enhancing display (CRED), as well as by the empirical analysis mentioned above.

3.3.2. Prosocial Equilibrium Model

The second model will be oriented toward answering RQ2. In this case, simulation experiments will be designed to explore the parameter space in order to identify the environmental and individual level factors that affect the achievement and maintenance (or collapse) of prosocial equilibrium in human populations. (see Figure 2).

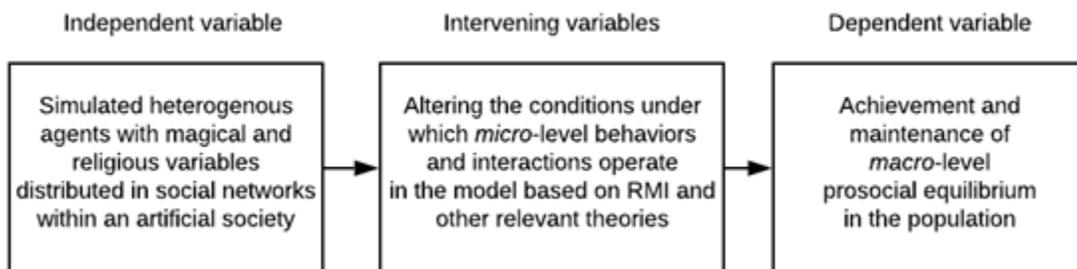


Figure 2

Plan and development of methods for data collection and data analysis (Survey) - This stage will be carried out during the first 12 months of the project. Here, we will design a survey (questionnaire) to collect empirical data about prosociality in individuals holding religious and secular ideologies. The main aim of

this project is two-fold. First, we will investigate to what degree different secular ideologies (such as nationalism) are an integral part (or linked) to religious ideologies. Second, we aim at understanding whether individuals holding different ideologies differ in the degree and type of prosociality, universal or parochial. Further, the empirical data obtained from this stage will be used as the basis for the conceptualization, validation and calibration of the prosocial equilibrium agent-based model.

Model development - All modelling stages will be done during months 16-27. This model will also be an extension of the earlier artificial society analytics platform (ASAP) (Shults et al., 2018). In this case, the model will be focus on prosociality. The survey will inform the model about the potential interrelation between variables related to magical beliefs, religiosity and ideology, as well as variables associated with naturalism and secularism (such as institutions that provide scientific education or provide existential security apart from religious institutions). The causal architecture that will guide agent behaviors and interactions will be informed by the survey’s results, RMI and other relevant theories (e.g. existential security). We are particularly interested in the spread of less tribal forms of altruism (using measures such as tolerance, trust, and actual care-giving behaviours), thus the model will aim at finding the conditions and mechanism leading to high prosociality levels at the society levels while at the same time maintaining a diversity of religious beliefs and ideologies.

3.3.3. Error Management Model

The construction of the Error Management model (third) and the Epistemic Vigilance model (fourth) models will follow a process similar to that created and utilized by members of the Norway research team for the study of the role of cognitive systems in shaping cultural and intergroup changes (Shults et al. 2018, Shults et al. 2018). This process is two-fold. First, we will construct a systems-dynamics model (SDM) of a human cognitive system. Second, once the SDM is calibrated and validated, it is then adapted and implemented within the simulated “minds” of the members of an agent-based model (ABM) of a social system.

The Error Management model will be designed to answer RQ3, and we envision the relationships among variables will be structured as depicted in Figure 3.

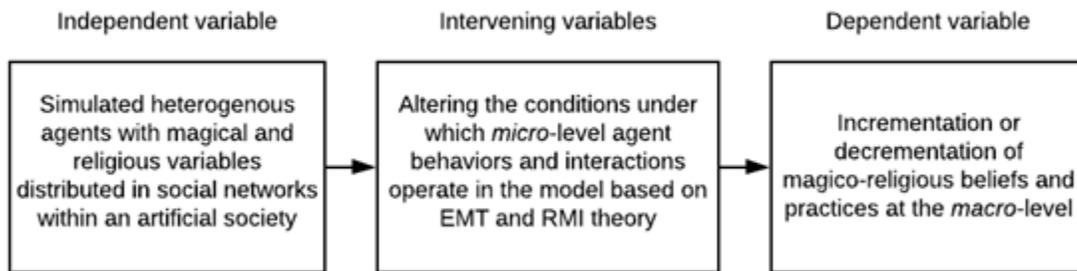


Figure 3

Empirical data analysis - Analysis of empirical data from the experiments performed with the PathGame paradigm will be carried on during months 1-3. This analysis will be used to calibrate and validate the SDM.

Models development - All modelling stages of the SDM will be done during months 3-15. The cognitive architecture guiding actions and responses in the SDM will be informed primarily by Error Management Theory (EMT) as well as by other relevant cognitive and cultural theories such as RMI. The SDM will then be calibrated and validated using the results of the experiments from the path-game computer model. Next, the ABM will be constructed during months 16-30. The cognitive architecture guiding the behaviors and interactions of the agents in this model will be the SDM previously developed. The successful validation of this model will enable us (and other scientists who use the platform) to experiment on artificial societies in order to test hypotheses about the causes and consequences of increased or decreased magical and religious practices and beliefs in contemporary societies.

3.3.4. Epistemic Vigilance Model

The fourth model will aim to address RQ4. The intended relationships among the variables of this model are depicted in Figure 4.

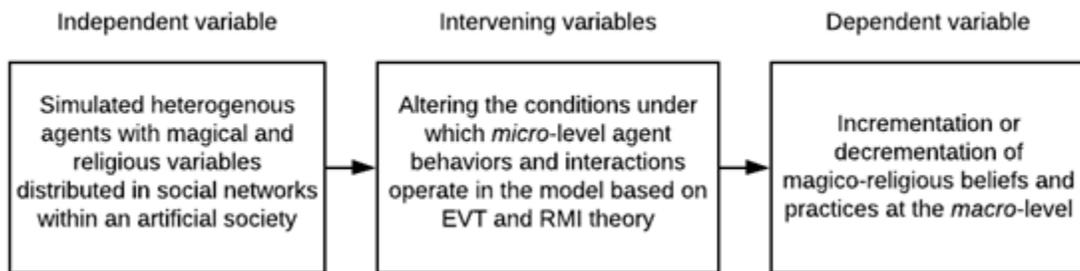


Figure 4

Plan and design of experiments of epistemic vigilance - This stage will be carried out during the first 12 months of the project. We will design an experiment using a computer-mediated task. The results of these experiments will help us elucidate what factors and/or conditions make individuals trigger cognitive mechanisms of epistemic vigilance when acquiring information from others. Further, the data and results obtained from these experiments will be used to calibrate and validate the SDM.

Models development - Like the third model, the construction of the SDM will require the development of a single cognitive architecture, in this case informed primarily by Epistemic Vigilance Theory (EVT). Once built, the model will be calibrated and validated using the results from empirical experiments. All these modeling stages will be carried out during months 13-27. Next, the ABM will be constructed during months 25-33. The SDM will form the basis of the cognitive architecture guiding the behaviors and interactions of the agents in the ABM. The ABM will shed light on the conditions under which the epistemic vigilance system interacts with other cognitive mechanisms to increase or decrease magico-religious beliefs and practices in a population.

3.4. Research team members

The core team of researchers includes the PI, six additional researchers and an administrative manager in Poland, the PP and a postdoc in Norway, as well as outside unpaid collaborators. It is expected that all of the researchers will collaborate on all of the team's research tasks as their time and abilities allow. However, each individual is going to be responsible for overseeing, driving and assisting with particular tasks. These are spelled out below as well as in the attached schedule.

The junior members of the research team - the post-doctoral researchers as well as the doctoral students - will be able to draw upon the expertise of subject matter experts, modelling experts and other methodological experts. This includes the experience of the PI within cognitive science of religion as well as the PP's experience in modeling social systems throughout the period of the project, and to meet and discuss their work with the collaborating subject matter experts at the annual project workshops. In addition, they will have the opportunity to participate in the Agent-Based Modelling for Social Scientists Summer Schools as well as having ample funds to present their work at international conferences. It is an aim of the project that at its conclusion the two doctoral students will be in the position to carry out independent research on social systems using a variety of computer modelling methods.

3.4.1. Society & Cognition Unit, Poland

The research team at the Society & Cognition Unit of the University of Bialystok will be primarily responsible for developing the Error Management and Epistemic Vigilance Models as well as for carrying out the empirical research necessary to calibrate and validate all the models.

Principal Investigator - Management of the overall project as well as overseeing the research tasks of the Bialystok team, and the administrative tasks of the Project Manager. Primary subject matter expert for all models. Primary author on theory papers describing the implications of the results obtained using the Error Management and Epistemic Vigilance Models. Supervisor for the doctoral students.

Quantitative Sociologist - Primary responsibility for developing and analysing the survey to be used to calibrate and validate the Prosocial Equilibrium Model as well as analysing the data from the most recent wave of the European Values Study to be used to calibrate and validate the Fuzzy Fidelity Model. Primary author on publications coming out of these analyses. Mentoring doctoral students in the QS's areas of expertise.

Cognitive Psychologist - Primary responsibility for developing and analysing the experimental study aimed at testing the theoretical underpinnings of the Epistemic Vigilance Model, which will also be used to calibrate and validate this model. Primary author on publications coming out of this study. Mentoring doctoral students in the QS's areas of expertise.

Post-doctoral Researcher 1 - Will have primary responsibility for developing the Error Management Model, including conceptualisation, coding, calibration and validation as well as subsequent optimisation, experimentation and analysis. Will be first author on technical papers describing the models.

Post-doctoral Researcher 2 - Will have primary responsibility for developing the Epistemic Vigilance Model, including conceptualisation, coding, calibration and validation as well as subsequent optimisation, experimentation and analysis. Will be first author on technical papers describing the models.

PhD Student 1 - Will pursue their own doctoral project closely connected to the grant project as well as participating in the research tasks integral to the project according to their abilities and project needs. Will learn how to construct computer models of social phenomena as well as learning how to tie these to results obtained using quantitative sociological methods.

PhD Student 2 - Will pursue their own doctoral project closely connected to the grant project as well as participating in the research tasks integral to the project according to their abilities and project needs. Will learn how to carry out studies using quantitative sociological methods as well as learning how to tie these to results obtained computer modeling of social phenomena.

Administrative Assistant - Not a researcher. Responsible for the day-to-day administration of the project.

3.4.2. NORCE team, Norway

The Center for Modeling Social Systems team at NORCE in Kristiansand, Norway, will be primarily responsible for developing the Fuzzy Fidelity and Prosocial Equilibrium Models.

Principal Partner - Overseeing the research tasks of the Norway team. Primary author on theory papers describing the implications of the results obtained using the Fuzzy Fidelity and Prosocial Equilibrium Models. Co-supervisor for the doctoral students

Post-doctoral Researcher 3 - Will have primary responsibility for developing the Fuzzy Fidelity and Prosocial Equilibrium Models, including conceptualisation, coding, calibration and validation as well as subsequent optimisation, experimentation and analysis. Will be first author on technical papers describing the models.

3.4.3. Unsalaries Collaborators

Apart from the core Norway and Poland teams, the project will make use of the expertise of the following researchers. Their primary form of input into the project will be to participate in team workshops and in the writing up of particular publications.

David Voas - Leading European quantitative sociologist of religion, carried out the research underpinning fuzzy fidelity theory, member of previous project team that developed models that this model will be based upon. Participating in the conceptualisation and analysis of the Fuzzy Fidelity Model.

Pippa Norris - Foremost quantitative sociologist of religion, developed the existential security theory underpinning the Prosocial Equilibrium Model. Participating in the conceptualisation and analysis of the Prosocial Equilibrium Model.

Martie Haselton - Leading evolutionary psychologist, developed the error management theory. Participating in the conceptualisation and analysis of the Error Management Model.

Hugo Mercier - Leading cognitive scientist, developed epistemic vigilance and the argumentative account of reason. Participating in the conceptualisation and analysis of the Epistemic Vigilance Model.

Saikou Diallo - Current president of the International Society for Modelling and Simulation, Chief Scientist at the Virginia Modelling, Analysis and Simulation Centre, involved in the developmental process of the models which will be used as the starting point for the development of the models to be used in the project.

Wesley Wildman - Director of the Centre for Mind and Culture and Professor at Boston University, involved in the developmental process of the models which will be used as the starting point for the development of the models to be used in the project.

David Voas, Saikou Diallo and Wesley Wildman have already confirmed their interest in participating. In the event that the other researchers listed above decline their invitations, the PI will seek to involve other subject area experts with similar interests.

4. ADDED VALUE

Computer modelling offers a completely novel way of studying social phenomena. It makes it possible to determine the consequences of theoretical claims about complex social systems, thereby allowing social scientists to evaluate those theoretical claims to a degree previously not possible. It also makes it possible to predict the probable behaviour of complex social systems given particular planned or natural social changes. This powerful social scientific approach is only currently being pursued in a small but rapidly growing number of research centres. Working with Prof. LeRon Shults and the NORCE Center for Modeling Social Systems will create the opportunity for young Polish social scientists to become familiar with the techniques necessary to make use of this novel methodology - with two postdoc positions as well as two doctorate scholarships in Bialystok. The planned research is to intended to form the beginning of a long-term collaboration with the creation in Bialystok of a permanent research group utilising computer modelling methods to understand social phenomena. The computer system to be used to carry out the computations necessary for the modelling will be located in Bialystok and will form a key part of the infrastructure of that ongoing collaboration.

4.1. Deliverables

This project will deliver four ABM and two SDM computer models, one that will explore the cognitive biases and/or social processes affecting the adoption/abandonment of beliefs and ideologies. We expect to write 12 scientific manuscripts (MS). One technical MS per computer model (i.e. six MS); four theoretical MS regarding the theories addressed in each project; and at least two MS about the policy implications of the computer models. Further, we will organize workshops, seminars, and public events where we will disseminate the results of the project to stakeholders and lay-people – given the policy significance of the studied topics, this outreach will be of potentially great consequence.

5. REFERENCES

Alvarez, R.M. (2016) *Computational Social Science: Discovery and Prediction*, Reprint Edition edn. University Press, New York, NY: Cambridge.

- Bruce, S. (2011). *Secularization: In Defence of an Unfashionable Theory*. New York: Oxford University Press, USA.
- Haselton, M. G., & Buss, D. M. (2000). Error management theory: a new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology*, 78(1), 81–91.
- Henrich, J. (2009). The evolution of costly displays, cooperation and religion. *Evolution and Human Behavior*, 30(4), 244–260. <https://doi.org/10.1016/j.evolhumbehav.2009.03.005>
- Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, 33(2–3), 61–83. <https://doi.org/10.1017/S0140525X0999152X>
- Jong, J., Bluemke, M., & Halberstadt, J. (2013). Fear of Death and Supernatural Beliefs: Developing a New Supernatural Belief Scale to Test the Relationship (El miedo a la muerte y creencias sobrenaturales: El desarrollo de una nueva escala creencia sobrenatural para probar la relación). *European Journal of Personality*, 27(5), 495–506. <https://doi.org/10.1002/per.1898>
- Malinowski, B. (1992). *Magic, Science and Religion and Other Essays*. Long Grove, IL: Waveland Press.
- Norenzayan, A. (2013). *Big Gods: How Religion Transformed Cooperation and Conflict*. Princeton: Princeton University Press.
- Norris, P., & Inglehart, R. (2004). *Sacred and secular : religion and politics worldwide*. Cambridge, UK: Cambridge University Press.
- Padgett, V. R., & Jorgenson, D. O. (1982). Superstition and economic threat: Germany, 1918–1940. *Personality and Social Psychology Bulletin*, 8(4), 736–741. <https://doi.org/10.1177/0146167282084021>
- Pew Research Center. (2018). *The Age Gap in Religion Around the World*.
- Skinner, B. F. (1948). “Superstition” in the Pigeon. *Journal of Experimental Psychology*, 38, 168–172.
- SPERBER, D., CLÉMENT, F., HEINTZ, C., MASCARO, O., MERCIER, H., ORIGGI, G., & WILSON, D. (2010). Epistemic vigilance. *Mind & Language*, 25(4), 359–393. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0017.2010.01394.x/full>
- Talmont-Kaminski, K. (2013). Malinowski’s magic and Skinner’s superstition: reconciling explanations of magical practices. In D. Xygalatas & William W. McCorkle (Eds.), *Mental Culture: Towards a Cognitive Science of Religion*. Sheffield: Equinox Publishing.
- Talmont-Kaminski, K. (2014). *Religion as Magical Ideology: How the Supernatural Reflects Rationality*. Abingdon, Oxon: Routledge.
- Voas, D. (2008). The Rise and Fall of Fuzzy Fidelity in Europe. *European Sociological Review*, 25(2), 155–168. <https://doi.org/10.1093/esr/jcn044>
- Voas, David, & Chaves, M. (2016). Is the United States a counterexample to the secularization thesis? *American Journal of Sociology*, 121(5), 1517–1556. <https://doi.org/10.1086/684202>
- Voas, David, & McAndrew, S. (2012). Three Puzzles of Non-religion in Britain. *Journal of Contemporary Religion*, 27(January 2013), 29–48. <https://doi.org/10.1080/13537903.2012.642725>

