

Coterie: A Visualization of the Conversational Dynamics within IRC

Dana Sean Spiegel

S.B., Brain and Cognitive Science, Massachusetts Institute of Technology (1999)

Submitted to the Program in Media Arts and Sciences,
School of Architecture and Planning,
in partial fulfillment of the requirements for the degree of
Master of Science in Media Arts and Sciences
at the Massachusetts Institute of Technology

August 10, 2001

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Abstract

Social patterns are observable in real-world interactions as visual cues. Online, however, there are few visual cues available that can be used to see and understand social patterns. In this thesis, I suggest that many of these social patterns are still present in our interactions online in text chat; they are merely encoded in the textual interactions. This thesis presents *Coterie*, a visualization of the conversational dynamics of an Internet Relay Chat(IRC) channel. Through *Coterie*, viewers can see the social patterns that underlie the text interactions between conversants. Using the chat messages posted to an IRC channel by users, *Coterie* builds statistical models for individual and channel-level interaction based on existing real-world sociometric models. *Coterie* also automatically separates out conversations using a conversation model based on a word usage algorithm. This information is then presented to the viewer through a novel display based on models for real-world small group interaction, which allows the viewer to see historical patterns of user interaction, such as a user's verbosity, as well as channel-level patterns, such as cohesiveness. The visualization is evaluated based on how well it makes such patterns visible, and further directions for its development are presented.

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The following people served as readers for this thesis:



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1 Acknowledgments

Though this thesis is the culmination of my two years as a Masters student at the MIT Media Lab, it is the product of my six years at MIT, and the interactions and collaborations I have had with many people over those years.

I would like to thank:

My advisor, Judith Donath, head of the Sociable Media Group. You have taught me great things about social research and design, and I am indebted to you for giving me the opportunity to pursue research at the Lab.

My thesis readers, John Maeda and Justine Cassell, who have enhanced this thesis through their guidance, and provided worthwhile feedback about its organization, design, and content.

The members of the Sociable Media Group: danah boyd, David Chiou, Kelly Dobson, Scott Golder, Jonathan Goler, Tina Huang, Karrie Karahalios, Raffi Krikorian, Hyun-Yuel Lee, Matt Lee, David Nguyen, Daniel Ramage, Roy Rodenstein, Joey Rozier, Derek Tang, Fernanda Viégas, and Rebecca Xiong. The Sociable Media Group has been my home for the last two years, and you have all helped me to challenge my thinking and design.

The Digital Life Consortium for supporting this research.

My friends at the Media Lab: Pascal Chesnais, Adam Smith, Jim Youll, Sunil Vemuri, Rebecca Reich, Youngmoo Kim, Mike Annany, Doug Koen, and many others. You have made the Lab a fun and playful place for learning and exploration.

Regina Joseph, who started me on the path to media and design. You have always challenged me, and have been one of my most dynamic, interesting, and fun friends.

My friends at home in New York: Jason Menkes, Eric Poretzsky, Matt Klein, Elissa Donenfeld, and many others. We've waited patiently for six years for all of us to be together again in New York. You have always been supportive and, whether or not you understood what I was talking about (even I'm not sure I do...) you were and still are always excited to listen.

Eric Plosky, best friend and partner-in-crime, for making these six years at MIT exciting and fun, and for never settling for anything less than the best from me.

Mindy Spire, for your love and support.

My mother, father, sister, and brother for always believing in me and supporting me. You have more influence upon my life than you know, and I am forever grateful for such a loving family.

2 Introduction

2.1 Social Beings in a Visual World

As social beings, we learn from a very early age how to interact with others in a social setting. Much of our understanding of how such social groups work and how we can interact with them derives from appearance. By observing a group of people interacting, we can understand their social dynamic. How people interact and converse with one another, how they move from conversation to conversation, and how their presence and level of activity changes over time are all patterns of small group interaction that we can understand by viewing such groups of people.

Imagine you are walking through a city square on a nice summer day. As you walk, you encounter people strolling and window-shopping.

Ahead, you see a gathering of people, arranged in a circle, who seem to be paying attention to something within the group. You walk up to the edge of the crowd, realizing that there must be something of interest within the circle, perhaps a street performer. How do you know that there is someone or something of interest beyond your view? You have watched the people in the group interact: there are people who are attending to whatever is going on within the circle, people who are talking to those around them, and people who are drifting into and out of the crowd. All of these visual patterns tell you that there is something interesting at the center of the group. If the people ahead of you were not engaged, or were running into and out of the crowd quickly, then your impression of what was going on in that space might be completely different. Patterns of social activity allow us to visually gather, or “read,” information about the group.

Alternatively, imagine you are at a cocktail party. You’ve just walked into the room, and there are a number of guests that have already arrived. Some you recognize as friends; others look completely new to you. As you glance around, you notice that most of the people in the room are interacting with one another. Moreover, there are a number of small groups, each with only a handful of people. In most of these groups a lively conversation is taking place. In some of the groups, people seem to be either drifting apart or moving into other conversations. Some groups are just forming, gathering people together into what seem to be growing conversations. There are people, mostly those milling around the edge of the room, who don’t seem to be interacting with anyone else; either they are com-

pletely absorbed in thought, or are glancing around, as you are, looking for a lively conversation to join.

In both of these scenarios, it is clear how important the appearance of each person, as well as the appearance of each group taken as a separate and coherent whole, is to our ability to understand social interaction. When you are at a party, and people form cliques, you can see at a glance groups of people who are having animated, dynamic, and therefore perhaps interesting conversations that you would like to join. You can also easily see dead conversations: those in which participants are looking around in search of another conversations, or are sipping their drinks quietly, barely saying anything to the people around them. There are the people-watchers, who watch the unfolding of the social situations around them, reading the groups and the interaction within them with interest, and perhaps learning about the participants in those groups.

Imagine trying to accomplish any of these tasks without sight. By carefully listening to the people around you, you might still be able to sense which groups are interesting and dynamic. However, your ability to distill this information depends on how well you can map out the conversations in your head. The visual portrayal of conversational groups in the real world is a concise and rich encoding of social patterns. We gather important information as our perception moves from the individual, to small groups, to the entire social landscape. Without the visual dimension, groups become mostly incomprehensible: we may be able to sense some disjoint information about a con-

versation—perhaps that person A is talking to person B—but the overall picture, and how each person fits into that picture, is hidden.

The Internet, through various communications channels such as email, multi-user dimensions (MUDs), Usenet, and Internet Relay Chat (IRC), is a social medium. We interact socially with each other online. We form conversational groups online, have discussions, and gather socially. Yet the visual expression of our group interactions is quite different on screen than in real life (there is minimal visual representation for users and groups in many cases), though behaviorally the interaction is very similar. When we interact in real time through online chat for example, we might play out the same social roles as at a cocktail party, but without most of the visual feedback that would allow us to navigate the social space with ease.

2.2 Coterie

Social patterns are observable in real-world interactions as visual cues. Online, however, there are few visual cues available that we can use to see and understand social patterns. In this thesis, I suggest that many of these social patterns are still present in our interactions online in text chat; they are merely encoded in the textual interactions. We can make these patterns visible by discovering what the patterns are, extracting them from the chat, and visualizing them in an understandable way. The choice of which patterns to extract—or even which patterns are extractable—and how to visualize those patterns is driven by social issues as well as cognitive principles. By making these social patterns visible, we can create online social

spaces that are more easily navigable, more intuitively understandable, and more revealing of the types and depth of social interaction taking place.

This thesis will present *Coterie*, shown in Figure 1, a visualization of the conversational dynamics of an Internet Relay Chat (IRC) chan-

Figure 1 Coterie. Coterie is a conversation-centric visualization for IRC chat. Each user is represented by a colored oval, and when a user posts a message, they “hop” above the crowd. When users are having a conversation, they are brought together into the center area of the display. Users who don’t interact (“lurkers”) exist in the background.



nel. Through *Coterie*, viewers (people who are watching *Coterie*'s visualization) can see the social patterns that underlie the text interactions between conversants. *Coterie*'s main goal is to make clear how each user (a person who is chatting in an IRC channel through a traditional interface) interacts within the channel, as well as to separate and distill the conversations between users on a channel (where there can be many conversations taking place simultaneously). *Coterie*'s visualization, which draws its

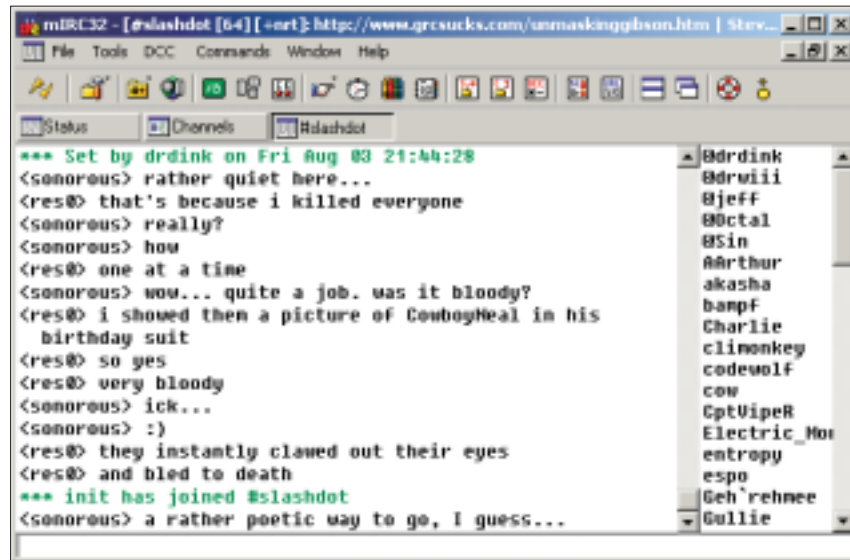
information from statistical models describing how users within a channel interact, can give viewers a rich display that encodes aspects of user behavior such as activity and verbosity. The visualization also portrays information about the channel as a whole, such as its cohesiveness. Along with this statistical information, *Coterie* automatically groups users based on the conversational thread in which they are currently participating. The visualization of this information can allow users to see, for example, who is talking to whom or which conversations are lively or boring. All of this information is gathered automatically over time from the chat messages that users post publicly to the IRC channel.

This thesis will discuss the pieces that make *Coterie* work: a statistical model of chat activity, automatically generated user representations, multidimensional interaction information display, and conversation separation. I claim that all of these components combine to create a visualization of IRC that is dynamic and information rich, is easily readable using already developed visual and social skills, and portrays the historical, social, and conversational patterns of users within a chat channel.

2.3 *Internet Relay Chat*

IRC, shown in Figure 2, is a well-known and popular chat system that presents both users and their messages as lists of text (Internet Relay Chat Protocol, 1993). A user can join a channel, and read or publicly post messages to the channel. In IRC, viewers can see the group of people currently within the channel as a list of names. Mes-

Figure 2 mIRC. mIRC is a standard IRC chat interface. Users are shown in a list on the right, while the chat is shown on the left.



sages posted to the channel are displayed in an list, ordered by their time of post. Though this interface is simple, it provides a rich environment for social interaction, and users of IRC gather and converse easily and fluidly.

Though the interface is very simple, IRC, like other purely text-based chats, is very popular. It is easy to use and has an almost transparent interface: all that users must do is type a message, and it appears within the channel. Addressing particular users is done by prefixing their user names to the message. Joining conversations requires no extra effort; a user only has to take his turn and post a message continuing the conversation. As a result, the only barriers to interaction within IRC are social ones. A user's ability to interact within a channel or join a conversation depends on the social etiquette of that channel as well as that user's social skills.

Within IRC, user representations are very basic. Each user in an IRC channel is represented only by his name, and differentiating users requires reading their names (though for some creative users, their uniquely chosen user names can be distinguished by visual pattern matching). A user's history in the channel is encoded completely in his chat postings, and users who don't participate in the chat have no visual differentiation from users who do. Generally, when using the IRC interface, users attend to the chat window, and not to the current users window. As a result, those users who don't chat seem to lurk—they become functionally invisible to active users, who often forget that such lurkers are there.

This text only interface, however, makes “reading” the group of people online difficult. The IRC interface requires constant attention to keep track of the activity on a channel. Though users can scroll back to see the content of conversations, they must read a significant portion of the transcript to keep track of which user belongs to what conversation, and to have a sense for the time-course for these conversations.

Coterie makes use of this already established community as a base for its visualization. IRC presents an ideal system for discovering and displaying information about conversations and interaction. The patterns of interaction discussed in Section 2.2 already exist within IRC, and using the text interactions of users within the chat system, *Coterie* can make these patterns visible. This thesis will discuss how *Coterie*'s visualization and modeling systems compare to the way that the

traditional text interface for IRC portrays conversation and interaction.

2.4 Existing Interfaces for Online Chat

Coterie is a visualization. However, it is useful to compare its design and display of social interaction to that of existing graphical chats; these graphical chats provide a baseline against which to compare and evaluate *Coterie's* visualization. All of these chat systems use text chat for user communication; however, each has unique characteristics and affordances for interaction, and *Coterie* builds upon the ideas presented by these chat interfaces. These graphical chats also present different models for social interaction, reflected in their interfaces. As such, they are useful for understanding the model of social interaction that *Coterie* uses, as well as the assumptions that it makes about the interaction within IRC.

ChatCircles, shown in Figure 3, is an abstract graphical chat system, where people, represented by circles, can move their representations around the chat space (Viégas and Donath, 1999). *ChatCircles*, by providing a graphical chat space, creates a visual display for the social interaction in a chat room. Every user is represented by a colored circle. Coloring, in this case, provides a visual characteristic with which to differentiate users. Since users actually move through a space on screen, they can also be tracked and differentiated through their location and motion. *Coterie* also uses a simple, abstract representation for each user with a channel.

Figure 3 ChatCircles. In ChatCircles, each user is represented by a circle that grows and shrinks as they post messages. Since ChatCircles has a “hearing range”, users must be near each other to have conversations. As a result, users move themselves into conversations groups, and those groups are shown visually by the appearance of clusters of people.



Though users still interact through text chat, a user’s activity level, as well as the overall activity level of the chat room, can be visually discerned by watching the expansion and contraction of the circles in the display. When a user doesn’t post messages, they appear as a small circle; even lurkers have this minimal visual presence. *Coterie* also employs a simple shape for user representations, but uses color, size, and motion to portray more information about each user’s interaction. From the history mode in *ChatCircles*, longer-term interaction patterns become apparent. *Coterie* builds on *ChatCircles*’s presentations of different time courses for interaction information, and integrates both short-term and long-term interaction history into a single display.

ChatCircles enforces a virtual hearing range: when users are beyond a certain distance, their chat messages can't be seen (though their circles still grow and shrink). The hearing range, which requires users to be close to one another to interact, causes users to form conversation groups. As a result, *ChatCircles* provides a conversation-centric environment for chat. *Coterie*, by contrast, automatically moves users close together when it believes they have formed a conversation group. Both of these systems, however, provide conversation grouping that allows viewers to easily follow conversation threads.

The Palace, shown in Figure 4, is an iconic chat system where people are represented by small, two-dimensional cartoonish figures (*The Palace*, 2000). *The Palace* is also a graphical chat, though different from *ChatCircles*. Users are represented graphically by icons, and can position themselves anywhere within a chat room. A user's represen-

Figure 4 The Palace. The Palace is a graphical chat where users are represented by icons. They can jump around the room, and talk to anyone who is present. Unlike ChatCircles, there is no "hearing range", so users often have conversations from across the room, and individual conversation groups can be difficult to separate out. Users can change and animate their representations, giving them greater ability to express their personalities.



tation in this system provides virtually no information about a user's activity; For example, a user's icon doesn't change when he posts a message (though a bubble does appear over his head).

The Palace does offer a user the ability to customize his representation on screen, allowing him a way to express identity within the chat. User representations in *The Palace*, therefore, are unique reflections of their users, since users can represent themselves in chat rooms through icons that are meaningful to them, and that portray part of their personality. *Coterie* provides a more mutable and fluid reflection of each user, based on how he interacts within a chat channel. Unlike *The Palace*, however, *Coterie's* representations are not directly changeable by users and are therefore less representative of how a user chooses to appear. Instead, *Coterie's* user representations are reflections of how a user acts in a channel.

BodyChat, shown in Figure 5, is an avatar-based chat system, where users are represented by three-dimensional, humanoid avatars that have some autonomous visual behavior (Viljalmsson and Cassell, 1988). Unlike other chat interfaces, a user's representation is controlled, in part, by an agent that can provide visual, body language-based cues:

BodyChat is a system that allows users to communicate via text while their avatars automatically animate attention, salutations, turn taking, back-channel feedback and facial expression, as well as simple body functions such as blinking of the eyes. (Viljalmsson and Cassell, 1998)

Figure 5 BodyChat. In BodyChat, users are represented by three-dimensional avatars. When interacting with others, a user's avatar automatically signals conversational cues, such as nodding and waving.



BodyChat's user representations contain information about the conversation. Though the system is limited to one-on-one interaction, the displays that each avatar produces allow users to “read” each other. *BodyChat's* interface is intended to be realistic, as opposed to *ChatCircles's* or *Coterie's* more abstract representations. The cues that are played out by *BodyChat's* avatars are specific motions that occur when users behave in certain ways.

BodyChat creates a display where body language is viewable. The visualization makes many assumptions about how a user wants to

communicate and about the user's intentions. These assumptions, based on *BodyChat*'s model for conversational interaction, free users from manually enacting certain behaviors, allowing them to concentrate on the chat:

Many visual cues important to conversation are spontaneous and even involuntary, making it impossible for the user to explicitly select them from a menu. Furthermore, the users are often busy producing the content of their conversation, so that simultaneous behavior becomes a burden. (Viljalmsson and Cassell, 1998)

This autonomy, however, can be heavy-handed; it “raises concerns about the system's capability to accurately reflect the user's intentions under unforeseen circumstances or resolve issues of ambiguity” (Viljalmsson and Cassell, 1998). While *BodyChat*'s displays are not necessarily suitable for giving an overview of a large number of users—its interface is intended for one-on-one interaction—the avatars do allow users to “read” each other.

Like *BodyChat*, *Coterie*'s visualization is built around the autonomous display of social information. However, this information takes the form of social *patterns*, not *cues*. In this case, the social cues in *BodyChat* are displays that signal certain behaviors and generally have expected responses from other people. The social patterns in *Coterie*, on the other hand, are comprehensible arrangements of people or behaviors that display information about those people, and generally have standard interpretations to outside viewers. There is also a difference of perspective: Cues are signals between two or more

Figure 6 Comic Chat. Comic Chat automatically creates a visualization of IRC based on a comic book metaphor. Users are represented by two-dimensional avatars of their choice, and can pose the avatars using a simple interface.



people, whereas patterns are signals recognized by an observer from a distance. These patterns are tracked by collecting statistical information about each user's activity, and this information is then used to create each user's representation, as well as to determine the overall layout of users within the channel. As a result, *Coterie* provides less information about conversational turn taking, instead presenting the viewer with information about individual and channel level activity and historical performance.

Comic Chat, like *Coterie*, provides a visualization of IRC. As shown in Figure 6, *Comic Chat* allows users to interact through the text chat interface, and automatically assembles comic book-like displays of the chat. *Comic Chat* provides very stylized two-dimensional representations, and gives users the ability to pose the avatars or allow the system to choose an appropriate pose. Like *BodyChat*, this system is

intended to allow users to chat without having to constantly control their avatar:

A second problem with current graphical chat programs is the requirement that participants must spend a significant amount of time doing things other than chatting. Most graphical chat programs require that participants navigate the room (or world), looking for an interesting conversation. (Kurlander, Skelly, and Salesin, 1996)

Coterie and *Comic Chat*, and to a lesser extent *BodyChat*, all address this issue.

Comic Chat's display is based on a comic book layout. As a result, the visual representation of the channel is very stylized and rigid. Due to space constraints, each panel only shows only a handful of users, and leaves out any user not currently participating in the chat. To form conversation groups in this interface, users either have to prefix their messages with another user's name (a technique that is used in IRC already to personally address messages, and one that *Coterie* makes use of as well), or they must explicitly click on a target user within the *Comic Chat* interface. Since there are at most only about five users in any frame, *Comic Chat*'s conversation grouping can only represent small conversation groups or small parts of larger conversation groups. *Coterie* uses a more sophisticated model that can group all conversation participants together simultaneously.

The nature of *Comic Chat*'s display does create an easily readable history of a chat, and it provides a view of the history of the channel that can be scanned and understood quickly. The comic form, how-

ever, can introduce misinterpretations of conversations. The stylized form of the avatars can make all conversations appear amusing, even though the text of the conversation doesn't match that tone. By displaying only a few of the currently active users in each frame, the context of the conversation, as well as the size of the conversation groups, can also be obscured. The relative time-course for conversations in *Comic Chat* is similarly destroyed by segmenting them into panels. While a viewer can still tell that one message came after another message, the amount of time that elapsed between the two messages is not shown, which can make rapid conversations indistinguishable from slower ones.

Coterie takes a different approach from *Comic Chat* by producing a view that is more abstract, as well as inclusive of all of the members of a channel. As a result, user activity can be contextualized based on how other users are acting. Furthermore, since chat messages in *Coterie* maintain their time component, viewers can more easily follow the time course for a conversation.

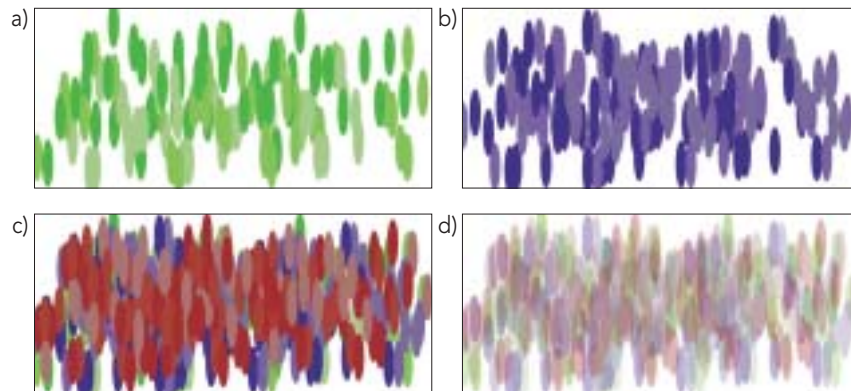
3 *Coterie's Evolution*

3.1 Dynamics in a Real World Social Space

The visualization used in *Coterie* was first developed in the fall of 1998 as a way to visualize how people were interacting with each other in a real world space. The visualization displays a virtual representation of the Media Lab atrium during a sponsor event, where professionals, students, and professors socialize with each other, using information about where each person is within the real world space.

The system discovers who is interacting with whom and how each person moves within the atrium over the course of the event. The visualization then categorizes each person based on different characteristics, such as research affiliation, gender, or age. To understand how this relatively diverse group of people move into and out of

Figure 7 Visualization of Real World Interaction. In these displays, people are represented by colored ovals that follow their motion through the Media Lab atrium. (a) and (b) show two different sets of people, NIF and TTT sponsors, respectively. (c) shows three sets of people within the room: NIF, TTT, and DL (Digital Life, in red). In (d), the groups each have transparency, so people in the background can be seen.



groups as well as how each set of people differ in how they interact—for example, students might be a more insular group than professionals—the interface shown in Figure 7 was designed.

In this visualization, each person is displayed as an oval that tracks on screen the person's real world location. The perspective of the display is a $\frac{3}{4}$ view: The viewer sees the crowd from an elevated platform, maintaining the impression that he is watching a group of people, but allowing him to see into the crowd more easily. (In this case, though a bird's eye view would provide an unoccluded view, it is a very unnatural viewpoint for people-watching.) Each set of people is given a hue: the people affiliated with the News in the Future (NIF) research consortium are green, for example, and people affiliated with the Things That Think (TTT) research consortium are blue. The saturation of each oval carries information about the corresponding person, such as how long they have been at the Media Lab.

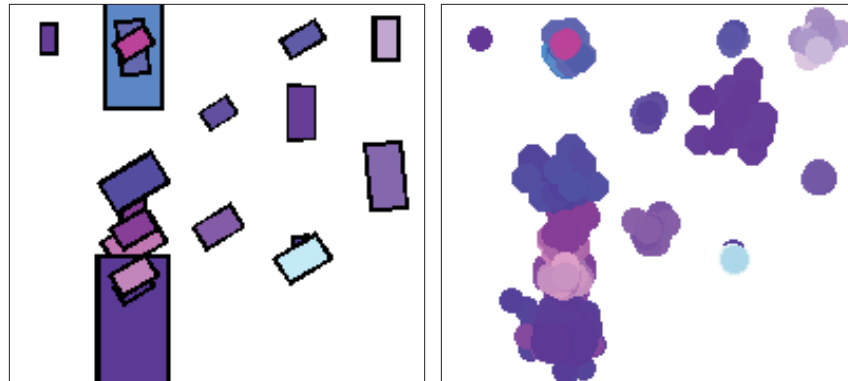
Showing only one set of people on the display, as in Figures 6a and 6b, allows the viewer to see how that set of people moves around in

the space, and shows correlations between certain sets of people and different levels and types of interactions, as present in the raw data. A viewer might notice, for example, how saturated ovals interacted with non-saturated ovals, thus showing how a longer affiliation with the Media Lab affects personal interaction among Lab sponsors. Different sets of people can be overlaid on the display, such as in Figure 6c. This visualization would emphasize differences between sponsor groups. For example, TTT people might interact predominantly with other TTT people, while NIF people might interact mainly with people outside of the research group. Since some people in the display are blocked by other people, the transparency of each set of people can be adjusted, as shown in Figure 6d.

3.2 Multidimensional Abstract Displays of People

During the spring of 1999, while working on this visualization of real world interactions, development began on qualitative displays of information that encoded multiple data about a set of people. To explore this idea, *PainterlyVisualization* was designed, which is a program that visualizes multiple types of data in an abstract way. Figure 8 shows two screen captures of the display. About 25 people filled out a questionnaire, providing raw data, such as age, gender, and number of years affiliated with the Media Lab. This visualization paints a portrait of the group of people as represented in the data. Each person is represented by a different object, and the different dimensions of that object are bound to data about that person (as shown in Figure 9).

Figure 8
PainterlyVisualization. Data about a set of people is painted on screen in an abstract manner. In these displays, position, hue, saturation, and brightness can be bound to data about each person. Rotation and clustering are also available dimensions.



While the data itself are quantitative, what is important in this display is the qualitative representation of each person. This is a key concept that is present throughout the work presented in this thesis. In real life, when we look at someone, we do not necessarily know their exact age, or other exact information about them. What we can see are general qualities about them: their race, how young or old they are, or the type of clothes they are dressed in. The quantitative measures, such as their exact ages, are not important. What are important are the qualitative things we can know

Data	Visual Dimension of Stroke
Number of siblings	Horizontal location
Room number in building	Vertical location
Age	Size
Soda Preference	Rotation (left = Pepsi, right = Coca-Cola, center = neither)
Media Lab group affiliation	Hue
Years at Media Lab	Saturation (or variation of saturation for dot view)
Number of countries visited	Coherency of dots

Figure 9 Data Bindings in PainterlyVisualization

about a person, and how those qualities relate to everyone surrounding that person. This is the core idea behind *PainterlyVisualization* and one of the driving forces behind *Coterie's* visualization. Though the measures that are made about people do deal with numbers, when this data are presented visually, one of the best

ways we can understand the social patterns within the data is by creating visualizations that emphasize qualitatively how one person is similar or different from another, and how one group of people relates to another group of people.

In PainterlyVisualization, there are four classes of data representation that build upon human abilities to distinguish different visual dimensions: *relation to environment*, *relation to others*, *categorization*, and *intensity*. These classifications are discussed in an unpublished paper called “PainterlyVisualization: Using Abstract Painting Techniques to Visualize Social Data” (Spiegel, 1999). This paper outlines these four classes of visual dimensions, and discuss the types of data that are best represented using these dimensions. Unfortunately, in PainterlyVisualization the relationship between the people and their representations on screen is too abstract and disconnected to be intuitively meaningful. *Coterie*, in its current form, addresses this issue, so that each user’s representation appears as a close and individual reflection of the person it is portraying.

3.3 Initial Implementation of Coterie

Research into real-time text chat systems began during the winter and spring of 2000. The first version of *Coterie* was built to understand how users interacted online, and to see the dynamics of those interactions in the same way that the dynamics of people interacting in the real world were seen. *Coterie* as shown in Figure 10, was designed using the visualization of the dynamics of a real world space, along with techniques from *PainterlyVisualization*.

In this first version, *Coterie* represents each user as an oval and gathers statistics about how they interacted within an IRC channel. *Coterie* also collects channel level data, such as turnover in membership. This statistical information is then mapped into an oval's size, brightness, and saturation. This version of *Coterie* uses a simple gravity model that causes anyone that posts a message to bounce into the center of the display. Each channel is given a hue, and everyone in that channel appears in the same color, though with different saturation, brightness, and transparency. In this version of *Coterie*, most users appear as anonymous ovals.

Figure 10 First Version of *Coterie*. In this visualization, users in each channel have a uniform hue. Multiple channels can be compared to each other to see the differences in interaction. Here, the Macintosh group (at the bottom) is very active, but there are only a small number of people in the channel. The Slashdot channel (top), on the other hand, has many people, but virtually no one is participating in a conversation.



This visualization was built to allow comparisons between different channels in IRC. *Coterie* incorporates channel level data into the display by mapping these statistics into changes in the overall appearance of the channel. For example, a channel where a large percentage of people are talking is shown as having a narrower distribution of ovals than one where most users are just lurking. In many cases, the particular patterns are emergent from the mappings of individual statistics into particular visual dimensions. By showing multiple channels next to each other differences in the activity levels of these channels is readily apparent. Figure 9 shows three different channels; the Slashdot channel has many users who appear to be lurkers, the Everything channel has fewer users, but still many lurkers, and the Macintosh channel has fewer people still, but most of them show a high level of activity. This comparison reveals the different interaction patterns within each channel, and provides context for relating the activity level of each channel to the group of channels as a whole.

3.4 Coterie Revisited

Coterie was further developed and refined during the spring and summer of 2001. During these months, it became clear that grouping all of the active users into the center of the display was not sufficient for creating an intuitive display of chat activity in IRC. The visualization also had to separate out the different conversations, so that the groupings of people represented separate conversation groups. *Coterie's* current form, seen in Figure 11, has a conversation finder,

discussed in Chapter 7, which introduces meaningful spatiality into the visualization and creates a more understandable display.

This evolution of *Coterie* also introduces more dimensions onto which the system can map richer sets of interaction data. A full physics system allows mass and bounciness to portray information, and each is now represented in his own hue, to create more identity in individual representation. Long- and short-term motion and dimension change are used to portray long- and short-term statistics. As a result, the display is more lively and more readable, and each user appears more as an individual when he is active within the channel, while still fading into the crowd when he is lurking.

Context plays an even more important role in the current version of *Coterie* than in its previous iterations. *Coterie*'s representation of each

Figure 11 Coterie's Current Visualization. Coterie's current visualization gives each person his own hue, and separates out conversations automatically. The visualization also employs a full physics system, so that each oval has a mass and a bounciness that can be used to portray more information, as well as to create a more organic display.



user can be compared and contrasted to those of other users in the channel, as well as to a visual average of the channel as a whole. As a result, viewers can see that the activity level of one user in a chat where everyone is active is visually different from the appearance of a user with the same activity level in a channel where there is no one else chatting.

Coterie and its predecessors have always centered upon displaying the patterns of dynamics and activity in social interaction. The evolution of the visualization is based on observing and researching how real world socialization works, and then bringing those techniques and ideas over into the domain of online interaction. The result is a visualization that is similar to the real world appearance of people interacting, and thus builds on our ability to visually understand social interaction.

4 Statistical Model of Chat Activity

4.1 Real World Social Measures

Real world social interaction is second nature. When we gather to socialize and talk, our actions, on both an individual and a group level, are understood automatically. By watching a set of people interact and converse, an observer can easily see the conversation groups that form and disperse, can see who the active and inactive people in the groups are, and figure out, to a certain extent, the social dynamic within those groups. I will refer to this ability throughout this thesis as “reading” a group.

This ability to read a group of people is implicit to our understanding of human interaction. Though it may be easy to say that a particular set of people form a conversation group and that group is tightly

knit, objectively, these are qualitative judgments based on a number of underlying assumptions as to how those people interact with one another.

To make this quantification process more explicit, the fields of sociology, sociometry, and social psychology have devised certain measures of small group interaction. (Though these measures are only a partial list of ways to describe how people interact, and though researchers don't fully agree on exactly what these measures are and what they mean, they nonetheless form a useful model for understanding group interaction.) By using these real-world models, a preliminary model for interaction on IRC can be devised that defines interesting and pertinent measures for keeping track of social activity.

Hemphill and Westie were the some of the first researchers to scientifically study the dimensions of groups. In their 1950 study titled "The Measurements of Group Dimensions," they describe fourteen measurable characteristics of group behavior (Hemphill and Westie, 1950). Borgatta et al. explain these dimensions in their critique "On the Dimensions of Group Behavior" (Borgatta, Cottrell, and Meyer, 1956):

Autonomy is the degree to which a group functions independently of other groups.

Control is the degree to which a group regulates the behavior of group members.

Flexibility is the degree to which a group's activities are marked by informal procedures rather than by adherence to rigidly structured procedures.

Hedonic Tone is the degree to which group participation is accompanied by a general feeling of pleasantness or agreeableness.

Homogeneity is the degree to which members of a group possess similar characteristics.

Intimacy is the degree to which members of a group are familiar with the personal details of one another's lives.

Participation is the degree to which members of a group apply time and effort to group activities.

Permeability is the degree to which a group permits ready access to membership.

Polarization is the degree to which a group is oriented and works towards a single goal which is clear and specific to all members.

Potency is the degree to which a group has significance for its members.

Size is the number of members of the group.

Stability is the degree to which a group persists over a period of time with essentially the same characteristics.

Stratification is the degree to which a group orders its members into status hierarchies.

Viscosity is the degree to which members of the group function as a unit.

Almost all of the fourteen measures above seem to be applicable to purely social groups. The one characteristic that does not seem to

fit—polarization—can be rephrased for use within this particular domain of study. In place of *working towards a single clear and specific goal*, we might describe polarization as *the degree to which a group maintains the conversation on the topic of the chat*. We can also define a new measure, cohesiveness, which describes *how well users stay within their particular conversation groups*. Also, it is important to distinguish polarization from viscidty. The former describes how the group interacts with itself internally, while the latter measures how the group interacts with its surroundings, including other groups.

In a later work, Cattell defines three general classes of measures of group and individual behavior. These three classes—population variables, structural variables, and syntality (meaning the personality of the group) variables—would seem to cover all of the measures we can make about a group and the individuals that belong to it:

Population variables or dimensions are merely *means (or other statistical parameters) of the measured characteristics of the component individuals*, such as the mean I.Q., mean structure, etc., of the component members. These are clearly distinct from the characteristics of the group *as a group*, which arise by interaction, for they can be measured in the individuals before they become a group. By structural variables or dimensions we mean the descriptions of the internal behavior of the group, such as the status gradients, the clique relations as revealed by sociometry, the reciprocal role relations, the form of leadership structure, and, in organized groups, what Stogdill has called “the sociometry of working relations in formal organizations.” These are inferred from observations on the internal interactions, processes, and procedures of the group and they are often quite high

level abstractions involving such complex concepts as status and leadership structure. The third category comprises the true syntality variables, which represent the *performances* of the group acting as a whole and commonly through its executive, e.g., its decision in a committee-like situation, its constructive performance on a building task or its acts of aggression or assistance towards other groups. (Cattell, 1951)

Cattell makes no qualification as to how important each of these classes of variables are to the description of a group; such a rating is dependent upon the types of questions or goals we have about a particular group.

4.2 Online Social Measures

In IRC, we cannot read the interactions of a group of people in a channel. We can still see the interactions: we can read what people write as they post it, and we can mentally follow conversations by keeping track of who is talking to whom. But the whole process is based on a mental model of the group that must be carefully maintained with very little visual input.

Coterie makes this modelling process explicit. Using only a user's post to a channel, *Coterie* extracts information about how and with whom a user is interacting, as well as information about the group as a whole. By collecting statistics about how every user in a channel is interacting, *Coterie* builds a statistical model for that person as well as for the channel as a whole. This information is passed along to the visualization system and the conversation finder (discussed in Chap-

ters 6 and 7, respectively), in order to create a readable display for IRC.

The particular statistics that *Coterie* gathers for individuals and groups fall generally into the categories of *population variables* and *structural variables* as described by Cattell. While Hemphill and Westie's dimensions of group measurement are well defined for real-world groups and are qualitatively easy for real-world researchers

to measure, they are difficult to measure and keep track of algorithmically. Still, they represent a level of thoroughness and meaningfulness that their online analogues should attempt to reach. *Coterie's* particular measurements, though simpler and easier to gather automatically by computer, were chosen as a first step in this direction.

Whenever a message is posted to the IRC channel to which *Coterie* is subscribed, the internal IRC client passes this message to *Coterie's* statistical database. These statistics, for both individuals and the channel as a whole, are shown in Figures 12 and 13.

Statistic	Description
Number of users	Number of users in the channel
Last join time	Most recent time a user has joined this channel
Last leave time	Most recent time a user has left this channel
Join rate	Percentage of people per second that have joined this group in the last hour
Part rate	Percentage of people per second that have left this group in the last hour
Last message length	Length of the most recently posted message
Average message length	Average length of messages posted over the last hour
Message post rate	Number of messages posted to this channel per second over the last hour
Percentage of talkers	Percentage of users in this channel that have posted a message in the last hour
User growth rate	Rate at which users have joined or left this group over the last hour

Figure 12 Group Statistics.

It is important, at this point, to provide some justification for the particular choice of statistics that *Coterie* measure. *Coterie*'s visualization should provide a display of the group structure of a channel (which includes relationships between individuals). Cattell describes group structure as the “patterns of interactions of individuals, out of which, by analysis, group traditions, roles, association patterns, hierarchies, cliques, status dimensions, etc. are inferred as constructs” (Cattell, 1966) To this end, *Coterie* attempts to use statistics that describe the channel as a group such that the patterns of interactions become visible. There are, unfortunately, no specific group variables to bring to bear upon this issue of interaction measurement; the exact

Statistic	Description
Last join time	Most recent time this user has joined this channel
Last leave time	Most recent time this user has left this channel
Join rate	Number of times per second this user has joined this channel in the last hour
Part rate	Number of times per second this user has left this channel in the last hour
Last message length	Length of the last message this user has posted
Average message length	Average length of messages this user has posted over the last hour
Message post rate	Number of messages this user has posted per second over the last hour
Last Message Time	Last time this user posted a message

Figure 13 Individual User Statistics.

choice of dimensions is therefore non-exhaustive, though representative of the classes of measurement that Cattell describes. To a large extent, the motivation of measurement dimensions is also based upon the ability to visualize those dimensions within the model of visual group structure as described in Section 6.3.

These chosen variables, upon evaluation within the context of the visualization, seem to describe to a large enough extent the behavior of the group of people within

an IRC channel such that interesting and relevant (according to Cattell) social patterns emerge. Coterie, in part, is performing a process that is the reverse of the process that sociometrists perform. Instead of measuring group and individual performance for the sake of evaluation of group characteristics, Coterie instead creates the visible social patterns that would lead to this measurement by sociometrists. The statistical model of interaction within Coterie is therefore tightly linked to its visualization.

By visualizing these measurements of social interaction, Coterie creates a display where the social patterns emerge visually. Questions such as “How talkative is a channel?” or “How many conversations do users within the group participate in?” can be answered by viewing the visualization, instead of by reading numbers from a chart. This has the possibility to make the display of this information more meaningful to the viewer, since they possibly relate more closely to the lively display than to raw numbers. The relations between statistics also have the ability to combine visually to provide higher-level descriptions. For example, a channel that has few users, each of whom are actively participating within and moving between conversations, can be said to be a cohesive, interactive, and tightly knit community, a description that is easily seen visually without understanding or reading the basic underlying measurements that create such a display.

The statistics do not take into account interpersonal interactions, such as how many times a user mentions another user’s name. Such statistics would add to the richness of the description of the chan-

nel, and could be used to portray more conversational information. In this example, users who talk to each other frequently could acquire some of the other's visual characteristics, a display that is suggested elsewhere (Lee, 2001). The social patterns that *Coterie* can display are limited by the statistics that are collected, as well as the visualization of those statistics.

All of these measures have a time component (with the exception of last message length). This time component is very important: Just like real world social interaction, online social interaction is dynamic. As such, the results of these measures are expected to change over time. A user might leave his computer or become disinterested in the conversation for a time, which should cause his message post rate to go down. Taken as a whole, a channel's interaction changes over time as well. Around meal times, there is usually a drop in interaction as some of the users (those who live in a time zone that is currently eating dinner, for example) stop posting messages.

To accommodate the dynamic nature of the interactions in IRC, and to gather timely and pertinent measurements for those interactions, the time-based statistics use a history window. *Coterie* uses a window of one hour, which means that it includes in its statistical analysis any message that was posted within that time.

It is important to choose an appropriate window size so that changes in the statistical model happen at an understandable rate. If the history window was small, then the measures would change too rapidly; a user who stopped posting for a few minutes would have the same

post rate as one that stopped over an hour ago. The opposite would occur if the history window was big; a user that posted this morning would have the same post rate as one who stopped posting 10 minutes ago. With a one-hour time window, a user that stopped posting an hour ago might appear statistically like one that stopped posting 10 hours ago, but would appear different from one that stopped five minutes ago. This characteristic is in line with the time-course for IRC interaction.

4.3 Higher-level Descriptions of Online Social Interaction

In real life, we can keep track of a person's interaction in a group by watching him. Each person will signal his activity through body language, movement, speech, and inflection. For example, someone who stands off to the side of a group, only occasionally attending to what is being said by other conversants, has a low level of activity and involvement in that conversation. Alternatively, a person who is attentive and always responds to what others are saying has a high activity level, and is very involved in the conversation. These types of qualitative measures are of the type suggested by Hemphill and Westie.

Within *Coterie*, the low-level measures discussed in Section 4.2 can be used to derive similar types of qualitative measures as in real life. On a channel level, the interactiveness of the group can be defined by the percentage of posters. A channel that has a high percentage of users who post can be seen as highly interactive, whereas one in which only a small percentage of people post might be seen as non-

interactive. The user join rate and user part rate of a channel is a measure for how cohesive that channel is: if these measures are low, the channel tends to keep its users. This is one way to define group cohesion. The size of a group can be mapped directly into this higher-level description for a channel.

Statistics about individuals can be used in the same way. A user's activity level is directly related to his message post rate, and his verbosity to his average message length. In this way, both user and group level statistics can be used to achieve Hemphill and Westie's higher-level descriptions of the group interaction. These qualitative, higher-level patterns are portrayed by *Coterie's* visualization through its use of mappings between particular statistics and specific visual dimensions (discussed in Chapter 6). Since *Coterie's* statistical model of IRC is based upon an already internalized model for real-world social interaction, the patterns that emerge from the visualization can be easily understood.

5 Automatically Generated Representations of People

5.1 User Representations in Online Chat

In IRC, users are represented only by their names. Figure 13 shows a normal chat window from mIRC, a Windows IRC client (mIRC, 2001). Users are listed to the right of the chat display, and messages are shown to the left, arranged in time order, with the most recent message at the bottom of the display. In order to keep track of who is chatting within the channel, a viewer must read the name of the user at the beginning of the message line. Users who don't chat aren't shown in the main chat window. Though users have different names within the chat, their display is uniform: Each user is represented by a small line of text, which visually is not very different from every other user's representation. Furthermore, since the only distinction

between users is their name, users that participate in the chat are shown no differently than those that do not.

Coterie, instead, displays each user as a colored oval, each assigned a different hue. These ovals then move on screen in response to their user's activity in the chat. Using an oval, a viewer can more closely tie a user's representation to that user, and the visual characteristics of that oval can be used to display information about a user's activities in the chat, thereby differentiating users and informing the viewer.

One of *Coterie's* requirements for representing a user is that the representation evokes the abstracted impression of watching a person. The representation should therefore seem to act in a way that is human, as opposed to that of an inanimate object. This requirement ensures that there is a close connection that is apparent between a user and his representation—the representation becomes a reflection of a dimension of the user, and not just a placeholder.

In other graphical, two-dimensional chats, people are represented by either abstract graphics, as in *ChatCircles*, or icons, as in *The Palace* and *Comic Chat*. In the case of *ChatCircles*, there is a connection between the user and the representation from the motions the user's circle makes on screen. For both *Comic Chat* and *The Palace*, there is little direct and continuous connection: these systems either don't allow the user to move their representation, or allow only discontinuous motion within the chat space. Though both of these systems allow the user to change his representation, the available representa-

tions are cartoonish, and thus offer little pretense for believing in a close connection between the user and the representation.

Three-dimensional avatar chats generally have a similar limitation: though the avatars can look more human, their motion is either stilted or non-existent. As a result, the avatars can become little more than fancy icons. Their motions do not give the impression that you are watching a real human interacting and their simple or non-existent motion can make users feel even less like they are interacting with other people. One exception to this is *BodyChat*, which models its body language after that of real people in conversations. However, these motions can still appear robotic and detached from the underlying user.

5.2 User Representations in Coterie

One of *Coterie's* goals is to portray users in such a way that a viewer believes he is actually watching people interact. To this end, *Coterie* goes beyond the user representations in existing chat interfaces by utilizing four qualities of motion, discussed in *The Illusion of Life* and seen in Figure 14, that make simple shapes appear to “live” on their own (Thomas and Johnston, 1984):

Squash and Stretch: defining the rigidity and mass of an object by distorting its shape during an action.

Anticipation: the preparation for an action.

Slow In and Out: the spacing of the in-between frames to achieve subtlety of timing and movement.

Arcs: the visual path of action for natural movement.

Coterie uses these visual characteristics to create realistic motion for a user's representation, as seen in Figure 15. When a user posts a message to the channel, their oval first squishes vertically and bows out horizontally. Then the oval appears to “jump,” stretching out vertically while tilting in the direction of motion. At the apex of the jump, the oval starts to tilt away from the direction of motion, as

Figure 14 Bouncing Ball.

This drawing, from *The Illusion of Life*, shows how you can make a simple circle look more life-like by stretching and squashing its shape as it bounces.

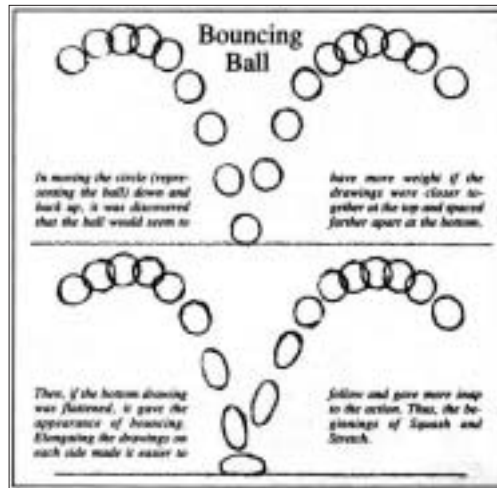


Figure 15 A User in

Coterie. In *Coterie*, when a user posts a message, their representation should squash at the beginning and stretch upon landing.

This way, the representation seems more “alive.” This image shows a user’s oval at multiple points during its jump.



if anticipating the fall.

Once the oval hits the bottom of the screen again, it catches itself, squashing slightly from the impact. This *Squash and Stretch* animation can make a shape appear organic.

Anticipation of the upcoming movement through a “wind-up” or pre-squash, coupled with *slow in and out* makes the motion seem intentional, and not just a result of the environment. *Arcs* ensure the motion seems believ-

able. Using these animation techniques, the user's oval seems much more alive than the static representations within graphical chats while not requiring users to manually position and animate their ovals.

Also important to this perception of the oval representation is its visual constancy. In real life, people don't instantaneously change their appearance or location. On a computer screen, however, instantaneous change is normal. In IRC, messages appear and user names appear, disappear, or change instantaneously. These discontinuities can lead to a distancing of the connection between users and their representations on screen. In *Coterie*, all changes in a user's appearance and motion take place smoothly: Changes in brightness fade in and out, ovals grow and shrink smoothly, and the move continuously from one place to another.

Coterie's display of the channel as a whole also serves to maintain this closeness between user and on-screen representation. In *Coterie*, viewers have a side-view perspective of the channel. This perspective is similar to the way we see groups of people in real life. In the display, everyone appears to be "standing." This perspective is similar to that provided by *BodyChat* and *Comic Chat*; however, *Coterie's* display goes one step beyond the interface in the latter case by showing everyone in the channel and not just those users who are currently chatting. Coupled with the principles of life-like animation discussed above, this style of display helps to maintain the appearance of an oval on the screen as closely tied to the user it is representing.

Coterie's display can go further. Though the current version does create life-like user representations, by taking advantage of the side-view perspective and including body language-like deformations, *Coterie's* display could be even more expressive. The oval's, with their squash and stretch, are still too static and impersonal. Ideally, *Coterie* would include some of the techniques used in *BodyChat* to portray the acts of forming, interacting in, and dispersing conversation groups for each user.

6 Multidimensional Display of User Information

6.1 Dimensions of Information Display

The simple oval representation of each user in *Coterie*, coupled with the motion characteristics of the oval's animation and the actual content of the chat messages, provides a multidimensional display for information about that user. There are four sets of dimensions used for information display in *Coterie*: color and size, motion, location, and chat. Each of these classes is best suited to display a different class of information, and *Coterie* uses each of these dimensions to display particular information about each person's interaction and history in the channel, as well as their current activities.

The particular mappings of statistics into visual dimensions is based generally on the type and mutability of the statistic and the capability

of the visual dimension to portray these qualities. Within classes of visual dimensions, the choice of which statistic maps to which visual dimension is based upon the aesthetic appeal that such mappings create within the visualization. In these cases, other choices could have been made, but these changes would lead to a change in the characteristics of the display, and especially its dynamics.

6.2 Color and Size

Each oval in *Coterie* has a different color and size. Though each user is represented by an oval, users are differentiated primarily by the hue of the oval (see Figure 16). When a user enters a channel in IRC, he is given a particular hue. Using the hue, saturation, and brightness (HSB) model for color in *Coterie*, there are a total of 360 different hues available. Since hue is constant over time in *Coterie*, it becomes a visual characteristic that viewers can be associated with each user.

In most cases, there are enough hues for everyone in a channel to be unique, though for large chats there will be overlap of hues. Since only a small percentage of users are usually active in a channel at a

Figure 16 Hue. In *Coterie*, every user has a different hue, which, along with a user's name, can be used to differentiate and identify him.



given time, however, it is unlikely that there will be two users with exactly the same hue active in the display. Even with the large selection of hues, it is possible that two users on screen will have very similar colors and are active simultaneously. Also, since humans are limited to keeping about seven items in memory at any given time, using only hue to keep track of people is not ideal, since there are likely more than seven users active within a channel (Miller, 1956). However, hue is a good carrier for discrete information, especially for data that doesn't change. Since hue represents the person, it stays constant and can therefore be used as a referent for a user's identity. To help identify these users, each user's name appears above his oval when he is active in the channel. Along with the continuity of an oval's animation, the name display allows each user to be recognized when they are active, even if they have the same hue as another user.

Brightness and transparency are the two other color components that carry information in *Coterie*, as seen in Figure 17. (Saturation is kept constant to help maintain the color of each oval in the display, and to create a more pleasing overall appearance.) These two color com-

Figure 17 Brightness and Transparency. When a user in *Coterie* posts a message, their brightness and transparency change. Here, a users who posts frequently becomes brighter and less transparent.



ponents are best used for showing relative changes in statistical information over time, particularly for continuously variable data. *Coterie* maps brightness to a user's message post rate. As a user posts more frequently, his oval becomes brighter. Similarly, an oval's transparency is mapped to the user's average message length. If a user only posts very short messages, such as "heh" or "lol," then he will appear more transparent than a person who posts longer messages.

With brightness and transparency, an oval can display both a short-term and a long-term component of a user's level of interaction through the use both base and temporary values. A dimension's base value defines how an oval usually appears. The dimension may be temporarily by some user action, changing continuously to a new, temporary value. After a short time (on the order of a few seconds), the dimension continuously changes back to the base value. Message post rate and average message length are longer-term statistics, which change relatively slowly. *Coterie* maps these statistics to the user's base brightness and base transparency, respectively. When a user posts a message, not only does his oval bounce, but his brightness and transparency also change temporarily as well. *Coterie* maps the change in brightness to the user's last message time, and the change in transparency to the user's last message length. After a few seconds, the oval fades back to the base brightness and transparency, to reveal the longer-term statistics. *Coterie* maps short-term and short-lived statistics to a short-term color change, and longer-term statistics to a longer-term color change.

Figure 18 Size. A user who has recently posted appears larger than one who hasn't posted in a while.



An oval's size can also change over time, as seen in Figure 18. In much the same way that stance and size can indicate a person's presence in a real world conversation, the size of an oval in *Coterie* similarly carries information about how present a user is in the conversations in the channel. When a user posts a message, he jumps to that conversation (see Section 6.4) and grows in size. Inversely, after some time has passed since a user has posted a message to a channel, his oval slowly shrinks in size. This behavior is very similar to the way user representations in *ChatCircles* behave: when a message is posted, the user's circle grows. After a short time, the user's circle shrinks back to normal size.

In *Coterie*, the size of an oval shows how active a user has been in the conversations. Furthermore, the relative size of a user's oval as compared to the surrounding ovals gives context to his activity level. This display is based on Tufte's *small multiples*, which says that if a set of slightly different images (in this case, each user's oval) are displayed

Figure 19 Lurkers. In Coterie, users who don't post messages are considered "lurkers", and are reduced in size over time. Here, the channel has many lurkers, and only a few active users.



close to one another, then they are easily compared (Tufte, 1990). In some cases, the differences between the ovals will also *pop out*, a well-known gestalt effect of visual perception (Kanizsa, 1979). Pop-out effects result when the color or motion of an oval is significantly different from that of the surrounding ovals. In these cases, the oval will appear visually distinct from its surroundings, and can be noticed more readily by the viewer. Using these visual qualities, a user can gain visual prominence when they act differently from the users around them.

In IRC, a user that lurks (doesn't chat) can't easily be seen: since only users that chat appear with their messages in the message window, lurkers are never shown, and only appear undifferentiated in the full list of users. In *ChatCircles*, lurkers appear as small circles. In other graphical chats like *The Palace*, lurkers appear just like conversants on screen; they don't change in appearance when they stop participating, and thus it becomes difficult to differentiate those who are lurking and those who are active in the chat.

When compared to the other ovals in *Coterie's* display, the size of any particular oval is a good indication of how much of a "lurker" a user

is (see Figure 19). Since the ovals of users that don't post messages begin shrinking after a few minutes, the smallness of an oval compared to the average sized oval indicates how long the user has been idle. A user who has recently started lurking will have an oval that is only slightly smaller than an active oval. Alternately, a user who has been lurking for a long time will have an oval that is much smaller, compared to other ovals.

Though this isn't a good indication of how long a user has been absent from the conversation—since users can just be listening in—status as a “lurker” in *Coterie* is both a relative and a slowly evolving one. If there are only a few active users in a channel, and all of the other members have been lurking for a long time, then the relative sizes of those lurkers are going to be very similar, signaling that the active users are the only ones that have been talking for quite some time. In this case, viewing the vast majority of the population as lurking is of little significance, since they haven't participated in the conversation for such a long time.

If instead only a few ovals on screen are small, then it becomes visually obvious that these users are unusual for not participating in the chat. This may signify that these lurkers are indeed keeping track of the conversation, though not actively participating. In both cases, the viewer, through the visualization, decides the behavioral modus operandi for the channel, and the macroscopic view of the channel provides an “averaged” view of the channel.

Compared to the traditional IRC display for a channel, the inclusion of color and size for each user creates a contextualized display. In IRC, viewers would not be able to see a visually “averaged” view of the channel, and couldn’t easily decide upon the interaction history and current level of interaction without following the recent posts to the channel. With *Coterie*, these patterns are visible at a glance.

6.3 Location

Coterie’s display provides two main locations for each oval: a central conversation area and a sideline area on both the left and right sides of the screen. The central area is where all conversations in a channel are placed, and consequently all active users appear in this space. The sideline areas are where “lurkers” are placed.

This configuration is based on research in how larger groups of people (usually more than 10-20 people) interact with each other. Newcomb et al., for example, claims that within these large groups, “there tended to be an ‘inner circle’ and an ‘outer fringe’” (Newcomb, Turner, and Converse, 1965). This prediction is more in reference to the process of social interaction, defining people either as active participants or as onlookers, than with the actual physical locations of the group members. *Coterie* uses physical location to portray the activeness of users within the channel since location has no pre-defined meaning in IRC.

Milgram presents a similar finding in “The Individual in a Social World” (Milgram, 1977). Shown powerfully through images of

Figure 20 Milgram's Crowds. In this photograph, we can see the different crowds that have formed in the public square. Each group of people has a defined center, where the crowd's main attention is placed, as well as an outer fringe where people move into and out of the crowd.



Fig. 17.1 Crowds in ring form. The same depicts crowds gathering around entrances to an open-air Mexican marketplace (Lerner) from *Jan. Life*, copyright © 1965, Time, Inc.

Figure 21 Crowd Layout. Milgram's diagram shows the variables that define a group of people who are gathered into a circle.

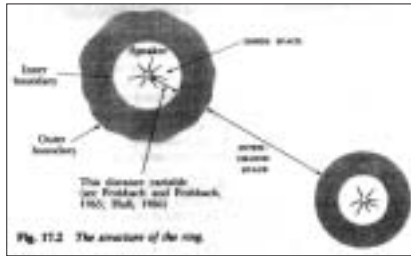


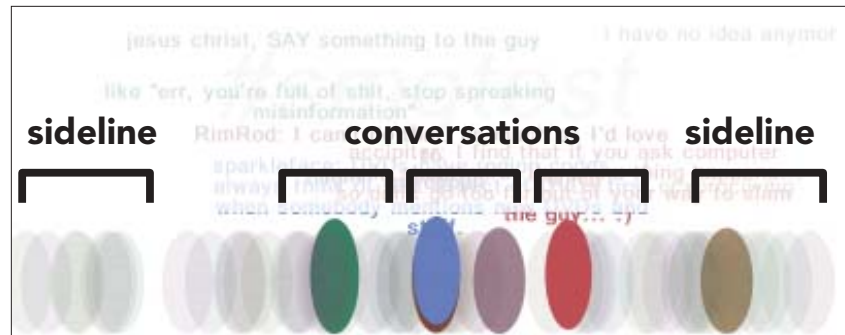
Fig. 17.2 The structure of the ring.

large group interaction, seen in Figures 20 and 21, he defines a visual *inner circle* of activity—a center of a large group—within which most of the activity takes place. Around this center is the *outer fringe*—a ring of people who attend mostly to the goings on in the center.

Coterie uses a hybrid model, seen in Figure 22, based on Milgram's, for placement of people within a channel. Since there are usually several conversations occurring within an IRC channel at any given time,

Coterie places each of these conversations in a particular location within the inner area of the display. However, since movement among conversations in IRC can be so fluid, and since it is impossible to know which of the available conversations a lurker (to Milgram, an onlooker) is listening to—they may in fact, be listening to multiple conversations—there is only a single outer fringe. *Coterie's* display can therefore be thought of as a vertical slice through one of Milgram's groups.

Figure 22 Coterie's Screen Layout. In Coterie, lurkers are constantly drawn to the sidelines, and conversations take place in the center of the screen.

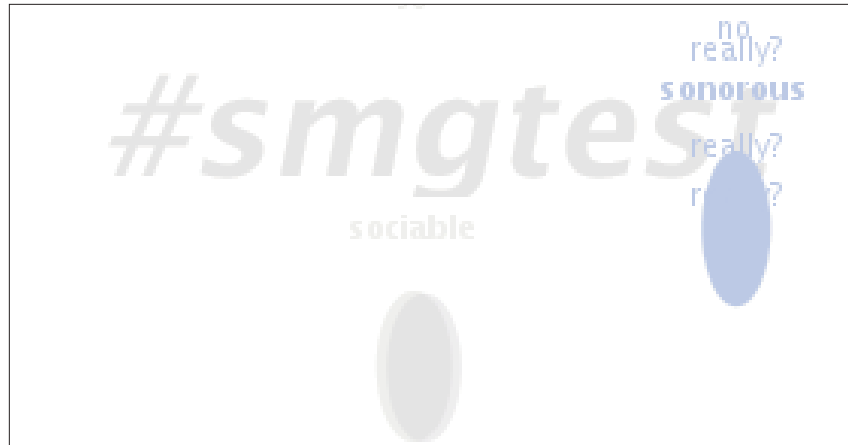


With this layout, it becomes easy to categorize a user based on his oval's location. If an oval is near the edge of the screen, then the user is a lurker. If an oval is close to a conversation in the center of the screen, then he is part of that conversation. It also becomes easy to pick out the conversation groups from a quick glance at the display: All the members of a particular conversation group are clustered around a central location. The size of a conversation is also immediately clear from its visual density. With this display, however, it may become too easy to disregard a user's post because of their appearance as a lurker. Since the display is based on a particular model of interaction, *Coterie* forces a channel's display into this model, even if the interaction within the channel doesn't cleanly fit. As a result, it is possible to misread the visualization because of *Coterie's* assumptions.

6.4 Motion

The motion of each oval in *Coterie* conveys immediate, short-term and long-term conversational information. As mentioned previously, an oval's motion is always continuous, meaning that an oval will never abruptly jump from one place to another, but will always move

Figure 23 Jumping. When a user posts a message, they jump into the air to grab the viewers attention.



smoothly on screen. This smooth motion is important both for the visual constancy as well as the life-like appearance of each oval.

When a user posts a message to a channel, his oval with hop vertically on the screen (see Figure 23). The height of this jump is dependent upon the length of that message. Very short messages like “hey” or “yeah” will result in small, barely noticeable jumps, whereas longer messages will cause the oval to jump higher (though *Coterie* has a maximum jump height so that if a message is longer than about 100 characters, the height of an oval’s jump is constant). *Coterie* uses the oval’s jump to grab the attention of the viewer when a user posts a message, and to make the current activity level of the channel visually distinct from the slower movement into conversation groups. In IRC, long posts aren’t necessarily more important than short ones; however, very short messages are usually either acknowledgments or emotes (expressions of emotion within chat) which don’t change the content of the conversation. *Coterie* utilizes a variable jump height for short messages to help viewers distinguish such messages from the general flow of the conversation. To make jumping more perti-

ment to the conversation, future versions of *Coterie* could bind this motion instead to the “volume” or emotional content of a message. For example, an irate, short post might generate a higher jump than a long, routine comment.

A jumping oval grabs the viewer’s attention and direct it towards the chat activity on screen. Though the appearance of a new line of text does provide a visual signal for a new message in IRC, the jumping motion of the oval in *Coterie* ties the new message to a user without requiring the viewer to read and understand the message. Furthermore, because the height of the jump is related to the length of the post, long posts will create more motion in *Coterie*’s chat display, and thus provide more action to grab the viewer’s gaze. This behavior is in contrast to IRC, where activity signals are binary: either there is a post, or there isn’t a post.

Coterie’s conversation finder, discussed in Chapter 6, also causes ovals to move on screen. When *Coterie* recognizes a conversation group, the users that are members of that group move to an area around the center of the conversation. This motion, which occurs over a short period of time, ties users to their conversation group in the same way that people in the real world move into closely gathered conversation groups.

When a user is a member of multiple conversation groups, he will bounce on screen from conversation to conversation. This motion differentiates such multi-group users from those that are part of only a single conversation group, and the smooth motion from conversa-

tion to conversation allows the viewer to easily track where a user currently is conversing. Just as an active member of a social gathering in the real world might buzz around from group to group, ovals in *Coterie* visually bounce from group to group in the display.

Over the long term, ovals will tend to move horizontally away from the center of *Coterie's* display. This motion, which happens over the course of a few minutes to a few hours, constantly pulls inactive users away from the conversation space. The speed of this motion depends on the user's recent rate of message posting. The oval of a user who only posts once in a while will generally be pulled towards the edge of the screen faster than that of a user who constantly posts messages.

This difference in movement speed towards the sidelines lets the viewer contextualize a user's post; if an oval bounces into a conversation, but is pulled relatively quickly towards the edges, then the viewer knows that the poster is only an occasional conversant. In *Coterie*, to maintain visual presence in a conversation, a user must maintain chat presence within that conversation. The motion towards the sidelines is slow enough, however, that even a casual poster will tend to stay near the conversation of which he is a part.

For slow conversations, however, this model can break down. Unlike IRC's text interface, which easily accommodates interaction that takes place at any speed, *Coterie* requires conversations to play out at a fast enough rate so that its assumptions about the speed of the conversations serve to maintain those groups cohesively on screen. For

very slow conversations, conversation groups in *Coterie* don't maintain themselves visually.

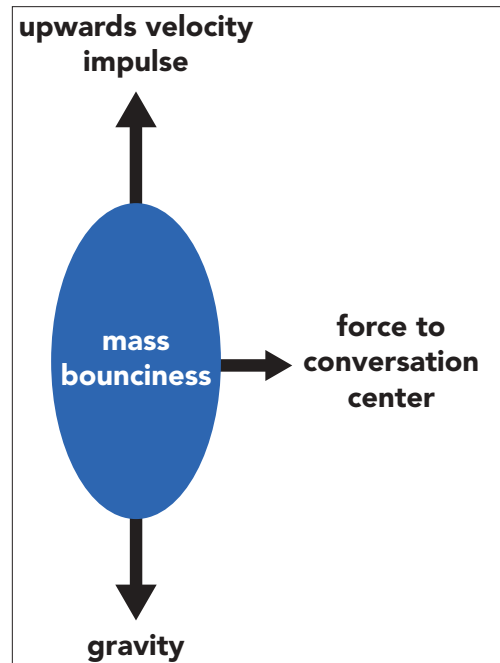
6.5 *Physically Based Modeling*

Size, location, and motion are all handled in *Coterie* by a physically based modeling system (Green, 1991 and Barzel, 1992). A channel has a physical "world" that has a ground (the bottom of the display) and gravity. Each user, in turn, is modeled as a "body" within this world, with a defined mass and bounciness (see Figure 24). Using this physical model, at any given time *Coterie* only has to map a user's size and location in the display onto a location in the physically modeled world.

A user's motion and behavior are controlled by simple parameters

Figure 24 Physical Model.

In *coterie*, every oval is treated like a point mass with a certain bounciness, and the channel is treated like a physical world with gravity. When a user posts a message, they are given an instantaneous upwards velocity, which causes their oval to jump. Each conversation has a point of attraction, which draws in users who are part of that conversation.



that *Coterie* can easily input into the physics system, such as points of attraction and velocity impulses. *Coterie* benefits greatly from using this physical model to drive an oval's visual parameters, instead of hard-coded animation. Movement of people on-screen is always automatically

smooth and linear (people never instantaneously appear in one location and then another).

The physical model also exposes higher-level properties for each person that can be used easily for representing personal information. For example, using the physical model, *Coterie* can let the length of time a user has spent in the channel determine his physical mass, and his activity level determine his bounciness. Since these statistics are longer-term ones that change slowly over time, the physical properties will change slowly as well. When a person then posts a message to the channel, he can be given an instantaneous upward velocity with a magnitude that is directly dependent upon the length of that message. The physical model then automatically drives the person's body using these three components (mass, bounciness, and upwards impulse), and *Coterie's* display only needs to update the position of the on-screen oval to match the model.

A traditional animation system would require specifically controlling the person's horizontal and vertical location—including how an oval would bounce when made contact with the floor—based on a scripted motion. While the scripted motion can be partially randomized by changing the total distance traveled by the person or the height of the jump, the more general physical model allows data driven motion to be programmed much more easily, and provides a realistic and believable animation.

The physical model also allows automatic modification of the world based on channel statistics. For example, if the channel tends to have

Figure 25 Chat Display. Chat messages move up the screen at a constant rate. The time between each post is reflected by the vertical separation between those messages on screen.



lengthier posts, the gravity of the world can be increased, so that all of the ovals bounce-heights are normalized. Alternatively, if the channel seems to be close-knit (the number of people that join and leave the group is small) then the points of attraction at the edges of the channel—which constantly pull inactive users away from the center are of the display—can be moved closer to the center, and thus cause users to appear overall tightly grouped and more closely related to each other. To accomplish this channel-wide change using traditional animation would require smoothly moving each person closer to the center of the display, taking into account how long they’ve been in the group, as well as the other properties mapped onto the oval’s display. This movement happens automatically using the physical model.

6.6 Chat

Chat is the fourth and final dimension of information display in *Coterie*. As in IRC, when a user posts a message to the channel, it appears on screen. Unlike IRC, however, all of the messages that a user posts are tied to that user’s oval. The binding of messages to the user is similar to *ChatCircles*, where a user’s chat messages follow the user’s

why not? just be telling your fellow employees
false information!

#everything

Shouldn't you correct him?

creams: I disagree. If someone asks me about
cars, I look at them and say "I know how to start
a car and make it go. THAT'S IT."

(screaming) one thing, making fun of people
because they're trying to figure it out isn't

Resisted Accepted:creams



representation as they move around the screen. Each message, when posted, appears directly over the user's oval. Over a short period of time, the message scrolls up the screen at a constant rate, until it reaches the top, at which point it disappears (see Figure 25). As a user chats, messages appear to float up from his oval.

Time moves constantly forward in *Coterie's* chat display (as it does in the other dimensions of display as well). In IRC a message only scrolls up the screen when there are new messages posted. The same message in *Coterie* begins moving up the screen as soon as its posted, making message times more apparent. Since the height of a message on screen signifies its age, the time-course of conversations is easy to understand.

Coterie's chat display functions as an integrated short-term history for conversations. For example, if three users are all having a conversation with each other, their messages will maintain their time ordering, as well as the pauses in between their postings. This behavior is similar to the history view of *ChatCircles*, where time marches forward at a constant rate as well.

Since *Coterie* also separates conversations automatically, watching two or more conversations take place simultaneously is easy. The messages that comprise each conversation appear separated horizontally, and flow upwards at the same rate. In text-mode IRC, conversations are interwoven; following and attending to only one of the conversations would require mentally filtering out some of the lines posted in the chat window. Since *Coterie* automatically separates and

positions conversations, the conversations are distinct and become easy to follow individually.

Each user's chat messages appear on screen in the color of his oval. Along with their location above each user, the coloring of each message allows a viewer to instantly associate a message with a user. This way, a viewer can follow the conversation by watching the chat messages scroll up the screen, and know who posted the message, the relative time of the message, and to which conversation the message belongs.

Coterie's chat display does not allow users to rewind conversations: Once a message has scrolled off the screen, it is gone. IRC provides the facility to scroll back and read all of the message posted to a channel, thus allowing the user to read entire conversations. To a certain extent, *Coterie's* display of each individual provides some of the context that a viewer would otherwise get from scrolling back in the text interface for IRC; users that are active, who would have posts that a viewer would read in the traditional IRC interface, are shown as such in *Coterie*. Message posts, however, provide more than activity information, and are required for actually following a conversation. *Coterie's* visualization does not provide a solution for this problem, however.

6.7 Time

Time plays a crucial role in all of the dimensions of display in *Coterie*. The pictures that *Coterie* creates as visualizations of IRC are constantly evolving. This evolution is driven by the constant change in user interaction within IRC. In any interaction, both real and virtual, people constantly move, change whom they are talking to, and, most importantly, change in how other people perceive their behavior, actions, and presence. *Coterie* tracks this constant change based on a user's chat behavior, and binds these constantly changing measures to a user's constantly changing representation.

Coterie's display is designed around the different time-courses of change in chat. When an oval jumps, the viewer's attention is drawn momentarily to the motion, providing a visual cue to the change in the chat. Attending to and reading this jump requires only momentary attention, and the short change in the on-screen display follows the usually small change a single message makes on the conversation. As in real world conversations, where each person takes turns talking, and the group's attention passes from person to person, so does *Coterie's* short-term motion pass from user to user as they post messages back and forth.

Longer-term conversational or interactional shifts in user behavior are shown by slower changes in *Coterie's* display. If a user has invested a lot of time in the channel, regularly conversing with other users, their oval will, over time, change in its display to represent this long-term behavior. In the same way that a user must invest time and

energy to become part of a group, so does their investment in time and energy online slowly change their representation.

6.8 *Autonomous Existence*

One particularly interesting side effect of this model for chat and user display is that *Coterie* gives a sense of space and location to the placeless and spaceless users and conversations in IRC. Users are now automatically tied to a particular place with respect to everyone else in the channel. Users have no direct control over where they appear on screen; their location is dependent upon whom they have conversed with and how they have acted (or not acted, in the case of lurkers) within the channel. *Coterie* takes a different approach from *Comic Chat* in this case; whereas *Comic Chat*'s display centers on the current conversation, and only shows those users that are participating, *Coterie* instead provides a display of the entire channel at all times, including users who aren't currently participating. This information is supplied entirely by the textual chat history that *Coterie* keeps track of for every user.

Coterie's autonomous display extends to the presence and portrayal of a user, creating his representation automatically, also only based on his chat history. In a sense, *Coterie* is painting a simple portrait of each user and of the chat space as a whole. This is in contrast to other graphical chats, where the system provides the building blocks for user representation, but the users themselves choose exactly how they appear, and the representation doesn't change based on a user's prior interactions within the chat.

7 Automatic Conversation Separation

7.1 Visual Conversations

When socializing in the real world, our conversations are usually tied to physical proximity: the people near us are usually part of the conversation, and people that are farther away are not. Though attention to, acknowledgment of, and participation in conversations are all important criteria for determining whether a person belongs to a conversation group, for smaller conversation groups, proximity can be a useful determinant for conversation grouping by external observers (those not part of the group).

Within these conversation groups, the subject of the conversation is often mutable. With perhaps the exception of highly structured groups, a conversation will move through a number of different sub-

jects over time. This change in subjects, however, does not require a change in membership within the group. Conversation groups can maintain all of their conversants while evolving the subject of the conversation. Groups can also withstand some turnover of members and still maintain the conversation flow (Frey, 1999).

This model for conversation generally holds true within IRC as well. Conversation groups form through mutually common discussion, and once these groups form, the conversation can maintain itself through changes in its subjects and slow changes in its participants. The conversation groups themselves appear and disappear, as in face-to-face interaction, when a set of people create a new group or when an existing group loses its members.

There is one important difference, however, between face-to-face and IRC-based conversation groups. A conversation group in the real world has a physical form that manifests itself as a cohesive whole, and exists independent of the individual visual forms of the participants. In IRC, the conversation groups are invisible; we only see the chat messages themselves, and different conversation threads are intertwined. While this intertwining does not prevent observers from distilling the actual groupings of conversants within IRC, it does make untangling the conversations a rather difficult task, especially for casual users. Also, while we can see and understand conversation groups in real life merely by glancing over a larger set of them—for example, when you walk into a cocktail party, you almost immediately see people’s conversational groupings—our understanding of

conversation groups in IRC requires reading through messages and building up mental representations of groups of people.

7.2 *Automatic Conversation Separation*

Coterie automatically groups users by conversation group. Within the center section of the display, *Coterie* establishes a small set of conversation points where it places the visual centers of the conversations that it finds (see Figures 22 and 25, as well as Appendix A). Members of a particular conversation group are then attracted to that group's center on screen. As a result, each conversation automatically gathers its members, and all of the conversations appear as small, closely-bound groups of people.

The conversation finder uses a simple statistical model of word use to group people into conversations. This statistical model keeps track of all of the conversations within a channel, and dynamically assigns each user to a conversation whenever that user posts a message to the channel. Each conversation is defined by a set of key words that describe the conversation's topics. When a user is placed in a conversation, the messages that they post are used to build up this topic list.

Conversations can exist in three states: *preconversation*, *active*, and *abandoned*. When a conversation is first created, it is in the *preconversation* state. This means that the conversation may either actually exist, in which case it will progress to the *active* state, or might just be a transient comment by a user. To progress to the *active* state, a con-

versation must have at least two members. (Though a user can talk to himself, *Coterie* doesn't consider this a valid conversation.) Once *active*, a conversation remains so until users leave the conversation. When there is only one user left in the conversation, it becomes *abandoned*. If users return to the conversation, it can become *active* again. *Coterie* only includes *active* conversations in its visualization.

A user can only belong to one conversation at a time. This rule follows from observations of IRC interactions. Though a user might move back and forth between any number of conversations, when a user posts a message to a channel, that message is part of a particular conversation, or is meant for everyone in the channel. In IRC, if a user is participating in multiple conversations, then subsequent posts may belong to any of those other conversations. As a result, the user may bounce from conversation membership to conversation membership as he pleases, but at no time will a user simultaneously belong to two or more conversation groups.

This conversation model does differ subtly from real-world conversation grouping. In the real world, a person can be a member of multiple conversation groups, yet not actually have to move physically. By changing their attention through the use of body language and vocal cues, a person can switch between multiple conversations. In IRC, however, there exist none of these cues that would signal a change in conversation groups. *BodyChat* provides some ability to use body language to enter and exit conversations, but its model is based on longer interactions with only one other person.

In *Coterie*, the physical movement between conversation groups serves as a way to keep those conversation groups separate and mark when a user enters and exits a group. Since the display is based on a more distant view of the conversation space than *BodyChat*, subtle visual cues aren't appropriate for signalling changes in conversation membership. The oval representation is also too generic to provide a mechanism for such cues without changing shape. Instead, *Coterie* uses motion and location to signal when a user changes groups. This mapping provides an easily understandable use for location of users on screen that takes advantage of the fact that IRC otherwise has no sense of space.

The word-use statistical model was chosen for the conversation finder because it was simple to implement and didn't require an understanding of the content of each message. As will be discussed in Section 7.5, *Coterie's* conversation finder does a good job at separating conversations for visual display.

7.3 *Conversation Finder Algorithm*

When a user posts a message to the channel, the conversation finder first compares the post to the list of users in the channel. If one user is talking directly to another user, the first user will usually prefix the message with the second user's name. Detecting this occurrence is a good way of discovering when one user is directly addressing another user. If there are any matches, the conversation finder groups those users, and places them into either the conversation the mentioned user is currently in, or if the mentioned user is not in a conversation,

into the conversation in which the message poster is present. If neither of the users is currently in a conversation, then the conversation finder creates a new conversation and places these users within it.

If no users are found, the conversation finder then filters out commonly used words that are kept in two stop lists. The first is just a list of the most common English words. The second is a list of words and symbols that are common to IRC communication, and include URLs, “smilies” (such as :) and :(), contractions (such as “lol,” which means “laughing out loud”), and commonly used expressions (such as “heh,” referring to a chuckle or small laugh). This filtering ensures that the words that are used by the conversation finder are ones that are generally meaningful to the conversation, though they may not be part of a set of topics that a human observer would pick out for the conversation. If there are no words left in the user’s message, then the user is left either in his current conversation group or un-bound from any conversation group.

Once the message is filtered, the conversation finder must then decide in which conversation the user is currently participating. To do this, the conversation finder follows this set of rules:

1. If the user was not in a conversation, and the filtered words in the user’s message do not match an existing conversation, then create a new conversation and place this user into it.
2. If the user’s message matches an existing conversation group, and the user is not a member of any other conversation group, then add the user to that conversation.

3. If the user's message matches the current group to which the user belongs, then keep that user in that conversation group.
4. If the user's post does not match the user's current group, but does match a different conversation group, then the user may have changed conversations. In this case, wait for the next message from that user, and if it too matches this new conversation group, then move the user to the group, and remove him from his old conversation group.

The message to conversation matching algorithm is straightforward. If the words in a message are found as topics of a conversation, then that message matches that conversation. In the case where there are multiple matching conversations, *Coterie* first chooses the conversation with the most matching words, and then the one that is most recently active. If there are multiple conversations that have the same number of matching words, then the most recently active conversation is chosen.

Once the conversation finder decides in which conversation to place the user, all of the conversation groups are consolidated. This process looks at each group's topics, and if any topics overlap, those groups are combined into one larger group. Conversation consolidation is performed to keep the number of conversation groups to a minimum, and essentially "chains" conversation groups together through common topics. For example, if one conversation has the topics "cheese" and "butter," and another conversation has the topics "butter" and "cooking," then these conversations are combined to

form one larger conversation with the topics “cheese,” “butter,” and “cooking”.

After every message post, the conversation finder updates *Coterie*’s set of active conversations. *Coterie* then takes each active conversation and positions it within the center area of the display. Active conversations maintain their place on screen, and each new conversation is given an empty location. Each conversation is also given an attractive force in the physics model for the channel, so it can draw in its members. All of the members of each conversation are pulled within the physics system described in Chapter 4 to the area around their conversation’s center.

It is not clear that a model that included natural language processing (NLP) would provide much better results. Particularly since IRC messages are short and very messy (with regard to sentence structure, grammar, and spelling) and often include channel-specific jargon, traditional NLP would require many special-case algorithms as well as large, channel-specific dictionaries to create a conversational model. NLP models would also require a sufficient number of messages to create a valid conversation model, and might not be usable for finding short-lived conversations. Similarly, complex statistical models—which keep track of how each user uses each word and how words are used within each conversation, subsequently using this information to find word use relationships between users and conversation groups—may also not provide much better results since it is unknown whether there is a correlation between conversation group formation and specific words.

7.4 *Comparing Manual and Automatic Categorization*

To understand how well *Coterie's* conversation finder performs when segmenting an IRC channel into conversations, four people were asked informally to separate, by hand, a log of IRC messages. These results, shown in Appendix B, were then compared to *Coterie's* separation of the same transcript. This comparison indicated that *Coterie's* simple algorithm for separating conversations was good at finding the same large conversations as the manual categorization. The differences between these results, as well as the differences between each manual categorization, sheds light on how we, as humans, group people into conversations on IRC.

When comparing the different human categorizations, a few interesting results were found. First, we generally have a very fuzzy definition of exactly what constitutes a conversation. In the transcript, people found between 8 and 15 conversations. For some, a conversation was as simple as a couple of people talking about a particular subject. For others, the conversation needed to maintain a certain group of people, even if the topics changed and people briefly talked one-on-one with each other.

Second, people used mostly the subject matter of the posts to segment the conversations. The longer conversations seemed relatively easy to pick out for everyone based on a common thread of subject matter. There were a handful of short, off-topic conversations that people seemed very unsure of: though they were separate from the larger, all-encompassing conversation, they didn't seem to warrant

the label “conversation” on their own since they were so short lived and their subject matter was so vague. In one case, there were only a few messages between two conversants who were commenting on a typo one of them had made. Human categorizations either included this as part of the larger conversation, or separated it as a set of comments made by the two conversants which not really a conversation.

Third, though there was a large disparity in the number of conversations reported, everyone agreed on where the large conversations were segmented. Each person’s choice of where a conversation began and where it ended was within a few lines of everyone else’s cutoff. This shows that while a conversation may be clearly recognized once underway, pinpointing the exact line that began or ended a conversation is not at all easy. However, once they have begun, conversations make themselves clear.

Coterie’s conversation finder, compared to manual segmentation, finds more conversation groups. These conversations, however, break along the same borders as the large-scale, manually categorized conversations. *Coterie* also does not always assign users to conversation groups that were assigned to groups by manually segmenting them. Upon inspection, these users are left out of conversation groups because their posts are short and do not contain any of the topic words for those groups. For human categorizers, such short posts were assigned to the conversation group to which the user belonged. This points out another important characteristic of manual grouping: person constancy within groups. Humans tend to keep conversants with their groups, so that group membership remains stable unless it is clear

that a user has changed groups. After this evaluation, group membership stability was later added to *Coterie*'s conversation model.

Overall, *Coterie*'s conversation finder isn't perfect: it doesn't assign to a group those users that don't mention the proper words for that group, even though human categorization would. The human categorization, however, is based on a more complex conversation model, and is expected to be better than the simple word-use statistical model that *Coterie* uses. Also, from this evaluation, it is clear that people tend to err on the side of grouping users into conversations, even if it's not clear whether they belong.

The groups that *Coterie* finds are also more fine-grained than human categorized groups. In other words, a set of messages that a human would call a single conversation, *Coterie* calls multiple conversations. While this may seem like a failure of the algorithm, there is an important aspect to *Coterie*'s conversation finder that isn't taken into account when compared to classifications done on paper. *Coterie*'s display is constantly changing, and if one conversation group (as found by *Coterie*) is replaced by another conversation group consisting of mostly the same users, then on screen, these groups will look like one evolving conversation.

This last point is important: *Coterie*'s conversation finder must be evaluated by how well it visually keeps users close when they are conversing on IRC. In this case, *Coterie* does a good job. It is clear from the display that people who are chatting with each other are located close together on screen. While the algorithm isn't perfect, it does

provide some conversation separation that aids viewers in following the separate conversations visually.

8 *Building upon Coterie*

8.1 *Understanding How Visual Patterns Affect Interaction*

Though this thesis explores how social patterns can be distilled and visualized in a natural way, it does not explore how such a system can affect how people interact online. *Coterie* represents a new way to make online interaction visible and readable, and as such, it may change how people use online chat. People's use of text-chat, whether through IRC, MUDs, or even newer chat systems such as AOL's Instant Messenger, comes from the interfaces and affordances of the systems themselves. For example, emotes evolved as a way to introduce emotional content into chat, and provide a stronger connection to body language that, in the real world, provides such back-channel information (Cherny, 1999).

With *Coterie*, it becomes possible to introduce some visual emoting automatically. ChatScape provides a way for users to emote visually or cause other user's representations to react visually to emotional state, such as tagging a user as obnoxious, in ways that are easily understandable (Lee, 2001). *Coterie* can build on this visual language by automatically recognizing some emotional states, for example detecting a "flame," and including them in a user's representation (Spertus, 1997).

Beyond including already developed extensions to chat interaction, it is important to understand how the automatically created visualizations affect user's interactions within IRC. By providing visualizations of a channel, does *Coterie* change how users perceive each other or the channel as a whole? For IRC users, who traditionally do not associate location or place with the channel, can *Coterie*'s spatial representations change their interactions? If there is an effect, such as a better ability to keep track of separate conversations or to better associate what other users say with those users, then is this effect similar to the way graphical chats, such as *ChatCircles*, change social interaction?

To get at these results, some amount of user testing, as well as in-the-field interviews, should be conducted. *Coterie* presents a unique opportunity to test for these results using a system where the only difference from text-mode chat is the display of the chat space. Unlike tests comparing graphical chats to text-mode chats, where the underlying system of interaction is different, *Coterie* and IRC use the same system for interaction.

8.2 Models for Chat Activity

Coterie's underlying statistical model is based on real-world group interaction research. While this is a good starting point for exploring models for how users interact online, chat represents a fundamentally different mode of interaction than face-to-face conversation. Even though the two modes seem to share a great number of social patterns and assumptions, there are likely to be basic differences in the interactions that take place that should be included in the models used for gathering interaction information.

Coterie presents a set of basic interaction statistics that can be used to distill the social patterns present in IRC. However, this set of patterns is limited, and probably does not include some important measures. For example, the reaction that users generate from their message posts is completely ignored by *Coterie*. Tracking this behavior in IRC chat might reveal how turn-taking in chat is similar or different from real-world models of small group interaction.

Social hierarchy represents another addition to *Coterie's* chat model. In real world interaction, social hierarchy can be tracked by looking at gaze, group attention, and the reaction of others to a person's conversational tone and content (Frey, 1999). While this is a difficult part of the conversational model to distill through chat analysis, using good enough NLP as well as time analysis of message posting, social hierarchy in IRC might be discoverable.

These two additions to *Coterie's* conversational model represent only a small selection of the measures that can be made of how chat groups

interact. Certainly, if this model is extended to include visual and locational measures, such as those available in graphical chats, the possibility for understanding online chat behavior will only become better, and the models for such behavior richer.

8.3 *Visual Techniques for Revealing Social Patterns*

The visualization used in *Coterie* concentrates on a conversational representation of activity in IRC. While IRC is mainly about participating in conversations, this is only one perspective on the activity that takes place in such text chats. To further explore these possibilities, alternative mappings for the statistics in *Coterie*'s interaction model should be explored.

Just as the visualization of IRC can affect how users interact within IRC, the particular mappings that *Coterie* makes to the statistics available in the conversational model can affect the patterns that users see in the visualization. For example, *Coterie*'s display is based on a conversational locus of interaction. If instead *Coterie*'s visualization were based on reaction to messages, or if people were pulled to the edges of the display based on how short their posts were, then a different pattern of interaction would be exposed.

It is important to note that the particular mappings used in *Coterie* were chosen to maximize a viewer's ability to understand the display using already developed skills for reading real-world social groups. Changing the mappings might make it harder for a viewer to understand what he is seeing. However, such changes, though they may

need more explanation, could reveal aspects of IRC interaction that were previously hidden.

A more drastic remake of the visualization might also be attempted. As discussed in Chapter 4, *Coterie*'s display is modeled after a particular type of real-world group structure. Changing the underlying assumptions made by this visualization would lead to a fundamental change in the display. One example of this might be to move from a side view of the channel to a top-down view. Such changes would go beyond the remapping discussed above, and change the nature of the display, perhaps making it less spatially oriented.

8.4 Conversation Recognition

While *Coterie*'s conversation finder works, its limitations suggest a number of improvements. Just as extensions to the interaction model in Section 8.2 would serve to enhance *Coterie*'s ability to understand how people in IRC behave, extensions to the conversation model on which the conversation finder is built would enhance *Coterie*'s ability to represent how people converse in IRC.

One simple extension would be to create actively adapting dictionaries for word use in IRC. Whereas *Coterie*'s current dictionaries are static, such active dictionaries would monitor which words were used, and how often they were used by individuals as well as by conversation groups. Using this information, *Coterie* would be able to determine just how important or common a word is, and would be able to use this information to better determine the topics of the con-

versations, thus creating a more accurate model for the topics of each conversation.

Deeper enhancements to *Coterie's* conversational model should include modeling of the time-course for posts. For example, back-and-forth conversations between two users can occur only if enough time is given between posts for those users to read each other's posts and form responses. This time model is determined by the length of each post, the pace of the conversation, and models for how each of those users interacts within the channel. One user might type faster than another, which would result in shorter turn times for that user. Using this information might inform *Coterie's* conversation model about how quickly conversations form and how each user performs within a conversation, allowing the model to decide whether a set of posts represent a new conversation, or are merely part of an existing conversation.

This enhancement suggests tighter integration between *Coterie's* conversation model and its interaction model. By integrating the two models, the conversation finder can make use of general information about each user's interaction within the channel, and take into account changes in his activity level when determining who belongs to particular conversations. The interaction model would also benefit by having access to information regarding whom a user interacts with. Using this information, the interaction model can keep track of response rates for users to better determine social hierarchy, for example.

The conversation model also suffers from a lack of understanding of the content of the conversations themselves. While Section 7.2 discusses the limitations of NLP when applied to such “dirty” content as IRC messages, it may be possible to get around such problems by employing conservative word correction dictionaries as well as word networks. Such word networks provide ratings for how related two words are, and may be useful for determining when two conversations are discussing similar or related topics (WordNet, 2001). These extensions should be added with care, however, since any algorithm that introduces information that is not present in the raw data (such as spelling-corrected words or external relationships between words) can produce incorrect results from the model.

9 *Conclusion*

In this thesis, I have presented *Coterie*, a system that creates a visualization of the conversational dynamics within internet relay chat. Through this visualization, the patterns of social interaction within text chat become visible, and are understandable and readable using skills similar to those we use to read real-world conversation groups. These visualizations are built up automatically, using both a statistical and a conversational model for interaction within IRC, and reflect the multiple time scales for online text interaction. As a result, *Coterie* is unique in how it gathers information about chat and in the displays it creates using that information.

Coterie's three parts work together to discover and model interesting social interaction information, to separate out different conversation threads, and to present this information using visual techniques to

expose social patterns and make IRC more readable. Each of these three pieces, the interaction model, the conversation finder, and the visualization system, are merely first steps in modeling and displaying information about text chat. Throughout this thesis, I have explained how each of these pieces fits into *Coterie*, discussed how they build upon existing text chat interfaces, and explored the ideas and techniques behind their design.

I have also explored some of the social patterns that *Coterie* can uncover within IRC. These patterns are compelling, and those who watch *Coterie* paint its conversations on screen are mesmerized by how much more alive IRC seems. *Coterie's* display is vibrant and active, and the representations of users are truly informative and fun to watch.

Coterie is more than for entertainment value, however. Its visualization provides meaningful information to the viewer about how users interact within IRC. The display of each user provides contextual information about the history of that user, and the display provides a way to visually average the action within the channel to get an overview of the interaction. In IRC, understanding social patterns can be a tedious and time consuming task, and relating a single user's actions to that of the channel as a whole requires constant attention. *Coterie* provides much of this information automatically to the viewer. Even so, *Coterie* represents only the first step in creating systems that model how people interact in chat over time, and that visualize this information through meaningful, understandable, and natural displays.

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11 Related Readings

While these readings were not directly referenced in this thesis, they have, nonetheless, influenced my work and provided ideas on models of social interaction.

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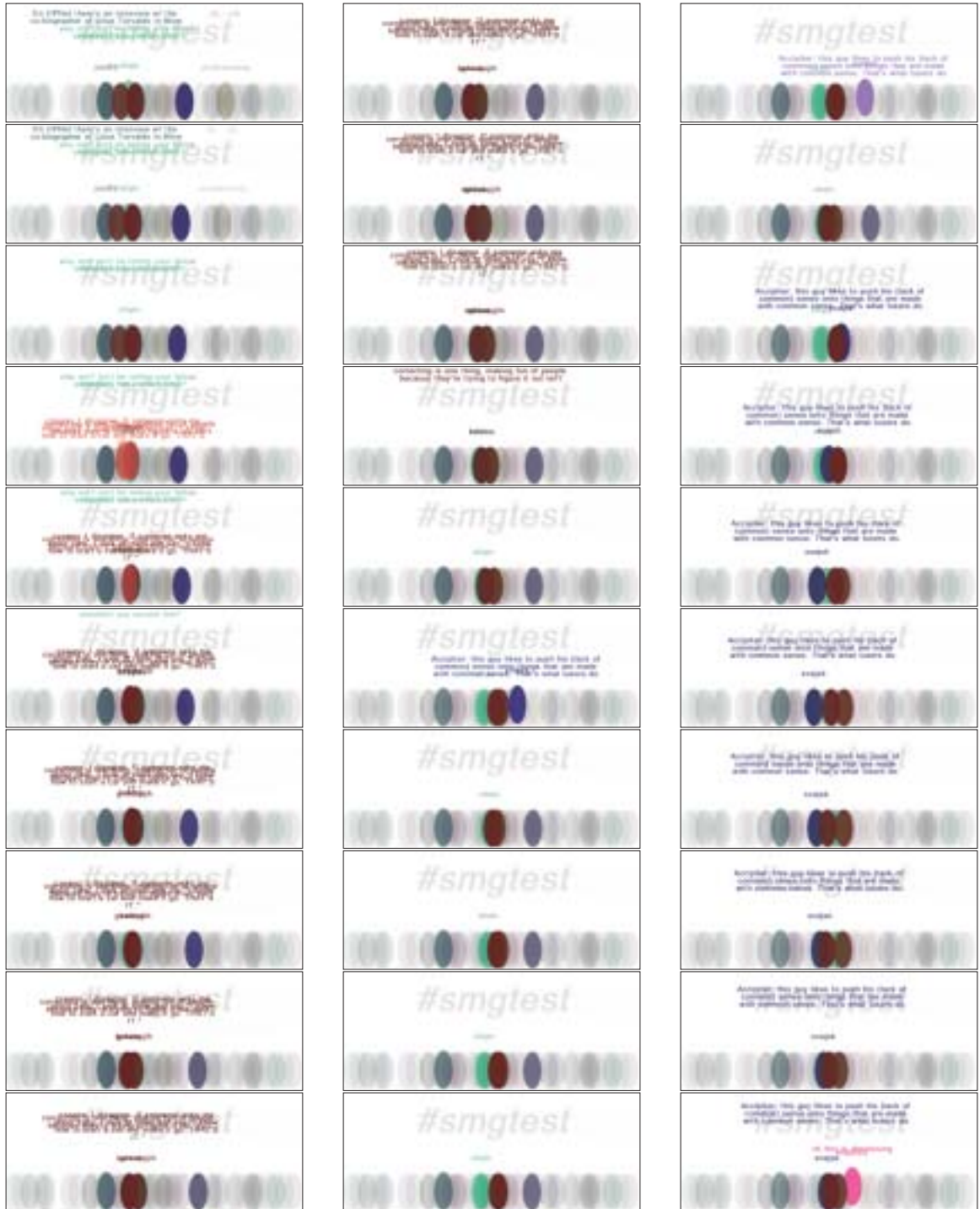
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Appendix A: Coterie in Action

The #Everything channel on us.slashnet.org

Here are shown 60 frames from a *Coterie* animation, at 1 frame per second. The frames are read column by column (top to bottom, then left to right). In the right column, there are two conversation threads: one made of the green and red ovals, another made of the blue and gold oval. On the next page, these two conversations combine into a single conversation, which can be seen by the movement together of those ovals.





Appendix B: IRC Conversations

Shown below is an excerpt from a conversation on the #Everything channel on us.slashnet.org IRC network. To the right of the conversation is shown the conversation separations as performed by four humans, as well as by *Coterie* (in the rightmost column). Color bars show conversations, with each color a different conversation. Posts that are not a part of a conversation have no color bar associated with them. From this graph, it is clear that *Coterie* separates conversations in the same general areas that humans do.

	Person A	Person B	Person C	Person D	Coterie
acidrain (6:18:47): I heard about that					
ref\ect (6:19:00): http://www.theregister.co.uk/content/6/19771.html					
acidrain (6:19:10): I submitted a funny story about a server being found 5 years later behind drywall, never missing a packet					
acidrain (6:19:13): didn't get posted					
acidrain (6:19:31): instead, some new program version did					
emad (6:19:48): acidrain, actually, I remember reading a story lie that					
emad (6:19:49): like					
emad (6:19:55): I don't recall where ...					
ref\ect (6:20:16): /. has gone pc					
acidrain (6:20:51): I don't care that they were bought out, and I know sometimes, they are bound to make mistakes, but geez					
ref\ect (6:21:00): after scientists threatened them					
ref\ect (6:21:19): "remove that post or we'll"					
ref\ect (6:22:30): i bet they watched operation swordfish					
ref\ect (6:22:42): a scientist movie					
ref\ect (6:23:46): haha, /. posted a review of it, the same people who threatened them					
ref\ect (6:24:5): "post a review of our movie or else"					
ref\ect (6:27:33): swordfish = Xiphiidae					
ref\ect (6:27:52): Xiphias					
ref\ect (6:28:04): Xiphias gladius					
yTTOCS (6:31:31): acidrain: http://slashdot.org/articles/01/04/10/1846258.shtml					
ref\ect (6:32:57): operation Xiphias gladius					
acidrain (6:37:04): :(I'm automatically dead					

	Person A	Person B	Person C	Person D	Coterie
Surrea (6:52:15): y0 biotch					
Nub (6:54:44): dear lord					
Nub (6:54:49): DMV == Hell					
Saveth (6:54:58): You're just now realising this?					
Nub (6:54:58): I spent 9 hours there today					
Nub (6:55:14): and we wasted about 6 hours on a saturday last weekend					
Nub (6:55:25): how bad is it for you guys?					
Saveth (6:56:11): I've never spent more than about 1.5 hours there. ;)					
Saveth (6:56:20): It's all automated in Texas.					
Nub (6:56:21): lucky bastard and a half					
Nub (6:56:37): in idaho they wait like 5 mins					
Saveth (6:56:37): There can be 100 people there, and it will only take you half an hour to get through.					
Nub (6:57:30): man, there were 9 people in front of me in the normal line, about 15 in the reserve line (people who had not gotten in the day before) and it tooks me till 3:30 to get my test done (we got there at 7:30 am)					
xirho (6:57:50): and then the DMV workers got to have nap time					
Saveth (6:57:58): It took 8 hours to go through 24 people?					
Nub (6:58:21): yeah, and "oh let's wander over in this direction... no wait, let's wander in that direction... oh fuck it, let's just wander around until we find somewhere where people aren't expecting us to get things done."					
Sin (6:58:50): heh					
Sin (6:58:50): Subject: ADV: Cranberry Juice SAVE 50% and MORE 753041					
Nub (6:58:50): the lady doing the driving test was rather nice though, in a mean sort of way					
Sin (6:58:52): spam these days					
Sin (6:58:56): SPAM for friggin cranberry juice					
Saveth (6:59:0): ha ha					
Nub (6:59:06): she skipped her lunch break and took on people even after closing					
Sin (6:59:07): that's a first.					
Nub (6:59:11): but she was a hardass					
Saveth (6:59:16): time to filter out "Cranberry"					
Nub (6:59:17): failed 5 people in a row					
Nub (6:59:38): easy					
Saveth (6:59:48): well					
Sin (6:59:49): uhh, you have a test instructor who feels like failing you?					
Saveth (6:59:51): unintentionally					
Sin (6:59:54): they're completely subjective					
Saveth (7:00:01): sin, Maybe in CA... not in TX.					
Sin (7:00:03): you can give a perfect performance and get failed					

	Person A	Person B	Person C	Person D	Coterie
Sin (7:00:09): and then go the next day, give a WORSE performance, and pass					
Nub (7:00:22): don't come to a FULL stop at a stop sign, not buckle both belts (if you have two parts, 3 people did that today), hit a cone parrallel parking, or go too slow					
Nub (7:00:28): she has failed people for stuff such as that					
Saveth (7:00:36): eep					
Saveth (7:00:37): well					
Sin (7:00:40): haha, you get to parallel park in cones?					
xirho (7:00:42): Nub: the solution is to make a pass at her					
Saveth (7:00:46): Maybe that's better for us drivers. :P					
xirho (7:00:49): maybe she'll become lenient					
Sin (7:01:8): my first test I got failed for a bullshit reason. an automatic failure, even though i had more than enough points to pass					
Sin (7:01:17): the second time they didn't even test me on what I was automatically failed on the day before.					
xirho (7:01:19): That's how I got through middle school!					
Nub (7:01:24): no way, she would devour you and spit you out in a quivering saliva-covered shriveled-up ex-man in a nanosecond if you attempted to converse casually					
Sin (7:01:43): but they insisted i parallel park on a downhill, then docked me points for backing up an incline. wtf!					
xirho (7:01:46): drwiii: Cal Ripken sucks					
Nub (7:01:55): wtf					
drwiii (7:01:56): xirho: you, sir, are a homosexual.					
Nub (7:01:59): we didn't go on the road though					
Nub (7:02:03): we had a parking-lot course					
Nub (7:02:04): that was it					
Nub (7:02:10): it probably was 1/4 of a mile total driving					
xirho (7:02:11): Ichiro > Cal Ripken					
drwiii (7:02:21): ichiro == goatse.cx					
xirho (7:02:22): even A-Rod > Cal Ripken					
Sin (7:02:33): nub, they gave you a road test in a parking lot?					
Nub (7:02:40): yeah					
Sin (7:02:43): man					
xirho (7:02:48): drwiii: oh yeah					
Sin (7:02:49): and you wonder why so many drivers can't drive					
Nub (7:02:50): and it still took 9 hours					
Saveth (7:02:56): heh					
Nub (7:02:57): don't ask me... it's their job to make sure the math doesn't work out					
xirho (7:02:58): drwiii: You must buy me a PS2 and acopy of All-Star Baseball 2002--now.					
drwiii (7:03:08): ps2 == goatse.cx					
Saveth (7:03:19): drwiii == receiver					
Saveth (7:03:21): xirho == giver					

	Person A	Person B	Person C	Person D	Coterie
Nub (7:03:25): xirho, your subliminal messages will not... work... suppressing urge to... afk					
Sin (7:03:40): in San Fran they give you a *road* test, in the middle of one of the busiest sections of SF, where there are tons of one way streets occasionally turning into two way, NO parking (but they'll make you anyway) and lots of hills					
xirho (7:03:57): then they make you drive off the golden gate					
xirho (7:03:58): just for fun					
xirho (7:04:8): if you panic you automatically fail					
Nub (7:04:23): and launch off of the back of a parked vehicle and spin in mid-air					
drdink (7:04:44): hmm					
Saveth (7:04:53): hmm					
xirho (7:04:57): hmm					
xirho (7:05:16): Internet, eh?					
xirho (7:05:18): Maud, eh?					
Nub (7:05:28): dude, the way to work in GA					
Nub (7:05:35): is to do this, when it's blistering hot in the summer					
jelerial (7:05:42): all I had to do was drive around the DMV office					
Nub (7:05:43): turn your AC up to the max, recline the chair					
xirho (7:05:46): you mean there are parts of GA that are not blistering hot?					
Nub (7:05:57): and have a cup of freezing ice water sitting in the cup-holder					
Nub (7:06:02): if she asks for a sip, you're in baby					
jelerial (7:06:12): literally. I got graded down a bunch of points for not slamming into another car that was illegally parked on a streetcorner					
Saveth (7:06:22): uh huhh					
Sin (7:06:37): jel, where did you test?					
xirho (7:06:38): and so now jel commutes by bike					
Saveth (7:06:45): xirho, I sure hope so.					
xirho (7:06:59): saveth: about the bike or about georgia					
Saveth (7:07:02): xirho, Especially if she learned that it's necessary to slam into cars when they're illegally parked.					
xirho (7:07:09): oh					
jelerial (7:07:18): almost failed the test too.. until I recounted the points for the old woman, and told her 2+3+1 is not 24					
jelerial (7:07:26): sin, concord DMV					
xirho (7:07:39): 3+1 = 4					
xirho (7:07:42): 2+4 = 24!					
Sin (7:08:01): jelerial, any suburb has got to be easy.. relative to SF.. but the test givers are jerks and it's totally up to them, and largely unrelated to your actual performance.					
Rydor (7:08:27): wheee fuck					

	Person	Person B	Person C	Person D	Coterie
jelerial (7:08:32): sin, yes, I agree. I'm scared to drive in SF, unless its going from the bay bridge to the golden gate, and then its still hard on me					
Rydor (7:08:45): i just realized my whole webpage was on that problem partition					
jelerial (7:08:48): that, and whenever I drive in the city, I get hopelessly lossed					
drwiii (7:08:49): uhh huh huh.. "hard on"					
xirho (7:08:54): Rydor: you had a webpage					
Rydor (7:09:01): yeah					
xirho (7:09:01): dwriii; huh huh huh					
Rydor (7:09:05): well, whatever					
xirho (7:09:11): rydor: where?					
Sin (7:09:18): jel, you need a gps nav system like mine :) sf is my home though so I'm comfortable here					
xirho (7:09:19): lossed?					
xirho (7:09:32): like, lossy compression?					
jelerial (7:09:34): sin, hehe, the system would be worth more than my car					
Sin (7:09:45): jel, :)					
Saveth (7:09:48): jelerial drives a Yugo.					
jelerial (7:10:01): saveth, no, its worse					
xirho (7:10:05): Tell me where you are now, you bastard!					
xirho (7:10:07): </Krusty>					
jelerial (7:10:11): its a honda from 15 years ago					
xirho (7:10:14): jelerial drives a Geo Metro?					
xirho (7:10:16): oh					
jelerial (7:10:31): a civic or somesuch nonsense					
Saveth (7:10:41): uh					
Saveth (7:10:45): Civic > Yugo					
xirho (7:10:51): Yugo					
xirho (7:10:54): sounds like some kind of dish					
xirho (7:11:01): I'll have a Yugo with extra wasabi!					
xirho (7:11:35): saveth: well enlighten us cowboy					