Grooming Analysis
Modeling the Social Interactions of Online Discussion Groups

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Abstract. This chapter looks into different ways of analyzing and modeling the time dependent development of social interactions between members in online discussion groups. Social grooming is an activity in which individuals bond and reinforce social structures. To groom someone can be for instance to mention someones name in a discussion or to cite something said by that person. The number of grooms received by a group member can be analyzed and used as an indicator of the social status in the group. By performing grooming analysis it is possible to attain information about how the relative status of the group members changes over time. The data in this study is taken from two different international online discussion groups. A validation showed that the estimate of status based on the grooming analysis showed remarkable correspondence with the collective status ranking performed by a group of independent evaluators.

Keywords: Social media, social network, community, social status, social dynamics, group dynamics, gender, Mathematica.

1 Introduction

At international online discussion sites, people from around the globe can exchange knowledge and opinions and become virtual friends. Even if these people never meet face to face, it seems that social hierarchies develops also within such groups. Some get a lot of attention whereas others get almost none. This is interesting since the medium does not give away any of the clues we are used to interpret in real life. We know that in real life, appearance, voice, accent as well as body language affect how we appraise other people and thus contribute to the social rank structure in a group. None of these clues are available in a virtual group. Because of this it is interesting to know what factors are influencing the social structuring in virtual groups.

Of particular interest is the notion of social status ranking of members in the group. This can be seen as a macro structure or a property of the group that emerges out of the many social interactions between the group members. We can

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say that the micro behavior of the group members give rise to the macro property of social stratification of the group. To be able to study such phenomenon we need to model the development over time in the group.

The approach taken here is to look at the discussion group from a psychological perspective and to search for signs of attention in the posts made. This is smart because it makes it possible to get many more insights into the social dynamics over time of the group, compared to only analyzing the number of posts that people make. Also it makes it possible to construct a social network graph even for groups that are not making links to each other.

2 Background

Social Interaction and the Emergence of Status in Groups. Social status replicates itself across different social circumstances. An important distinctions is made between *maintenance of status* and *emergence of status*. Maintenance of status occurs when the group members already are ranked. Emergence of status however is what happens when individuals that do not know each other come together. Processes of social interaction between the members result in the emergence of status rank in the group [1]. High status members of a group can be characterized by being helpful, remind others about rules, provide suggestions and establish norms for the group. Furthermore they are not targets of aversive behavior but they will defend themselves when attacked. Low status members of a group can be either rejected members or neglected members. Rejected members are characterized by aggressive and disrupting behavior, they start conflicts, often approach others and are rejected, thereby collecting a lot of rejection experiences. They also respond to aggression by more aggression. Neglected members on the other hand are characterized by being shy and getting very little attention from the other members, they also respond to aggression by withdrawal, ignoring the aggression or by submission without retaliation. [1].

Social Grooming. In social animals, grooming is a major social activity, and a means by which animals that live in proximity can bond and reinforce social structures, family links, and build relationships. Social grooming is also used as a form of reconciliation and a means of conflict resolution in some species. In animals, it has been studied how grooming was performed by one animal upon another animal of the same species. It was found that grooming was significantly correlated with social rank. High-ranking individuals received more grooming than their low-ranking group mates. The results support the notion of grooming as an indicator of social status [2].

Social Attention Analysis. For humans the notion of giving attention has been used as a parallel to grooming in animals. In social attention analysis the objective is to measure the attention that people give to each other over time. To do this a particular metric is used. This metric keeps track of who give attention to whom at what time. By analyzing such data it is possible

to assess the communities attention to a group member, the group members impact over time and the group members diversion of attention over time [3]. This method requires that the notion of attention can be defined as something measurable. When social attention analysis is carried out in face-to-face settings such measures can be for instance nodding in approval when someone is speaking or reciting what another group member has said previously.

Social Status in Online Groups. In a face-to-face situation there are a number of signs that can be used to assess status. Examples are erect posture, glares, eye contact and assertive speech. In online discussion groups there are no such signs, thus status has to be assessed based on the information available in the discussion group pages. So how is status assessed in an online setting?

Sometimes, a social media group is started by a small group of friends and then grows with the addition of their real-world friends. In that situation the social status pattern is reproduced from the real-world status.

If a social media group is evolving over time by the accumulation of users that does not formerly know each other we have a situation where the social status pattern emerges over time in a group of mutual strangers independent of any former real-world status patterns. What can be the basis of such emergent status patterns?

In groups that work together, the number of contributions and the quality of contributions can be a basis for assessment of status. In many online groups there are links between the group members. If the numbers of links are visible to the group members it is possible that this could be used as a basis for the assessment of status. In groups that are merely socializing, the assessment can be based on how interesting a particular group members posts are. Another possible base for assessment of status is how much a group member is socially attentive to the other members of the group. Thus a high-status member would be helpful, encouraging and pay attention to others in the group.Other basis for assessment of status can be gender, geographic location or displayed knowledge about a particular topic.

There are thus several possible things that can work as a basis for the assessment of status in an online group and there is probably not a single scalar rank in the group. Regardless of what basis is used for the assessment of status in an online group there is a real social status out there in the sense that we could ask people about the social status of group members and they will give you an answer. This answer is dependent on what special meaning that individual gives to the concept of social status. In this work we define social status in an online group as the collective ranking made by a group of individuals that possibly base their ranking on different factors. In this work, we want to find an indicator of social status that is possible to assess by analyzing the available content.

The question is thus: - Can we find an indicator of social status in the available data from an online discussion group - Is the social status ranking obtained by this indicator equivalent to the collective social status ranking as perceived by a group of individual evaluators. If we can find such a measure it will be possible to analyze how the status emerges over time and evolves dynamically.

Methods for Analyzing Social Status and Group Dynamics Online. Different types of methods have been used to assess the social status in online groups (the concept of status used here is similar to the concepts of *influence* or *reputation*). The methods use different types of indicators of status. These are chosen dependent on what kind of data that is available and the purpose of the study. The purpose is most often to find the most influential persons in the group with a possible sub-goal of exposing these people to marketing activities.

One commonly used indicator of status is the number of user contributions. Here it is assumed that the more a person contributes to the group in the form of posts, uploaded material and answers to questions, the higher the social status of the individual. Yan and Vassileva used a systems dynamics approach to study the incentive mechanisms in a virtual community [4]. In this work a combined measure of different forms of user participation was used as an indicator of social status. They successfully modeled the dynamics of how members raised to higher and higher status in the group as measured by their status class that was assigned to them by the system software.

Another, subtler, indicator of status is the *quality* of the contributions. Agent based methods models the essential characteristics of the individual, as well as the rules and the global consequences of the interactions between individuals. Zhang and Tanniru made an agent based study where the characteristics included expertise level, activeness level, sharing level and social gain. In this study it was assumed that the quantity and quality of the messages posted was an indicator of social status (reputation) [5].

Another indicator of status that has been used is *the number of in-links* to a person. Agarwal et al developed a model for identifying the most influential bloggers in community blogs. In their model, a weighted measure combined by number of comments, number of in- and out-links and length of the post was used as an indicator of social status (influence). One thing that was apparent in their study was that activity was not correlated to influence. There were bloggers with low activity that were nevertheless very influential and vice versa [6].

Some virtual communities use *peer ranking of the quality of messages* to recognize and label an agents reputation. This has been used as a validating indicator of status [6].

Another indicator that has been used in settings of online marketplaces is *the quality of former interactions*. Sabater and Sierra have constructed a model of social status (reputation) that generates sociograms that show the relations between individuals. In their work the quality of the former social interactions in a marketplace system was used as an indicator of social status (reputation) [7]. Within the field of bibliometrics, *the number of citations* that authors of scientific publications receive over time has been used to indicate status [8]. Many interesting results have been found regarding the notion of status and its relation to a tree structure of citations of citations. Here, the total number of citations is used to indicate status.

In the studies mentioned above, the validations made were based on other computer-generated data. There has not been any study where validation was made in terms of comparison with status as appreciated by a group of humans.

Many of these indicators have no relation to social interactions in a group. This type of status can only be observed by a global system having access to, for instance, all citation data and we cannot know if this is equivalent to emergent social status as attributed to a person by a group of people. This has been noted by Sabater and Sierra who writes *"This external position gives the analyst a privileged watchtower to make this analysis"*[7]. They conclude that, actually, each agent has to do this analysis from its own perspective.

Our approach to analyzing social status is to try to find an indicator that can be shown to be equivalent to the social status ranking that emerges from many individual judgments by individuals each assessing a limited set of interaction data. In the study described here the concept of *social grooming* is used as an indicator of status. The social status ranking based on this indicator will be validated by comparison to the global status ranking that emerges from the combination of individual assessments of status made by a group of people that each have access to a limited set of the data. The perspective chosen is thus to study how micro activities by the group members together generates macro properties of the group, more specifically the macro property of social status stratification.

3 Empirical Material

The two online discussion groups were selected for two reasons. First I wanted to have two groups of similar sizes in terms of number of people and number of posts. Secondly I wanted to have groups that were different in terms of content since I wanted to find out what a content independent analysis can reveal about a group. Also, though not a member, I happened to be familiar with both groups. (Please note that *subject* in this text refers to a person in accord with tradition in experimental psychology)

The two data sets consisted of 1604 and 971 posts respectively. Data was captured by copying the content from the website pages and saving as text files. The data represented the activity in the groups over a period of 3-4 years. There were no links between group members. See Table 1 for more information about the data sets.

Online Discussion Group 1: Fashion. The first of the groups studied is the people that comment about fashion in a particular thread on the site *Fashionspot*. The website is dedicated to discussions of different aspects of design and fashion. This particular thread is about a rock band with a distinctive style in fashion. The discussions are about the style and appearance of the band members and their girlfriends but also about the music of the band. The activities that the group members engage in are viewing posts, commenting, posting pictures or links, asking questions, answering questions and generally socially chatting

with each other. The data structure was as follows: Date and Time of Posting, Post Number, Subject Name (a unique name was required to be able to post comments, this was chosen by the subjects themselves), Subject Location (this text field was voluntary and could be filled in with city or country, or sometimes only by continent), Subject Gender (this was voluntary, but most filled this in), Quote (the name of the quoted subject was automatically filled in when one subject quoted another subject), and a Text Field (which contained the written text).

Online Discussion Group 2: Science. The second of the groups studied is the people that comment about computer science in a particular section called *The core science of simple programs*on the forum *A New Kind of Science*. The discussion regards cellular automata and computational theory. The activities that the group members engage in are viewing posts, commenting, posting program files, pictures or links, asking questions, answering questions and to some extent, socially chatting with each other. The data structure was as follows: Date and Time of the Post, Subject Name (a unique name was required to be able to post comments, this was chosen by the subjects themselves), Subject Affiliation (the subject could give an affiliation as a company or a university), Subject Location (this text field was voluntary and could be filled in with city or country), and a Text Field containing the written text.

4 Method

4.1 Analysis of the Posting Activity

The text files were imported to Mathematica. A program was written that searched for text patterns and picked out data and reconstructed the following general descriptive data for each post: Post number, Post Day (this was calculated so that the first day of posting was day 1, the next day, day 2 and so on) and Subject number (this was constructed so that the first poster was given number 1, the next poster number 2 and so on).

For each subject data about gender and location was picked out if this was available otherwise this was categorized as unknown. The gender data in the Science group had to be inferred from the names of the subject since no registration of gender was made. The gender classification was made by identification of a male or a female name. All names that were ambiguous were classified as unknown. For each given location a table was constructed that stated if the location could be described as an English speaking country or not.

4.2 Grooming Analysis

The idea behind the groom analysis is to combine two methods used in other contexts when trying to map out the social rank order in a group. The first method

is simply that used by primate researchers of counting number of grooms and relating that to the social rank order in the group. The second method is social attention analysis, which tries to capture how a group gives differentiated attention to the different group members. In the groups studied in this work, the structure is like a bullentin board with every post basically directed to all the members of the group. If a post contains a name reference to one of the other members then this is a sign that this individual has been seen and is acknowledged. In the studies by Joyce & Kraut it was found that replies to posts increased the probability that a user would post again. This was so regardless of the emotional tone in the answer. Because of this we argue that the name reference can be seen as an indication of that a member receives attention in the group [9]. Attention can in this context be seen as a social reward. Two assumptions are made. First it is assumed that attention from other group members works as a social reward and thus is a positive reinforcer of participating in the group. Secondly, it is assumed that the amount of attention that an individual gets in the group is an indicator of the social status or rank order in the group. In particular, a person who gets more attention than he or she gives to others is considered to be a high-status person while a person who receives much less than he or she gives to others is considered to be a low-status person. It is thus assumed that this balance reflects the social status in the group. By finding indicators of attention in the data, and keeping track of who gives to whom, it would thus be possible to quantize an estimated measure of an individuals status in the group.

In this analysis the concept of groom is defined as a social reward, in form of attention from other group members. For the Fashion group, attention was operationalized as one of two things. The first was *explicit mentioning of someones name* in a post. The second was *quotation* of something that the group member had written in a post. For the Science group, attention was operationalized in a similar way as one of two things. The first was *explicit mentioning of someones name* in a post. The second was *commenting on something that a group member had posted*. These acts were possible to identify in the data. If a group member received attention in this way, it was said that the he or she was groomed, or received a groom. For each identified act of grooming, it was registered who gave the groom and who received the groom. A groom balance was constructed for each subject. This increased by one each time the subject was groomed, and was reduced by one each time the subject groomed someone else. In this way we could construct a time-dependent groom-balance for each subject. Also the accumulated number of grooms received for each subject was counted. The data was imported to Mathematica and a program was made to pick out grooms in all of the posts. Unfortunately, the mentions of some names had to be manually edited because of short forms or misspelling of the names of members. This was the case in 4% of the grooms in the Fashion group. For each member the program kept track of the number of posts made, the number of grooms given to others and the number of grooms received from other group members.

Table 1. Results of the Analysis of the Posting Activity

Basic Data	Fashion	Science
Number of active group members	187	167
Number of posts	1604	971
Number of days studied	1189	1604
Gender distribution: Females	84,1%	4,2%
Gender distribution: Males	8.5%	79.0%
Gender distribution: Unknown gender	7.4%	16.8%
Group members from English speaking countries	36.4%	35.5%
Group members from Non-English speaking countries	19.3%	14.5%
Group members from unknown location	44.9%	50.0%
Countries represented	Argentina Australia Belgium, Brazil Canada, China Colombia Czech Republic El Salvador England Finland, France Germany Israel, Kenya Latvia Netherlands Norway Philippines Poland, Russia Scotland Spain, Sweden Turkey USA	Australia Brazil Canada England Egypt France Germany India Israel Italy Korea Mexico Netherlands New Zealand Paraguay Romania Switzerland Vietnam Ukraine USA
Derived Measures	Fashion	Science
Posts per subject all	8,6	5,8
Posts per subject English-speaking countries	10,0	6,6
Posts per subject Unknown location	8,8	6,1
Posts per subject Non-english-speaking countries	4,7	3,1
Posts per subject Females	9,7	1,7
Posts per subject Unknown gender	2,8	6,1
Posts per subject Males	2,2	6,0

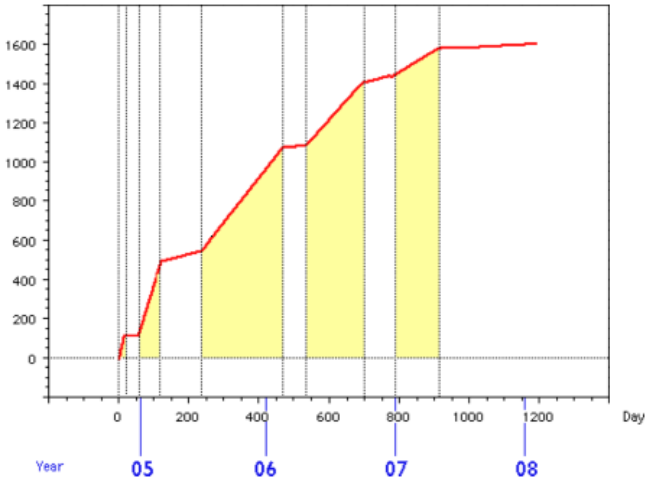

Fig. 1. Fashion Observed data. Accumulated number of posts as a function of days. Periods of high activity are interspersed with low activity.

5 Results

The basic results of the analysis of the posting activity is presented in Table 1. By plotting each post as a data point where the day of the post is shown on the x-axis and post number on the y-axis we can get an overview of the posting activity over time. The height of the curve shows the accumulated number of posts. The slope of the graph shows how the activity in the group varied over time. The graph shows that periods of intense activity (high slope) intermingle with periods where the activity in the group almost died out. This kind of graph can also reveal variation coupled to seasons, however in this example no such tendency can be seen. See Figure 1.

Group Member Activity over time. In this graph each post is shown as a data point where the post number is shown on the x-axis and subject number on the y-axis. By doing this plot we can get an overview of the posting activity by different group members. Figures 2 and 3 show the group member activity graph for the Fashion and the Science groups respectively. The slope of the graph shows us how the number of members increases over time. We can also see that some members post many times and keep posting all the time, while many post only once. If we compare the graphs for the two groups we can see some differences. In the Fashion group there are no group member that stays in the group the whole time, in fact if we compare the first and the last quarter the posting members are a completely different set of people. In contrast we can see

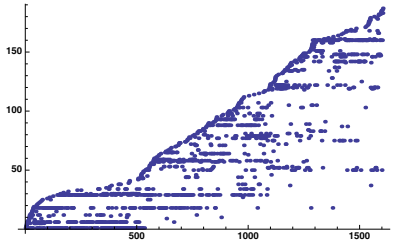

Fig. 2. Activity Graph Fashion

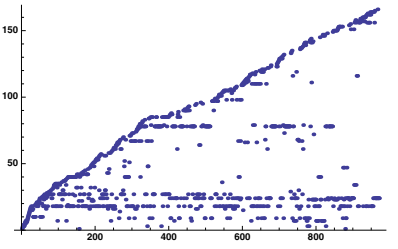

Fig. 3. Activity Graph Science

that in the Science group a few members keeps posting steadily throughout the observed time period of more than four years, however many in this group post only once.

Differences in Activity. In figures 4 and 5 we can see an ordered plot of the number of posts made by individual subjects for the two groups. These plots show that there is an uneven distribution of posts. A few subjects make most of the posting and a large number of subjects only make one post. The two groups are very similar in this respect. Naturally, we can expect a difference between different subjects since the persons joined the group at different times and thus have not had the same effective amount of time available to post comments. Regression analysis of the number of posts as a function of the day of entering the group, show that indeed there is a small effect. About 4% of the variance can be explained by this correlation.

The activity can be broken down in gender and language groups. The under-represented gender post much less per individual, about 2 per person, than the majority gender group, about 6-10 per person. People from English-speaking countries makes about twice as many posts as people from non-English speaking countries.

Results of the Grooming Analysis. Let us first look at the Fashion group. The overall occurrence of mentions was 152 and the occurrence of quotes was 295 in the data set. The concept of groom, defined as the sum of quotes and mentions is thus 447 in the whole set. This corresponds to one mentioning for every 10,6 posts and one quote for every 5,4 posts.

In the Science group the number of grooms were 816 composed of 342 mentions and 474 comments on posts. Thus there was one mentioning for every 2,8 posts, and one comment for every 2 posts. This means that there were relatively more grooming in the Science group compared to the Fashion group.

Of the 187 people in the Fashion group, 113 or 60% got no grooms at all. Of the 74 people that received any grooms there was a center group of 8 people that received 50% of the grooms. At the very center was four females that got 40% of the total number of grooms. 2 of those were from US, one from Canada and one did not disclose her location.

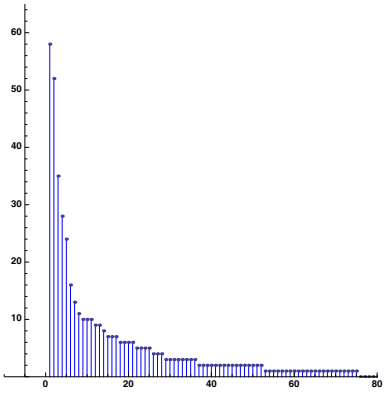

Fig. 4. Distribution of posts Fashion

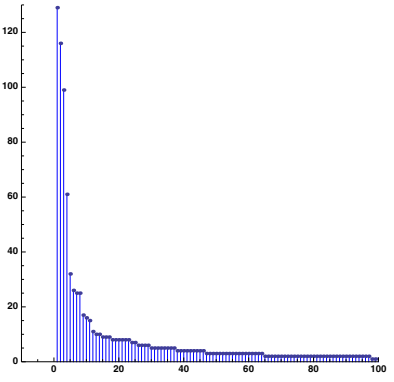

Fig. 5. Distribution of posts Science

Of the 166 people in the Science group, 46 or 27,7% got no grooms at all. Of the 120 people that received any grooms there was a center group of 10 people that received 50% of the grooms. At the very center was five males that got 38,5% of the total number of grooms. 3 of those were from US, two did not disclose their location.

The correlation between number of posts and number of grooms for each subject was 0,94 for the Fashion group and 0,03 for the Science group. The mean correlation for the two groups was 0,48.

Reciprocity in the Distribution of Grooms. A calculation was made of the relation between grooms given and grooms received. (Fashion 96 people gives nothing, 19 or 19,8% of these get groomed, 91 people gives and 55 or 60,4% of these were groomed). (Science 56 people gives nothing, 37 or 66% of these get groomed, 110 people gives and 83 or 75,5% of these were groomed). Thus, in the Fashion group, your chances to get groomed increase from 20% to 60% if you groom someone else. In the Science group, the chances increase from 66% to 76%. The effect was not statistically significant (ANOVA P-value 0.410992), but the data indicates that it is generally a good idea to groom someone if you want to be groomed yourself.

Effect of Grooming on Posting Activity. For the Fashion group: 187 people made a first post, 28 of these got feedback in the form of a groom. Of the 28 persons that got feedback, 20 made at least one more post. Of the 161 persons that did not receive any feedback at all, 43 made at least one more post. Thus the probability of making a second post was 0,72 for those who received grooming and 0,27 for those who did not. The mean number of posts needed before any grooming was received was 3,3. The maximum was 17 posts. That means that one person made 17 posts before anyone acknowledged her presence in the group. Most of those who were groomed, however, was groomed after one or two posts.

In the Fashion group, 15,5% of the females were groomed after their first post compared to 5,9% of the males. The females got 1,13 times their input whereas the males only got 0,37 times their input. So actually the males got much less return for their investments than the females in this group. In the Science group, 52% of the males got feedback after their first post, compared to 33% of the females. In the Science group, both the males and the females got 1,0 groom for every invested.

In the Fashion group, people from English-speaking countries got 1,0 for each groom while the people from non-English speaking countries got 1,76. In the Science group, people from English-speaking countries got 0,94 for each groom while the people from non-English speaking countries got 1,10. Thus it seem that the reason that people from non-English speaking countries get fewer grooms is not that they get less return on their investments, bur rather that they give less grooms in the first place.

The nicknames used by the subjects in the two groups could be classified in three sets. Nicknames that were actual names, nicknames that were not names but pronouncable words and nicknames that were combination of letters and numbers and not possible to pronounce. We thus have the three categories of nicknames: Names, Words and non-pronouncable. Names got most, pronouncable words next and unpronouncable nicknames got least. (Fashion: 2,96, 2,04, 0,8; Science: 1,31, 0,60, 0,33). This means that if you want to be groomed you should avoid an unpronouncable nickname.

The Grooming Network. The notion of grooms are directional in the sense that it is possible to identify that one subject gives a groom to another subject. This means that it is possible to construct a grooming-network showing the social interaction between the group members. Each subject is considered as a node in this network and the degree of social interaction can be visualized as the connection strength. The community modularity was 0,55 for the Fashion group and 0,44 for the Science group. As the groom data holds information about when a particular groom was given it is also possible to construct the grooming networks for different time periods, an example of a the grooming-network at a particular point in time can be seen in figure 6.

The Groom Balance. Every groom can be said to represent a certain point in time. For every post including a groom it is possible to calculate the groom balance for each subject. The idea behind the groom balance is that for a random member of the group we can expect reciprocity so that on average people give approximately as many grooms to others as they receive themselves. A person with many more grooms received than given would indicate that that person had a high status at that particular moment in time. The groom balance was calculated for each subject in the folllowing way: the number of grooms the subject had received minus the number of grooms a subject had given to others.

In figure 7 we can see the groom balance over time for a subject in the Fashion group. This is an example of a person who gives about as much as she get and the groom balance consequently fluctuates around the zero level.

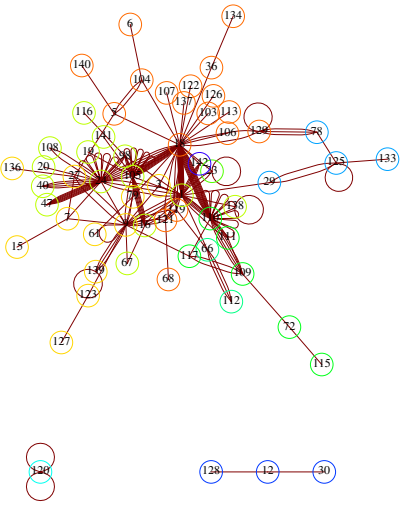

Fig. 6. Science. The Grooming Network show the social interactions. Every line represents a groom from one member to another.

In figure 8 we can see the groom balance over time for a subject from the Science group. This is an example of a person that gives a lot but receives very little. It is argued that this as a sign of low status.

In figure 9 we can see the groom balance over time for a subject from the Fashion group. This subjects receives more than what is given to others. It is argued that this as a sign of high status.

It also possible to plot the groom status for the whole group. In figure 10 we can see for the Fashion group how different high status individuals replace each other successively over time. When one high status member leave the group, it seems that another member soon takes her place as the alpha member in the group.

6 Validation

The grooming analysis resulted in a value of total number of grooms received for each subject. It is assumed that this value can be used as an estimate to rank order the group members according to their social status in the group. To know if this estimation corresponds to reality it is necessary to make a validation. But how can we get a real measure of the social status of the group members? One way would be to let someone make subjective judgements and rank order the members of the group. This is problematic since it would only reflect the opinion of one single individual and therefore we rather need to use a group of people. How much of the original material should be used for the judgement? The dataset covers several years of material and the printouts consist of hundreds of

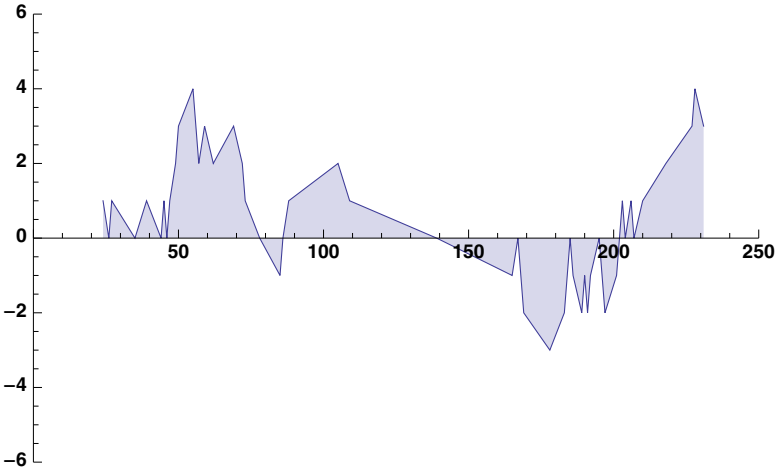

Fig. 7. Fashion. The groom balance for this subject fluctutates around zero. The person gives approximately as much as she gives.

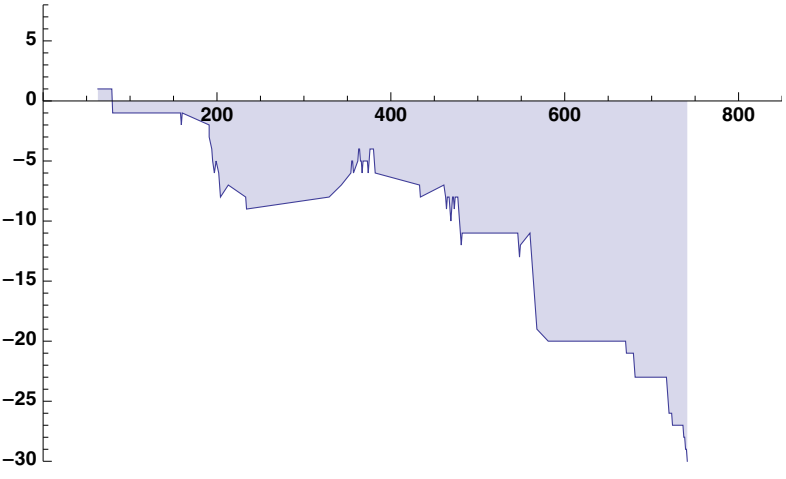

Fig. 8. Science. The groom balance for this subject stays negative. The person gives much more than he gets.

pages. It will be difficult to recruite persons to read that many posts. This will especially be true for the Science group, where the posts were very long and the content often was very scholarly. After considering these questions the following method was chosen.

Method of Validation. 40 people were recruited to the evaluation group, 17 males and 23 females. The mean age was 22 years (range 19-30). Each person read the printouts of 80 posts from the Fashion group. Each person read a different

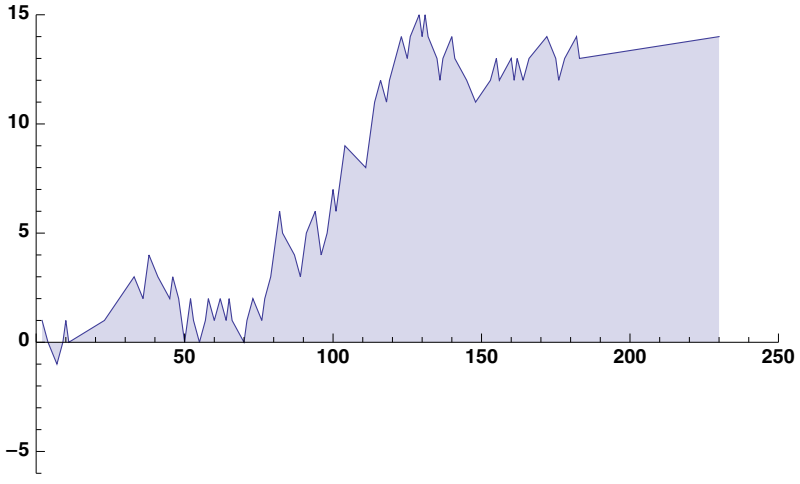

Fig. 9. Fashion. The groom balance for this subject gets more positive. The person gets much more than she gives.

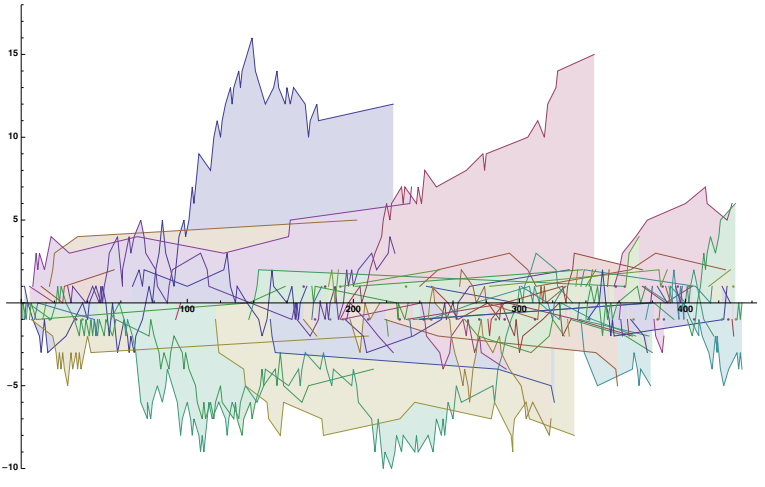

Fig. 10. Fashion. The combined groom balance for the whole group. Individuals with high positive groom balance replace each other during the time period studied.

set of posts, but the set of posts were overlapping so that one read posts 1-80 and another read posts 40-120 and so on. Thus every post was read by two different persons. They had 30 minutes to do the reading. After reading the posts the persons were asked to give their subjective impression of the different group members status in the group. The instruction was phrased as "pick out the participants in the discussion that you think have the highest status". To do this they were presented with a response sheet including a list of the names of all group members that had appeared in the set of posts that they had read.

They were asked to give status points in the following way: the subject with the highest status was assigned 10 points, the subject with the next highest status was assigned 8 points, no 3 gets 6 points, no 4 gets 5 points, no 5 gets 3 points and finally no 6 get 2 points. The rest get no points at all. The status points were added up so that every group member had a total amount of status points. The ranking based on this value, was used for the validation.

Intra Validator Correlation. Since each group member had been judged by at least two different evaluators, it was possible to split the data set into two sets of data based on different evaluators to assess the intra evaluator correlation. A total of 2 x 598 judgments were given in the process of validation. When the correlation of these two sets of judgments was calculated it was 0.39. When *the sum* of all ranking points for all subjects was calculated for the two sets (each including 187 sums of points) the correlation between the two lists were 0.97. This means that the individual of status varied between individual evaluators but that the sum of points for each individual poster was very similar in the two calculations based on different judgments.

Results of the Validation. The ranking based on the collective subjective judgments of the evaluator group is called the evaluator ranking.

The correlation between the groom based ranking and the evaluator ranking was 0.85.

If the groom based method was used used to pick out the five people with highest status in the group the correspondence was 100%. Similarly for picking out the ten best it was a correspondence of 90% and for the best half of the group (94/187) it was 76%.

7 Discussion

In this study a number of similarities was found between the two groups. The total number of posts made by different individuals in the group followed a power-law like distribution. This was similar for the two groups. We could also see signs of scale-free self-similarity in the sense that if the data was broken up in four parts, each representing a certain time-period, the distribution of posts seemed to follow a power-law in all of the four periods. This is in accordance with the observations of Wilkinson who was able to estimate the power law exponent to between 2,35 to 1,5 [10]. (The data in this study suggests an exponent of 0,5). Other possibilities for explanations of the lognormal distribution has been proposed, like novelty decay [11] and changes in how easily content is seen by users [12].

The distribution of grooms between the group members seemed to follow a power law just as the distribution of posts. The number of grooms was extremely unevenly distributed. In both groups there was an inner circle of 8-10 people that received about 50% of the grooms. In the center of the inner circle was a core

of a 4-5 people that together received 39-40% of the total number of grooms. In both groups the individuals in the inner core were from the majority gender of the group and, mostly, from English-speaking countries.

Another similarity was that in both groups the probability of making a second post was higher if a person was groomed after their first post compared to if they were not groomed after their first post. Also, in both groups there seemed to be reciprocity in the giving of grooms. The probability of beeing groomed was higher if a person had groomed someone else compared to if a person had not groomed someone else.

The introduction of the concept of groom as a directed social action made it possible to construct grooming networks for the two groups. The networks clearly showed the tight social connections between the people in the inner circles, and the dominance of the inner core. The community modularities for the two groups were similar: 0,55 for the Fashion group and 0,44 for the Science group.

Another similarity between the two groups was the distribution of posts over language categories. English speaking subjects made more than twice as many posts per person as the people from non-English speaking countries. In both groups people from non-English speaking countries groomed less but were more rewarded for their grooms when they did, compared with people from English speaking countries.

Gender related differences were similar but mirror imaged in the two groups. The under-represented gender made around 2 posts per person compared to 6-10 per person for the majority gender group. The gender also influenced the probability of getting groomed in a similar way. The under-represented gender was less likely to be groomed after their first post compared to people of the majority gender.

In both of the groups we could see that the choice of nickname seemed to affect the probability of getting groomed. Choosing a name was better than choosing a word, and choosing an non-pronouncable letter combination was the worst.

The analysis also enabled us to identify some differences between the groups. In the accumulated post graph we could in fact see that the Fashion group was dying out as indicated by the decreasing slope of the curve at the end of the observed time period. The Science group however showed no such slowing down, but instead the activity level kept constant.

The graph over group member activity over time uncovered that there were differences between the groups in terms of turn-over of the set of active subjects. In the Fashion group no subject remained active the whole time, in fact we could see a complete replacement of the active members so that the people active in the last quarter of the time period was a completely different set of people than the set that was active in the first quarter. In the Science group however, there was a set of subjects that remained steadily active for the whole time period studied.

Finally, the concept of groom enabled us to construct the groom balances. By doing so we could identify different types of grooming behavior. Most individuals showed a groom balance fluctuating around zero that indicates that they give

about as many grooms as they receive. A small group of individuals get much more than they give and thus show a steadily rising groom balance. This may be the signature of a high-status person. Some individuals gave a lot of grooms but consistently stayed on a negative groom balance. This may correspondingly be the signature of a low-status person. The groom balance for the whole Fashion group showed that when a person with a very high groom balance left the group, another persons groom balance started to rise so that there always was at least one person with the signature of a high-status individual.

A clear difference between the groups showed up in the groom balances for the whole groups. In the Science group there was one individual who had written a book. This book was frequently cited in the discussion and because of that this group members groom balance sky-rocketed out of range. There was also another individual in the group who was paid as a facilitator. As a consequence of his role he answered very many questions from newcomers. Politely, responding with dear John Doe, he thus gave away many more grooms than he got. So even if he got quite a few grooms himself, his groom balance dived consistently the whole time period. The groom balance thus enabled us to identify that such special individuals were present in the group.

Discussion of the Method of Grooming Analysis. The mentions of names could not be automatically identified in 4% of the grooms for the Fashion group. The most common problem was that a name was shortened so that a part of the name, most often the last part was omitted. A few of the cases were due to misspellings, for instance replacing a vowel with another vowel as in writing *Sephie* instead of *Sophie*. Solving this problem require more elaborate string pattern recognition than the ones used in this program.

The grooming analysis can only be used to rank order the persons in the group that have received grooms. The ones that have not received any grooms at all however can not be rank ordered by this method as they all will have a total number of grooms equal to zero.

8 Conclusion

This study show that we can get a new perspective on the social dynamics in groups by introducing the concept of groom and applying the method of grooming analysis. When applied to the observed online discussion groups it gave additional insights into the behavior of the group members.

Based on the performed analyses the behavior of the discussion groups can now be described as follows. There is a constant inflow of people who *check out* the discussion groups. Some of these people are interested enough to make a post. If they get groomed, the probability increases that they will make a second post. If not, they will most likely leave the group. In this way a small subset of the whole group is filtered out that will keep posting. Among this active group there is an inner-circle that grooms each other. In the center of this group there is an inner core of a few people that receive a large amount of grooming.

This development is self-similar in the sense that it doesn't matter which time period we look at, there is always this center core of a few people that gets about 40% of the grooms given in that period. The center core may consist of different people in the different time periods.

Groups evolve to be gender specific. This effect is due to two reasons, first the two groups attracted different interest from females and males respectively, secondly that the under-represented gender got less return on investment for their given grooms, this in turn affected the probability of posting and thus the probability of getting groomed and so on in a self-reinforcing way that filters them out from the group.

The number of posts and the number of grooms are related in a complex way. The more you post the more you get groomed. But the reverse is also true, the more you get groomed the more you post. This reward some people and punish others so that we get this concentration of the social interaction to an inner core of a few people while the majority of people are in fact left out of the social interactions and have very low activity in the group. The validation showed that using the total number of grooms to rank order the group members in terms of social status resulted in a ranking with a correlation of 0.85 to that obtained with 40 independent subjective evaluators. This is a strong indicator that the grooming analysis actually reveal something "real" about the social interactions in the group.

In situations where there are no available data about quantity or quality of user contributions, or to data about links between group members, the method of grooming analysis can be used as an alternative to assess status. To generalize the methods to larger groups, further work needs to be done, in particularly the method of automatically identify names must be improved

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