

# Opinion Dynamics: A Multidisciplinary Review and Perspective on Future Research

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## ABSTRACT

*As a key sub-field of social dynamics and sociophysics, opinion dynamics utilizes mathematical and physical models and the agent-based computational modeling tools, to investigate the spreading of opinions in a collection of human beings. This research field stems from various disciplines in social sciences, especially the social influence models developed in social psychology and sociology. A multidisciplinary review is given in this paper; attempting to keep track of the historical development of the field and to shed light on its future directions. In the review, the authors discuss the disciplinary origins of opinion dynamics, showing that the combination of the social processes, which are conventionally studied in social sciences, and the analytical and computational tools, which are developed in mathematics, physics and complex system studies, gives birth to the interdisciplinary field of opinion dynamics. The current state of the art of opinion dynamics is then overviewed, with the research progresses on the typical models like the voter model, the Sznajd model, the culture dissemination model, and the bounded confidence model being highlighted. Correspondingly, the future directions of this academic field are envisioned, with an advocacy for closer synthesis of the related disciplines.*

*Keywords: Bounded Confidence Model, Culture Dissemination Model, Opinion Dynamics, Social Influence, Sznajd Model, Voter Model*

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## INTRODUCTION

In the last decades, there are growing interests on applying the models and tools that are developed in complex system studies to investigate various complex social phenomena, under the brands of, for example, “generative social science” (Epstein, 2007), “computational social science” (Banks et al., 2002), and “sociophys-

ics” (Galam, 2008). One notable sub-field of this new research paradigm is so-called “opinion dynamics” (Hoylst et al., 2001), which can roughly be defined as a research field in which mathematical-and-physical models and computational tools are utilized to explore the dynamical processes of the diffusion and evolution of opinions in human population. In recent years, the studies on opinion dynamics have attracted wide attention, especially in the statistical physics community; and many

DOI: 10.4018/jkss.2011100106

interesting outcomes have been reported. Nevertheless, today this research field is still at its very infancy. As noted by Castellano et al. (2009), *“the development of opinion dynamics so far has been uncoordinated and based on individual attempts ... without a general shared framework and often with no reference to real sociological studies”*. In order to develop this research field, it is worthwhile to track its academic origins and development trails, and to envision its future trends.

With the prominence the related research endeavors, there have been some good academic reviews on opinion dynamics, such as Castellano et al. (2009), Staufer (2005), and Lorenz (2007), which are mostly based on the viewpoint of statistical physics. Those physics-centric efforts have demonstrated great significance as they may reveal that the societal processes also obey the universal statistical laws that govern the motions of massive particles in nature; and it might become possible to bridge the disciplinary gap between natural and social sciences by adopting the well-established mathematical, physical and computational methods to study such societal processes. Correspondingly, the review on opinion dynamics from the physics point of view is doubtlessly valuable. However, our contention is that those physics-centered reviews may be insufficient for offering a comprehensive view on opinion dynamics, regarding the interdisciplinary nature of this research field. On one hand, the physical models on opinion dynamics, which are currently in the spotlight, are fundamentally based upon earlier investigations in various social disciplines, especially in social psychology and sociology. Those social investigations are critical to today's physical modeling of opinion dynamics as the key problems and modeling assumptions of physical modeling are both originated from the social investigations. On the other hand, for the future development of opinion dynamics, it is deserved to pursue deeper confluence between the “hard” disciplines (e.g., mathematics, physics and computer science) and the “soft” disciplines such as sociology, social psychology, communication studies, cultural anthropol-

ogy, and politics. The insufficiency of such disciplinary confluence is the key drawback of the current physics-centered studies. This also requests a multidisciplinary view on this field. For the above reasons, we in this paper attempt to review this research field from a wider disciplinary scope, regarding opinion dynamics as confluence of multiple academic sources.

In tune with this aim, the remainder of this paper is organized as follows. In the next section, we try to answer the question “where opinion dynamics comes from” by giving a multidisciplinary retrospect on the academic sources of opinion dynamics. Then, the key research endeavors on opinion dynamics are highlighted in the subsequent section and the state of the art is discussed in accordance with a modeling framework that is induced from the reviewed contributions. Some research directions are envisioned consequently and the paper ends up with a short concluding section.

## THE DISCIPLINARY ORIGINS OF OPINION DYNAMICS

The studies on opinion dynamics cover a wide range of social phenomena, e.g. emergence of fashions and fads, minority opinion survival and spreading, collective decision making, consensus building, emergence of political parties, diffusion of rumor, expansion of extremism, and propagation of cult. These phenomena are the persisting topics of interest in many areas of social sciences. In this section, we try to take a brief retrospect to examine where opinion dynamics comes from.

Various studies in sociology and social psychology have great impact on the birth of opinion dynamics. One major theme of sociology is to explore the collective action of human population. Since the 19th century, the irrational and sometime maniac collective behaviors have been noticed and discussed, which were termed as the “madness of crowds” by Mackey (1841) and the “stupidity of crowds” by Le Bon (1895). This observation was then followed by a series of experimental studies in social psychology

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