Gatekeepers in Social Networks: Logics for Communicative Actions

In recent times, information control has become an increasingly pressing issue. Social media platforms, such as Facebook or Twitter, have the power to make decisions on which information to spread and which information to block, thereby raising concerns about data protection and freedom of expression. In the literature, agents who have the power to control the information flow are called *gatekeepers* [2]. Despite being a widespread phenomenon, this notion has been mainly investigated in a compartmentalized form, i.e. applied to a specific field. Some scholars have recently started working towards providing the gatekeeping concept with a full and independent theoretical status [2]. Here, we propose a formal model that captures the essential properties of gatekeepers in a social network, both in terms of *structure* and in terms of *informational dynamics*. With this work, we make two main contributions: (i) providing a formally precise understanding of the gatekeeper notion, and (ii) identifying a suitable formal language to reason about the former and the resulting information dynamics. Consequently, this work also contributes to show the advantages of applying logic to the social sciences, and thereby progresses the exploration of the intersection between the fields [4].

Structural Study. We model a social network as an undirected graph, where a gatekeeper is a set of agents that can control the information flow between two otherwise disconnected sets of agents (groups). More specifically, gatekeepers can be defined as having the capability to both (1) enable and (2) block the information flow. To structurally characterize a gatekeeper we thus need both a notion expressing that it connects the groups, thereby enabling the information flow between them, as well as a notion expressing that it intersects all the connections between the groups, thereby having the capability to also block such flow. Call the first notion *connector* (Figure 1) while the second *blocker* (Figure 2), and define a *gatekeeper* as the conjunction of connector and blocker.

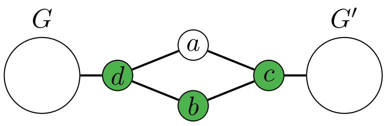

Figure 1: The set $\{d, b, c\}$ is a connector. Other connectors are the sets $\{d, a, c\}, \{d, b, c, a\}$.

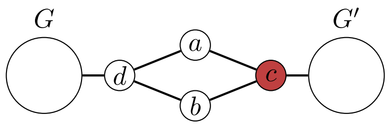

Figure 2: The set $\{c\}$ is a blocker. Other blockers are $\{d\}, \{a, b\}$, and any combination of the three.

By slightly modifying the notions of connector and blocker we can obtain different kinds of gatekeepers, each having different informational capabilities. For instance, consider the notion of *minimal connector*. This type of connector contains only agents that are necessary to enable the information flow between the two disconnected groups (Figure 3). Moreover, in such a set, each agent is sufficient to block the information flow between the groups and the set is thus a blocker. Since it is both a connector and a blocker, a minimal connector is a gatekeeper. Alternatively, consider the notion of *minimal blocker*. This set contains only agents that are necessary to block the information flow between the groups. By considering a minimal blocker that is also a connector, we obtain a gatekeeper such that each of its members is sufficient to enable the information flow between the groups, but only necessary to block it (Figure 4). Minimal connectors and minimal blockers are both gatekeepers, but their agents have very different informational capabilities.

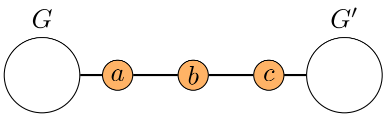

Figure 3: The set $\{a, b, c\}$ is a minimal connector and a blocker, thus also a gatekeeper.

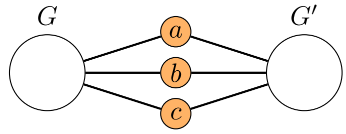

Figure 4: The set $\{a, b, c\}$ is a minimal blocker that is also a connector, thus also a gatekeeper.

We characterize the network structure and the above structural notions by means of a hybrid version of Propositional Dynamic Logic. The logic we use for this part resembles a non-epistemic form of Facebook Logic, as proposed by Seligman et al. [5]. It is based on Network Models, as in Smets et al. [6] and is a static logic. We call it *Network Logic*.

Informational Study. In order to characterize the informational capabilities of gatekeepers, we need to first define what kind of information exchange the agents in the network can perform. To represent the exchange, we consider each agent as having the binary choice to either post the information they have gathered from other agents or not. We take posting information to mean that an agent makes it available to all agents connected to her, i.e. her "friends". This kind of action is relatable to the information exchange typical of Facebook, where agents can post information on their profile and all of their friends can read it. We use such posting actions as *model transformers*, namely as modal operators that update the model according to what information the agents posted. The notion of model transformer is taken from Dynamic Epistemic Logic [1], and it introduces dynamism to the static Network Logic.

The capabilities of gatekeepers essentially consist in the power to force an outcome to happen, namely either to let some information pass or not to let it. However, a gatekeeper can be composed of numerous agents. Only if all the agents cooperate and form a coalition, the gatekeeper as a whole has indeed such power. Coalition logic is designed to model the situation in which if all the agents in a set choose to do the same action, then they can enforce an outcome [3]. To illustrate, consider Figure 3. If agent a blocks the information, then the gatekeeper cannot enable the flow between the groups anymore. Consequently, we adopt the coalition modality that Coalition logic introduced and define *Coalition Logic for Posting Actions*. This logic results from Network Logic and the addition of a coalition modality. This framework is sufficient to capture the capabilities of gatekeepers.

References

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