

Diffusion of Opinions in a Complex Culture System: Implications for Emergence of Descriptive Norms

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Abstract

People take descriptive norms into account when making decisions, even when they do not personally believe in the norms; when the norms do not correspond to the actual preferences of the group; and when the decision is a high stake one. A prevailing challenge in culture and norm research is to identify the sociocultural processes through which ideas spread and become part of the descriptive norms in the society, as well as the processes through which the diffusion of ideas is contained. In the present article, the authors review two emerging communication perspectives on idea diffusion and norm emergence: neo-diffusionism and complexity theory. In addition, the authors illustrate in an agent-based modeling study how complexity theory can shed new light on how opinions spread through interpersonal communication in a complex cultural system. Preliminary results show that as long as most agents in the system prefer talking to others sharing the same opinion, the relative distribution of majority and minority opinions in the system will not change. Interestingly, when egocentric speech is coupled with the preference to communicate with dissimilar others, the level of cognitive homogeneity level (i.e., opinion consensus) in the system increases. In contrast, when audience design is coupled with the preference to communicate with dissimilar others, the level of cognitive diversity level in the system increases. The implications of the results for emergence of descriptive norms are discussed.

Keywords

agent-based modeling, shared reality, communication, norm emergence

Descriptive norms refer to behaviors or opinions that are popular in the group (Cialdini, 2007). Norms that are perceived to be popular can have an inordinate amount of authority over individual behaviors. People take perceived descriptive norms into account when making decisions (e.g., “I would not want fellow Americans to think that I don’t respect their rights to bear arms.”), even when they do not personally believe in the norms; when the perceived norms do not correspond to the actual preferences of the group; and when the decision is a high stake one (e.g., a

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decision to pass a gun control bill in the Congress; Wan et al., 2007; Zou et al., 2009). Moreover, when people (e.g., some members of the National Rifle Association) personally agree with these norms, they would strongly identify with the group and forcefully defend the perceived norms (Wan, Torelli, & Chiu, 2010; Zhang & Chiu, 2012).

Neo-Diffusionism

Despite the clear behavioral consequences of descriptive norms, a prevailing challenge is to understand *how* a certain opinion would spread and become part of the descriptive norms in the society. The objective of the present article is to review two recent communication theories that seek to explain the emergence of descriptive norms in a society: neo-diffusionism and complexity theory.

Kashima (2009, 2014) has proposed a neo-diffusionist approach to idea diffusion. In this approach, culture is defined as a non-genetically transmitted body of knowledge. Through communicative actions that take place in concrete interactions, ideas are passed to other agents. Communicative actions are collaborative actions through which two or more agents jointly construct shared meanings (Clark & Wilkes-Gibbs, 1986).

Successful communication requires coordination between the communication partners, which includes overt behaviors such as turn-taking and covert behaviors such as cognitively formulating what to say in each speaking turn (Clark & Wilkes-Gibbs, 1986). For example, Don tells Donna that he thinks their philosophy professor is a Cartesian. He does so because he *expects* that Donna would know what Cartesianism is and may accept his characterization of the professor as a Cartesian (Fussell & Krauss, 1992; Lau, Chiu, & Hong, 2001). Don will need to revise the referring expression when feedback from Donna indicates that she actually does not know what Cartesianism means, disagrees with Don on the definition of Cartesianism, or does not think the professor practices it (Isaacs & Clark, 1987). These processes of grounding of meaning in interpersonal communication are repeated until both the speaker and the listener agree on how to characterize the professor.

Success in grounding of meaning in communication requires two kinds of knowledge: knowledge about what information is shared and knowledge concerning who shares the information (Kashima, Klein, & Clark, 2007). To establish a common ground, the speaker would estimate the knowledge they share with the listener concerning the topic of conversation and use the estimated knowledge to tailor an appropriate message for the listener. This process occurs both in communications between individuals of the same culture (Fussell & Krauss, 1992; Lau, Chiu, & Hong, 2001) and in intercultural communication (Leung, Lee, & Chiu, 2013).

At the end of a conversation, the speaker and the listener will accept shared meanings of what they have talked about (what Cartesianism refers to and what school of thoughts the professor's teaching belongs to). Moreover, the speaker will believe more strongly in the shared interpretations that have emerged during the conversation. This phenomenon is known as the "saying is believing" effect (Chiu, Krauss, & Lau, 1998; Higgins & Rholes, 1978; Shteynberg & Apfelbaum, 2013).

A culture consists of many networked agents, each with a unique history of communication with other agents. Hence, each agent owns a different subset of the shared meanings emerged from the totality of communicative actions that have taken place within the culture. Consequently, the same memory representation is more cognitively accessible to some agents than to others. In this sense, knowledge is not uniformly shared but is interpersonally distributed (Barth, 2000). Moreover, the same memory representation receives stronger cueing in some situations than in others (Hong, Morris, Chiu, & Benet-Martinez, 2000). As a result, the probabilities of retrieving a certain memory representation also vary across situations for the same individual. In this sense, knowledge is also intrapersonally distributed. The doubly distributed property of knowledge gives rise to cognitive diversity within a cultural system (Kashima, 2009).

In short, in every communication, agents would draw on their local common ground to construct a social reality that is mutually meaningful in the communication context. Through iterative repetitions of the meaning grounding process, locally grounded information would spread across the agents' social networks and develop into a generalized shared reality (Kashima, 2014).

Other things equal, ideas that are perceived to be widely accepted (e.g., stereotypical information) have a higher chance of being reproduced and become popular through repeated communications (Lyons & Kashima, 2001, 2003). When a message containing both stereotypical and counterstereotypical information is reproduced in a communication chain (Person 1 transmits the message to Person 2, who in turn relays it to Person 3, etc.), although counterstereotypical (vs. stereotypical) information, by virtue of its novelty, is more likely to be reproduced in the first positions of the communication chain, stereotypical information is more likely to be reproduced toward the end of the chain, because people expect stereotypical information to be in the common ground. Through this process, each agent transforms the information environment of other agents in the network, allowing the entire network to remake itself.

Generally speaking, when people pursue social integration or cooperation goals in communication, stereotypical information is much more likely to be reproduced in communication because the speaker assumes that this type of information is grounded to the generalized common ground and hence will be readily accepted by the listener (Kashima, 2014). Thus, through iterative repetitions of the meaning grounding process, ideas perceived to be widely shared will have a higher chance of becoming popular.

Complexity Theory

The neo-diffusionist approach provides a parsimonious account of how normative opinions emerge in a culture. As Kashima (2014) puts it,

As people join and leave joint activities in succession, they carry forward their memories of context-specific common grounds. Thus, the common grounds—or mutually shared meaning—that results from individuals' continuous participations in numerous joint activities are cumulated in their cognitions, which are embodied and situated in their social milieu. (p. 87)

Neo-diffusionism emphasizes the pursuit of social integration goal and collaborative meaning construction processes in communication. It assumes that the speaker is inclined to formulate messages that the addressee will likely understand. Hence, ideas that are in the common ground (e.g., messages that are consistent with the addressee's intuitions) have relatively high likelihood of being expressed by the speaker, and remembered and reproduced by the addressee in subsequent communications. However, experimental evidence shows that this does not always happen. For example, narratives that contain a few counterintuitive concepts in addition to intuitive ones are more likely to be memorized and reproduced in communication than do narratives that contain intuitive concepts only (Norenzayan, Atran, Faulkner, & Schaller, 2010).

Neo-diffusionism also overlooks important variations in interpersonal communication that are instrumental to maintenance of cultural diversity (Chiu & Qiu, 2014). In pluralistic or multicultural societies, there are often competing discourses on the same issue. In these societies, agents pursuing social integration goals may frame the issue differently when they speak to different opinion or cultural groups (e.g., Leung et al., 2013; Zou et al., 2009). In addition, when two agents with dissimilar views talk to each other, they may collaborate to construct new meanings that are different from the original view of either agent (Wilkes-Gibbs & Kim, 1991). Moreover, sometimes, agents are motivated to maintain psychological divergence with their communication partners. Under this circumstance, the agents may highlight their mutual disagreements instead of trying to reach consensus in their communication (Tong, Hong, Lee, & Chiu, 1999). Furthermore,

there are individual differences in the amount of social influence agents have over others (Nowak, De Raad, & Borkowski, 2011), and in how receptive agents are to persuasion. When the number of committed contrarians in the community is large enough, the system can tip over and favor the minority opinion (Xie et al., 2011). Finally, agents do not randomly select their communication partners. Some agents are particularly inclined to communicate with others with similar backgrounds (Byrne, 1971). Given these variations in communication processes, it is a challenge to predict from the principles of interpersonal communication how likely a certain idea will become widely accepted in the culture.

To meet this research challenge, we have taken a complexity theory perspective to study the diffusion of opinions. We contend that each culture has internal processes that connect its agents and reproduce its contents, and communication plays an important role in these self-organizing and self-reproducing processes. As Hatt (2009) puts it,

System and environment become operational due to a process of differentiation, which occurs not in consciousness but in the world of experience, through communication. Through successive repetition, a system achieves autopoiesis, a process that transforms itself into itself through recursive closure that is regulated by communication. Social systems are comprised of communication, not persons or actions. (p. 320)

Because agents' actions are not independent and there are individual differences in communication goals, preferences, social influence, and cognitive openness, it may be impossible to predict how likely a certain opinion would become a widely accepted one. As Salgado and Gilbert (2012) put it, "Feedback enters the system and a continuous interplay between the emergent structures and the agents' actions take place, altering the dynamics of the system and moving it towards unpredictable states" (p. 92).

Agent-Based Simulation of Opinion Diffusion

Nonetheless, researchers interested in diffusion of opinions can specify in a computer simulation model the psychological characteristics of the agents in complex system as well as the principles governing the interactions of the agents, and test whether the micro-specifications in the model are sufficient to generate the macro-level characteristics of interest (Chalmers, 2006). A widely used modeling technique is agent-based modeling (ABM). ABM assumes the presence of a complex system consisting of a large number of heterogeneous individual agents that interact to produce emergent phenomena difficult to be explained in terms of properties of the individuals. Although experimental methods typically allow for strong causal inferences and provide detailed micro-level understanding of psychological processes, unlike ABM, they do not capture the interactive, non-linear, recursive, and dynamic processes that lead to complex social phenomena (Smith & Conrey, 2007). Not surprisingly, ABM has been applied extensively to the study of cultural dynamics.

Nowak and his colleagues (2011) pioneered in the use of agent-based models to simulate the effect of social influence on cultural processes. In their model of social influence, the magnitude of social influence at the individual level increases with immediacy (operationalized in terms of physical proximity), attitudinal strength of the influencer, and the number of influencers. Their results show that when individuals of different levels of attitudinal strength spread their influence to their neighbors according to the aforementioned lower-level rules governing interpersonal influence, initially unorganized attitudes are turned into organized attitudinal syndromes. Meanwhile, neighborhoods populated by people of similar attitudes begin to emerge. These simulation results show that specification of simple rules of interpersonal influence at the micro-level is sufficient to generate culture-like clusters of attitudinal syndrome.

Communication did not play a role in Nowak's models. Interestingly, several recent studies carried out in mathematical physics have examined the role of communication in minority influence in a cultural network. For example, one study (Xie et al., 2011) showed that when the percentage of agents committed to the minority opinion reached 16.2%, the whole network could be induced to quickly tip over to favor the minority position. These studies illustrate the possibility of modeling the role of "communication" in minority influence in a network of agents (Moscovici, 1980). Nonetheless, meaning grounding did not play a role in the "communication" processes modeled in these studies, because the speakers in these studies did not need to take the listeners into account when formulating their messages. The speakers randomly selected a listener in their neighborhood to talk about an opinion randomly selected from the list of opinions they owned.

In a recent study (Chiu & Qiu, 2014), we applied ABM to simulate diffusion of opinions in a cultural system. In each simulation, there were 2,600 autonomous agents. Each agent was randomly assigned to occupy a node in a grid. We used a response competition model to characterize the decision process of each agent. Specifically, each agent holds two competing opinions (A and B). If the strength of Opinion A is higher than that of Opinion B, the agent adopts Opinion A and vice versa. If the opinions are equally strong, it remains undecided (indifferent). In the initial distribution, 75% of the agents hold Opinion A ($\text{Strength}_A = 1$, $\text{Strength}_B = 0$), and 25% hold Opinion B ($\text{Strength}_B = 1$, $\text{Strength}_A = 0$).¹

At each time step, a randomly selected agent chooses a conversation partner from its nearest neighbors and decides whether to make an egocentric speech (speak positively about the speaker's opinion) or accommodate to the attitude of the listener (speak positively about the listener's opinion). The tendency to tune one's message in the direction of the listener's attitude is referred to as audience design and has been found to be a crucial process contributing to the construction of shared reality through concrete social interactions (Fussell & Krauss, 1989). When the listener receives a message favoring a certain opinion, the strength of that opinion will increase by 1 unit. As an illustration, if the $[A = 1, B = 0]$ represents the initial opinion strengths of the listener, the opinion strengths will change to $[A = 2, B = 0]$ after receiving a message supporting Opinion A from the speaker and to $[A = 1, B = 1]$ after receiving a message supporting Opinion B. Past finding has shown that audience design in communication can alter the speaker's subsequent opinion as well. That is, a speaker who formulates a message for a certain listener tends to believe more strongly in the message regardless of whether the message is congruent with the speaker's initial attitude (Chiu et al., 1998). To model this effect, after the speaker has formulated a message supporting a certain opinion, strength of that opinion for the speaker will also increase by 1 unit. If the $[A = 0, B = 1]$ represents the initial opinion strengths of the speaker, the opinion strengths will change to $[A = 1, B = 1]$ after speaking favorably about Opinion A and to $[A = 0, B = 2]$ after speaking favorably about Opinion B.

Note that both audience design and egocentric speech could contribute to a shared reality. If the speaker and the listener hold the same initial opinion, communication will strengthen the opinion for both parties. If the speaker and the listener hold different initial opinions, communication will bring the opinion of the speaker closer to that of the listener. In contrast, if the speaker always speaks egocentrically and both parties have the same initial opinion, communication will also increase the strength of the initial opinion for both parties. If two parties hold different initial opinions, egocentric speech will bring the opinion of the listener closer to that of speaker. In short, there are two possible paths to construct shared meanings in interpersonal communication. In our study, the likelihood that the speaker will engage in audience design versus egocentric speech varied from 0% through 25%, 50%, 75% to 100%.

Another parameter we varied is the likelihood that a speaker will prefer talking to somebody with the same opinion. The "bird of feather flock together" effect has been observed in interpersonal communication (Byrne, 1971) and computer-mediated communication (Reeves & Nass, 1996). On one hand, the preference to communicate with others with the same opinion could help

maintain cognitive diversity in the network by protecting the minority group from the influence of the majority. On the other hand, this preference could also reduce the opportunity for minority influence and support gradual assimilation of the minority opinion into the majority opinion. In the present study, we varied the likelihood that the speaker will choose a listener with the same opinion from 0% through 25%, 50%, 75% to 100%. Note that both topic choice and listener choice require the speaker to consider the opinions of their neighbors.

All simulations were done for $N = 2,600$ and 100 replications with a different randomly constructed initial distribution of agents. In most instances, it took fewer than 2,000 time steps for the model to stabilize (the number of agents holding Opinions A and B to remain constant). The model stopped if it did not stabilize after 2,000 time steps.

The main results of the simulation study are as follows:

1. When the percentage of agents who prefer to communicate with agents sharing the same opinion reaches 75%, the distribution of opinions does not change: About 75% of the agents continue to hold the majority opinion when the model stabilizes.
2. When most agents prefer to communicate with agents holding dissimilar opinions, egocentric speech wipes out the minority opinions in the system. That is, the level of opinion homogeneity or consensus in the culture increases even when most minority opinion holders, like the majority opinion holders, are eager to promote their opinions to their listeners.
3. The level of cognitive diversity in the system increases when most agents practice audience design and are motivated to communicate to dissimilar others. Under this circumstance, the distribution of the two opinions becomes more even.
4. In a follow-up study, we also manipulated how cognitively open versus conservative the agents were. Results (1) to (3) are particularly pronounced when the agents become more cognitively open (vs. conservative).

Conclusion

Descriptive norms influence behaviors and are important components of an intersubjective culture (Chiu, Gelfand, Yamagishi, Shteynberg, & Wan, 2010). A prevailing challenge in culture and norm research is to understand how ideas become norms through social interactions. Neodiffusionism addresses this issue by exploring the implications of the meaning grounding process in interpersonal communication for the construction of shared reality in a human group, assuming that the process connecting context-specific common ground to generalized common ground is a linear one (Kashima, 2014). Contrary to this view, complexity theory and the simulation results described above show that diffusion of opinions in a complex system is non-linear and path dependent. Variations in the properties of agents can create different paths of opinion diffusion. These results invite researchers to rethink the relationships between communication, shared meanings, and culture. A well-received idea in cultural psychology is that grounding of meaning in interpersonal communication facilitates reproduction of cultural information (Kashima, 2009). Shared meaning construction through communication is also regarded as a critical mechanism for members of a culture to construct shared representations of who knows what (Chiu et al., 2010). Our simulation results add nuances to these generalizations. As long as most agents strongly prefer to talk to others holding the same opinion as the self, the distribution of opinions in the system will remain stable, regardless of whether the speakers prefer making egocentric speeches or practicing audience design.

Interestingly, when some opinions are more popular than others, it is the coupling of egocentric speech and the preference to communicate with dissimilar others that forms an escalating loop, producing a higher level of consensus in the system. When audience design is coupled with

the preference to communicate with dissimilar others, an equilibrating loop is formed, which reduces consensus or increases cognitive diversity in the system.

These new insights attest to the utility of applying complexity theory and ABM to understand the dynamic outcomes that emerge from complex interactions of lower-level entities. The strength of ABM is that it provides computational demonstrations of generative sufficiency (Epstein, 1999): Specifications of the psychological processes governing the interaction of the lower-level entities are sufficient to generate the macro-level phenomena of interest. This kind of demonstration provides candidate mechanism-based explanations of macro-phenomenon. Hopefully, these explanations will inspire future research that tests these explanations empirically.

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Note

1. We varied the percentage of the agents who hold Opinion A in the initial distribution from 25% to 50% and 75%. For simplicity's sake, we focus on the 75% / 25% split in the current discussion.

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