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Ileana Maris

Ard Huizing

Wim Bouman

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# ON THE DEVELOPMENT OF ONLINE CITIES AND NEIGHBORHOODS: AN EXPLORATION OF CUMULATIVE AND SEGMENTIVE NETWORK EFFECTS IN SOCIAL MEDIA

Maris, Ileana, University of Amsterdam, Department of Information Management  
Roetersstraat 11, 1018 WB Amsterdam, the Netherlands, i.maris@uva.nl.

Huizing, Ard, University of Amsterdam, Department of Information Management  
Roetersstraat 11, 1018 WB Amsterdam, the Netherlands, a.huizing@uva.nl.

Bouman, Wim, University of Amsterdam, Department of Information Management  
Roetersstraat 11, 1018 WB Amsterdam, the Netherlands, w.bouman@gmail.com.

**Abstract:** *This paper outlines a research in progress set to study network effects in social media. The focus is on outlining the theoretical framework in which this study is embedded. The concepts of cumulative network effects and segmentive network effects are introduced to explain the processes by which social media can generate and maintain both a larger network of members (an online city) and a more personalized space within that larger network (an online neighborhood). Taking an actor network approach, it is theorized that cumulative and segmentive network effects are generated by unique assemblages of humans and objects engaged in meaningful epistemic relationships. This study contributes to theory by considering how the two network effects can be simultaneously fostered on the same platform and by taking technology into account as an active actor in online human activities.*

**Keywords:** *network effects, online cities and neighborhoods, social media, actor network theory.*

# 1. Introduction

Soon after it reached 500 million members in July 2010, Facebook launched a new feature called Groups ([www.facebook.com/groups](http://www.facebook.com/groups)). Groups offer the possibility to Facebook members to create, share information and communicate with smaller groups, such as family, school friends, work colleagues, etc. within their larger network of online friends ([www.facebook.com/groups](http://www.facebook.com/groups)). Similar recent developments are observed as well on other social media. The importance of these new features is that they are emblematic of a larger shift in the organization and functioning of social media sites, that from mass technology adoption to a more personalized technology usage (Huberman *et al.* 2008). Theoretically, they draw our attention to reconsider our conceptualizations of mass networked technology adoption: the value of a network for members does not seem to spring only from how many people are using the network (see Shapiro and Varian 1999), but also from how many of their close friends (Lin and Bhattacharjee 2008) or people sharing their interests are in the network.

This paper outlines a research in progress set to study the development of exclusive social networks on increasingly larger social media sites. In our discipline, network effects theory (Shapiro and Varian 1992) has guided insightful studies on the patterns of mass technology adoption. However, while taking a macro-level approach these studies focused on either only positive network effects (see Lee and Mendelson 2007) or viewed negative network effects as detrimental to the network (see Asvanund *et al.* 2004). Little attention has so far been given to how interactive technologies such as social media foster simultaneously both types of network effects, creating different types of social networks on the very same platform (Hummel and Lechner 2002). To obtain a better understanding of the interplay between the two types of network effects and their outcomes, the following research question is formulated: *How is the interplay between cumulative and segmentive network effects affecting how we organize ourselves on and through social media?*

In this paper, a theoretical framework is developed to explore the generation of the two types of network effects and their role in fostering and sustaining different types of social networks on social media. These two types of network effects are conceptualized as reinforcing each other, with cumulative network effects sustaining the growth of the total network of members and segmentive network effects facilitating the formation of personal networks within the total network (see also Hummel and Lechner 2002). To this end, this study builds on the IS literature on network effects by taking an actor network theory approach (Latour 2005). Actor network theory, originally developed in sociology, is gradually entering the IS field (Cordella and Shaikh 2006). Its importance to this research lies in that it puts forward a sociomaterial ontology and epistemology in which humans and technologies (in this case social media, music files, news items etc.) are viewed as “constitutively entangled” (Orlikowski 2007). The recent launching of the new Groups features on various social media, among which Facebook, offers a unique and timely opportunity to study empirically and to theorize the human-technological entanglements (Orlikowski 2007) that make possible the formation of smaller social spaces (Huberman *et al.* 2008) in increasingly larger and more complex networks of friends and acquaintances on social media.

The paper is structured as follows. Section two outlines a brief literature review and presents how this research builds on these studies. Section three develops the theoretical framework of this research. It introduces the metaphors of *cities*, *neighborhoods* and *metropolises* to theorize the interplay between cumulative and segmentive network effects in social media. Section four briefly presents the methodology while section five outlines the current stage of this research.

## 2. Network effects theory in Information Systems and beyond

In our field, three strands of research employing network effects theory (Shapiro and Varian 1999) can be identified. The first investigates only positive network effects and focuses primarily on non-interactive technologies. Examples are Zhu *et al.* (2006) on the adoption of open interorganisational systems and Kauffman *et al.* (2000) on banks' adoption of ATM's (cf. Lee and Mendelson 2007). The second strand focuses on interactive technologies and adds to the first an analysis of both positive and negative network effects. Examples are Asvanund *et al.* (2004) who focused on peer-to-peer networks and Lin and Bhattacharjee (2008) who investigated the adoption of Instant Messaging (cf. Butler 2004). Focusing primarily on network size, the authors in this strand of research concluded that as the network increases, it becomes more and more difficult for members to sustain meaningful interactions. As such, negative network effects are generated, which are detrimental to the quality of the network. The third is represented by studies on e-commerce. They add to the two strands mentioned above by discussing the social dynamics that make possible the simultaneous generation of both positive and negative network effects on the same platform (Hummel and Lechner 2002, Jones 2000). While these latter studies are closest to our interests, they are still limited in their focus on human interactions only. Like the authors in the other two strands of literature, they leave technology and the "constitutive entanglements" (Orlikowski 2007) between humans and technology unaddressed. As will be argued below, these constitutive entanglements are fundamental to the generation of both types of network effects in social media.

The present research builds on these studies in three ways:

- It theorizes network effects in social media from an actor network perspective (Latour 2005). It conceptualizes cumulative and segmentive network effects as fostered and sustained by epistemic relationships (Knorr Cetina 1997) in diverse assemblages of human and non-human actors;
- It brings technology to the fore as an active, agentic actor. Rather than being the backdrop of human interaction, social media is itself an actor fostering and sustaining network effects;
- It looks at cumulative and segmentive network effects as reinforcing each other. Social media is viewed as *a network of networks* that reinforce each other to create an online social space that is meaningful and ordered.

## 3. Cumulative and segmentive network effects in social media

Shapiro and Varian (1999) write that: "when the value of a product to one user depends on how many other users there are, economists say that this product exhibits network externalities, or network effects" (1999: 13). As such, the larger the network of people using a particular technology, the more valuable that technology will become to the people using it. The lesson Shapiro and Varian (1999: 175) give is that it is better to be connected to a larger network, than to a smaller one. It is this "bigger is better" aspect of networks, Shapiro and Varian (1999) argue, that brings about positive feedback through which large networks get larger and small ones get smaller. Negative network effects arise when the actions of some members in the network diminish the value other members derive from the network. Shapiro and Varian (1992) argue however, that negative network effects are less common, and that most information technologies encourage positive rather than negative network effects (see also Lin and Bhattacharjee 2008).

Recent theoretical and empirical analyses challenge Shapiro and Varian's (1999) idea that a bigger network is always better (see Lin and Bhattacharjee 2008, Asvanund *et al.* 2004, Hummel and Lechner 2002). Building on these recent analyses, this paper argues that the value of being connected to either a large or a small network is situational, depending on the

goals a member has for connecting to that particular network. It is argued that in social media, both larger and smaller networks are simultaneously fostered, by means of cumulative and segmentive network effects. Cumulative network effects are defined in this study as when the value of a network for a member depends on how many other people sharing objects of general interest (such as photos, news items, videos etc.) are in that network. Segmentive network effects are defined as when the value of a network for a member depends on how many close friends or people sharing objects of common interest are in the network.

The terms cumulative and segmentive network effects are preferred in this study instead of positive and negative network effects for the following two reasons. On the one hand, the terms cumulative and segmentive indicate processes of accumulation and segmentation of human and non-human networks that can be empirically researched, whereas positive and negative indicate an evaluation of such processes. On the other hand, positive and negative indicate opposing outcomes that cannot be reconciled. The terms cumulative and segmentive account for their simultaneous presence, by virtue of their mutual reinforcement.

The metaphors of *cities*, *neighborhoods* and *metropolises* are employed in this study to help explain the internal social dynamics in and across social media. Cities refer to the entire network of members and the content they post on a social media, neighborhoods - to interest groups within that larger network and metropolises - to the larger network of networks that develops among various social media sites. In what follows, the different types of social networks will be outlined by zooming in and out on one network at a time. In each network, the human and non-human assemblages will be traced, indicating how network effects are fostered and how they encourage or limit the networks' further expansion. Due to space limitations, a theoretical analysis will be given of network effects and their interrelation in cities and neighborhoods, while reserving the analysis of network effects from metropolises for the conference presentation.

### **3.1 Cities**

Looking at the entire platform of Facebook, one could easily identify elements reflecting an urban environment in its offline sense. The city of Facebook, or any social media for that matter, is a heterogeneous assemblage of people and objects. The inhabitants of such online cities have different interests, such as keeping in touch with friends (Wittel 2001), discovering new trends (Donath 2008), or socializing with strangers. They perform different roles, such as members, designers, administrators or advertisers. Likewise, they engage with diverse objects, be they profiles, pictures, videos, links to other sites, messages, or infrastructures such as the platform itself. Like in any physical city, one cannot separate people on Facebook from the objects making up the sociomaterial space of the media. On the contrary, what gives Facebook, or any other media, its character and meaning is the unique assemblage of human and non-human actors continuously present and actively engaging with each other in a "constitutive entanglement" (Orlikowki 2007) at any moment in time.

Objects and people on social media are constitutively entangled in the sense that they become meaningful only in relation to one another (Law and Mol 1996). Objects in social media, such as pictures, videos, news items, links to other sites, the platform itself etc. are social objects (Engeström and Blackler 2005) as they bring and tie people together (as when people discuss a picture posted on the site), they mediate their interactions and bring order (or disorder) to their social actions (Latour 2005). What keeps people and objects together in social media in a constitutive entanglement and what makes it valuable to its current and potential members are the epistemic relationships (Preda 1999, Knorr Cetina 1997) fostered among people and objects. Social objects, including the media itself, are open ended, continuously being defined in their interactions with other objects and people (Knorr Cetina 1997). This open-ended nature of social objects is matched by the people's continuous desire for knowledge, that due to the undefined nature of social objects, is never completely fulfilled (Knorr Cetina 1997).

In analyzing the epistemic relationships among people and objects developed in an online city and those developed in an online neighborhood, Tuomela's (2007) distinction between *I-mode* and *We-mode* sociality offers insightful starting points. A city could be said to encourage an *I-mode* sociality, in which an individual actor participates in a network in order to achieve a private goal that presumably he or she cannot achieve on their own. Whereas this private goal can be shared with all the members of the network – all the members, designers etc. of Facebook share the goal of achieving freedom to connect and share information (<http://www.facebook.com/principles.php>) - the individual members do not jointly intend to achieve this particular goal (Tuomela 2007). In *I-mode* sociality, the individual member is only weakly committed to the network. As such, he or she is not required to actively participate in the network and can leave without having to ask for permission from the other members (Gilbert 2007). Extending this argument also to the non-human members of the network, it can be argued that the people engaging with social objects in an online city are only weakly committed to each other and have no collective intention of achieving a common goal.

The epistemic relationships characteristic to the city dimension of social media are fostered in (and further enable) an *I-mode human and non-human* sociality. In the online city weak commitment to hundreds of acquaintances and their posts is common (Donath 2008), while anonymity and lack of social obligations for reciprocity are not excluded. The members continue to participate in the network and engage with social objects in order to achieve their private knowledge goals. City specific knowledge goals can include but are not restricted to (boyd and Ellison 2008, Donath 2008):

- Keeping informed about what acquaintances in the network are doing. The weak commitment to the network of members and objects is visible in the irregular comments posted by the members on the content their acquaintances post, such as holiday pictures, videos, links to favorite sites, personal messages, etc.
- Discovery of endless novelty. Here too, there is a weak commitment to the network of members and their content. Members are more interested in learning about general current themes or new stories than in the life of those who post them.

By nature of its ability to temporally fulfill never-ending personal knowledge goals or desires about friends and objects the assemblage of people and objects on social media will constantly attract and accumulate new members and new objects, generating *cumulative network effects*. As Preda (1999: 358) puts it: “the larger the network with its objects, the stronger its force will be, and hence its authority, legitimacy, and power”. Such object-centered accumulative power is exemplified by the ever expanding assemblages of millions of objects and members that Facebook, Flickr, Digg and other social media currently experience.

**Working hypothesis 1:** *The more the assemblage of people and objects in a social media help temporally meet the individual members' never-ending knowledge goals, at the lowest level of social obligation, the more value the assemblage will have for its current and potential members.*

### 3.2 Neighborhoods in cities

As empirical evidence has shown so far not all interactions scale up in social media (Hummel and Lechner 2002) or are needed to scale up to sustain cumulative network effects. Indeed, it has been argued that due to the size of the network and the diversity of its contents, miscommunications can occur, making it more difficult to maintain meaningful relationships and as such to sustain the network (Butler 2004). However, taking a closer look at Facebook or Flickr one can easily observe that the network is expanding by accumulating new members and content while at the same time segmenting itself into smaller networks. This argument resonates with Hagel and Armstrong's (1997) notion of scalability. The authors argue that a

scalable virtual community (or network) is able to grow without losing its “sense of community” by sustaining smaller sub-communities of interest (1997: 134). It is through the formation of smaller neighborhoods that the city of any social media can remain meaningful and valuable to its current and potential members.

Like in cities, neighborhoods in social media too consist of diverse assemblages of humans and objects constitutively entangled in meaningful epistemic relationships (Knorr Cetina 1997, Latour 2005, Orlikowki 2007). However, unlike in cities, the epistemic relationships forming in neighborhoods are fostered in (and fostering) a different mode of sociality, namely the We-mode sociality. According to Tuomela (2007), in a We-mode sociality, the members accept a common goal as being the group goal, rather than as a private goal. When acting as group members in a We-mode sociality, all members act in concert, they share a joined intention, and are collectively committed to achieving the group goal. Tuomela (2007: 4) argues that an important characteristic of We-mode thinking and acting is the we-perspective that requires all members to see themselves and others as members of the group, as “being in the same boat” or “stand or fall together”. It is the group goal that “glues its members together” and directs joined action. As such, its achievement must meet the Collectivity Condition: “the goal is satisfied if and only if it is satisfied for all other members” (Tuomela 2007: 4).

It can be argued, that the epistemic relationships formed in an online neighborhood are fostered in (and further fostering) a *We-mode human and non-human* sociality. Online neighborhoods in social media are formed either around close friends, colleagues or family members and their social objects as are the new Groups in Facebook, or around particular social objects related to certain hobbies or events that bring strangers together as in Flickr or Digg. In contrast to the city, the members of a neighborhood share a strong commitment to the network and to its human and non-human members. There is a higher pressure but also willingness to actively participate and contribute comments and content to the network (as there is also higher visibility of the members in the network, which is due to the predominately smaller sizes of neighborhood networks). The members cannot leave the network without informing the others. Similarly, new human and non-human members cannot join the neighborhood network if they are not granted access by the other members of the network. In Flickr for example, new members need to ask the group administrator for permission to join, which is granted only if those new members are willing to commit and contribute to the group. Likewise, pictures that do not meet the criteria of the group are not published on the group’s page.

In neighborhoods therefore, the members engage in unique epistemic relationships with other human and non-human members in order to achieve collectively accepted neighborhood knowledge goals. Based on the particular identity of a given neighborhood, such as sport groups on Digg or gear groups on Flickr, neighborhoods become valuable for their current and potential members as they temporally fulfill specific never-ending knowledge goals, such as:

- Keeping themselves up to date about neighborhood related new trends and news;
- Discovering endless novelty about neighborhood related new practices, themes, events etc.

By nature of the common we-perspective they sustain, the collective commitment that is required and the specialized knowledge goals they satisfy in the unique epistemic assemblages of humans and objects they accommodate, neighborhoods attract only certain types of members and objects while restricting the access of other types. As such, they foster *segmentive network effects*.

**Working hypothesis 2:** *The value of a neighborhood for current and potential members springs from how many close friends and acquaintances as well as knowledgeable people*

*sharing specific objects of their interests are there and willing to engage with them in meaningful epistemic relationships.*

### **3.3 Cities and neighborhoods**

As it has been argued above, social media simultaneously foster both cumulative and segmentive network effects by nature of the unique assemblages and epistemic relationships of humans and objects that make up their cities and neighborhoods. It is not excluded that the same actors (human and non-human) can be present and active in both cities and neighborhoods. Yet, it is argued that because they are fostered by different types of knowledge activities and with different goals, the two types of network effects can be seen as interrelated. On Facebook or Flickr the networks of humans and objects increase cumulatively by attracting new members and more content to the network while at the same time they segment themselves in smaller networks by delineating types of goals (private or collective), types of commitment (weak or strong), types of objects and types of knowledge. It is argued that it is the very interrelation between cumulative and segmentive network effects that makes the expansion of sites like Facebook or Flickr meaningful and ordered in the first place.

How is the interplay between cumulative and segmentive network effects affecting how we organize ourselves on and through social media? Examining empirically the epistemic relationships formed and sustained among humans and objects on social media can offer an insightful lens to find an answer to this question. The importance of processes of knowledge production for the generation of social order has been addressed by Preda (1999: 351) who argued that “if the possibilities for action are defined by epistemic resources then the generation of social order is coextensive with the process of knowledge production”.

The **third working hypothesis** of this study is: *Both cumulative and segmentive network effects are needed for an ordered and sustainable development of online cities and neighborhoods.*

## **4. Research methods and analysis techniques**

The above outlined theory is examined empirically through an actor network ethnographic approach. The empirical study focuses on two types of online networks (or communities). One type consists of the social networks currently developing on the social media sites Facebook, Last.Fm and Flickr. The other type consists of the social networks in the Warez Scene, a worldwide virtual file sharing community. The three authors have divided the research sites among themselves, while still maintaining close collaboration and having periodic discussions about the different research sites. The aim of this multi-sited study is to obtain an understanding of how network effects are fostered in different online settings in which epistemic relationships between people and social objects are central. Both social media and P2P networks can be characterized by these epistemic relationships between people and social objects. A comparison between social media and P2P networks would not only help better understand how cumulative and segmentive network effects are generated on these two types of networks. It will also help better understand the design of human and non-human networks, in particular how insights from one type of network could provide useful design principles for facilitating meaningful human and non-human engagement in the other type of network. At the moment of writing, fieldwork is still being conducted on the social media sites. As fieldwork on the Warez Scene is closest to completion, a description will be offered of the data collection strategies employed in the Warez Scene.

The Warez Scene is the source of most of the pirated material on the Internet. In this community people copy, crack and distribute copyright material such as games, music, movies and software. The Warez Scene is comprised of different areas, each with its own



objects of interest, organization and structure. As such, there is the MP3 area (also the most active one), the games area, music, television and movies areas. Each area is composed of releasegroups, each specialized in particular genres. In the MP3 area, there are groups specialized in dance, electronics, jazz or pop. As described by the members of this community, the key drivers for participation and contribution to the Scene are based on passion for the objects of their interest (such as music) and by anarchic and idealistic motives.

During fieldwork, an important guiding principle was the actor network approach to “follow the actors themselves” and begin the inquiries from “the traces left behind by their activity of forming and dismantling groups” (Latour 2005: 29). Therefore, in order to be able to better elucidate the nature and development of the epistemic relationships between the Scene’s members and the objects they engaged with, a series of tracking strategies were employed.

A first such tracking strategy was participant observation in the Scene, particularly in the MP3 area. A member of the research team was a true insider, who was involved in the Warez Scene for more than five years. This allowed for a study of the Warez Scene “from within”. For a period of six months, observations were made on the IRC networks EFnet and LinkNet, where members of the Scene gather to chat either in groups or in one-to-one conversations. Attention was paid to conversations related to preparing files for release, negotiations about how files should be encoded and released but also conversations about the members’ daily activities in the Scene.

A second tracking strategy was the creation of a database containing information about approximately 2.6 million releases starting from January 1998 to May 2007. This database was useful in providing information about the growth dynamics of the MP3 area. Two PHP scripts were created and used in order to extract relevant information from the database that can be used in statistical analysis. Additional insights were obtained from five in-depth interviews with members of the MP3 area. In these interviews, particular attention was paid to the personal stories of participation in the MP3 area, engagement with objects of interest (the MP3 files), learning, critical events within the area and prediction of the future with regard to the development of the area. All interviews were held on IRC and were anonymous. The duration of the interviews was between a couple of hours and 30 minutes. Apart from these five interviews, structured conversations were conducted with at least 15 members regarding subjects that needed more understanding. These members were carefully selected based on their experience, age and function within the MP3 area.

Due to the nature of the data obtained, both qualitative and quantitative analysis techniques were employed. The fieldwork notes and the transcripts of interviews and conversations were coded with codes obtained from previous literature, supplemented with new codes that emerged from the data itself. The unit of analysis was the subject-object-subject interactions. As for the database, the two scripts were employed to extract particular information: the first script was used to extract the amount of releases done per releasegroup per month and the second script was used to get an overview of each group, their total releases, total nukes, their start date and the date of their last release. The output of the scripts was later converted in order to serve as a dataset for descriptive statistical analysis.

## **5. Current stage of the research**

At the moment of writing, fieldwork in Facebook, Last.fm and Flickr is underway while the data obtained on the Warez Scene is being analyzed. Preliminary findings indicate that in the Warez Scene, which would correspond to the metropolis metaphor in this study, both cumulative and segmentive network effects are simultaneously maintained, sustaining the development of both cities and neighborhoods inside the Scene. Different cities have so far developed, each with its own social organization, internal dynamics and developmental

history. Examples of cities are the MP3, games, movies and television areas. Inside each of these cities, different specialized neighborhoods developed. In the MP3 city for example, there are the pop, electronics, jazz and dance neighborhoods.

From the preliminary analysis of the data on the Warez Scene, a number of insights were obtained that can help further improve the theoretical framework developed in this paper. Likewise, they can help direct the current fieldwork on the three social media sites. The first insight is that whereas both cumulative and segmentive network effects were observed as being simultaneously present in the MP3 area, it became clear that at different moments in the temporal development of the area one type of network effect was stronger than the other. This development did not follow an S-shaped pattern, as indicated by previous studies (see Asvananund *et al.* 2004). On the contrary, a double-curve pattern was observed:

- Until mid-1990's, segmentive network effects sustained highly committed, independent neighborhoods of releasegroups. From mid-1990's to 2004, these segmentive network effects were overtaken by cumulative network effects attracting more rippers and more MP3's. This increase in members and MP3 files resulted in the formation of the MP3 city.
- From 2004 until present, cumulative network effects have been supplanted by segmentive network effects. While the city is still attracting new members and new MP3 files, certain releasegroups that show a strong we-commitment are also developing, indicating the formation of new neighborhoods through segmentive network effects.

Following this observation, time became an important concept for refining the present theoretical framework. Therefore, an exploration of the temporal dimension of the development of both online cities and neighborhoods became necessary. Questions such as "When do online cities and neighborhoods develop in the history of the particular social media?" or "How long does their development take?" are being addressed.

Second, it was observed that particular events that took place inside as well as outside the MP3 city had great effects on the social dynamics inside the city and its neighborhoods. These events can influence which type of network effect will become stronger or weaker at a given moment in time. Internally, it was observed that as online stores were recognized by the MP3 Council (established in 1998) as valid alternative sources of music files, more rippers could and did join the MP3 city. The collective commitment in the releasegroups weakened following the influx of more self-oriented rippers. As more rippers joined, bringing in more MP3 files, cumulative network effects became stronger. Externally, it was observed that the anti-piracy campaign against the distribution of music files had the effect of strengthening the we-commitment inside certain releasegroups, making members more wary about distributing practices of other rippers. Segmentive network effects became stronger in this case. In the fieldwork in the three social media, closer attention is now paid to particular internal or external critical events that might influence one type of network effect to be stronger than the other. Inquiries are made into the role of such events as shifts in corporate image of the site, design decisions as well as networking initiatives undertaken by the members themselves.

These two particular insights further draw the authors' attention to issues of community design, in particular to whether cumulative and segmentive network effects can and should be designed for. Obtaining the designers' own perspectives on this issue would add an extra layer of understanding of the development of online cities and neighborhoods. Conversely, understanding the nature of the development of network effects in both social media and P2P networks could provide a useful knowledge base for thinking about designing sustainable communities of humans and objects, in which epistemic relations between the two are central.

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