The dynamics of mass interaction

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ABSTRACT
Usenet may be regarded as the world's largest conversational application, with over 17,000 newsgroups and 3 million users. Despite its ubiquity and popularity, however, we know little about the nature of the interactions it supports. This empirical paper investigates *mass interaction* in Usenet. We analyse over 2.15 million messages from 659,450 posters, collected from 500 newsgroups over 6 months. We first characterise mass interaction, presenting basic data about demographics, conversational strategies and interactivity. Using predictions from the common ground [3] model of interaction, we next conduct causal modelling to determine relations between *demographics, conversational strategies* and *interactivity*. We find evidence for moderate conversational threading, but large participation inequalities in Usenet, with a small minority of participants posting a large proportion of messages. Contrary to the common ground model and "Netiquette" guidelines [8,10] we also find that "cross-posting" to external newsgroups is highly frequent. Our predictions about the effects of demographics on conversational strategy were largely confirmed, but we found disconfirming evidence about the relations between conversational strategy and interactivity. Contrary to our expectations, both cross-posting and short messages promote interactivity. We conclude that in order to explain *mass interaction*, the common ground model must be modified to incorporate notions of weak ties [5,6] and communication overload [11,18].

Keywords
Mass interaction, Usenet, conversation, newsgroups, common ground, moderation, FAQS, netiquette, empirical.

INTRODUCTION
Usenet may be regarded as the world's largest and fastest growing conversational application. In 1988 there were fewer than 500 newsgroups. Current estimates vary, but at the time of our data collection in Dec. 1996, there were over 17,000 newsgroups, with approximately 3 million users worldwide [7]. This growth has been achieved without any centralised organisation or governing body [9]. The ubiquity of Usenet and the fact that it supports conversations between hundreds or even thousands of participants, provides the opportunity to study what we term *mass interaction.* However, we currently lack basic data about Usenet interactions. The current paper analyses over 2.15 million messages produced by 659,450 people in 500 representative newsgroups collected over 6 months. We provide descriptive data about newsgroup demographics, communication strategies and interactivity. We then derive predictions from the *common ground* model of communication to test predictions about how these parameters interact.

Previous research on Usenet has tended to carry out small scale qualitative studies of specific newsgroups, their culture and their conversation [1,17]. While these studies have drawn attention to important phenomena, their specific focus means they cannot address general questions that are central to mass interaction such as the levels of communication between different newsgroups. They also cannot easily examine the effects on interaction of different demographic variables or communication strategies, in order to test specific communication models.

The current study attempts to redress the balance. We first present basic information from the 500 newsgroups about mass interaction addressing the following questions. What are the *demographics* of a typical newsgroup: how many people contribute and how often do they do so? Is participation roughly equal or are groups dominated by a few verbose individuals? A second set of questions concern *conversational strategies*. Do participants restrict their interactions to the current newsgroup or do they broadcast them widely to multiple groups (a phenomenon known as cross-posting)? How long is a typical message? Do most newsgroups have FAQs ("lists of frequently asked questions") and how often do they post them? Finally we can ask questions about *interactivity*: how deep is a typical conversational thread, and how often are attempts to initiate conversation successful?

We also tested how well the *common ground* communication theory [3] explains mass interaction. The scale of mass interaction, and the huge numbers of messages and participants, gives rise to two novel communication problems. The first of these concern how participants establish common ground in mass interaction. Common ground is a key principle of face-to-face conversation, and refers to the fact that participants must establish a degree of mutual knowledge for their conversational contributions to be understood [3]. Face-to-face conversations generally take place between dyads or small groups, however. So how can common ground be established when there is a huge set of conversational participants with potentially diverse perspectives? There are also issues concerning the stability of the newsgroup population. In some newsgroups, there is a core set of participants who repeatedly converse, allowing participants to become familiar with one another. This familiarity supports common ground, but how do conversations fare in newsgroups where the participants are constantly changing? Some newsgroups employ a strategy of moderation to address the problem of common ground. In a moderated group, all interactions are filtered by a small set of moderators who are knowledgeable about the goals and history of the newsgroup. Only messages that are relevant to the newsgroup's goals are allowed to appear. Our first set of hypotheses concern how the three *demographic* factors of newsgroup *size*, the *familiarity* of participants, and the effects of *moderation* affect common ground. We also investigate how these same factors affect *interactivity*. One measure of conversational interactivity is the extent to which a given conversational contribution depends on prior context [3,14]. By this definition, deeply threaded conversations are indicators of interactivity. We therefore looked at how demographic factors affect threading.

The second major communication problem arises directly from the difficulty of establishing common ground. Lack of common ground may mean that participants are inundated with postings that are redundant or irrelevant. For example, new participants who are ignorant of a newsgroup's goals or conversational history, may post questions that have been discussed before, or are largely irrelevant to the group's interests. We therefore investigated a second set of factors concerning people's *conversational strategies* in addressing redundancy and irrelevance. We tested the effects of three conversational strategies on interactivity: (a) FAQ production; (b) long messages; (c) low levels of cross-posting. These strategies are all derived from the notion of common ground. FAQs exemplify common ground by summarising prior discussions and providing information about newsgroup culture; cross-posting can be seen as a failure of common ground, representing participants' need to go outside the newsgroup for conversation; long messages can be taken as evidence for substantive discussions and hence established common ground. The common ground model would therefore predict that FAQ production, decreased cross-posting and greater message length should all increase interactivity. A second set of partially overlapping predictions about the effects of conversational strategy on interactivity, can be derived from the Netiquette guidelines (news.announce.newusers and news.answers). These are a set of prescriptive guidelines about effective communication strategies [8,10]. They tell users to be succinct ("avoid long postings"), avoid redundant or repeat postings ("read the FAQ"), and to avoid widespread posting of messages of only marginal relevance ("don't cross-post"). With the exception of succinctness, the Netiquette guidelines and common ground model make identical predictions about the effects of conversational strategies on interactivity.

To summarise, the paper first presents basic descriptive statistics for newsgroups: (a) *demographics* - size, familiarity and moderation; (b) *conversation strategies* - FAQ production, message length, and cross-posting; (c) *interactivity* - the extent of conversational threading. We then use predictions derived from the common ground model to test three further questions: (a) how the three demographic variables affect conversational strategy; (b) how demographic variables affects interactivity; (c) how conversational strategy affects interactivity. We conclude with a general characterisation of mass interaction and a discussion of how well the common ground model applies to mass interaction.

USENET ORGANISATION, DISTRIBUTION AND INTERACTION

There are several levels of structure in Usenet. Collections of messages are clustered into newsgroups, and newsgroups themselves are organised into hierarchies. Each hierarchy is intended to address different conversational topics. There are over a hundred different hierarchies but the majority of newsgroups belong to one of eight main hierarchies ("the big eight"). These eight are: *alt* for alternative topics; *comp* for computer issues; *humanities*; *misc* for miscellaneous discussions; *news* for discussions about Usenet; *rec* for recreational topics; *soc* for social issues; and *talk* for general conversations. Each hierarchy is then subdivided into more specific subhierarchies. The name of each newsgroup begins with the relevant main hierarchy, and terms of increasing specificity are added to this. Typical newsgroup names are rec.music.dylan and rec.music.beatles, where both newsgroups are part of the music subhierarchy within rec. Twelve percent of newsgroups are moderated, and moderation is reflected in the newsgroup name: soc.russian.culture.moderated. Newsgroup distribution also varies from site to site. Newsgroups are distributed through an informal network of servers, with the specific set of

groups available at a given site being dependent on the particular site administration policy.

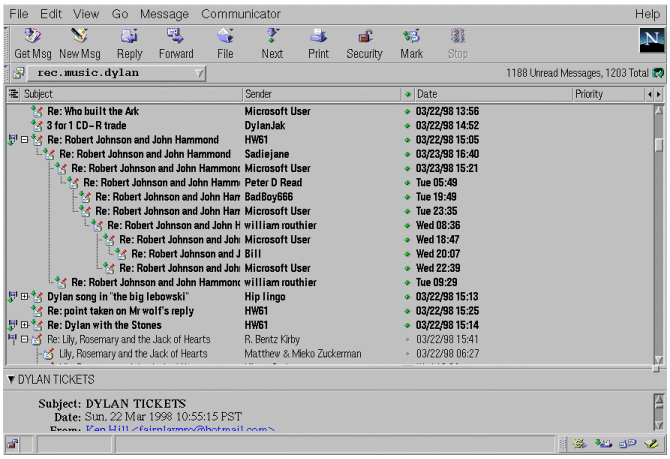

Figure 1*: Interaction and threading in rec.music.dylan*

A third level of structure within newsgroups is achieved by a mechanism that tracks conversational threads (see Figure 1). A conversation begins with an initiating post about a new issue or question ("Re: Robert Johnson and Don Hammond", posted by HW61) and any messages responding to the new posting will be linked to the message to which they respond. This is a conversational thread, i.e. a conversation consists of an *initiating post* along with various responses (if the posting elicits responses). There are also multiple levels of threading, so responding to an initial post is different from responding to a response to the initial post. For example, Figure 1 shows that the final message in the "Robert Johnson" thread (from william routhier) was actually a response to the second posting in that thread (from Sadiejane), as revealed by the line joining them. Most newsreading software organises messages according to threads, so users can view conversations in terms of the initiating post. They can also view the thread depth of a given message, i.e. whether it is an initiating post (depth of zero) a response an initiating post (depth of 1), and so on. Finally, cross-posting a message to multiple newsgroups is done by entering the names of additional newsgroups in the newsgroups field while composing a message.

DATA COLLECTION AND SAMPLING

We sampled from 26 different top-level categories, including seven of the "big eight" categories. We excluded various newsgroups for different reasons. We first excluded *alt* groups. Many server administrators have a policy of not distributing *alt* groups because of the tone and subject matter of many *alt* discussions. This makes *alt* groups less ubiquitous in terms of their distribution. *Alt* groups also differ from all other groups in their approval and creation process. We also excluded *humanities* groups because there are only a few groups (less than 10 worldwide that we have been able to find). We did not collect data for any *binaries* groups. These messages contain computer programs or images and we were only interested in textual messages, since we are studying conversation. For the same reason, we excluded *news*, **biz**, and **jobs** groups, because these groups are places for general announcements and advertisements, not conversation. We excluded regional groups, as our focus was on groups with global distribution.

This left us considering groups from the categories *comp*, *misc*, *rec*, *sci*, *soc*, and *talk*. From our newsfeed, we selected a stratified random sample of 500 newsgroups from these groups in proportion to their global occurrence, where the proportions were derived from a master list of 17,112 currently active newsgroups downloaded from uunet (ftp.uu.net). We selected only "active" groups, which we defined as those groups for which there were at least 180 messages over 6 months, equivalent to one message per day. A final selection criterion was moderation: the groups selected were representative of the overall level of moderation in Usenet.

We collected header information about each message in each of those newsgroups over a six month period, from July to December 1996. For each message we extracted various types of information including: the email address of the message poster; the date that the message was posted, the subject line of the message; message length (number of lines in the body of the message); and thread depth. In cases where messages were cross-posted we also gathered information about the newsgroups that the message was posted to.

We first present descriptive data about newsgroup *demographics*, *conversation strategies* and *interactivity*. We then outline specific hypotheses about the relations between these factors, and present a causal model testing these hypotheses.

DESCRIPTIVE RESULTS

Demographics

Table 1 shows demographic statistics for the 500 newsgroups. For each newsgroup, we calculated the total number of messages that people posted over the 6 month interval, and the number of different people who posted to that newsgroup. Overall levels of message traffic were high, with each group on average receiving 4299 messages (an average of 24 messages per newsgroup per day). In addition, each newsgroup attracted contributions from an average of 1319 different posters. Together these statistics provide evidence for mass interaction.

To calculate the *familiarity* of posters in a newsgroup, we used the criterion of repeat posting, i.e. whether a person posts more than once to a newsgroup. Our data show that in general a significant proportion of users are unfamiliar: 27% of messages are from "singleton posters" who only

contribute to a newsgroup once. This raised the issue of whether newsgroups have participation inequality. Some participants must be contributing large numbers of messages, given: (a) the high proportion of singleton posters; and (b) that the mean level of contribution is 3.1 messages/poster. Figure 2 shows highly unequal levels of participation in each newsgroup. The right hand side of the graph shows that the majority of people post only a few times, while the left hand side reveals that there are a few people who post a large number of times. A final statistic bearing this out, is that a tiny percentage (2.9%) of posters in each newsgroup account for an average 25% of the total posts.

	DATA COLLECTED	MEAN
Demographics	Number participants	1319
	% messages from repeat posters	73
	Number messages	4299
Conversational Strategies	Message length	44
	% messages that were cross-posted	34
	% messages that were FAQs	0.4
Interactivity	Thread depth	1.8

Table 1: *Descriptive statistics for the 500 newsgroups over the 6 months of the study*

Conversational strategies

We found *cross-posting* to be prevalent. On average 34% messages in each newsgroup were addressed to at least one other group, and the average cross-posted message targetted 3.1 other newsgroups. Cross-posting was not specific either: newsgroups were highly inconsistent in the set of external groups they cross-posted to. Each newsgroup overall cross-posted to a mean of 272 distinct groups. To further investigate the precision of cross-posts, we calculated the mean number of cross-posts per distinct cross-posted group. Strong links between groups would lead to a large number of cross-postings to a small number of groups and hence a high mean. However the mean was 5.4. The absence of specific cross-posting argues against the view there are strong communication ties between specific newsgroups.

FAQs were detected automatically by an algorithm which searched subject lines for the words "FAQ" or "Frequently Asked Questions". It excluded certain other special cases such as subject lines including the word "re". FAQs are a common feature of newsgroups which is shown by the fact that 54% of newsgroups had FAQs, although less than 0.5% of messages were FAQs. We also calculated average *message length*, which was 44 lines.

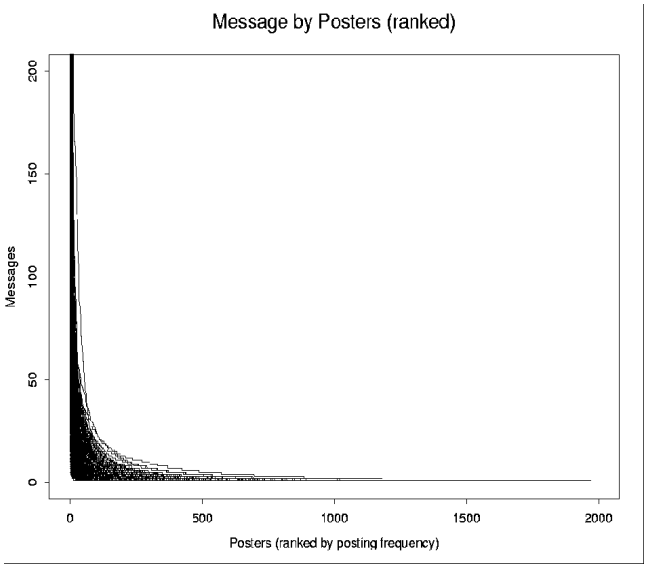

Figure 2: *Levels of individual participation within newsgroup*

Interactivity

Finally we looked at *interactivity*. The average thread depth is 1.8 messages, suggesting a typical exchange in which the average message refers to approximately two other messages. A substantial proportion of messages (33%) had two or more threads, indicating frequent extended conversations. We also calculated a complementary measure of interactivity, the number of initiating posts (those with zero references and thread depth of one). A high proportion of initiating messages would indicate repeated failures to start conversations, or a prevalence of conversational dead-ends. We found that initiating messages are highly prevalent, accounting for over more than 40% of messages. This suggests a view of Usenet in which it is hard to start a conversation. Once a conversation starts, however, then it seems to attract multiple contributions.

TESTING THE COMMON GROUND MODEL

We next use the common ground model to derive a specific set of predictions. Each of the conversational strategy variables of (a) increased FAQ production; (b) decreased cross-posting; (c) longer messages can be seen as an index of common ground. From our earlier arguments we would therefore expect *demographics* to affect common ground and hence *conversational strategies* in the following ways:

H1a,b,c: Newsgroups that are larger in *size* will have more difficulty establishing common ground, we would therefore expect them to have (a) fewer FAQs; (b) more cross-posting; and (c) shorter messages;

H2a,b,c: Newsgroups containing many repeat posters (i.e. people who are *familiar* with the newsgroup) will establish

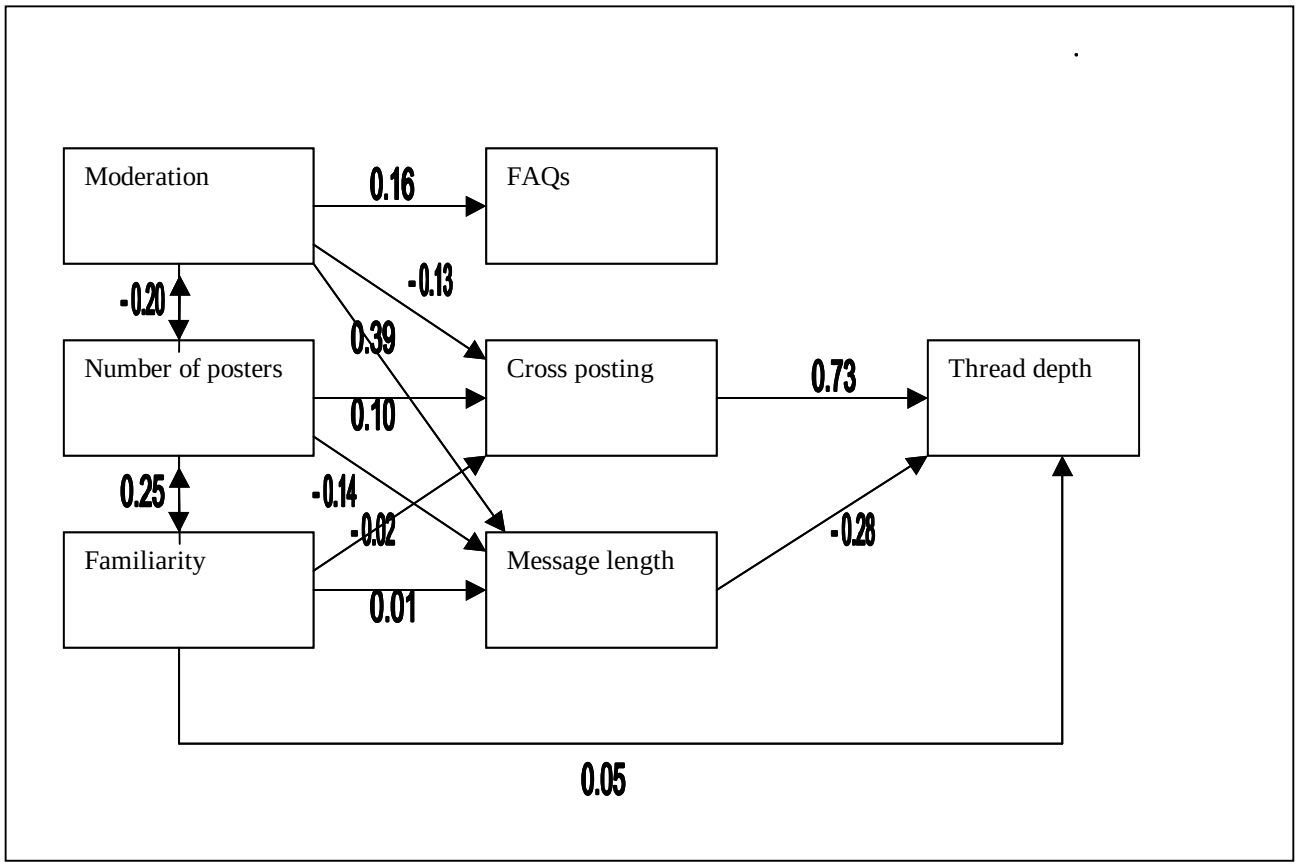

Figure 3: *Causal model showing effects of variables in structural equation analysis, for demographic, conversational strategy and interactivity variables*

common ground more easily, they will therefore have (a) more FAQs; (b) less cross-posting; and (c) longer messages;

H3a,b,c: *Moderated* newsgroups should more easily establish common ground, and hence have (a) more FAQs; (b) less cross-posting; and (c) longer messages;

We also expected *conversational strategy* variables to influence *interactivity*. If newsgroups can establish common ground through effective communication strategies, we should expect this to be manifested in terms of more *interactive conversation* as indicated by greater thread depth:

H4: Newsgroups with more FAQs will have greater interactivity as manifested by increased thread depth;

H5: Newsgroups with less cross-posting will have greater interactivity as manifested by increased thread depth;

H6: Newsgroups with longer messages will have greater interactivity as manifested by increased thread depth;

We should also expect *demographic* factors to have direct affects on *interactivity*:

H7: Newsgroups that are larger in *size* will have less interactivity as manifested by reduced thread depth;

H8: Newsgroups containing repeat posters (i.e. people who are *familiar* with the newsgroup) will have greater interactivity as manifested by increased thread depth;

H9: *Moderated* newsgroups will have greater interactivity as manifested by increased thread depth;

We tested these predictions using the following causal model, which was tested using a series of regression analyses [4]:

Demographics → Conversational strategies → Interactivity

The overall analysis involved two steps. In the first we regressed each of the *demographic* variables onto the *conversational strategy* variables to test H1-H3, and second we regressed all variables onto *interactivity* to test H4-H9. Where relevant, variables were normalised to allow for the fact that there were different numbers of messages and participants contributing to each newsgroup. For several variables (e.g. cross-posting) we experimented with different operationalisations (e.g. mean number of cross-posts/message, mean overall number of groups cross-posted to), choosing the operationalisation that best accounted for the variance in the regression equations.

Effects of demographics on conversational strategy

Figure 3 shows the results of three regressions of demographics on conversational strategy. The numbers on the arcs represent the standardised beta weights. For simplicity of presentation we show only significant relationships. Overall the models for each of the three factors was statistically significant. For message length (F[3,496] = 41.3, $p < 0.001$, $R^2 = 0.20$), for cross-posting (F[3,496] = 11.3, $p < 0.001$, $R^2 = 0.06$), and for FAQs (F[3,496] = 5.89, $p < 0.01$, $R^2 = 0.03$). We now discuss the specific predictions about the effects of each demographic factor. While *size* had no effect on FAQs (H1a), predictions concerning hypothesis H1b and H1c were confirmed: newsgroups that are larger in *size* have more cross-posting ($t = 2.2$, $p < 0.05$, $\beta = 0.10$) and shorter messages ($t = 3.2$, $p < 0.01$, $\beta = 0.14$). The familiarity predictions H2b and H2c were also confirmed: newsgroups containing more *familiar* contributors had less cross-posting ($t = 4.5$, $p < 0.001$, $\beta = 0.02$) and longer messages ($t = 2.4$, $p < 0.05$, $\beta = 0.01$), although again there was no affect of familiarity on FAQs, so H2a was not confirmed. Finally predictions H3a,b, and c were all confirmed. *Moderation* led to more FAQs ($t = 3.5$, $p < 0.001$, $\beta = 0.16$), reduced cross-posting ($t = 2.8$, $p < 0.01$, $\beta = 0.13$), and longer messages ($t = 9.5$, $p < 0.001$, $\beta = 0.39$).

Effects of demographics and conversational strategy on interactivity

The full model was very successful at predicting interactivity (F[6,493] = 133.9 , $p < 0.001$, $R^2 = 0.62$). However, two of the predictions about the effects of conversational strategy on interactivity were disconfirmed. H5 predicted that newsgroups with less cross-posting will have greater interactivity, but in fact the less cross-posting there was in the group, the *less* the threading ($t = 23.3$, $p < 0.001$, $\beta = 0.73$). H6 predicted that newsgroups with longer messages will have greater interactivity, but in fact message length *reduced* interactivity ($t = 5.2$, $p < 0.001$, $\beta = 0.28$). There were no effects of FAQs on interactivity (H4).

Only one of the predictions about the effects of *demographics* on *interactivity* was confirmed, namely H8, newsgroups containing familiar contributors will have greater thread depth ($t = 16.2$, $p < 0.001$, $\beta = 0.05$). Neither H7 nor H9 concerning the effect of FAQs and size were validated.

CONCLUSIONS

We can draw a number of conclusions about mass interaction from this research. Although there are large numbers of people contributing to each newsgroup and large numbers of messages overall, the descriptive data show that the default mass interaction consists of a 43 line message referring to two previous messages. This indicates moderate but not large amounts of interactivity. This general view about interactivity should be tempered, however, by the fact that many attempts to initiate interaction were failures; over 40% of messages were initiating attempts. This suggests a problem of *conversational inertia*: it seems to be problematic to start a mass interaction but it is relatively easy to continue it once started.

We also found massive *participation inequalities* between different people in a given newsgroup. This is an important clarification of the view that the Internet is an egalitarian forum [9]. While it is true that anyone can post to a newsgroup, the descriptive data clearly show that conversations in newsgroups are dominated by a minority of highly verbose participants. Again this argues for a view that Usenet conversations do not strictly involve repeated levels of mass participation, as evidenced by the fact that 27% of messages are generated by people who only contribute once to the newsgroup. Overall these results suggest that as far as active posting is concerned, mass interaction may be a misnomer. Typical conversations involve only small numbers of posters, and newsgroups are often dominated by cliques of verbose contributors. This participation inequality contrasts with research on face-to-face interaction and video-mediated communication which has shown much more equal levels of participation [14]. Participation inequality may not have wholly negative outcomes, however. The majority of Usenet participants may well be satisfied with making infrequent contributions, posting only about issues that are important to them. Such peripheral participation may enable people to remain in the background, monitoring general conversations until they spot a topic of direct relevance, or they need to pose a question of their own. This type of background involvement has been observed to be beneficial in the case of corporate email [11] and interpersonal communication [12]. This form of participation has also been proposed as an important way for novices to learn about a novel topic [12].

While the conversational and participation data suggest a view in which conversation is carried out locally by a few participants, the cross-posting data suggest a slightly different perspective. It turns out that cross-posting is frequent, although it propagates potentially irrelevant messages and is thus contrary to both the common ground model and Netiquette guidelines. Cross-posting can also inform us about the relations between newsgroups. When people do cross-post, they are unspecific about the groups they cross-post to, as indicated by the fact that the average newsgroup cross-posted to over 200 others. This in turn argues against the view that there are tight conversational links between different newsgroups [15].

We also tested a number of predictions derived from the common ground model. These were mainly verified for the

effects of demographics on common ground. The demographic variables of moderation, familiarity and smaller newsgroups all increased common ground as measured by increased message length and decreased cross-posting. The effects on FAQ production were less clear however. Only moderation increased FAQ production, with neither familiarity nor size having an effect. This view argues against the view that FAQs are a "defence mechanism" arising from participants' desire to instill consensus in diverse or rapidly changing user populations. Rather FAQs are most likely to arise under the orderly conditions induced by moderation.

What about the effects of demographics on interactivity? Here the common ground model fared much less well: only familiarity directly increased threading, with neither moderation nor size having an effect. Furthermore, and contrary to our expectations, cross-posting *increased* interactivity. This is counter to both the common ground view and the Netiquette guidelines: both of these contend that cross-posting should dilute conversational focus and hence reduce interactivity. This result is consistent, however, with a different perspective on large scale interaction, namely *weak ties* [5,6]. The positive effects of cross-posting on interactivity suggests that people exploit the mass distribution properties and diverse population of Usenet to go beyond a particular newsgroup to carry out their conversations. Combining the results about the effects of familiarity and cross-posting on interactivity indicates that there may be two complementary sets of circumstances that facilitate mass interaction. The first occurs when familiar participants share common ground and the second is where people seek out diverse perspectives by posting outside their newsgroup. Our final prediction about the effects of message length on interactivity was also disconfirmed: shorter messages actually promoted interactivity. How can we explain this? One possibility is consistent with communication overload [11,18]. Given the huge amounts of conversational traffic in Usenet, people are less likely to read, and hence reply to, long messages. Such an interpretation would be consistent with the Netiquette stricture ("avoid long postings").

Although moderation and FAQ production increased common ground, they had no effects on interactivity. Why was this the case? One reason why moderation does not increase threading may be that moderators increase conversational relevance by deciding that a new posting is tangential to the topic, and stopping the current thread. In doing so, however, they automatically reduce the amount of threading. A reason for the absence of expected conversational benefit of FAQs may be that FAQs have two contradictory effects. FAQs may promote conversation by providing access to information about group culture, conversational expectations and a precis of group conversational history. At the same time they may discourage newcomers from productively revisiting a previous conversation out of the mistaken belief that the topic has been exhausted. New research involving content analysis of FAQs and moderators' strategies is necessary to determine whether these suggestions are the case.

Our findings should also be qualified by a number of provisos. Our strictly quantitative analysis needs to be complemented by content analysis, as well as surveys of Usenet participants. The current analysis is silent about the effects of conversational content: which specific topics or conversational styles encourage large responses and which fail to elicit a response? What factors encourage or discourage flaming? What are people's reactions to flagrant examples of cross-posting? Surveys and interviews could also address people's attitudes to, and satisfaction with their Usenet interactions. Why do people contribute to certain discussions but not to others? How long do people lurk before they first post? And how is dominance viewed? Why do certain people post multiple messages and how are they perceived by others for doing so? Again some of these issues have been addressed in small scale studies, but more of this type of work is needed [1,17]. There are also issues about moderation and FAQ maintenance which are highly relevant for issues of group memory [2]: why do certain people take on the responsibility of moderating or maintaining FAQs, and what is their motive for doing so? Other issues that need to be addressed by content analysis include deliberate attempts to subvert Usenet conversation ("spamming, "trolling") or the generation of messages by artificial agents ("bots").

Finally there are issues concerning the use of thread depth to measure interactivity. One potential objection to using threading is it fails to include "backchannel" responses in email: Usenet users report that they sometimes reply to a public Usenet message privately in email. However, our interest here was in publicly observed mass interaction, and email conversations are not part of the public record. This argument also applies to the issue of "lurking", i.e. reading newsgroup messages without responding to them. While lurking may be a prevalent behaviour, again it leaves no public conversational trace. Finally there is the question of "flaming". Deeply threaded Usenet interactions sometimes result from emotionally charged and occasionally personally abusive exchanges. However this addresses the question of conversational content, an issue which we leave to future work.

What are the theoretical implications of these results? Our data show that while the common ground model provides a good account of the effects of demographics on conversational strategy, it is much weaker at predicting interactivity. Two major modifications need to be made in applying the common ground model to mass interaction. The fact that shorter messages promoted interactivity

suggests that a model of *mass interaction* also needs to incorporate the notion of conversational overload: participants have to filter large numbers of messages to find relevant information, with the consequence that long messages may be ignored. Our finding that cross-posting benefits interaction indicates that the model needs to take account of the benefits of both familiarity and diversity. On the one hand common ground can promote consensus but conversations can grow stale through overfamiliarity of topics and people. On the other hand, a diverse population may stimulate interaction but their widely disparate perspectives may mean that no conversational progress can be made.

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