38. I2S: Prescriptive, descriptive or both?

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The primary rationale Bammer presents for envisioning I2S as a discipline is that it needs a storehouse of ideas, a network of specialists and its own organs for evaluating and disseminating new developments. Even if we accept this rationale, the notion of I2S-as-discipline still has some problems. I will attempt to address some of them by taking up Bammer's fruitful analogy between statistics and I2S. I will argue that statistics is not a sufficient template, at least not for I2S at this stage in its development. Alternative templates can be found, and investigations of these lead to the notion that I2S needs both a descriptive and a prescriptive branch.

Templates for I2S as a Discipline

I2S as a discipline is the key metaphor in the framework Gabriele Bammer develops in this book. More specifically, Bammer envisions I2S as a discipline akin to statistics. As statistics supports quantitative data analysis, so I2S would support 'integrative applied research'. Like statisticians, I2S experts would work on a wide variety of social and environmental problems. I2S methods would be applied by specialists in other disciplines much as statistical methods are. Nevertheless, like statistics, I2S would have its own professional journals and conferences, and new developments in it would be evaluated by I2S specialists and published in I2S outlets.

Why base the template for I2S on statistics? Why wouldn't disciplines like chemistry, architecture or history do instead? What about professions such as medicine, engineering or law? These all fail primarily on two criteria. First, other disciplines do not often engage with the *subject matter* of these disciplines or professions. Second, they do not often apply *methods* from these disciplines or professions.

Are there other disciplines, professions or even cross-disciplinary areas that satisfy these two criteria? Two disciplines come readily to mind—namely philosophy and mathematics, both with much longer pedigrees than statistics.

1 Michael Smithson was invited as a senior researcher 'who has outstanding expertise in unknowns, and who also has broad knowledge about research'.

Let us consider philosophy first. As with statistics, many disciplines and professions claim to possess or use a philosophy. Even those that don't make such claims depend on an implicit philosophical foundation of some kind; however, they seldom make explicit use of philosophical methods or perspectives, nor do their specialists consult philosophers as they do statisticians. There are few 'philosopher' experts in these disciplines who play the same kind of role as statistical experts. Why not? Is it because the philosophical issues facing most disciplines don't require specialists to deal with? Or have philosophers been unable to 'sell' their expertise on practical grounds?

I suspect it is both. Most disciplines proceed on a philosophical consensus about their ontology and epistemology unless they are mired in a crisis that threatens their foundations. There is little practical philosophical work to be done in the course of normal science or arts practice. Much the same holds true for professions. In cases where members of a profession perceive a need for such work, as in the recent surge of interest in ethics by professional business managers, they bring in philosophical expertise with the aim of integrating the resultant knowledge into normal professional practice.

Turning to mathematics, we find a closer analogy with statistics. Many disciplines and professions use mathematical methods, they consult with mathematicians, and there are numerous examples of 'pure' mathematics finding applications in practical problems (number theory applied to cryptography, to name just one). And of course, new developments in mathematics are assessed by mathematicians and not specialists from other disciplines. Unlike philosophy, mathematics has been successfully sold to other disciplines.

What distinguishes mathematics and statistics from philosophy that could account for the greater and wider practical impacts of the former two disciplines? Could I2S learn anything from the answer to this question? Unfortunately, the answer appears to boil down to a phenomenon that is not well understood: the widespread 'mathematisation' of a variety of disciplines during the 19th and 20th centuries. I say that this is not understood because we have no entirely sufficient account for why mathematics works so well in so many areas. Even the success of statistics can be accounted for by mathematisation. The earliest statistical associations (circa 1830–60) were devoted to the collection of neutral, routine and quantifiable knowledge about society, and one of their avowed aims was to exclude opinions. Probability, meanwhile, remained a branch of mathematics. Probabilistic inference from samples to populations did not enter into this area until the late 19th and early 20th centuries. The spread of statistics gained momentum when probability theory was imported into it, enabling both the founding of inferential statistics and the randomised, controlled experimental designs. Statistics was transformed from merely rearranging information already in hand to making inferences about and estimates of unknown quantities.

Alas, none of the foregoing yields clues about a 'magic selling point' for I2S. Mathematisation is unlikely to play the same role there, although some mathematics (for example, complexity theory) may well prove useful in I2S. There might be other transdisciplinary conceptual or methodological developments that would provide this kind of selling point for I2S, but they have yet to emerge.

Comparisons with other disciplines yield a potentially more productive question: what distinguishes philosophy, mathematics and statistics from disciplines like chemistry, architecture, history and music that makes the former more attractive templates for I2S than the latter? To begin with, a discipline is partly defined by its subject and partly by its methods. Some are defined more by one than the other. Disciplines such as chemistry, architecture and history are defined chiefly by their subject matter. Indeed, these three have their origins partly in specific crafts. The subject matter of philosophy, mathematics or statistics is more universal than the subjects of craft-based disciplines, and these three disciplines also are chiefly defined by their methods. Their subjects differ from those of chemistry, architecture and history in another crucial respect: they are primarily prescriptive, and their methods embody those prescriptions. These are 'how-to-think' disciplines. Thus, in Bammer's vision, I2S is cast as a prescriptive 'how-to' discipline to be defined mainly by its methods.

There are considerable obstacles to be overcome before this vision can be realised. I will briefly discuss two of these. First, I2S is a long way from having a basis for 'gold standard' methods or even a methodological consensus. Statistics and mathematics can support claims of well-founded methods, which enable them to be strongly prescriptive and consensual as well. This is not to say that there are no foundational problems or disputes in these disciplines; of course there are; however, their foundations are not nearly as contestable or undecided as those in most of the concerns to be addressed by I2S. Therefore, I2S as a discipline will need to orient itself towards enabling extensive and productive discourses regarding its foundations.

Second, statistics and mathematics have well-established training and educational programs and a host of specialists who have graduated from those programs. It will be some time before I2S will possess such programs or experts. Meanwhile, I2S will need to orient itself to draw on relevant sources of expertise, insights or learning. Both of these obstacles suggest that 'how-to' disciplines such as statistics and mathematics may not provide an adequate template for I2S in its nascent stages (although they might eventually suffice for a mature I2S discipline).

There is a third possible template for I2S, but it is not a discipline. Instead it is an area I shall call 'decision science': the bastard offspring of psychology, probability theory and behavioural economics. Its subject matter, decision making, is a ubiquitous human activity and so, like statistics, it has very wide applicability in other disciplines and areas. It is also a 'how-to' subject. Like I2S, decision science is young. Its foundations are contestable, and there are deep disagreements among decision scientists about fundamentals. Decision scientists are in the process of building storehouses of knowledge, ideas, educational programs and resources with prescriptive goals in mind.

I shall offer decision science as an alternative template for I2S because it has a feature not found in statistics, mathematics or even philosophy: a descriptive branch that actively debates with its prescriptive branch. Statisticians and mathematicians are not seriously interested in how non-specialists do statistics or mathematics. Decision scientists, however, are interested in studying how novices and area experts alike make decisions. They evaluate and compare these practices with the prescriptions of formal decisional frameworks. Decision science journals and conferences typically include a mix of prescriptive and descriptive material, and each kind is expected to connect with the other. Contemporary debates about rationality (the 'how-to' of decision making under uncertainty) are being shaped by these exchanges between proponents of formal frameworks and students of decisional 'heuristics' used by human decision makers.

It is noteworthy that the earliest versions of decision science (in the 1950s and 1960s) were strongly prescriptive. Formal decision methods were grounded in subjective expected utility theory, whose foundations included Bayesian probability theory. Perspectives such as neo-classical economics were built on an assumption that humans acted as subjective expected utility decision makers in economic activities; however, the 1970s and 1980s saw an accumulation of evidence that human decision makers do not adhere to the prescriptions of subjective expected utility. Researchers raised the possibility that some aspects of non-adherence were not 'irrational', and the ensuing debates led to reconsiderations of subjective expected utility and eventually the foundations of rationality itself. In retrospect, the early prescriptive stance of decision scientists was premature.

At this stage in its development, then, it seems ill advised for I2S to aspire to be solely prescriptive. It needs an active *descriptive* branch that can exchange findings and ideas with its prescriptive branch. What might this descriptive branch look like, what would it need to undertake and what methods would it require?

Descriptive I2S

A descriptive branch of I2S would produce or accumulate careful accounts of integrative applied research and its near kin. It would develop frameworks and theories for understanding how and why this kind of research gets done. Descriptive I2S also would have an evaluative component, generating and guiding debates about the strengths, weaknesses, successes and failures of relevant research practices. This evaluative component would provide a conduit of exchange between descriptive I2S and prescriptive I2S. Indeed, all of these points are raised in the first two chapters of this book, indicating compatibility between this notion of descriptive I2S and Bammer's vision of I2S as a discipline.

Descriptive I2S would need to encompass more than the study of specific attempts at integrative applied research. Its purview would include histories of relations among disciplines and subject areas. These histories influence the current relations among the disciplines concerned, and thereby affect the potential for integrative applied research that involves those disciplines. Here are some examples of such relations.

- Division of subject area: Organic and inorganic chemistry form a paradigmatic example. The division between sociology and anthropology ('society' versus 'culture') is a messier and more contested example.
- Division of labour: Analytical philosophy (how should we think?) and cognitive psychology (how do we think?) form an example. The professional and scientific wings of some disciplines (for example, medicine and psychology) display another kind of division of labour.
- Level of analysis: Examples are molecular biology → chemistry → physics, and sociology → psychology (again, a messier and more contested instance).
- Borrowing and lending: Engineering borrows from physics; medicine from biology; and geography from several disciplines. Mathematics lends to numerous other disciplines; however, there are also plenty of cases of duplication or reinvention, sometimes within the same discipline.
- Competition: Psychology competes directly with psychiatry as a profession, and with most of the other social sciences as a discipline.
- Cooperation and constructive disputation: Psychology, neuroscience and economics have recently collaborated to generate neuroeconomics.

How would studying relationships among disciplines help I2S? On the one hand, it requires no special effort to know whether to turn to an organic or an inorganic chemist; however, many relationships between disciplines are messy, contested and poorly understood. In the case of newly emerging areas and disciplines, those relations also are fluid. Little is known about how effective or ineffective relationships among disciplines emerge. Knowledge about those relationships will be of practical value to I2S specialists because the potential for interdisciplinary collaboration and integration will hinge on matters such as whether the disciplines concerned are in a turf war with one another.

Descriptive I2S also would have to include two additional sub-areas: accounts of stakeholder perspectives and responses to research processes and outputs, and how researchers and stakeholders understand and manage unknowns. Both of these sub-areas could be built up initially by borrowing heavily from relevant disciplines and research areas (for example, political and social sciences re stakeholders and decision sciences re management of unknowns), but there would still be considerable work to be done by descriptive I2S scholars and researchers.

I will limit discussion of this last point to the issue of unknowns. There is a wealth of research on how people judge and deal with unknowns, most of which has occurred in psychology and behavioural economics. This literature could be mined for insights relevant to I2S. Consider judgments regarding the likelihood of novel (heretofore unobserved) events, or even just events that are contrary to predictions. An empirical literature on the psychology of probability judgments has unearthed a tendency for people to underestimate the likelihood of such events and to be overconfident of their predictions.

Another example with a theory-constructing component is the link between problem framing and attitudes towards unknowns. Orientations towards risks associated with unknowns can be influenced by framing. A large literature on Prospect Theory[2] tells us that framing a problem in terms of prospective gains will make people risk averse whereas framing it in terms of losses will make them more risk tolerant. Another psychological perspective, regulatory focus,[3] claims that framing goals in terms of preventing outcomes will tend to induce risk aversion, whereas framing them in terms of achieving outcomes will tend to induce risk tolerance.

These are examples of ready-made productive research and theory that descriptive I2S can use, but there are important limitations in the research literature on unknowns. Chief among these is a general restriction of unknowns to 'uncertainty'—usually probabilistic uncertainty. Research on other kinds of unknowns such as vagueness or bias is scarce. A second major limitation is that most research on judgment and decision making under uncertainty is framed by an implicit assumption that unknowns always are unwanted and deleterious. This is far from universally true. People have motivations for not knowing some things, and uses for unknowns. Unknowns also underpin specific forms of

2 Kahneman and Tversky (1979).

3 Higgins (1998).

social capital such as privacy and trust.[4] Almost no research has been done on these issues, and references to 'positive' functions of unknowns are scattered throughout several unconnected literatures.

An example of the kind of work that could complement the largely psychological research and theorising in the decision sciences is Gross's monograph on surprise.[5] Gross begins his book by declaring: 'Ignorance and surprise belong together.'[6] Events are surprising to us only if we are ignorant of them in some respect prior to their occurrence. Surprise therefore signifies ignorance. Like various kinds of unknowns, surprise often is framed negatively. The major exceptions are the concepts of 'serendipity' and learning from mistakes.[7] That the generation of new knowledge brings with it new unknowns and surprises is not a new insight.[8] Nevertheless, the notion that accelerating the rate of new knowledge production also might increase the frequency and even profundity of ensuing surprises has not been fully appreciated until relatively recently. A 'knowledge society' is also a 'surprise society'. Gross develops a framework integrating concepts of surprise, knowledge and unknowns and applies it to complex environmental issues.

Let us turn now to the scope outlined by Bammer in Section 3 for the consideration of unknowns by I2S. Two purposes for the inclusion of understanding and managing diverse unknowns are raising awareness of the inability to eliminate unknowns and awareness of the limitations of discipline-based approaches to unknowns. These are unobjectionable, but we should add 'consideration of which unknowns should or should not be eliminated'. This makes another a subject for descriptive I2S—namely the possibility of disagreements among researchers and/or stakeholders about how unknowns should be dealt with.

Bammer also lists four reasons unknowns are unlimited: 1) change is constant, so new unknowns will continue to arise; 2) research always uncovers new unknowns; 3) some things are unknowable; and 4) techniques to research some unknowns have not yet been developed. I would recommend adding a fifth reason unknowns are unlimited: 5) people have motivations for creating and maintaining some unknowns. In connection with reason two, for instance, *researchers* are the ones who uncover unknowns, not '*research*', and researchers are motivated to do so. Likewise, an example of intentional maintenance of unknowns in recent times is the suppression or prevention of certain kinds of biotechnological research.

4 Smithson (2008).
5 Gross (2010).
6 Gross (2010, p. 1).
7 For example, Wildavsky (1995).
8 See, for instance, Fleck (1935).

Finally, let us briefly consider the question of methods for descriptive I2S. Obvious candidates for the core methods include historiography, ethnography and survey methods. This list raises at least one concern. These are labour and time-intensive methods, unlikely to yield the rapid returns called for in Chapters 1 and 2 even with a massive injection of funds for descriptive I2S research. A large volume of such research also will require considerable time for scholars to derive theories and frameworks from it. Decision science has been able to make rapid progress partly because it is able to employ experimentation, simulation and mathematical methods, all of which tend to take less time and labour than methods such as historiography and ethnography. This issue is not fatal to the development of descriptive I2S, but should serve as a warning against optimistic estimates of how long it will take for the discipline to mature.

Summing Up

Because I2S has neither the kind of well-founded agreed-upon base that is enjoyed by mature disciplines such as statistics nor a readily identifiable network of experts, I have argued that statistics is not an adequate model for the discipline of I2S. Instead, I have presented decision science as an alternative template, chiefly because it is a young area that deals with similar problems by growing a descriptive branch that exchanges findings and ideas with its prescriptive branch. The resulting recommendation is that I2S develop its own descriptive branch, and the second half of this commentary is an attempt to adumbrate the shape and scope of descriptive I2S. Descriptive I2S, in turn, emerges as an area that will take some time and considerable effort to develop, both because of the complexity of its subject matter and because of its methodological requirements.

In closing, it is noteworthy that descriptive I2S might provide the same kind of 'insurance' that descriptive work in decision science has yielded for that area—namely insurance against wholesale failures in the prescriptive branch. The early developments in expected utility theory were followed by a growing realisation that humans not are subjective expected utility agents most of the time, and subjective expected utility theory is applicable only to well-structured decisional contexts where there is ample time for computations. These revelations posed a great threat to the field. Had decision scientists continued relying solely on subjective expected utility, they would have found their field relegated to a very small corner in the realm of decision making. Instead, they derived new concepts such as bounded rationality and adaptive heuristics from their descriptive research storehouse, and have since set about refashioning their prescriptive frameworks to encompass contexts where subjective expected utility cannot apply. I2S could find itself in a similar quandary, because it is possible that no overarching prescriptive framework for I2S can be found.

Descriptive I2S will render this new discipline robust enough to survive such an eventuality, and it will also provide the raw materials for constructing such a framework if it can be found.

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Brief Biography

Michael Smithson is Professor in the Department of Psychology at The Australian National University and received his PhD from the University of Oregon. He is the author of *Confidence Intervals* (2003), *Statistics with Confidence* (2000), *Ignorance and Uncertainty* (1989) and *Fuzzy Set Analysis for the Behavioral and Social Sciences* (1987), co-author of *Fuzzy Set Theory: Applications in the social sciences* (2006), and co-editor of *Uncertainty and Risk: Multidisciplinary p*erspectives (2008) and *Resolving Social Dilemmas: Dynamic, structural, and intergroup aspects* (1999). His other publications include more than 120 refereed journal articles and book chapters. His primary research interests are in judgment and decision making under uncertainty, social dilemmas, statistical methods for the social sciences, and applications of fuzzy set theory to the social sciences.

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