5. Conclusions and Recommendations

This section presents our conclusions regarding the present state of development and use of scenarios for climate-change applications, and some recommendations for specific changes or initiatives to advance current practice to make scenarios more useful.

Before doing so, we briefly reprise some key definitional points, because uses of the term scenarios are so divergent. We have defined scenarios as descriptions of future conditions produced to inform decision-making under uncertainty. This definition distinguishes scenarios from assessments, models, decision analyses, and other decision-support activities. As descriptions of potential future conditions, scenarios can serve as inputs to such activities, but are not identical to these, and not alternatives to them.

We have also distinguished scenarios from other types of future statements intended to inform decisions, such as projections, predictions, and forecasts. Relative to these, scenarios tend to be more multivariate (but still schematic), tend to be developed in groups, and tend to presume lower predictive confidence. The last condition is the case in part because scenarios tend to be used in situations where the basis for forecasting is less established because of deeper uncertainties, or for situations that pertain to further in the future beyond the range for which there is high confidence in specific projections, even contingent ones.

Having distinguished scenarios from these related activities, we consider a broad set of scenarios of diverse characteristics and uses, including simple and complex, various combinations of quantitative and qualitative, and positive and normative. Unless stated otherwise, our conclusions and recommendations pertain to this whole set. Where we intend them to apply to only certain types or uses of scenarios, we state this explicitly.

5.1 Use of Scenarios in Climate-Change Decisions

Scenarios can make valuable contributions to climate-change decision-making. Many of the decisions that will comprise the societal response to climate change – whether mitigation, adaptation, or some other form of response – involve high stakes, deep uncertainties, and long time horizons. Scenarios can make valuable contributions to these decisions by structuring present knowledge and uncertainty, prompting critical examination of present assumptions and practices, stimulating new insights, identifying key pitfalls or opportunities, or providing a framework for the assessment of particular decisions. For some decisions, that involve irreversible near-term commitment to choices whose consequences extend over a horizon involving substantial uncertainties, some form of scenario-based reasoning may be essential.

There is a big gap between the use of scenarios in current practice and their potential contributions. Despite this evident value and capability, many climate- related decisions that could benefit from scenarios (e.g., many decisions regarding long-term management and investments in climate-sensitive areas such as freshwater systems or coastal zones) are not using them. Indeed, many such decisions are still being made without considering climate change at all. Conversely, many exercises producing climate-change scenarios have only weak and indirect connections to practical decisions related to climate-change mitigation or adaptation.

Interest in considering and using climate-change scenarios is sharply increasing. There appears to be a rapid increase in interest now underway in considering climate-change scenarios in diverse decision and planning processes. This trend is strongest for planners and decision-makers concerned with climate-change impacts and adaptation. The trend reflects the combined effects of advanced in scientific understanding of climate change, maturation of models and analytic tools, and increased recognition of the potential importance of climate change by decision-makers. Given the high general concern about climate change and the advance of background scientific knowledge, we expect this trend to continue, for these and other types of decisions.

Scenarios of global emissions and resultant climate change are required by many diverse climate-related decision-makers. Although climate-change decision-makers and their particular needs from scenarios are highly diverse, many will need scenarios of global emissions and resultant climate change and many more will need information that depends upon these. Commonly provided scenarios of these types can serve these needs of extremely diverse decision-makers, provided they are presented with enough transparency and documentation about their underlying reasoning and assumptions.

Beyond global climate forcings and resultant climate changes, decision-makers' needs from climate-change scenarios are highly diverse. Different climate-change decision-makers will have greatly differing information needs from scenarios, in the factors and variables included, the time and spatial scale at which they are provided, and the breadth and interpretation of uncertainty represented. One dimension on which these needs can be distinguished is the type of decision-maker: national officials, impacts and adaptation managers, and technology and energy managers. The means for meeting these additional needs will likely be diverse too. Some will call for additional, separate capabilities. For all of them, it is likely that scenarios will have to be updated frequently based on new knowledge, experience, and priorities – much more frequently than the time horizons of the decisions.

Impacts and Adaptation Managers are a major group of scenario users with distinct information needs. Impacts and adaptation managers – including both national officials and others responsible for more specific domains of impact – will need climate-change scenarios, driven by specified global emissions scenarios, to provide information about potential climate-related stresses on their areas of responsibility. In addition, they will need climate, environmental, and socio-economic information specific to their area of responsibility, at the appropriate spatial and temporal scale. Meeting these needs will require both easy access to centrally produced climate scenario information and associated tools and support, and development of decentralized capabilities for developing and applying additional scenario-related information. Although not identical, many of these specific information needs are likely to be similar in character for many particular locations and types of impact.

Meeting information needs for impacts and adaptation may require a cross-scale organizational structure. The combination of centralized and decentralized information needs suggest the desirability of a cross-scale organizational structure – a linked network of institutions at the international, national, and sub-national level – for providing scenario-related information. Such a structure would combine central provision of nationally or globally consistent climate and socio-economic scenarios; decentralized elaboration of these with variables and characteristics especially required for particular impact analysis or drawing on superior local knowledge; and provision of tools and resources to allow modification of regional socio-economic scenarios and elaboration of new ones within loose larger-scale consistency constraints, to address specific regional capabilities and concerns.

Scenarios for Impact and Adaptation Managers should be based on emissions assumptions that presume a likely range of mitigation interventions, now and in the future. The emissions assumptions underlying scenarios for impacts managers should be based on the likely range of future global emissions trajectories, including explicit assumptions about what degrees of further mitigation effort are likely over time. This will typically imply a narrower range of emission futures than is considered in scenarios to support mitigation decisions.

Mitigation Policy-Makers are also a major group of climate-change scenario users with distinct needs. Most mitigation policy-makers are national officials making national policy and participating in international negotiations, but this group also includes sub-national officials when they share mitigation responsibilities or undertake mitigation initiatives. Serious mitigation initiatives are likely to represent major policy innovations and carry significant risks of many kinds, including the effectiveness and cost of the policies but also their effects on government budgets, competitiveness of particular industries, opportunities for national technological capabilities, etc. Decision-makers considering such policies will need scenarios of global and national emissions trends, resultant climate change, and aggregate impacts. In addition, they will need to consider many factors specific to their jurisdiction – e.g., national policies, institutions, economic structure, technological capabilities, and the detailed structure of national emissions – and information about the relevant policy and bargaining environment for their choices, including alternative scenarios of other nations' mitigation strategies and various degrees of implementation and compliance with international mitigation decisions.

Scenarios for mitigation decisions should include a wide range of baseline emissions assumptions and not pre-judge the likely level of mitigation effort. In contrast to scenarios for impacts and adaptation decisions, those used for mitigation decisions should not estimate the likely level of mitigation effort. Rather, mitigation decisions should consider the full range of potential mitigation choices on the agenda, defined relative to baseline assumptions that, as much as possible, reflect only efforts already enacted or committed, including a range of reasonable assumptions about implementation and compliance. This will typically imply a wider range of emissions futures than is considered in scenarios used to support impacts and adaptation decision-making.

Mitigation Decision-Makers can use target-driven scenarios for backcasting. Mitigation decision-making may also benefit from scenarios that impose explicit future environmental targets such as limits on emissions or atmospheric concentrations, together with assumptions about policy and implementation elsewhere, and reason backwards to explore alternative paths to, and implications and requirements of, attaining that goal, including feasibility, costs, and tradeoffs. These must be defined in ways relevant to the level of decision-making being informed, i.e., alternative national targets to inform national policy-making, in the broader context of alternative global baselines or global targets.

Mitigation decisions will require scenario development capacity at the national level. While core scenarios of global emissions and climate-change can provide a partial input into mitigation decisions, the scope and specificity of additional information needs for these decisions suggests the need for additional elaboration of relevant scenarios at the national level (or sub-national, if mitigation decisions are being considered there), generated in consultation with policy-makers.

Energy Resource and Technology Managers are a third major group of climate-change scenario users with distinct needs. Energy resource and technology managers concerned with private responses to mitigation policy primarily need scenarios that represent alternative policy regimes. Emissions and climate change underlie these as influences on policy decisions, but do not capture the most important uncertainties for these decision-makers. While many actors may wish to generate these scenarios privately to keep their assumptions and analyses confidential, there may also be value in multi-party collaborative scenario-building exercises in which today's policy-makers and corporate planners jointly examine what range of policy, economic, and energy regimes is plausible or likely in 30 years.

5.2 Use of Scenarios in Climate-Change Assessments

Large-scale, official assessments are the major use for scenarios at present, and are likely to remain an important use. Large-scale, official assessments represent the most prominent demand for climate-related scenarios at present, and are likely to remain major users, particularly for coordinated scenarios of global emissions and resultant climate-change.

Within assessments, scenarios are principally used to support further analysis, modeling, and assessment. When scenarios are used in assessments, some users are clearly identified: e.g., climate modelers are major users of emissions scenarios, while impacts assessors and modelers are major users of climate-change scenarios. Users of these types have specific needs from scenarios, and close consultation is possible between scenario producers and users to meet these needs. Substantial progress has been made in providing useful scenarios for these groups, at both the national and international level. These efforts should be continued and expanded.

The presentation of scenarios in assessments leads to many additional uses, not foreseen. Scenarios presented in large-scale assessments gain prominent dissemination that results in their being put to many uses their developers did not foresee. Scenarios should strive for maximal clarity of documentation and transparency about underlying reasoning and assumptions, to improve the ease of use and reduce the risk of misunderstanding in such derivative uses, although they cannot anticipate all information needs of an open-ended set of diverse potential uses.

In assessments, scenarios can be an effective issue-framing device. Also because of their prominent dissemination, scenarios presented in major assessments can exercise substantial influence over the framing of policy discussions, or provide simple, widely used metrics of the seriousness of the issue. They may consequently exercise broad influence over many decisions that depend upon such an aggregate perception of seriousness. The expectation of such influence further heightens the responsibility for transparency in the production of scenarios.

Scenarios contain unavoidable elements of judgment in both their production and use. Although they draw on relevant data, knowledge, and analysis, scenarios contain unavoidable elements of judgment. This puts serious responsibilities onto scenario developers, and also means that there is no authoritative way to resolve arguments over whether a scenario is plausible or not. When a wide enough range of potential futures is considered, some scenarios are likely to draw criticism, in part motivated by opposition to their foreseeable implications for action. Any scenario can be attacked as unreasonable, speculative or unlikely, and close enough scrutiny of any scenario can usually reveal inconsistencies, but these do not provide sufficient basis for excluding a scenario from consideration. Indeed, scenarios designed to represent extreme events, or to lie near an end of a presently judged distribution, should by definition appear unlikely. The most productive response to such criticisms lies in transparency about the process, reasoning, and assumptions used to produce scenarios, which can both shift arguments to underlying uncertainties that are worth arguing about, and help limit biases in the production of scenarios.

5.3 A Sustained Capacity for Scenarios

CCSP should provide resources to support a new capacity for producing, analyzing, supporting, and updating scenarios of global emissions and resultant climate change. Because scenarios of global emissions and resultant climate change are needed directly or indirectly for so many diverse uses, there is strong value in centralized, coordinated provision of these. A capacity should be created to stimulate, produce, analyze, and disseminate global emissions and climate-change scenarios, and to periodically evaluate and update them in light of new knowledge, experience, and decision needs.

Several institutional models would be feasible for this capacity. It could be US-based or international. It could be a government office, a non-governmental organization, or a collaborative multi-party network. And it could do any or all of producing scenarios itself, convening activities to produce scenarios with broader participation, or receiving and reviewing scenarios produced by others.

Several criteria would have to be met, however, for this capacity to be effective:

> ***Adequate sustained resources.*** The capacity must build and maintain a sophisticated analytic capability, and develop skills and institutional memory regarding prior experiences, successes, and failures. This requirement precludes the scenarios capacity being a series of *ad hoc* one-time activities or a part-time burden imposed on people and organizations with other full-time responsibilities.

Connections with outside expertise, analysis, models. The capacity needs to build and maintain close collegial connections with outside networks of researchers and analysts in multiple fields of expertise, including emissions modelers, climate scientists and modelers, impacts researchers, and resource managers – including collaboration with parallel international and national efforts, including scenario projects established to serve more specific needs.

Insulation from political control. For the scenarios and analyses based on them to be perceived as credible by their diverse users, the capacity needs enough insulation from political control, at both the national or international level, to prevent scenarios from becoming proxies for conflict over preferred near-term policies, and to allow exploration of the implications of alternative futures that represent plausible risks but that some major political actors would find objectionable.

Maximum transparency. The capacity must strive for maximal transparency regarding inputs, models, assumptions, and reasoning employed in developing scenarios, as well as any significant disagreements that arose and how they were resolved and any remaining weaknesses recognized by the developers. The broader and more diverse the collection of intended uses and users, the more crucial is transparency of the scenario-production process – because different users may require scenarios produced using different underlying assumptions, and they must be able to track the underlying logic to exercise this choice. This would enhance credibility in the scenario-development process. While calls for such transparency are widely made, experience suggests it is difficult to achieve, particularly for such matters as disagreements or recognized weaknesses that may risk professional embarrassment. Still, achieving more transparency and more widely informed debate on such matters is essential for advancing scenario methods.

A mandate to support development of methods and models. Attempts to characterize emissions trends and the socio-economic factors driving them have repeatedly had to consider new issues, identify newly relevant data sources, and develop and test new modeling capabilities. High-priority methodological challenges beyond model and data development also arise frequently, such as the current need for better methods to integrate qualitative and quantitative aspects of scenarios. A major contribution of this centralized scenarios capacity can be to support exploration, development, critical examination, and testing of such methods, and dissemination of results and lessons learned.

Authority for effective coordination and quality control. The capacity needs authority to provide effective coordination of scenarios for transparency, consistency (e.g., of units, formats, etc.), and quality control. A weak "clearinghouse" for scenarios that lacks authority to critically scrutinize scenarios, request changes, and grant or withhold some status or benefit (e.g., resources, publication, certification, or inclusion in some process) based on a judgment of acceptable standards being met is not an adequate model.

5.4 Characteristics of 'core' emissions and climate scenarios

Scenarios should be global in scope and century-scale in time horizon. Core emissions and climate scenarios should be global in scope; should specify all major climate-relevant emissions and other human perturbations, as well as their underlying socio-economic drivers; and should extend over time horizons of at least 100 years, including some with horizons of 200-300 years, to support assessments of long-term vulnerability to sea-level rise.

Several distinct logical types of emissions scenarios should be developed. Socio-economic and emissions scenarios should include some combination of alternative baselines, alternative levels of incremental stringency of mitigation effort, and specified future targets to support backcasting and feasibility analysis.

Emissions scenarios should be based on diverse socio-economic futures. Emissions and associated socio-economic scenarios should explore a wider range of potential socio-economic and policy futures than has been done, including explicit examination of the implications of varying patterns of mitigation effort. What would the world look like if emissions grow strongly for several decades with little control effort, then we shift to stringent mitigation efforts? What if part of the world makes a lot of effort and part makes very little? What if development stagnates in major world regions? Considering such varied future histories is crucial for considering long-term risks and opportunities from major mitigation choices.

Scenarios should reflect various explicit degrees of coordination. Scenarios provided should reflect explicit variation in the degree and type of coordination, including for example, a) provision of a few standard scenarios to meet the needs of downstream models and analyses for coordinated inputs in intercomparison exercises (i.e., standard emissions scenarios for climate-model comparison, standard climate scenarios for impact model comparison); b) scenarios generated using multiple models with common exogenous inputs, for exploration of uncertainties related to model structure, and; c) non-standardized scenarios produced at the initiative of researchers and modelers seeking to explore alternative assumptions or meet specific user needs – provided these meet basic standards of quality control, transparency, and documentation.

Global socio-economic and emissions scenarios should include and link qualitative and quantitative components. Global scenarios of emissions and the socio-economic variables underlying them should include qualitative and narrative scenario components, as well as quantitative projections of emissions and underlying socio-economic drivers, and should include a sustained analytic effort to integrate qualitative and quantitative components. The qualitative, narrative elements can provide a vehicle for exploration of major historical uncertainties with large implications for global emissions and climate change; provide a coherent logical structure that ties together quantitative assumptions on multiple variables; and provide guidance for extension of scenarios through elaboration of additional detail. Gaining these benefits will require much more sustained effort to integrate quantitative models of emissions and their socio-economic determinants with qualitative and narrative scenarios, to iterate between them, and to critically examine each in light of the other, than has been made in climate-change scenario exercises thus far.

Emission scenarios should connect narratives to model structures, not parameter values. These efforts should strive to connect alternative qualitative narratives to alternative logical structures of quantitative models, not just alternative parameter values. Alternative quantifications conditioned on the same narrative storyline and associated basic causal logic can provide insight into uncertainty in key parameters such as GDP and emissions, conditional on the broad historical conditions defined by the storyline, provided model quantifications are not harmonized on these outputs.

Centrally provided scenarios of global emissions and climate change cannot provide all information needed for either mitigation or adaptation decisions at national or smaller scale. Information needs for decision-making at national or smaller spatial scale, whether for adaptation or mitigation, may be finer-scale and more detailed than can be provided by the global-scale scenarios capacity, for both climate and socio-economic information. For emissions and socio-economic information, the global capacity can provide scenarios of world trends in emissions, socio-economic conditions, and the large-scale pattern of policy response elsewhere that can serve as background information to be elaborated or modified by national scenario processes. For climate information, the global capacity can provide access to climate-model output, plus access and support for statistical methods or finer-scale modeling tools for producing required finer-scale data for particular impact and adaptation applications.

5.5 Scenario Process: Developer-User Interactions

In general, there are benefits in collaboration between scenario developers and users, particularly at the beginning and ending stages of a scenario exercise. There is always value in close communication and collaboration between the developers and intended users of scenarios, although the most appropriate means of realizing this vary substantially among scenario exercises. User engagement is most important in the initial scoping and design of a scenario exercise, and in the evaluation and application of the scenarios generated. The value of user engagement in the detailed middle stages of scenario development, quantification, elaboration, and checking, depends on the precise conditions.

The value of such interactions, and the ease of achieving them, are likely to be greater when scenario users are few in number, clearly identified, and similar in their interests and perspectives. When the set of users for scenarios is clearly identified, relatively small, and homogenous, there is the strongest case for close and intensive collaboration between users and developers throughout the process. When potential users are numerous and diverse, such intensive engagement may be infeasible, and various structured processes for consultation, representation, and information exchange are needed. While progress has been made in new methods to increase the numbers participating in scenario exercises, further development of such methods is needed.

5.6 Communication of Scenarios

Effective communication of scenarios is essential, including the means to reach audiences of diverse interests and technical skills. Scenarios must be communicated effectively to their potential users, including both technical and non-technical audiences. In addition to the contents or outputs of scenarios, communication must include associated documentation, tools, and support for their use. Various methods should be used to promote broad dissemination of scenario information; for instance, presentations, reports, websites, and centralized data distribution centers. To facilitate user understanding of results, various methods should be used to communicate numerical and technical information, including multiple tabular, summary, and graphical formats, ideally with user-interactive capabilities.

Transparency of underlying reasoning and assumptions is crucial. Scenario communication must also include transparent disclosure of the underlying assumptions, models, and reasoning used to produce the scenarios, to support the credibility of scenarios, to alert potential users to conditions under which they might wish to use or modify them, and to promote dialogue that can support subsequent updating and improvement of scenarios. When scenarios combine scientific uncertainty and uncertainties that arise from alternative assumptions, this should be clearly conveyed. It is possible in virtually all cases to formulate simple, accessible, honest descriptions of why a scenario was undertaken, why it was necessary, what was done, how and why, and why it merits respect as a reasonable judgment.

5.7 Consistency and Integration in Scenarios

Each scenario needs internal consistency. Any scenario should be internally consistent in its assumptions, to the extent that this can be established given present knowledge. Carefully pursuing consistency within individual scenarios can be an intensive and time-consuming process, but is crucial to avoid problems that can discredit a scenario exercise.

In scenario exercises that use multiple models to explore potential future conditions, model inputs should be controlled for consistency, rather than model outputs. Use of multiple models in parallel to produce alternative descriptions of future conditions can improve understanding of uncertainties, if models are run under consistent assumptions about exogenous inputs. Forcing convergence of outputs among multiple models suppresses model variation, including variation from alternative causal structures, that could provide valuable information about uncertainties. Temptation to seek a spurious increase in credibility by forcing convergence of multiple model outputs should be resisted. The appropriate treatment of quantities that are exogenous in some participating models and endogenous in others can vary case by case. In general, however, forcing multiple models to convergent values of such variables is not desirable.

An important exception to the advice not to control for consistency in model outputs is that such control can be valuable in exercises that specify common output targets for policy evaluation. For example, consistent emissions constraints are needed in order to explore implications of alternative atmospheric concentration stabilization levels.

Transparency in reporting model differences, assumptions, and reasoning can help to overcome the presence of some inconsistencies in scenario generation. Ideally, multiple scenarios in an exercise should differ from each other only on those issues that are intentionally chosen to distinguish them, and be consistent on all other factors. This is not always possible, particularly when scenarios are generated using different models. In this case, it is particularly important to pursue maximal transparency about the models, assumptions, and reasoning underlying each scenario – perhaps by publishing diagnostic reports that include discussion of points of weakness, uncertainty, and disagreements and the means used to resolve them.

5.8 Treatment of Uncertainty in Scenarios

More explicit characterization of probability judgments should be included in some future scenario exercises than has been practiced so far. The advantages of assigning explicit characterization of probability to scenarios – or their consequences for a few key variables – are likely in our judgment to outweigh their disadvantages. Such specification should be pursued to a greater degree than has been done in major global-change scenario exercises to date.

Including explicit probability judgments is likely to be more useful when key variables are few, quantitative outcomes are needed, and potential users are numerous and diverse. The case for assigning explicit confidence or probability measures is strongest when scenarios' most salient components are quantitative projections of a few key variables, such as emissions or average temperature change over the globe or some region, because the technical barriers to assigning probabilities are least severe in this case. The case is strongest when a primary purpose of the scenario exercise is to provide inputs to other quantitative assessment activities, or to inform decisions that primarily depend on one or a few key quantitative variables, because these are situations in which at least some users are likely to require probability judgments. The case is strongest when the set of potential scenario users and uses is large and heterogeneous, because this situation provides the least opportunity for informal or implicit communication of judgments of importance or confidence based on intense, sustained collaboration between scenario developers and users.

Including explicit probability judgments is likely to be less useful when scenarios specify multiple characteristics, including prominent narrative or qualitative components; when the purpose of a scenario exercise is sensitivity analysis or heuristic exploration; and when potential users are few, similar, and known. When scenarios are primarily construed as rich, qualitative narratives that present major alternative historical and socio-economic trajectories, the technical obstacles to explicit probability assignment are greatest and the confidence in scenario developers' subjective probability assignments is likely to be lowest. When the primary purpose of a scenario exercise is stimulate critical or creative thought, or to conduct sensitivity analysis to probe the limits of a subsequent model or analysis or a proposed robust decision strategy, or to explore ways of meeting a specified output target, explicit probability assignment provides little or no benefit. When users are few, homogeneous, and specifically identified, they or their proxies can be intensively involved in the scenario generation exercise, allowing effective informal communication of developers' judgments of relevant probabilities without requiring explicit formal statements. Alternatively exercises with such intensive collaboration can support dialogs that engage scenario users in the potentially illuminating exercise of assigning and discussing their own probability judgments, rather than imposing that responsibility exclusively on the researchers or analysts developing scenarios.

The centralized capacity we propose should endeavor to provide probability estimates for global emissions and climate-change scenarios. The global emissions and climate-change scenarios produced by our proposed capacity should include explicit probability assignments to ranges of their few key quantitative outputs, including global emissions and global-average temperature change (conditional on specific underlying assumptions), because of the large and diverse set of users to whom these are targeted. Emissions and climate scenarios should typically present several paths that span a wide range of judged uncertainty, e.g., 95% to 99%. In making these judgments, the distribution of previously produced or published scenarios provides one source of guidance but is not authoritative, because these are not independent and may have been developed for different questions and purposes.

Providing explicit probability and likelihood statements allows users to choose whether to use them or not. Some users may choose to use these explicitly in their subsequent analysis or decision support, others may use them only to help decide which scenarios to use, while still others may appropriately choose to disregard them entirely. Users may choose to use a different group of scenarios or a different subset of the uncertainty range due to differences in risk aversion, differences in the scope of their decision authority, or differences in assumptions about decisions by other actors, present or future.

Scenario exercises should give more attention to extreme cases. Some uses of scenarios require consideration of low-probability, high-consequence extreme cases, such as loss of a major continental ice sheet or collapse of meridional ocean circulation. Consequently, such scenarios should be included in large, general-purpose scenario exercises producing emissions or climate-change scenarios, together with more likely middle-case scenarios. Including extreme scenarios in a set makes it especially critical to be explicit and transparent about the reasoning and assumptions underlying each scenario, and scenario developers' judgments of relative likelihoods.