Thomas C. Schelling's psychological decision theory: Introduction to a special issue

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Abstract

Thomas C. Schelling's most influential contributions include focal points in coordination games, commitment and credible threats in bargaining, the theory of social dilemmas, and anticipatory self-command in intertemporal choice. His spatial proximity models are early prototypes of cellular automata. Contributions to this special issue were inspired by a few of these theoretical ideas.
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1. Introduction

Many of Thomas C. Schelling's articles, books, and book chapters have had a profound impact on the development of the social sciences in general and on game theory in particular. One admittedly crude and fallible but nonetheless revealing index of impact is the number of citations in academic journals. The ten most frequently cited of Schelling's publications in journals covered by the Institute of Scientific Information's *Social Sciences*

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Citation Index up to the end of 2005, when he became a Nobel laureate, are the following, in descending order:

1. *The Strategy of Conflict* (Schelling, 1960).
2. *Micromotives and Macrobehavior* (Schelling, 1978).
3. *Arms and Influence* (Schelling, 1966).
4. "Dynamic Models of Segregation" (Schelling, 1971a).
5. "The Life You Save May Be Your Own" (Schelling, 1968, reprinted in *Choice and Consequence*).
6. *Choice and Consequence* (Schelling, 1984a), subtitled on its cover but not on its title page *Perspectives of an Errant Economist*.
7. "Self-command in Practice, in Policy, and in a Theory of Rational Choice" (Schelling, 1984b).
8. "Some Economics of Global Warming" (Schelling, 1992).
9. "Hockey Helmets, Concealed Weapons, and Daylight Saving: A Study of Binary Choices with Externalities" (Schelling, 1973, reprinted in *Micromotives and Macrobehavior*).
10. "An Essay on Bargaining" (Schelling, 1956, reprinted in *The Strategy of Conflict*).

The comments that follow are intended to place these publications in perspective and to show how they relate to the articles in this special issue, all of which were directly or indirectly inspired by aspects of Schelling's work.

2. Focal points in coordination games

The Strategy of Conflict, a book cited almost three times as frequently as any of Schelling's other publications, has had a profound and lasting influence on the development of game theory and is one of the great classics of the theoretical social sciences. It includes 10 chapters and three appendices ranging over various aspects of game theory, bargaining, and nuclear war. Sugden and Zamarrón, in their contribution to this special issue, argue persuasively that one of its most significant contributions is the concept of *focal points* in coordination games. A coordination game is an interactive decision in which two or more players have a common interest in coordinating their actions and their expectations of one another's actions. A focal point is any feature of such a game that provides a focus of convergence. A combination of actions may function as a focal point if it stands out from others because of some property of prominence or salience that it possesses, even if its distinguishing feature is a psychological or cultural attribute that is filtered out of its abstract representation in orthodox game theory.

This focal point concept is almost universally acknowledged by game theorists as an important device for equilibrium selection, but it has not been assimilated into formal game theory, although Binmore and Samuelson (2006) and Janssen (this issue) have recently taken tentative steps in that direction. The continuing influence of this concept in contemporary research is reflected in its strong representation in this special issue, in which three of the seven research articles are devoted to aspects of focal points. Sugden and Zamarrón probe its theoretical foundations; Janssen formalizes it and discusses its importance in bargaining; and Heath, Ho, and Berger report new experimental evidence on the use of focal points by players whose objective is to distinguish themselves from others.

3. Social dilemmas

Second in terms of citation impact is *Micromotives and Macrobehavior*. This book brings together discussions of diverse social aggregation phenomena sharing the property that individual actions combine to produce unexpected – and sometimes undesired – social consequences. Such phenomena exemplify perfectly what Popper (1969) described as the "*main task of the theoretical social sciences. It is to trace the unintended social repercussions of intentional human actions*" (p. 342, italics in original). The final chapter of *Micromotives and Macrobehavior*, "Hockey Helmets, Concealed Weapons, and Daylight Saving: A Study of Binary Choices with Externalities", is a reprint of an article, among Schelling's most frequently cited publications in its own right, that laid the theoretical foundations of research into multi-player social dilemmas. In fact, as so often happens when the time is right, multi-player social dilemmas were discovered simultaneously and independently by more than one person – by Dawes (1973), Hamburger (1973), and Schelling (1973). The underlying idea arises naturally from the Prisoner's Dilemma game, the well-known two-player game in which each player chooses between a cooperating and a defecting strategy, and each player receives a higher payoff by defecting than by cooperating, irrespective of what the other player chooses but, paradoxically, each receives a higher payoff if both cooperate than if both defect. The *N*-player Prisoner's Dilemma – the archetypal multi-player social dilemma – is a generalization of this to arbitrary numbers of players, its key strategic property being that each player receives a higher payoff by defecting than by cooperating, irrespective of how many other players cooperate or defect, but each receives a higher payoff if all cooperate than if all defect. The original two-player Prisoner's Dilemma game turns out to be a special case of this more general game.

Social dilemmas crop up in many important areas of social, political, and economic life. For example, over-fishing destroyed British herring fisheries by the middle of the twentieth century and is now causing terminal decline in other fish stocks in the English Channel, the North Sea, the Baltic, and other fishing areas. Anyone who makes a living by fishing is motivated to catch as many fish as possible (to defect), because restraint is unnecessary if enough others exercise restraint, and is futile if they do not, but if everyone follows this individualistic line of reasoning, then fish are driven to extinction and everyone is worse off than if they had all cooperated by limiting their catches. Numerous everyday problems involving conservation of scarce resources, contributions to joint enterprises, and other activities involving possible cooperation turn out, on analysis, to be social dilemmas. Global warming is another obvious example, which Schelling discussed in depth in his frequently cited article on "Some Economics of Global Warming", though he did not bring the conceptual apparatus of social dilemmas to bear on it there.

The formalization of multi-player social dilemmas by Schelling and others led to a resurgence of research using experimental games. This was given added impetus when an article by Thaler (1980) signalled the emergence of a new domain of economic research, at the interface with psychology, that came to be called *behavioural economics*. The literature on social dilemmas grew rapidly, and various new avenues of theoretical and empirical investigation emerged. In this issue, Rapoport, Mak, and Zwick investigate the *Braess paradox* (Braess, 1968), a counterintuitive phenomenon closely related to social dilemmas. It can arise in a network, such as a road network, when the addition of a new link adds to the overall network capacity but has the effect of increasing rather than reducing congestion if network users pursue their individual interests rationally. Rapoport and his

co-authors provide strong experimental evidence that a new link can be beneficial to all network users when network congestion is relatively low, harmful when congestion is moderate, and neutral when congestion is high.

4. Spatial proximity models

In *Arms and Influence*, Schelling developed some of the ideas that he had presented in *The Strategy of Conflict*, especially his concept of credible threat in bargaining and other ideas relevant to the limitation and prevention of nuclear war. Next in the list of his most frequently cited publications is ''Dynamic Models of Segregation'', an article describing *spatial proximity* models, as he called them. His simple linear model is represented by a line segment with elements of two types (X and 0, say) arranged along it in an arbitrary sequence, and his hardly more complicated two-dimensional model is a ''checkerboard'' with pennies and dimes arbitrarily placed on some of its squares. He used these models to show how extreme segregation might arise without anyone willing it. The elements can be interpreted as black and white people in a city, Protestants and Catholics in Northern Ireland, boys and girls in a school playground, or any other binary classification of individuals with potential for spatial segregation. If we specify the apparently mild condition that individual elements are contented if at least 50% (say) of their immediate neighbours are of their own type, and if those who are discontented according to this criterion move to the nearest spaces where they are contented, and this process is repeated until every element is contented, then Schelling showed that the result is extreme segregation, although none of the individuals required it for their contentment and their human counterparts may even have preferred less segregation. This is another striking example of a social aggregation effect that can arise as an unintended consequence of intentional human actions.

Many writers have described and discussed Schelling's spatial proximity models, which are now generally viewed as early prototypes of cellular automata (e.g., Hegselmann & Flache, 1998). An outline of the ''checkerboard'' model in *Micromotives and Macrobehavior* is indubitably a contributory factor to the book's popularity. But relatively few researchers have developed Schelling's approach to the study of segregation, and this special issue contains no contributions on spatial proximity models. Readers who wish to study the research in this area might begin by reading Schelling's other major contributions on the topic (Schelling, 1969, 1971b, 1972) and the closely related but independent and far less frequently cited work of Sakoda (1971) before examining the more recent research (e.g., Clark, 1991, 1992; Goldstone & Janssen, 2005; Pancs & Vriend, 2003; Ruoff & Schneider, 2006; Sander, Schreiber, & Doherty, 2000; Torrens & Benenson, 2005; Zhang, 2004). See also Aydinonat (2005) for candid revelations about how Schelling came to develop his spatial proximity models.

5. Life-saving and intertemporal choice

Choice and Consequence contains a reprint of an article that is among Schelling's most frequently cited publications in its own right, ''The Life You Save May Be Your Own'', in which he examines the problem of evaluating the worth of reducing the probability of death. We respond quite differently to the possibility of saving the lives of identifiable individuals and of people in general, and this article includes a famous passage that vividly

encapsulates this point: "Let a six-year old girl with brown hair need thousands of dollars for an operation that will prolong her life until Christmas, and the post office will be swamped with nickels and dimes to save her. But let it be reported that without sales tax the hospital facilities of Massachusetts will deteriorate and cause a barely perceptible increase in preventable deaths – not many will drop a tear or reach for their checkbooks" (Schelling, 1968, p. 129; Schelling, 1984a, p. 115). This article stands out from Schelling's other most frequently cited publications inasmuch as it is not concerned with game theory or decision making, and none of the contributions to this special issue is closely related to it.

Another major theme of *Choice and Consequence* is anticipatory self-command in intertemporal choice, and this is also the focus of "Self-command in Practice, in Policy, and in a Theory of Rational Choice". The key insight here is that when people have difficulty governing their own behavior, they sometimes resort to special strategies to constrain their future choices, especially when they expect to be exposed to temptations – food that will make them fat or damage their health, cigarettes that may kill them, sex that involves certain dangers, and so on. A dramatic example occurs in Greek mythology, when Ulysses has himself bound to the mast of his ship to prevent him from yielding to the temptations of the Sirens as he sails past their island. Schelling interpreted strategies such as this as rational attempts to cope with foreseeable lapses from rationality, but others have interpreted it differently.

Intertemporal choice has generated a great deal of research, and three articles in this special issue are devoted to it. Frederick provides a general theoretical framework for understanding aspects of intertemporal choice, specifically the phenomenon of discounting future utilities. Read argues that people who use self-command to prevent their future selves from acting in certain ways divide themselves, in effect, into two decision makers with conflicting desires, and he analyses various possible solutions to the problem of deciding which of these conflicting selves represents the individual's true or rational interests. Finally, Shafir and Thaler present empirical evidence on intertemporal aspects of *mental accounting* – the set of cognitive operations, first described and named by Thaler (1980), whereby people organize and keep track of economic activities by, for example, keeping separate mental accounts for current income, future income, and savings, so that these classes of wealth can be valued and handled differently. Shafir and Thaler show how advance purchases may be treated as investments rather than spending, that consumption of something purchased earlier may be treated as though it were costless, and so on.

6. Concluding comment

When Schelling was awarded a Nobel Prize in Economics jointly with the Israeli game theorist Robert J. Aumann, the Royal Swedish Academy of Sciences (2005) described him as a "pre-eminent pathfinder" (p. 12). His formidable theoretical powers are plainly evident in his own publications, and the contributions to this special issue testify to the continuing influence of his ideas in many areas of game theory and decision making.

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