ECONOMICS AND POLITICS 0954-1985
Volume 12 November 2000 No. 3

INFORMATION AND COMMON KNOWLEDGE IN COLLECTIVE ACTION

ARIEH GAVIOUS AND SHLOMO MIZRAHI*

The paper suggests a theoretical game framework to explain collective action dynamics by learning processes. When a certain fact becomes common knowledge due to a certain event, people accumulate knowledge about the state of the world and act accordingly. We concentrate on a conceptual example of the bandwagon dynamic showing the insights which this approach adds to existing studies. We analyze two other conceptual examples showing that the accumulation of information does not always bring people to know the truth about the state of the world. On the other hand, it may make them aware of their ignorance. Several practical implications follow.

1. INTRODUCTION

PROBLEMS ASSOCIATED with collective action are usually explained by the motivation of participants to obtain a ''free ride'' or by information problems in the sense that an individual does not necessarily know everything about others and especially whether or not he/she is a decisive player (Downs, 1957; Olson, 1965; Hardin, 1982; Taylor, 1987; Gavious and Mizrahi, 1999). The information parameter and learning processes are therefore central in analyzing solutions for such problems – particularly, the problem of mobilizing mass collective action.

Analyses of learning or Bayesian updating processes explain how a player acquires new information about other players by means of observing their actions (Granovetter, 1978; Taylor, 1987; Chong, 1991; Lohmann, 1993, 1994; Kuran, 1995). Traditional threshold models suggest that by observing the number of participants in events of collective action, players update their beliefs concerning the chances of success as well as the costs of action. As the number of participants increases, players infer that the costs of action are expected to be low and the chances of success to be high, a situation which should finally lead to mass participation through a more or less complex bandwagon dynamic (Schelling, 1978; Granovetter, 1978; Oliver et al., 1985; DeNardo, 1985; Taylor, 1987; Chong, 1991; Karklins and Patersen, 1993; Kuran, 1995).

An alternative explanation of the role of information in mass mobilization is provided by the informational cascade model (Lohmann, 1993, 1994). Applying

* Corresponding author: Shlomo Mizrahi, School of Management, Ben-Gurion University, P.O. Box 653, Beer-Sheva 84105, Israel. Tel: +972-7-6472218; fax: +972-7-6472896. E-mail: shlomom@bgumail.bgu.ac.il

signalling games to the interaction between various groups in society, this model suggests that people decide whether or not to join collective action based on the identity of those who already participate rather than solely relying on the number of participants. For example, if only people who are known for their revolutionary ideas take to the streets, people will consider that action as an indication that most of the society is not in favor of change. On the other hand, if the same number of people but now moderate or pro-status quo activists take to the streets, it will serve as an indication that many people in society are willing to support a change. Yet, people often lack information about each other's identity, so they use the observed number of protesters as compared to their expectations as a signal about the protesters' type. In this process the number of those who already participate is indirectly used for revealing the protesters' identity.

In this paper, we follow the idea that, in dynamics of collective action, people learn from the actions of others. But, we suggest a different approach to analyze the learning mechanism in such dynamics, i.e., a theoretical game approach that is well rooted in the framework of "common knowledge" literature (for example: Aumann, 1976; Geanakoplos, 1992). According to this approach, when people watch other people participating they do not necessarily update their cost–benefit calculations or learn about others' identity. Rather, given that they know other people's beliefs they use the actions of these people to learn about the state of the world, i.e., a whole set of parameters external to the players themselves. Although the focus in this paper is on three examples, we suggest this approach as a general conceptual framework to analyze information processing in any dynamic of collective action, rather than developing different models for different processes.

The theoretical approach developed here does not refute existing explanations, nor do we claim to prove that it solely explains all dynamics of collective action. Rather, we argue that this conceptual approach can both accurately, yet simply, describe complex mechanisms of information processing and, at the same time, it is general enough to rationalize individual behavior in a wide variety of collective action dynamics.

This theoretical approach is applied to the analysis of three conceptual examples of collective action dynamics. The first analyzes a learning process that may explain the bandwagon effect. The second example concerns a learning process that may lead to a sudden eruption of mass collective action. The third example explains the decline of mass collective action after it had been successfully mobilized. The analysis shows that in such learning processes an error may occur and that people often learn about their ignorance.

The analysis reaches two counter-intuitive conclusions. First, in analyzing a possible learning process that leads to a sudden eruption of collective action, we show that players may conclude that the chances of successful collective action are high, although no player had taken to the streets in previous stages of the game. In comparison, the rationale adopted by current studies implies that if no

one takes to the streets, people will infer that there are low chances of success combined with high costs and will not take to the streets. Second, in analyzing a possible learning process that leads to the decline of mass collective action, we show that players may conclude that there are low chances of success, even though all players had taken to the streets in previous stages of the game. Again, this is not expected according to the rationale adopted by current explanations.

The paper is organized as follows. In section 2, we discuss the literature related to the role of information in collective action dynamics thus explaining the contribution of our approach to existing studies. In section 3, we outline the theoretical approach through reviewing the common-knowledge literature. Section 4 analyzes the three conceptual examples mentioned above. Section 5 concludes the analysis.

2. INFORMATION IN COLLECTIVE ACTION

The impact of the information parameter on collective action dynamics has been studied from various points of view. In this section, we first introduce threshold models of collective action arguing that they can explain changes in the state of the world and therefore can explain changes in individuals' beliefs about that state, but they do not explain learning processes when the state of the world is fixed. Then we present the informational cascade model that explains the bandwagon effect by a learning mechanism of a signalling game between different groups in society.

2.1 Threshold Models of Mass Collective Action

Threshold models of collective action basically concentrate on the information that people adduce from observing the number of those who already participate. In this respect, the ''snowball'' or bandwagon dynamic where individuals gradually join collective action, after observing that others are participating, has been a focus of threshold models of mass collective action (Schelling, 1978; Granovetter, 1978; Oliver et al., 1985; DeNardo, 1985; Taylor, 1987; Chong, 1991; Karklins and Patersen, 1993). Assuming that individuals recognize the need to protest in order to achieve a collective goal, it follows that larger numbers of participants reduce the costs of action and increase the chances of success. Players join protest efforts when the number of participants reaches a certain subjective threshold. Since individuals have different subjective thresholds for participation depending on their beliefs and the initial structural conditions, they will join collective action at different points in time, thus creating an accumulation effect that may lead to mass mobilization.

However, Granovetter (1978) and Kuran (1995) argue that since minor changes in individual thresholds may significantly affect the behavior of an entire society, models based solely on a simple aggregation of ''beliefs'' or ''thresholds'' have limited explanatory or predictive power. Moreover, when the

cost of publicly expressing preferences is high (for example, in non-democratic systems) individuals may prefer to hide their true preferences thus creating a wrong impression about these preferences (Kuran, 1995; Gartner and Segura, 1997). Kuran (1995) suggests that this is a main source of information problems for the regime, as well as for researchers, about the preferences in society.

Indeed, threshold models of the bandwagon effect focus on explaining its basic rationale (Schelling, 1978; Karklins and Patersen, 1993; Colomer, 1995) or its disadvantages and limitations (Granovetter, 1978; Kuran, 1995). Implicit in these models is the strong impact of mass participation on the regime's cost–benefit calculations, meaning that those who participate actually transform the state of the world by creating new conditions and then provide information about these conditions through their actions. DeNardo (1985) and Chong (1991) explicitly model the strategic interaction between a regime and its opponents. In both models the regime can control the level of protest by supplying demands, but there is a critical level of mass turnout beyond which the regime collapses. Yet, in these models people also use the number of protesters as the main source for information updating.

In other words, threshold models are more an explanation of the ways in which cost–benefit calculations are manipulated and changed than an explanation of a learning mechanism given fixed conditions. For example, the regime or certain factions within it may change their attitudes through a long learning process and favor reforms prior to collective action. This was the situation in several communist countries in Eastern Europe during the 1980s (Schopflin, 1993). When society becomes aware of these conditions, it may take to the streets in order to fasten reforms. Yet, threshold models do not suggest any mechanism by which people learn about these conditions. Such a learning mechanism is provided by the "common knowledge" approach developed here.

2.2 Signalling Games and the Informational Cascade Model

A similar information problem is analyzed by Taylor (1987, pp. 45–52) who suggests that a non-cooperative equilibrium in the *n*-person chicken or participation game can be explained by the fact that individuals are not sure whether or not they are the decisive players. When they acquire new information about the expected moves of others, they update their beliefs concerning the expected number of participants. If a player believes that he/she is decisive, he/she will join collective action. Since subjective beliefs may vary among individuals, players may join collective action at different points in time, thus potentially creating a bandwagon effect. Ainsworth and Sened (1993) enrich Taylor's framework by developing a signalling game between political entrepreneurs and two audiences – their followers and the regime. Political entrepreneurs provide their followers necessary information about the level of participation achieved at each point in time and use the number of participants as a signal of their power in their bargaining with the regime.

A signalling game is also elaborated by Lohmann (1994) as an informational cascade or a dynamic threshold model composed of several stages. First, people take costly political action to express their dissatisfaction with the regime. Second, the public takes information cues from changes in the size of the protest movement over time. Third, the regime loses public support and collapses if the protest activities reveal it to be malign. In addition, the model assumes that information about the nature of the regime is dispersed among the heterogeneous members of a society, while these people are limited in their abilities to articulate their personal experiences and opinions on complex policy issues or to understand other people's communications. It is also assumed that while people know the distribution of individual preferences, they do not know the identity of any particular individual. The information-updating mechanism is then based on a comparison between an individual's estimation of the expected turnout and the actual turnout at a given point in time. Lohmann (1994) suggests that "the higher the turnout relative to prior expectations, the higher this estimate, and the higher the number of people who favor a regime change."

In other words, the gap between the expected and the actual turnout indicates both the number and identity of those who are in favor of change. A small gap implies that mainly anti-status-quo extremists are in favor of change while a large gap implies that many people, characterized by a wide variety of preference ordering, are in favor of change. Given that individuals in society have different prior expectations, the observed turnout will be interpreted differently by various players thus bringing people to join collective action at different points in time. This creates an informational cascade leading to the bandwagon effect.

In the Lohmann model participants provide a signal to other people about the existing situation, while in threshold models the focus is on the changes in cost–benefit calculations and the transformation of the state of the world. Yet, in the Lohmann model, the number of participants is also the basis for any information updating about the players' identity. Lohmann (1994) then presents a detailed case study of the Monday demonstrations in Leipzig, East Germany, 1989–1991, showing the contribution of the informational cascade model to the explanation of the events.

In the following section we develop the "common knowledge" approach to collective action dynamics and the learning mechanism given a fixed state of the world.

3. COMMON KNOWLEDGE AS A BASIS FOR LEARNING IN COLLECTIVE ACTION DYNAMICS

The models discussed so far analyze collective action dynamics when people in society do not have complete information about the calculations, expected actions or identity of other people in society, but they have firm information or beliefs about the regime. However, it is very likely that the opposite is true, i.e.,

that members of society know the type of information held by other members as well as the willingness of these people to join collective action, but they do not have complete information about the structural conditions composing the state of the world. We suggest that in such cases a learning mechanism based on the concept of ''common knowledge'' can be utilized to explain collective action dynamics.

An event is common knowledge among a group of agents if each one knows it, each one knows that the others know it, each one knows that each one knows that the others know it, and so on (Schelling, 1960; Lewis, 1969; Aumann, 1976). When a certain fact becomes common knowledge, learning processes, which can be formally represented, are triggered. The literature on common knowledge suggests several examples of the ways in which a fact that becomes common knowledge, i.e., new information, influences behavior (Bollobas, 1953; Gamow and Stern, 1958; Geanakoplos and Polemarchakis, 1982; Gardner, 1984; Geanakoplos, 1992). The famous examples are known as ''the cheating wives'' and ''the dirty faces'' stories. This reasoning is also the basis of Aumann's (1976) seminal paper concerning the inability of rational players to ''agree to disagree'' about the probability of a given event. The intuition for this is that, if a player knows that his/her opponent's beliefs are different from his/her own, he/she should revise these beliefs to take the opponent's information into account. Following that conceptual example, a variety of applications to economic theory have been elaborated (Kreps, 1977; Tirole, 1982; Milgrom and Stokey, 1985; Rubinstein, 1989; Hart and Tauman, 1996).

This approach has been also used to explain dynamic information aggregation. Rob (1991), Caplin and Leahy (1993, 1994), and Chamely and Gale (1994) showed how information externalities may cause agents to delay action inefficiently, since there is an incentive to wait for others to take costly action. Caplin and Leahy (1998) suggest a search-theoretic model with information spillovers showing that the delay until the first player acts is suboptimally long owing to information externality. They provide examples in which social optimality demands immediate action, but the market produces an arbitrarily long delay. These models provide an appropriate setting for explaining dynamics of collective action by dynamic information aggregation.

We apply the ''common knowledge'' approach to collective action dynamics as follows. We suggest that players who decide whether to join collective action or not, face a complex decision situation that includes several variables. They do not simply count the number of participants but, rather, try to identify the ''state of the world'' in which they act. This state is composed of various structural parameters, external to the group, such as the government's attitudes, the conflicts and coalitions in the political system, the international conditions, the socio-political situation, economic conditions, and other parameters that may be relevant to specific groups. Each player forms subjective beliefs concerning the state of the world that must exist before he/she decides to take to the streets. These beliefs implicitly express the individuals' cost–benefit calculations as well

as attitudes toward risk. In comparison, in the threshold models the costs and benefits attached to collective action constantly change according to the observed number of participants.

The centrality of structural conditions in dynamics of collective action, is also emphasized by Tilly (1984) and Tarrow (1994) who suggest the idea of a political opportunity structure.

> Social movements form when ordinary citizens, sometimes encouraged by leaders, respond to changes in opportunities that lower the costs of collective action, reveal their potential allies and show where elites and authorities are vulnerable.
>
> (Tarrow, 1994, p. 18)

The theory of political opportunity structure provides explanations of the correlation between specific political structures and particular dynamics of collective action. However, it does not explain how people learn about either the existing structure or changes in that structure when they do not have full information about the components of the state of the world – a problem which especially exists in non-democratic systems and in macro-socio-political processes. For example, consider two states of the world – State 1 and State 2 – that are identical in all aspects except one, i.e., the attitudes of the government towards collective action. State 1 represents a situation in which the government is flexible toward collective action, while in State 2 the government is determined to suppress mass collective action. In such a case, a player, who has all the information about the state of the world except the attitudes of the government, cannot distinguish between State 1 and State 2. The less information a player has about his/her situation, the less he/she can distinguish between states of the world.

Starting from this point, players use other players' actions (or inactivity) to learn about the existing structural conditions by distinguishing between different states of the world. This learning process does not include the creation of new facts or new structural conditions. For example, if an individual knows that the military elite is in favor of change and will not violently crash mass protest, he/she does not have to rely on the number of protesters when calculating the cost of action as implicit, for example, in threshold models.

By assuming fixed structural conditions the model allows for focusing on the learning mechanism itself.[1] The Lohmann model is also based on fixed structural conditions but there the observed number of participants is the main signal for the information updating process given prior subjective expectations about that

[1] The structural conditions may indeed change during the learning process, but at a slower rate than learning through common knowledge. The learning mechanism developed here is therefore useful for analyzing learning processes given certain structural conditions during a certain period of time. If the structural conditions change from one period to another, then the whole setting is changed as well and the learning mechanism may lead to different actions. Thus, in order to analyze long dynamics we have to construct several models – each for a different period of time – characterized by a different structural setting, and analyze both the transformation between the models and the learning process in each individual model.

number. As will be explained, in our setting, the basis for acquiring information is the prior beliefs of members in society about the type of information that each other holds.

In other words, owing to strong social networks, which especially characterize repressed societies (Schopflin, 1993), members of society may know the identity, beliefs, and type of information held by other people in society but they may be ignorant of certain structural conditions or the attitudes among the regime. In comparison, threshold models and the informational cascade model implicitly assume that people in society believe that the regime is against change and that people have enough information about structural conditions, but these people lack information about other people in society. Thus, the common knowledge approach assumes that people face a different information problem, and therefore go through a different learning mechanism, as compared to either threshold models or the informational cascade model.

The theoretical game approach that we present here includes a few basic components. The conceptual term "*the state of the world*" gives a detailed specification of the physical universe, past, present, and future. It specifies the players' preferences, mutual beliefs, subjective knowledge, strategies, and actions, as well as the rules of game and structural conditions. When a player cannot accurately observe all the components that compose a specific state of the world, he/she cannot distinguish between several states of the world in respect of a certain component. The player's knowledge is formally described by a collection of mutually disjoint and exhaustive classes of states of the world (Ω), called "cells," that *partition* Ω. If two states of the world are in the same cell, then the player, who observes reality, can tell which cell reflects this reality, but cannot distinguish the states that are in the same cell. Note also that the fewer states of the world there are in each cell, the greater is the player's information about reality.

In the examples presented later we use the same basic notations and definitions.[2] Consider m groups of participants taking part in a game and n possible states of the world $\Omega = \{1, 2, 3, \ldots, n\}$. A group contains symmetric players with the same beliefs and knowledge but it is not necessarily an organized group. For simplicity, we will analyze the behavior of one individual in each group, and assume that the same applies to all other members in that group.

Denote by H_i the partition of group i – that is, a group of cells, each contains the states of the world between which the group's members cannot distinguish. Assume that there is an a priori probability distribution over Ω such that the probability of State k occurring is $p(k)$ where $k = 1, \ldots, n$, $p(k) \geqslant 0$ and $\sum_{k=1}^{n} p(k) = 1$. For each group i, there is a set of states, $B_i \subseteq \Omega$, that require collective protest in order to be changed. The set B_i represents the states of the

[2] We do not develop here a complete formal model, since it may confuse and obscure the main insight of this approach regarding collective action dynamics. However, one can find a game formulation that can exactly fit any of the following examples. Fundenberg and Tirole (1992, p. 547), for example, suggest a game formulation of "the dirty faces" story.

world where the conditions for joining collective action, which are subjectively set, are fulfilled. A player in each group decides to take an action by a decision rule depending on his/her information about the world and the history of the game. That is, each player knows all the past actions of the other groups' members.

It is assumed that members of each group know the type of information held by other groups and their decision rule. This can be explained by the existence of social networks through which social groups get some basic information about each other. Indeed, through these networks people can distribute all the information they hold, thus making the process of learning through actions redundant. But in terms of game theory such information may be considered as "cheap talks" which is costless pre-play communication that does not bind the players to statements they make, meaning that its reliability is questionable. Therefore, people tend to rely on other people's actions, rather than on talk, as an indication of these people's preferences and beliefs. For example, from 1976–1980 there were 30 illegal independent newspapers operating in communist Poland (Lipski, 1984, p. 310). They distributed a variety of information in an attempt to convince people to support opposition groups arguing that such a support was already widespread (Raina, 1981). Yet, in July 1980, activists and observers were not sure whether society was ready for a mass protest (Kemp-Welch, 1991, p. 17; Garton Ash, 1983, p. 38). In August 1980, however, a nationwide mass protest developed by a bandwagon dynamic leading to the establishment of Solidarity as a free trade union (Garton Ash, 1983). Thus, the information distributed through newspapers was not considered reliable enough to take people to the streets, but, rather, actions were reliable indications.

The learning mechanism in collective action dynamics is developed as follows. At time $t = 0$, the information of each group member, i, is limited by his/her partition on Ω. At the same time, an event occurs making a certain fact common knowledge. At $t = 1$, each group updates its beliefs based on the new information and takes an action according to its members' decision rule U_i. A player's decision rule is:

$$U_i = \begin{cases} \text{Take to the streets; if the probability of } B_i \text{ occurring is } a_i \text{ or more;} \\ \text{Stay home; if the probability of } B_i \text{ occurring is less than } a_i. \end{cases}$$

Following Hart and Tauman's (1996) suggestion, we assume that the decision rules are exogenous. At $t = 2$, each player becomes aware of the other groups' actions and updates his/her beliefs about the states of the world. Then, each group member again takes an action. The process continues until the groups' behaviors reach a steady state.[3]

[3] This learning process requires a great deal of information processing ability. For example, Nagel (1995), Duffy and Nagel (1997), and Ho et al. (1998) experimentally show that people usually go through up to two or three levels of reasoning owing to their bounded rationality. This may limit the application of the mechanism to selected groups in society. In any case, it is a good analytical way to rationalize individual behavior and to detect possible reasons for mass mobilization.

To illustrate this learning mechanism, we consider three conceptual examples: each has the same set of states of the world Ω and the same number of groups. We assume that the distribution probability of the states of the world is uniform. The examples differ in the partition of Ω for the groups' members and in the decision rules.

4. LEARNING THROUGH COMMON KNOWLEDGE: THREE EXAMPLES

This section applies the "common knowledge" approach to three examples of collective action dynamics – the bandwagon dynamic, a sudden eruption of collective action, and the decline of collective action. We construct an empirical setting of a non-democratic regime, but do not empirically apply the approach to a particular case study. We only offer anecdotal examples to help follow the reasoning. The analysis shows the advantages of this approach for rationalizing behavior, though the complex reasoning that it requires may be a weakness in respect of real-world applications.

4.1 Example 1: The Bandwagon Dynamic

The bandwagon dynamic exemplified here is based on a setting of a non-democratic regime where various groups in society are potentially involved in mass collective action aimed to bring political reforms or a regime change.

Assume the set of states of the world $\Omega = \{1, 2, 3, 4, 5, 6, 7, 8\}$ as described in Table 1.[4] Consider a non-democratic system in which each state of the world represents a different composition of three parameters – the attitudes of the government and the military elite towards collective action and the ability of opposition groups to support collective action. The government and the military elite can be either flexible or inflexible toward collective action while the opposition can be strong enough or too weak to support mass collective action. Table 1 presents the eight possible combinations of these alternatives, which means that there are eight states of the world.

Let us now assume a society composed of three groups – each has a different type of information. Assume the partition:

$$H_1 = \{\{1, 2, 3, 4\}, \{5, 6, 7, 8\}\};$$
$$H_2 = \{\{1, 3, 5, 7\}, \{2, 4, 6, 8\}\};$$
$$H_3 = \{\{1, 2, 3, 4, 6, 7, 8\}, \{5\}\}.$$

This partition expresses the limited knowledge that the groups' members have about the state of the world. It means that members of Group 3 have almost no information about the state of the world, with one exception. They can only distinguish the state of the world in which both the government and the military

[4] We present the states of the world only to illustrate the concept. The analysis applies to different compositions of states of the world.

TABLE 1 THE STATES OF THE WORLD IN EXAMPLE 1

State of the world	The government is flexible toward collective action	The military elite is flexible toward collective action	Opposition groups are strong enough to support collective action
1	No	No	No
2	Yes	No	No
3	No	Yes	No
4	Yes	Yes	No
5	No	No	Yes
6	Yes	No	Yes
7	No	Yes	Yes
8	Yes	Yes	Yes

elite are not flexible but opposition groups are strong enough to support collective action. In such a case, the conflict between the regime and opposition groups is so strong that the information becomes clear to the group members. Members of Group 3 cannot distinguish other states of the world in which the combination of conditions as described above does not exist. This means that the parameters are dependent on each other as far as the information of Group 3 is concerned. This type of information may characterize, for example, the grassroots of social opposition groups who do not have independent information about the attitudes among the government or the military elite and also do not have reliable information to evaluate the opposition power. Only when the conflict is revealed owing to social leaders' activity, for example, then information about the state of the world is revealed to these people. As long as there is no strong conflict between opposition leaders and the regime, the opposition grassroots do not know the true reasons for that situation – reasons that may be embodied in each of the other seven states of the world.

However, the leaders of such social opposition groups often have enough information about the strength of the opposition but they may be ignorant of the attitudes among the government and the military elite. These social leaders may therefore compose Group 1 who can distinguish the states of the world 1, 2, 3, and 4 from the states of the world 5, 6, 7, and 8, but cannot distinguish between the states 1, 2, 3, and 4 themselves and between 5, 6, 7, and 8 themselves. This means that social entrepreneurs may be distinctive in the sense that they possess superior information.

Group 2, in our setting, does not have information about both the military elite's attitudes and the opposition strength, but it has enough information about the government's attitudes. In non-democratic communist regimes, this type of information may characterize local party apparatus who may support collective action against the regime under certain conditions; for example, if they believe that the government and the military elite are too weak to maintain the regime (Sanford, 1986). As outlined in the partition above, they can distinguish

the states of the world 1, 3, 5, and 7 from the states of the world 2, 4, 6, and 8, but cannot distinguish between the states 1, 3, 5, and 7 themselves and between the states 2, 4, 6, and 8 themselves.

Given this partition, let us now assume the following decision rules. Let $B_1 = B_2 = B_3 = \{8\}$. That is, collective action will achieve the desirable goal, which is the same for all groups, under the conditions represented by State 8; i.e., both the government and the military elite are flexible toward collective action and the opposition is strong enough to support mass collective action. If groups' members believe with a certain probability that State 8 occurs, they will take to the streets. The groups differ in their willingness to take a risk which is expressed in the probability assigned in the decision rule. Groups 1, 2, and 3 will take to the streets if the probability of State 8 occurring equals or is greater than 0.2, 0.4, and 0.5, respectively. Thus, opposition grassroots are relatively risk averse as compared, for example, to their leaders.

Note, however, that the decision rules are subjective, meaning that they reflect the players' subjective beliefs. These beliefs are constantly updated until they reach the limits outlined above at $t = 0$. At $t = -1$ or before, the probability in the decision rules is lower and this explains the fact that there is no collective action prior to $t = 0$.

Let us now suppose that State 8 occurs, meaning that at $t = 0$ the conditions for successful collective action are fulfilled for all groups and the subjective decision rules are as outlined above. Indeed, the probabilities may be also changed during the learning process, but if State 8 occurs the government and the military elite are not expected to suppress collective action. Therefore, it is more likely that the willingness to take a risk will increase, meaning that the probability in the decision rules is expected to decrease rather than to increase. Such a decrease does not influence the basic rationale presented below. Recall also that, based on the framework presented in the previous section, all the groups know each others' partition and decision rule.

The learning process which leads to the bandwagon effect is presented in Table 2. It starts at $t = 0$, when members of Group 1 calculate the probability of State 8 occurring to be $\Pr(8|\{5, 6, 7, 8\}) = 0.25 > 0.2$. In other words, leaders of opposition groups know that the opposition is strong enough to support collective action meaning that the states of the world 1, 2, 3, and 4 do not reflect reality. Given that states 5, 6, 7, and 8 may reflect reality the probability of State 8 occurring is 0.25, which is bigger than 0.2. So Group 1, composed of social opposition leaders, takes to the streets at $t = 0$.[5] However, for Group 2 $\Pr(8|\{2, 4, 6, 8\}) = 0.25 < 0.4$ and for Group 3 $\Pr(8|\{1, 2, 3, 4, 6, 7, 8\}) = \frac{1}{7} < 0.5$. Therefore, Groups 2 and 3 do not take to the streets while Group 1 does at $t = 0$.

The actions at $t = 0$ trigger the process of learning through common knowledge. All the groups become aware of the fact that Group 1 has taken to

[5] Note that the probability for each state of the world is 0.125.

TABLE 2 THE LEARNING PROCESS IN EXAMPLE 1

			Groups		
			1	2	3
	Decision rules: Take to the streets if ⟶		$\Pr(8\|H_1^t) \geqslant 0.2$	$\Pr(8\|H_2^t) \geqslant 0.4$	$\Pr(8\|H_3^t) \geqslant 0.5$
			Groups' actions		
t	Ω^1	H_i^t	1	2	3
0	{1, 2, 3, 4, 5, 6, 7, 8}	$H_1^0 = \{\{1, 2, 3, 4\}, \{5, 6, 7, 8\}\}$ $H_2^0 = \{\{1, 3, 5, 7\}, \{2, 4, 6, 8\}\}$ $H_3^0 = \{\{1, 2, 3, 4, 6, 7, 8\}, \{5\}\}$	$\Pr(8\|H_1^0) = 0.25 > 0.2$ Take to the streets	$\Pr(8\|H_2^0) = 0.25 < 0.4$ Stay home	$\Pr(8\|H_3^0) = \frac{1}{7} < 0.5$ Stay home
1	{5, 6, 7, 8}	$H_1^1 = \{\{5, 6, 7, 8\}\}$ $H_2^1 = \{\{5, 7\}, \{6, 8\}\}$ $H_3^1 = \{\{6, 7, 8\}, \{5\}\}$	$\Pr(8\|H_1^1) = 0.25 > 0.2$ Take to the streets	$\Pr(8\|H_2^1) = 0.5 > 0.4$ Take to the streets	$\Pr(8\|H_3^1) = \frac{1}{3} < 0.5$ Stay home
2	{6, 8}	$H_1^2 = \{\{6, 8\}\}$ $H_2^2 = \{\{6, 8\}\}$ $H_3^2 = \{\{6, 8\}\}$	$\Pr(8\|H_1^2) = 0.5 > 0.2$ Take to the streets	$\Pr(8\|H_2^2) = 0.5 > 0.4$ Take to the streets	$\Pr(8\|H_3^2) = 0.5$ Take to the streets
3	{6, 8}	$H_1^3 = \{\{6, 8\}\}$ $H_2^3 = \{\{6, 8\}\}$ $H_3^3 = \{\{6, 8\}\}$	$\Pr(8\|H_1^3) = 0.5$ Take to the streets	$\Pr(8\|H_2^3) = 0.5$ Take to the streets	$\Pr(8\|H_3^3) = 0.5$ Take to the streets

the streets and thus they conclude that States 1, 2, 3, 4 (between which Group 1 cannot distinguish) have not occurred. At $t = 1$, the set of possible states of the world is reduced to $\Omega^1 = \{5, 6, 7, 8\}$ and the updated partitions are given in Table 2. This means that members of Group 2 (for example, local party apparatus) know from the actions of social leaders that the opposition is strong enough and from their own knowledge they know that the government is flexible toward collective action. They do not know, however, the attitudes of the military elite so they calculate the probability of State 8 occurring to be $\Pr(8|\{6, 8\}) = 0.5 > 0.4$. For Group 3, $\Pr(8|\{6, 7, 8\}) = \frac{1}{3} < 0.5$, so, at $t = 1$, Groups 1 and 2 take to the streets while Group 3 does not. By the same reasoning as for $t = 0$ and $t = 1$, Table 2 shows that at $t = 2$, Group 3 will join collective action. At $t = 3$, we get a stable situation in which all groups participate in collective action, because for all of them the probability of success is 0.5 which is equal to or higher than their subjective threshold.

We should emphasize, however, that if State 6 is the one that reflects reality, the same process will still take place. This means that the groups will take to the streets under unfavorable conditions, thus failing to achieve their goal. This learning mechanism does not guarantee that players will learn the truth but, rather, an error can occur.

Social history suggests numerous empirical examples of dynamics of political collective action that develop as a bandwagon mechanism (Schelling, 1978; Chong, 1991; Kuran, 1995, pp. 267–281). In particular, the socio-political events that led to the collapse of the East European communist bloc during 1989–1990 clearly developed by that mechanism both within and between states (Tarrow, 1994; Karklins and Patersen, 1993; Kuran, 1995, pp. 267–272). Yet, according to the rationale developed here, groups and societies did not necessarily imitate each other, nor did they necessarily think that there were better chances of success owing to the great number of participants. Rather, the example presented above demonstrates how different groups in society can learn from the actions of other groups, independently of the number of participants, about the state of the world that reflects reality. Yet, when there is a probabilistic decision rule, an error may occur.

The model also suggests that social entrepreneurs may be distinctive only in the sense that they possess superior information. Since they are also more willing than their followers to take a risk, they often trigger learning through common knowledge leading to a bandwagon dynamic.

As explained earlier, this learning mechanism is more complex than the "quantitative" mechanism provided by most studies of the bandwagon effect and, therefore, provides a richer framework to analyze a wide variety of processes. For example, the simple "quantitative" mechanism cannot explain the error of players who join mass collective action but fail to achieve the goal. Our approach explains such a phenomenon by the players' ignorance about the state of the world in which they operate. We now demonstrate learning processes that can possibly explain a sudden eruption of mass collective action.

4.2 Example 2: Sudden Eruption of Mass Collective Action

This example demonstrates how mass collective action can suddenly erupt following unobserved learning processes. It may also explain a sudden entry of a large number of participants given that some already participate. The example is equivalent to the examples known as ''the dirty face'' and ''the cheating wives'' stories, but with different interpretations for the players and the sage (Fundenberg and Tirole, 1992, pp. 544–545). This example is also based on a setting of a non-democratic regime as in Example 1, but here the learning process starts with a public announcement of a reliable leader or the media.

Let us assume that there are eight states of the world as described in Table 1. Let us also assume that there are three groups with the following partition on Ω.

$$H_1 = \{\{1, 2\}, \{3, 4\}, \{5, 6\}, \{7, 8\}\};$$
$$H_2 = \{\{1, 3\}, \{2, 4\}, \{5, 7\}, \{6, 8\}\};$$
$$H_3 = \{\{1, 5\}, \{2, 6\}, \{3, 7\}, \{4, 8\}\}.$$

This partition expresses the limited knowledge that the groups' members have about their own situation. It means that members of Group 1 have insufficient information about the government's attitudes so they cannot distinguish between the states of the world 1 and 2, between 3 and 4, between 5 and 6, and between 7 and 8. Members of Group 2 have insufficient information about the attitudes of the military elite so they cannot distinguish between the states of the world 1 and 3, between 2 and 4, between 5 and 7, and between 6 and 8. Members of Group 3 have insufficient information about the opposition's strength so they cannot distinguish between the states of the world 1 and 5, between 2 and 6, between 3 and 7, and between 4 and 8.

Assume also that each group is sensitive to a different parameter. Group 1 is sensitive to the government's attitudes but indifferent in respect of the military elite and the opposition – i.e., Group 1 will take to the streets if its members believe that the government is flexible toward collective action. By the same rationale, Group 2 is sensitive to the attitudes of the military elite but indifferent in respect of the other parameters. Group 3 is sensitive to the strength of the opposition but indifferent in respect of the other parameters.

The learning process is presented in Table 3. The states in which a group takes to the streets are given by $B_1 = \{2, 4, 6, 8\}$, $B_2 = \{3, 4, 7, 8\}$, $B_3 = \{5, 6, 7, 8\}$. In this example, we assume that the decision rule of each group member, i, is to take to the streets if B_i occurs with probability 1: i.e., only if he/she is certain that the condition, which is set subjectively, is fulfilled. Mass collective action that includes all three groups requires that State 8 occurs. However, under the conditions specified so far ($t = 0$), if State 8 occurs, members of Group 1 cannot be certain about that, because they cannot distinguish between States 7 and 8. Since the decision rule is to take to the streets only if a member in Group 1 is certain that the government is flexible toward collective action, Group 1 will not

TABLE 3 THE LEARNING PROCESS IN EXAMPLE 2

			Groups		
			1	2	3
	Decision rules: Take to the streets if $\longrightarrow$		{2, 4, 6, 8}	{3, 4, 7, 8}	{5, 6, 7, 8}
t	Ω	H_i^t			
0	{1, 2, 3, 4, 5, 6, 7, 8}	$H_1^0 = \{\{1, 2\}, \{3, 4\}, \{5, 6\}, \{7, 8\}\}$ $H_2^0 = \{\{1, 3\}, \{2, 4\}, \{5, 7\}, \{6, 8\}\}$ $H_3^0 = \{\{1, 5\}, \{2, 6\}, \{3, 7\}, \{4, 8\}\}$	Media or a reliable leader announces that State 1 does not reflect reality		
			Groups' actions		
			1	2	3
1	{2, 3, 4, 5, 6, 7, 8}	$H_1^1 = \{\{2\}, \{3, 4\}, \{5, 6\}, \{7, 8\}\}$ $H_2^1 = \{\{3\}, \{2, 4\}, \{5, 7\}, \{6, 8\}\}$ $H_3^1 = \{\{5\}, \{2, 6\}, \{3, 7\}, \{4, 8\}\}$	Stay home	Stay home	Stay home
2	{4, 6, 7, 8}	$H_1^2 = \{\{4\}, \{6\}, \{7, 8\}\}$ $H_2^2 = \{\{4\}, \{7\}, \{6, 8\}\}$ $H_3^2 = \{\{6\}, \{7\}, \{4, 8\}\}$	Stay home	Stay home	Stay home
3	{8}	$H_1^3 = \{\{8\}\}$ $H_2^3 = \{\{8\}\}$ $H_3^3 = \{\{8\}\}$	Take to the streets	Take to the streets	Take to the streets

protest. The same reasoning holds for Groups 2 and 3. At $t = 0$, no group takes to the streets, although the conditions for collective action are fulfilled.

Let us now assume that State 8 reflects reality, but none of the groups can be certain about that. Also assume that the media, or a certain reliable leader, announces that at least one condition of the three is fulfilled. That is, either the government or the military elite is flexible or the opposition is strong enough to support collective action. The fact that State 1 does not reflect reality becomes common knowledge and all groups' members exclude State 1 from their calculations (see Table 3). The set of possible states of the world, Ω, is reduced to $\Omega^1 = \{2, 3, 4, 5, 6, 7, 8\}$ and the new partitions of the groups' members are given in Table 3. Under that information structure, all groups' members cannot know that State 8 applies, because they cannot distinguish it from other states. Therefore, no group takes to the streets at $t = 1$. At $t = 2$ all groups' members observe that no group took to the streets and update their knowledge accordingly. By the same reasoning, they believe that States 2, 3, and 5 do not reflect reality since Groups 1, 2, and 3 stayed at home (see Table 3). All groups' members eliminate these states from the set of possible states of the world that is now $\Omega^2 = \{4, 6, 7, 8\}$.

Table 3 shows that, under that information structure, none of the groups takes to the streets because no group member is certain that the conditions for collective action are fulfilled at $t = 2$. By the same reasoning, at $t = 3$, all groups' members observe that no group took to the streets and become certain that the States 4, 6, and 7 do not reflect reality. The set of possible states of the world is reduced to $\Omega^3 = \{8\}$ and the partitions are $H_1^3 = H_2^3 = H_3^3 = \{8\}$. Then, all groups' members identify that State 8 occurs and since the conditions are fulfilled for all groups, they all take to the streets at $t = 3$ (see Table 3).[6]

This analysis demonstrates sudden eruption of mass collective action or a sudden entry of a large number of participants after a public announcement triggers learning processes. Yet, this is only one case. By changing the partitions and/or the decision rules or when the set of possible states of the world is much larger, we can have similar phenomena but with different timing. This example stresses the role of leaders or the media in providing some basic information, which leads players to learn about the state of the world in which they operate. According to this account, social leaders and the media do not convince people that they are in a bad situation nor do they always inform players about others' preferences or expected actions. Rather, they make a certain fact common knowledge, thus leading people to update beliefs by their own observations.

We should emphasize that the mechanism analyzed so far does not explain preference changes. We assume that people's preferences are already shaped,

[6] Note that if State 7 had occurred instead of 8, then at $t = 3$ the members of Groups 2 and 3 would have identified it and taken to the streets, since both of them would have seen that the conditions they set are fulfilled. Yet at $t = 3$ the members of Group 1 identify that State 7 occurred and they will not take to the streets, since the condition for Group 1 is not fulfilled. Under State 7, only two groups will take to the streets beginning at $t = 3$.

meaning that they are willing to take to the streets if they know that certain conditions are fulfilled, but before the learning process starts they simply do not know if this is indeed the case. In comparison, Kuran (1995) argues that a sudden eruption of collective action happens after preferences change but remain hidden. In many cases, people do not act because no one gives expression to a preference change that has occurred. Following Schelling (1978), he attributes sudden eruption of collective action to certain focal points, but does not elaborate a mechanism to explain why it occurs at a particular point in time. This is exactly where our approach contributes the most.

The example presented here shows that people may learn something ''active'' from the passive behavior of others. There is a continuous learning process in which people infer that the conditions for collective action have been fulfilled, although no player had taken to the streets in previous stages. In comparison, the rationale adopted by existing models implies that when everyone is passive, no one will take to the streets.

This rationale can explain the relatively sudden and unexpected compromises between leaders of opposing forces such as politicians, military leaders, and social leaders as happened for example in Hungary, Czechoslovakia, and East Germany during 1989–1990 (Lohmann, 1994; Schopflin, 1993). By this example, we can also rationalize the behavior of members from the party apparatus and from the military forces who suddenly joined mass protest in favor of regime change in several East European communist states such as Hungary, Poland, Czechoslovakia, and East Germany during 1989–1990 (Lohmann, 1994; Schopflin, 1993).

The last application, presented here, of the ''common knowledge'' approach to collective action dynamics explains the decline of collective action or a mass movement after it has been mobilized.

4.3 Example 3: Declining Collective Action

Empirical evidence shows that mass collective action often declines after a short period of activity. In extreme cases, it lasts for only one event and then ceases to exist. The decline of a mass movement is usually explained by the fact that its goals have been achieved to a certain extent, thus bringing back the ''free-rider'' problem (Chong, 1991, pp. 191–229). However, in the following example, we adopt a different approach. We show how public announcements trigger a learning process that improves players' knowledge about certain aspects of the state of the world, but also stresses their ignorance about other aspects. Thus, a learning process may make people aware of what they do not know and may therefore discourage participation in mass collective action.

To demonstrate that mechanism, let us assume that there are three groups and eight possible states of the world. The concrete properties of the states of the world are different from those specified in the previous examples. To show the general relevance of this example, we do not specify these

properties. Assume, also, that the partitions on Ω for Groups 1, 2, and 3 respectively, are as follows.

$$H_1^0 = \{\{1, 2\}, \{3, 4, 5, 7\}, \{6, 8\}\};$$
$$H_2^0 = \{\{1, 2, 3, 4, 5, 6\}, \{7, 8\}\};$$
$$H_3^0 = \{\{1, 2, 3, 4, 5, 6, 7, 8\}\}.$$

Let B_1, B_2, and B_3 be the states of the world under which Groups 1, 2, and 3, respectively, will take to the streets. That is, $B_1 = \{3, 6, 7, 8\}$, $B_2 = \{2, 3, 8\}$, $B_3 = \{3, 6, 7\}$. Note that all the players cannot distinguish between States 3, 4, and 5, while States 4 and 5 will lead all players to cease collective action. As will be shown later, these conditions finally lead to the decline of collective action.

The decision rules and the learning process are presented in Table 4. Let us suppose that State 3 occurs – that is, if all the groups are aware of that state, with a certain probability, they take to the streets. To construct the starting point of declining collective action, we assume that the media or a reliable leader announces that State 1 does not reflect reality. As shown in Table 4, this will bring all groups to join collective action at $t = 1$. The declining process starts at $t = 2$ after all groups' members monitor each others' actions and conclude that States 1 and 2 have not occurred. The reason is that if State 2 had occurred, Group 1 would have identified it and would have not taken to the streets at $t = 1$. However, the players cannot know whether Group 1 monitored the set {3, 4, 5, 7} or {6, 8} when deciding on the group's action since, in both cases, the decision rule leads to the same behavior. Table 4 shows that this will lead Group 2 to cease collective action while the two other groups will continue at $t = 2$. By the same reasoning, Table 4 shows that at $t = 3$ Group 1 ceases collective action and at $t = 4$ Group 3 ceases collective action.

Through the learning process exemplified here mass collective action gradually declines, although State 3, which is the only one that can lead all the groups to the streets, indeed occurred. The reason for that decline is that all groups do not have enough information about the relevant factors that compose the state of the world, so they cannot distinguish between States 3, 4, and 5. The initial announcement only gave them some basic indication but the learning process itself revealed their ignorance about the state of the world.

Learning processes therefore allow players to accumulate information by eliminating possible states of the world, but in the end this accumulation of information may highlight what they do not know, i.e., they become aware of their own ignorance. This conceptual example shows how people may cease collective action although all others participate, the collective goal has not yet been achieved and the conditions for joining collective action are fulfilled. In comparison, the rationale provided by threshold models of collective action implies that, given such conditions, players will not cease collective action.

This focus on information problems as a reason for the decline of mass collective action also has practical implications. In many cases, social leaders

TABLE 4 THE LEARNING PROCESS IN EXAMPLE 3

			Groups		
			1	2	3
	Decision rules: Take to the streets if $\longrightarrow$		$\Pr(\{3,6,7,8\}$ information$) \geqslant 0.45$	$\Pr(\{2,3,8\}$ information$) \geqslant 0.35$	$\Pr(\{3,6,7\}$ information$) \geqslant 0.4$
t	Ω^t	H_i^t	Media or a reliable leader announces that State 1 does not reflect reality		
0	$\{1,2,3,4,5,6,7,8\}$	$H_1^0=\{\{1,2\},\{3,4,5,7\},\{6,8\}\}$ $H_2^0=\{\{1,2,3,4,5,6\},\{7,8\}\}$ $H_3^0=\{\{1,2,3,4,5,6,7,8\}\}$	Groups' actions		
			1	2	3
1	$\{2,3,4,5,6,7,8\}$	$H_1^1=\{\{2\},\{3,4,5,7\},\{6,8\}\}$ $H_2^1=\{\{2,3,4,5,6\},\{7,8\}\}$ $H_3^1=\{\{2,3,4,5,6,7,8\}\}$	$\Pr(\{3,6,7,8\}\|\{3,4,5,7\})$ $=0.5>0.45$ Take to the streets	$\Pr(\{2,3,8\}\|\{2,3,4,5,6\})$ $=0.4>0.35$ Take to the streets	$\Pr(\{3,6,7\}\|\{2,3,4,5,6,7,8\})$ $=\frac{3}{7}>0.4$ Take to the streets
2	$\{3,4,5,6,7,8\}$	$H_1^2=\{\{3,4,5,7\},\{6,8\}\}$ $H_2^2=\{\{3,4,5,6\},\{7,8\}\}$ $H_3^2=\{\{3,4,5,6,7,8\}\}$	$\Pr(\{3,6,7,8\}\|\{3,4,5,7\})$ $=0.5>0.45$ Take to the streets	$\Pr(\{2,3,8\}\|\{3,4,5,6\})$ $=0.25<0.35$ Stay home	$\Pr(\{3,6,7\}\|\{3,4,5,6,7,8\})$ $=0.5>0.4$ Take to the streets
3	$\{3,4,5,6\}$	$H_1^3=\{\{3,4,5\},\{6\}\}$ $H_2^3=\{\{3,4,5,6\}\}$ $H_3^3=\{\{3,4,5,6\}\}$	$\Pr(\{3,6,7,8\}\|\{3,4,5\})$ $=\frac{1}{3}<0.45$ Stay home	$\Pr(\{2,3,8\}\|\{3,4,5,6\})$ $=0.25<0.35$ Stay home	$\Pr(\{3,6,7\}\|\{3,4,5,6\})$ $=0.5>0.4$ Take to the streets
4	$\{3,4,5\}$	$H_1^4=\{\{3,4,5\}\}$ $H_2^4=\{\{3,4,5\}\}$ $H_3^4=\{\{3,4,5\}\}$	$\Pr(\{3,6,7,8\}\|\{3,4,5\})$ $=\frac{1}{3}<0.45$ Stay home	$\Pr(\{2,3,8\}\|\{3,4,5\})$ $=\frac{1}{3}<0.35$ Stay home	$\Pr(\{3,6,7\}\|\{3,4,5\})$ $=\frac{1}{3}<0.4$ Stay home

believe that people withdraw from participation because they are satisfied with the outcome. By concentrating on the lack of information, such leaders can maintain collective action by providing information that becomes common knowledge. By the same token, this rationale may serve politicians who want to stop collective action against the regime. According to this example, they do not necessarily have to suppress collective action but, rather, they can provide certain information that becomes common knowledge.

5. CONCLUSION

This paper suggests a theoretical game approach to explain a wide variety of collective action dynamics by a learning mechanism of individuals about the state of the world in which they operate. We illuminate theoretical aspects that are currently neglected by the theoretical game literature on collective action. The analysis stresses the mechanism by which people learn from other people's actions something about the state of the world rather than solely learning about the nature of those who participate or updating their cost–benefit calculations. The role of the media or reliable social leaders as possible suppliers of necessary information that triggers learning processes has been also illuminated.

The central point in the learning processes, discussed in this paper, is that people are not necessarily convinced to participate in collective action, nor do they necessarily imitate others. Rather, when a certain fact becomes common knowledge, owing to public announcements or other players' actions, people accumulate knowledge about their own situation. Two practical implications follow. First, in influencing people's beliefs or mobilizing mass collective action, the media or social leaders do not necessarily have to use an intense public campaign. Rather, the analysis shows that, given a certain structure of beliefs, a reliable announcement which makes a certain fact common knowledge can lead to mass mobilization. Therefore, in analyzing dynamics of collective action, special attention should be paid to such an involvement of the media or social leaders.

Second, the particular type of learning process depends on the reliability of those who supply information. Usually, there are several providers of information and their reputation determines which fact becomes common knowledge. As shown in the analysis, different information clues may trigger different learning processes. It follows that the relative reliability of those who provide information is a central parameter in analyzing collective action.

Further, the conceptual examples show that, through learning processes, people do not necessarily reveal the truth about the state of the world in which they operate. Example 1 demonstrates that although people seem to improve their knowledge they do not necessarily learn the truth. Example 3 shows that learning processes allow players to accumulate knowledge by eliminating possible states of the world, but in the end this accumulation of knowledge may highlight what they do not know, meaning that they become aware of their ignorance.

The approach offered here improves the applicability of game theory to macro-socio-political processes, because it suggests theoretical tools to analyze situations where players are ignorant about the state of the world in which they operate. Indeed, many critics of game theory argue that it is oversimplified, since the analysis must assume that people have knowledge of their own situation. Here we have addressed exactly this point, offering the tools to analyze complex decision situations.

ACKNOWLEDGMENTS

We would like to thank Randell Calvert, John McLaren, and two anonymous referees for very insightful comments.

ARIEH GAVIOUS
School of Industrial Engineering and Management, Ben-Gurion University

SHLOMO MIZRAHI
School of Management, Ben-Gurion University

REFERENCES

Ainsworth, S. and I. Sened, 1993, The role of lobbyist: entrepreneurs with two audiences. *American Journal of Political Science* 37, 834–866.

Aumann, R., 1976, Agreeing to disagree. *The Annals of Statistics* 4, 1236–1239.

Bollobas, B., ed., 1953, *Littlewood's Miscellany* (Cambridge University Press, Cambridge, UK).

Caplin, A. and J. Leahy, 1993, Sectoral shocks, learning, and aggregate fluctuations. *Review of Economic Studies* 60, 777–794.

——— and ———, 1994, Business as usual, market crashes and wisdom after the fact. *American Economic Review* 84, 548–565.

——— and ———, 1998, Miracle on Sixth Avenue: information externalities and search. *Economic Journal* 108, 60–74.

Chamely, C. and D. Gale, 1994, Information revelation and strategic delay in a model of investment. *Econometrica* 62, 1065–1086.

Chong, D., 1991, *Collective Action and the Civil Rights Movement* (Chicago University Press, Chicago, IL).

Colomer, J. M., 1995, *Game Theory and the Transition to Democracy: The Spanish Model* (Edward Elgar, Aldershot, UK).

DeNardo, J., 1985, *Power in Numbers* (Princeton University Press, Princeton, NJ).

Downs, A., 1957, *An Economic Theory of Democracy* (Harper & Row, New York).

Duffy, J. and R. Nagel, 1997, On the robustness of behavior in experimental "beauty contest" games. *Economic Journal* 107, 1684–1700.

Fundenberg, D. and J. Tirole, 1992, *Game Theory* (MIT Press, Cambridge, MA).

Gamow, G. and M. Stern, 1958, Forty unfaithful wives, in: G. Gamow and M. Stern, eds., *Puzzle Math* (Viking Press, New York) 20–23.

Gardner, M., 1984, *Puzzles from Other Worlds* (Vintage Books, New York).

Gartner, S. S. and G. M. Segura, 1997, Appearances can be deceptive. *Rationality and Society* 9, 131–161.

Garton Ash, T., 1983, *The Polish Revolution* (Granta Books, London).

Gavious, A. and S. Mizrahi, 1999, Two-level collective action and group identity. *Journal of Theoretical Politics* 11, 497–517.

Geanakopolos, J., 1992, Common knowledge. *Journal of Economic Perspectives* 6, 53–82.
——— and H. Polemarchakis, 1982, We can't disagree forever. *Journal of Economic Theory* 28, 192–200.
Granovetter, M., 1978, Threshold models of collective behavior. *American Journal of Sociology* 83, 1420–1443.
Hardin, R., 1982, *Collective Action* (Johns Hopkins University Press, Baltimore, MD).
Hart, S. and Y. Tauman, 1996, Market crashes without external shocks. Working Paper No. 31/96 (Faculty of Management, Tel-Aviv University).
Ho, T., C. Camerer, and K. Weigelt, 1998, Iterated dominance and iterated best response in experimental "*p*-beauty contests". *American Economic Review* 88, 947–969.
Karklins, R. and R. Patersen, 1993, Decision calculus of protesters and regimes: East Europe 1989. *Journal of Politics* 55, 588–614.
Kemp-Welch, A., 1991, *The Birth of Solidarity: The Negotiations* (Macmillan, London).
Kreps, D., 1977, A note on fulfilled expectations equilibrium. *Journal of Economic Theory* 14, 32–43.
Kuran, T., 1995, *Private Truths, Public Lies: The Social Consequences of Preferences Falsification* (Harvard University Press, Cambridge, MA).
Lewis, D., 1969, *Convention: A Philosophical Study* (Harvard University Press, Cambridge, MA).
Lipski, J. J., 1984, *KOR: A History of the Workers' Defense Committee in Poland, 1976–81* (University of California Press, Berkeley, CA).
Lohmann, S., 1993, A signaling model of informative and manipulative political action. *American Political Science Review* 87, 319–333.
———, 1994, The dynamic of informational cascades: the Monday demonstrations in Leipzig, East Germany, 1989–91. *World Politics* 47, 42–101.
Milgrom, P. and N. Stokey, 1982, Information, trade and common knowledge. *Journal of Economic Theory* 26, 17–27.
Nagel, R., 1995, Unraveling in guessing games: an experimental study. *American Economic Review* 85, 1313–1326.
Oliver, P., G. Marwell, and R. Teixeira, 1985, A theory of the critical mass I: interdependence, group heterogeneity, and the production of collective action. *American Journal of Sociology* 91, 522–556.
Olson, M., 1965, *The Logic of Collective Action* (Cambridge University Press, Cambridge, UK).
Raina, P., 1981, *Independent Social Movements in Poland* (Orbis, London).
Rob, R., 1991, Learning and capacity under demand uncertainty. *Review of Economic Studies* 58, 655–675.
Rubinstein, A., 1989, The electronic mail game: strategic behavior under "almost common knowledge". *American Economic Review* 79, 385–391.
Sanford, G., 1986, *Military Rule in Poland: The Rebuilding of Communist Power, 1981–83* (Croom Helm, London).
Schelling, T., 1960, *The Strategy of Conflict* (Harvard University Press, Cambridge, MA).
———, 1978, *Micromotives and Macrobehavior* (W. W. Norton, New York).
Schopflin, G., 1993, *Politics in Eastern Europe 1945–92* (Blackwell, Oxford).
Tarrow, S., 1994, *Power in Movement* (Cambridge University Press, Cambridge).
Taylor, M., 1987, *The Possibility of Cooperation* (Cambridge University Press, Cambridge, UK).
Tilly, C., 1984, *Big Structures, Large Processes, Huge Comparisons* (Russell Sage, New York).
Tirole, J., 1982, On the possibility of speculation under rational expectations. *Econometrica* 50, 1163–1181.