

# The Consent of the Crowd Detected in an Open Forum

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## ABSTRACT

Within Reddit, *Change My View* is a specific debate forum where anyone can expose her or his view on a given topic and ask the crowd to provide counter-arguments with the aim of potentially changing this view. CMV uses a dual reward system according to which a) anyone, often the person who had asked the initial question, can highlight and acknowledge an argument (a post) by giving it a "delta" ( $\Delta$ ) and b) anyone can up- or down-vote one or several posts in a discussion. We take advantage of this dual reward system to investigate a phenomenon we call the *Consent of the Crowd*. Our results provide evidence on the use of the up-vote reward system by the crowd in order to express a dissent against the  $\Delta$  reward. This phenomenon may be observed when not enough contributors got a chance to join the discussion before the  $\Delta$  is granted. Our result highlights the necessity for forum moderators to foster discussion between as many participants as possible before closing discussions.

## CCS CONCEPTS

• **Networks** → **Network management**; • **Social and professional topics** → *User characteristics*;

## KEYWORDS

wisdom of crowds, online forum, Reddit – CMV, consent of crowd

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## 1 INTRODUCTION

People commonly exchange messages online — from the 1980s and the first *newsgroups* to today's online fora, social networks, chats, etc. The biggest sites where online discussions take place, such as StackOverflow, gather millions of threads and users, calling attention to the importance of such platforms in social life. And,

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even after the expansion of social networks, still 15% of Internet users in the U.S. exchange actively on fora [19]. Basically, online discussions are active on any kind of subject, from politics to video-games, about finding a technical answer to a problem through a Q&A site or in order to seek help from fellow students in Massive Open Online Courses (MOOC) fora. Fora are often used to discuss and challenge opinions [30], such as in the sub-Reddit *Change My View* (CMV), which is dedicated to individuals who are looking to challenge and potentially change their view on a given topic.

In parallel, much attention has recently been devoted to what has been called the *Wisdom of the Crowds* (WoC). This concept had first been introduced long ago and way before the Internet, by F. Galton [21], who had provided early evidence of the existence of the WoC, by comparing the median estimation of an ox weight with its true weight. The crowd had performed surprisingly well, with an estimation error lower than 1%. Needless to say, the development of information technologies has considerably renewed this interest in the WoC. Many recent articles have investigated this phenomenon in its modern settings highlighting a better performance on a task from a crowd rather than an expert [10, 42, 49]. But these crowds need to be independent, as indeed characterized by Surowiecki [42] in his seminal book, for the WoC to exist. For the so-called WoC to exist, members of the group should not influence each other. Each of them should be able to propose her or his own solution.

What happens then of interacting crowds, such as in online fora? Can they also be wise? Since they rely upon social interactions, fora do not seem to fulfill the WoC condition. All the more so as most of the issues there discussed are qualitative and not quantitative, far from estimating the weight of an ox. Indeed, what takes place in open fora is closer to another historical analysis of crowds, the one of G. Tarde [44] who had developed a theoretical framework about the *opinion of the crowd*, where members of the crowd are linked because they are physically in contact with one another. Although this contact is not anymore physical, Tarde's insights might guide us towards a larger understanding of what the crowds can do when they interact and address non-quantitative issues.

What can the crowd do in online fora? In this paper, we show that it can notably consent, and sometimes dissent: it can consent or dissent with someone, an individual, who often has a prominent role in online fora, be he or she the moderator, the person who has asked the initial question, or a salient member of the community. We address this issue by taking advantage of CMV's dual reward system: an individual reward system where a reward, the delta, is given by an individual, and a collective reward system where people vote. By analyzing when discrepancies between both occur, we show that the crowd consents when it has been allowed to have a sufficient voice.

In the next section, we review recent literature that studies dialectic activity within online communities. To progress towards a model adapted to the analysis of online discussions, we then describe CMV and our methodology. Next, we present descriptive statistics and results before discussing them and concluding.

## 2 RELATED WORK

### 2.1 Modeling a Discussion

An important area of interest with regard to online discussions is mailing lists. One can see a mailing list as a "thread" [40] or as a "quotation" structure [6], to analyze the thematic coherence of a discussion. Some research has focused on the manner with which a community tackles issues such as coordination or vandalism [29], developing tools to help the online community to prevent from unwanted behavior. The development of the Internet 2.0, however, steers communities to move from mailing lists to open online fora [45].

Another widely studied issue tackles whether the discussion evolution follows predefined patterns. The typical approach consists in modeling fora as graphs. A thread is an aggregate of messages linked together according to the order of posting. Thus, a discussion takes the form of a *tree* where vertices model the messages and are linked if one answers directly another. A large part of the literature reports attempts to model the structural evolution of discussions. From the growth of general networks, the random evolution [20] and the small world [47] to the preferential attachment [5], researchers demonstrate the relevance of certain patterns in online discussions evolution [28]. The preferential attachment model can be summarized by the "rich gets richer" slogan. Gómez *et al.* [22] proposed its variant, taking into account the importance in a discussion of the opening message which attracts more answers. Besides a discussion can be modeled by a tree, as said above, but we can also build an author network, where nodes are the authors and they are linked if one answers to another. Dorat *et al.* [18] model a mailing list with the random multi-level approach. Next, they compare the real and synthetic mailing lists, emphasizing the importance of basic characteristics of such author network in the discussion evolution.

In addition to studying the variables of the structure of an online discussion, researchers focus on subgraphs (mainly on dyads and triads), formalized by Wasserman and Faust [46]. The methodology consists in counting occurrences of a certain subgraphs of size  $k$  and make a comparison with a reference model, often built with random graphs, conserving some of its properties. Park and Barabási [39] focus on dyads and develop a model to understand whether a certain property of nodes (a characteristic of proteins, for instance) explains the structure of the graph. Holland and Leinhardt [24] characterize the sixteen possible triads which can be obtained between three people – modeled by nodes – in a sociogram with any binary "choice relation" – represented by edges – (Figure 1). Milo *et al.* [37] define as *network motifs* subgraphs occurring significantly more frequently than those in random graphs.

Motif analysis allows one to compare different types of network [13, 36]. Moreover, in social sciences literature, Holland and Leinhardt [25] argue that "most theories of structure in interpersonal relations concern average local properties". The analysis of

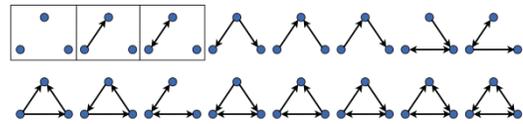


Figure 1: Triad dictionary from [13]

motif allows researchers to bring evidences on specific characteristics of different types of threads [1, 35], in different communities [12, 31].

Those researchers enrich the analysis of the discussion evolution taking into account additional informations. However, difficulties appear when anticipating this evolution. The anticipation may consist in predicting the behavior of a participant in the future. Studies on this subject focus on social roles in online fora. Lumberas [33] affirms that "*Roles are both descriptive and predictive categories of behavior*". Two authors share the same role if they tend to interact in the same type of discussions. Focusing on conversational behaviors, Lumberas brings out several typical roles. This is allowed by the analysis of the motifs discussed above.

The above-mentioned studies do not take into account additional information which can be gathered from the fora, such as up- or down-votes for an answer; if the conversation is closed; a level of authors' experience and the time laps between consecutive answers. Several studies ask questions how these variables might explain the discussion evolution. Anderson *et al.* [3] present results about the first reply to the initial question on the forum StackOverflow. The most experienced users reply before other participants as one gets more points if his or her answer is chosen by the questioner as the best answer. The points level reflecting the expertise of an individual, it has become a labor market signal in the computer science field. Thus, the forum creates a direct incentive to answer quickly. Others studies draw similar conclusions from editing possibilities on StackOverflow. They emphasize the fact that the first best answer is more edited than the second-best, the quality of answer being a difference of total up- and down-votes [16, 48].

### 2.2 The Wisdom of the Crowd and Open Collaboration

The previous works do not consider, however, either the motivations of the participants or the theoretical concept driving their behavior.

An evidence for self-organizational properties has started to be gathered [17]. This fact has pleaded for the existence of stigmergic phenomena driving the allocation of online efforts and thus orienting coordination within Free/Libre Open Source Software (FLOSS) projects [8, 15], for instance. These coordination models assume that the code and/or other existing online artifacts actually mediate coordination, making it mostly indirect and/or implicit, in such a way that it reduces transaction costs and gives rise to aggregate properties [15]. The latter approach has recently received further support through the emergence of theoretical notions such as transparency [14] or superposition [27], which also tend in both cases to emphasize indirect and/or implicit coordination mechanisms.

In his seminal book, Surowiecki [42] develops a theoretical framework for the WoC. He defined four conditions that characterize wise

crowds: diversity, independence, decentralization, and aggregation. It is then legitimate to ask the question: "Does forum framework ensure those characteristics?"

Concerning the diversity, the more diverse the crowd is, the more different solutions are proposed, which increases the chance for a good one to be among the proposals. In their last report, *We Are Social* organization reveals that more than four billion of individuals are using the Internet around the world<sup>1</sup>. With half of the planet being connected online, we assume that the diversity is ensured.

Nevertheless, it is possible to ensure it. In "contest" type of fora [34], challengers compete with other participants to win the reward. In this case, they do not have interest to exchange with each others thus the independence condition is fulfilled.

The decentralization process is a system where decision process is not fully the power of one part of the system. Here again, Q&A fora do not fulfill this condition. The reward is usually awarded by the problem questioner, who selects which solution she prefers. This is the case of the platform *InnoCentive* where companies ask the community to solve a technical problem and pay a financial recompense to the author of the best solution [9]. Nevertheless, on other platforms such as StackOverflow, even after the "best" solution has been selected by the questioner, the crowd can act on it. In [16], authors demonstrate that the number of edits (modifications of a post) is higher for the winning answer than for the second best answer. In both cases, the crowd improves the selected answers performing a decentralized optimization. Finally, aggregation is ensured through the platform itself: the best answer is usually the first one to be seen when someone visits the question thread or at least, one can sort post according to their score.

The Wisdom of the Crowd (WoC) is an important area of investigation in Open Innovation [11] since, under the right circumstances, a company could have an advantage to outsource its innovation [2]. A main condition for the crowd to perform better than a group of experts is the diversity among its members [26, 38, 41]. Thanks to the diversity — regarding "intelligence", social background, skills, etc. — the proposed solutions are better. Moreover, it is often the combination of these solutions which performs the best to solve a problem (such as the disappearance of the *USS Scorpion* submarine [42]). Nevertheless the WoC is not always the optimal mean to get the proper solution. One of the obstacles comes from social interactions [32]. If and when members of the crowd have the possibility to exchange about their proposals, a decrease of the diversity can be observed, due to psycho-social mechanisms such as conformism [4]. However, under right circumstances, social influences can have a positive impact on the WoC. In experimental settings, Becker *et al.* [7] bring to light a positive influence of knowing the group answer — the mean answer of the group, on individual estimates when people could modify their answer. In this case, social influences improved both individual and group estimates.

### 3 REDDIT – CHANGE MY VIEW (CMV)

Reddit – *Change My view* (CMV)<sup>2</sup> admits discussions and opinions on any subject. Such as *Agora* in Ancient Greece, the initiator — Original Poster (OP) — opens a discussion announcing her idea on

a topic. CMV has developed constrained rules to join the debate. To open a topic, one agrees to follow the conversation, at least three hours after its beginning and one *must personally hold the view and be willing to have it changed*<sup>3</sup>. All participants, OP included, can award with a delta  $\Delta$  any argument that allowed her to make a step in the change of her view. The reward attribution should be accompanied by the argumentation why the comment has been convincing. The opinion change may be minor as  $\Delta$  does not have to terminate the thread. We thus observe some threads where several  $\Delta$  were assigned. The DeltaBot, a *Reddit bot*, confirms the  $\Delta$  attribution through a post.

Figure 2 presents an example of a thread in CMV<sup>4</sup>. The boxes indicated with blue solid strip indicate the author who is the OP in this example; This author opens a thread about of an investment plan called "tontine". She develops her point of view on the subject. She finishes her post by asking the forum members to change her view (CMV). A first challenger answers (post A.1). Then the OP answers (post A.2), attributing a  $\Delta$  to the post A.1 and providing explanations of her decision. The DeltaBot confirms the delta award in the post A.3. Similarly, another challenger answers the OP (post B.1), which the OP answers (post B.2) before the intervention of another strip with orange horizontal lines challenger (post B.3). This is followed by a discussion between the OP and this strip with orange horizontal lines challenger (between post B.2 and post B.11). In this example, two other challengers participate (posts A.4 and B.12) with or without an answer from the OP or another challenger.

In the studied forum, as a participant can directly address any post, the "thread" framework preserves the thematic coherence of a discussion. Moreover, we have access to an important quantity of information, such as whether a post was awarded with a  $\Delta$  and by whom and its numbers of up- and down-votes; the number of  $\Delta$ s that a participant has been awarded until now approximates the *experience* of the participant in this forum. The  $\Delta$  system allows us to ascertain on the *quality* of a conversation, despite a bias of which we are aware. Even if the  $\Delta$  does not ensure a full change of view, it gives some hints on the number of relevant arguments and thus, whether a discussion progresses or stagnates.

Reddit – CMV occurs to be an original study case. On the one hand, it has common features of open online discussions. This forum allows its participants to reply one to another. It provides them with an award system, a vote system on posts, and a user experience system. Furthermore, the discussion structure ensures that one can answer on any sub-comment level, contrary to a Q&A website such as StackOverflow. On the other hand, CMV requires a unique and strict framework on the discussions, as described above. Finally, while Reddit itself has been the subject of numerous research works, CMV has been rarely chosen as research object. Altogether, CMV appears to be an appropriate and original candidate to evaluate the dynamics in online discussions.

Moreover, CMV fulfills the four characteristics of a wise crowd in action (Section 2.2): diversity and aggregation are ensured by the forum website type, independence by a contest forum type, and decentralization by a vote system. Still, few researches examined the presence of the WoC in open online fora. They have focused

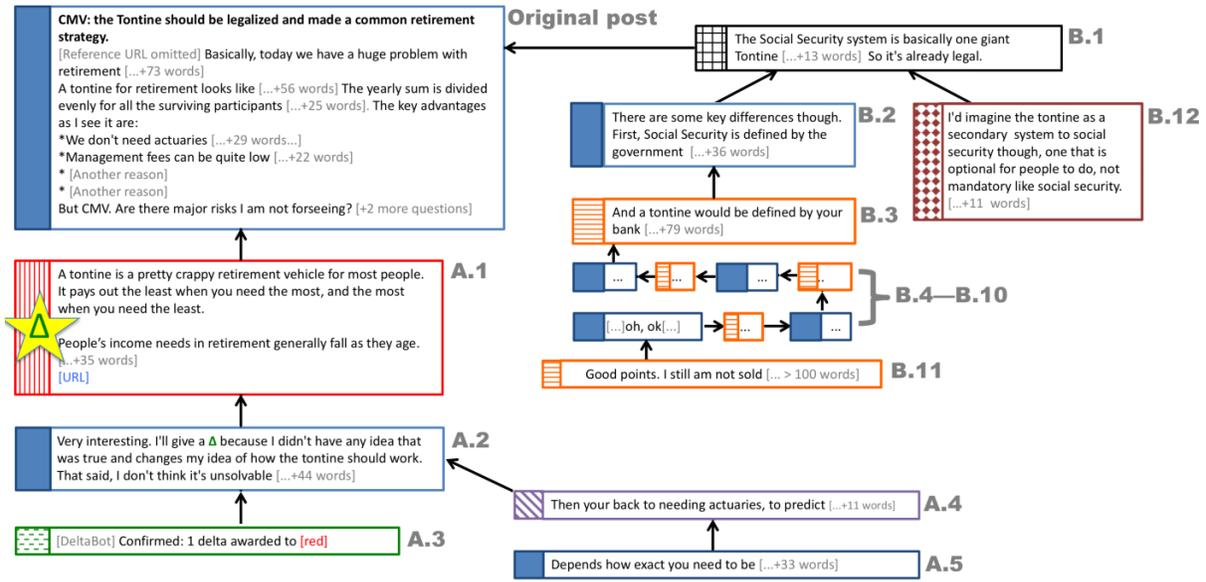
<sup>1</sup><https://wearesocial.com/blog/2018/01/global-digital-report-2018>

<sup>2</sup><https://www.reddit.com/r/changemyview/>

<sup>3</sup><http://www.reddit.com/r/changemyview/wiki/rules>

<sup>4</sup><https://www.reddit.com/r/changemyview/comments/3mzc6u/>

cmv\_the\_tontine\_should\_be\_legalized\_and\_made\_a/?sort=top&st=jf2di5d1&sh=27df2763



Note: Colors and shapes in posts indicate distinct users. OP awarded post A.1 with a Δ.

Figure 2: Real CMV thread, example from [43]

on the resolution of a problem, which the solution is an objective outcome [10, 49], in experimental settings. There is no such objective solution to change someone’s point of view. Still, the crowd influences the discussion outcomes. Thus, instead to focus on the WoC, we propose to study the power of the crowd on the reward system through its *approval*:

- What are the conditions for the crowd to manifest its agreement?
- Does the crowd always consent with the Δ reward?

### 3.1 First delta context

A classical approach to model a thread forum consists in using the graph theory [23, 33, 43]. A thread is an aggregate of messages linked together according to the order of posting. Thus, a discussion takes the form of a *tree* where vertices model the messages and are connected if one answers directly another.

We focus on the context of a reward in CMV threads and want to know if the crowd intervenes in this process. Besides, as already mentioned, several Δs might occur in a thread. The Δ attribution underlines a new step in the discussion. Thus, threads with different number of Δs are not at the same evolution level. To be able to compare the threads awarded with at least one Δ, we fix our attention on part of the discussion leading to the first Δ attribution.

To reach this goal, we prune the trees step by step. First, we remove all posts occurring after the post awarding the Δ, as they have no impact on the Δ attribution. Next, we assume that each independent sub-tree, appearing after the removal of the root of a thread (the opening post), models an independent sub-discussion, where different arguments are developed. Thus we only retain the sub-tree where the Δ occurred.

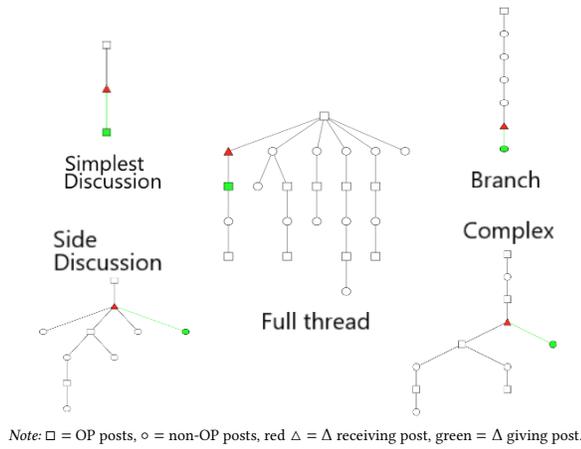
Applying the pruning process on the 5037 threads having at least one Δ<sup>5</sup>, we observe four types of sub-graphs, presented in Figure 3:

- (1) the simplest ones are composed solely of the root and two posts, the delta receiving ( $\Delta_r$ ) and the delta giving ( $\Delta_g$ ), 38% of the threads – top left corner;
- (2) the *Branch* which are composed of several posts between the root and the  $\Delta_r$  post, 32.60% of the threads – top right corner;
- (3) the *Side discussion* where a dense sub-discussion occurred between the  $\Delta_r$  and the  $\Delta_g$  posts, 22.40% of the threads – bottom left corner;
- (4) the *Complex* composed both by a branch and a side discussion, 7% of the threads – bottom right corner.

For the first type, either the question was easily answered or an expert of the field happened to spot it quickly and gave a strong argument. In both cases, the crowd has no role in the Δ attribution process. This observation is confirmed by the average number of authors in each discussion types: 2.00, 2.45, 4.95, and 3.80, respectively. Thus, when the sub-tree is a *Simplest discussion* type, there are always exactly two authors: the OP and one challenger. We exclude this type of sub-discussions.

Moreover, on the one hand, the *Branch* type attracts significantly fewer authors than the *Side discussion*. In order to detect the influence of the crowd on the rewarding process, we make certain assumptions on those discussion types. The *Branch* type might reflect an expert intervention, the  $\Delta_g$  author asking for more details before awarding the last post of the expert, the  $\Delta_r$  post. We thus assume an absence of crowd’s intervention, despite the fact that it has enough time to intervene. On the other hand, the *Side discussion* type attracts significantly more authors. We thus assume that the

<sup>5</sup>We also removed three threads where the OP received the Δ.



**Figure 3: Sub-graphs identified after pruning process**

crowd debates on the content of the  $\Delta_r$  post, which results in the  $\Delta$  occurrence.

Besides the  $\Delta$  mechanism, each participant could up- or down-vote one or several comments (down-votes are allowed but not recommended by the CMV rules<sup>6</sup>). On the one hand, a  $\Delta$  reward might be the result of an intense debate between participants, still it reflects the decision of an individual. On the other hand, even if the voting action is individual, the visible characteristic of a post is the number of votes it gathered. Thus, the voting system expresses a collective view. We investigate which post received the maximum score in each sub-threads (after the pruning process). This post is assumed as the one which brings along the winning argument for the crowd. The "winner" post may be:

- (1) the root post, assumed as a popularity choice to point out the interest of the discussion in its entirety;
  - (2) one of the two  $\Delta$  posts, assumed as the consent of the crowd on the reward;
  - (3) any other post, assumed as the disapproval of the crowd.
- Thus the crowd points out a potentially better argument.

If the most popular post is the root, we cannot affirm that the crowd consents with the first  $\Delta$  awarded. Therefore, in this case, we look for the second most popular post occurrence, which is either one of the  $\Delta$  posts or any other post. In Figure 2, the  $\Delta$  post also received the maximum vote score.

Besides, we must underline that we compare award systems which might occur at a different timing. We know for sure the exact timing of the  $\Delta$  being awarded by a post, for which we get the timestamp. However, it is not the case for the voting system. Thus, the votes might have occur before and/or after the  $\Delta$  attribution. Moreover, the pruning process might cut an important argument occurring after the  $\Delta$  attribution. Still, we observe that, the  $\Delta$  posts possibly are also the posts receiving the most upvotes *in the analyzed sub-discussion*. For this reason, comparing those two award systems allow us to capture a collective decision about an individual action. From this voting system, we state the following assumption:

**H1:** If the crowd does not manage to influence the rewarding process through posting actions, it will intervene by its upvote power.

If **H1** is verified, the *Consent of the Crowd* would be the mechanism through which the crowd will assure the quality of a discussion reward.

### 3.2 Descriptive statistics

We work on an open database from [43]<sup>7</sup>. Its authors extracted from Reddit API all discussions from January 2013, the creation of CMV, to April 2015. We analyze the following groups of variables in order to understand the dependent variable: is the  $\Delta_r$  post also the post receiving the largest number of upvotes (labeled afterward *MaxVote*  $\Delta$  and equals to 1 if it is the case).

First, we analyze the global activity in the thread: a binary variable to detect if the  $\Delta_g$  author is the OP or not (labeled as  $\Delta_g$  OP); the numbers of posts from the  $\Delta_g$  author and from the  $\Delta_r$  author (labeled as *Post*  $\Delta_g$  and *Post*  $\Delta_r$ , respectively); the number of posts occurring between the root and the  $\Delta_r$  post (labeled as *Post Bfr.*  $\Delta$ ), and the number of posts occurring between the  $\Delta_r$  and the  $\Delta_g$  posts (labeled as *Post Inbtw.*  $\Delta$ ).

Second, we take into account the vote activity: vote received by  $\Delta_g$  and  $\Delta_r$  posts (labeled as *Vote*  $\Delta_g$  and *Vote*  $\Delta_r$ , respectively); the average number of votes received by a post in the sub-thread divided.

Finally, we measure the experience level by classifying authors according to the quartile of the experience distribution: the ones having no  $\Delta$ , those having exactly one  $\Delta$ , those who have between 2 and 5  $\Delta$ , and those having at least 6  $\Delta$ . The levels are labeled from 0 to 3. Thus, we get the level of experience of the  $\Delta_g$  and  $\Delta_r$  authors. For the crowd, we compute the average level of experience as a proxy for the Wisdom of Crowd. We also want to control for the diversity of the crowd [26, 38, 41] using the Gini index for this purpose, as it expresses a disparity in the distribution of experience, that ranges between 0 and 1. The higher the index is, the more diverse the distribution is.

As described in Section 3.1, we focus on the threads rewarded with at least a  $\Delta$  and which attracted at least four distinct authors. We also removed threads where at least one author gets her account closed, the action which replaces her pseudo by the label "deleted" in the database. In these cases, we are not able to distinguish authors if there is several "deleted", which could bias the experience variables. After these adjustments, the final dataset includes 543 sub-discussions. Table 1 provides the mean and standard deviation of the variables we defined to conduct our analysis.

In 59% of cases, the post which is awarded by the  $\Delta$  is also the one receiving the maximum vote score and in 40% of the cases, the  $\Delta$  is awarded by the OP. Fraction 19.15% of the threads are *Branches*, 60.59% are *Side discussions* and 20.26% of them are *Complex* discussion types. For the following statistics, we remove from the data set the root post. Indeed, this post brings the same information for all the threads: it is a post written by the OP. It will not help us distinguish the different types of discussions. Thus, in average, 6.29 authors participate in the sub-discussions, writing 10.19 posts<sup>8</sup>. The

<sup>7</sup><https://chenhaot.com/pages/changemyview.html>

<sup>8</sup>This value does not reflect the heterogeneity of the size of the discussions. The biggest one gathered 98 authors, who have written 235 posts.

<sup>6</sup>[https://www.reddit.com/r/changemyview/wiki/guidelines#wiki\\_upvoting.2Fdownvoting](https://www.reddit.com/r/changemyview/wiki/guidelines#wiki_upvoting.2Fdownvoting)

$\Delta_r$  author participates slightly more than the  $\Delta_g$  author (2.22 posts against 1.70 posts, in average). Moreover, while, in average, 1.33 posts are written before the  $\Delta_r$  post, there is 6.86 posts in between the  $\Delta$  posts. Concerning the experience of the different actors, the average level of experience of the  $\Delta_g$  author is equal to 0.52, against 2.15 for the  $\Delta_r$  author. The average crowd experience level is 1.02, with the average Gini index at 0.66, showing a considerable diversity. Finally, in average, a post will have a score of 13.41, when the  $\Delta_r$  post will have a score of 43, against 4.75 for the  $\Delta_g$  post.

Moreover, we have analyzed the correlation between the variables with the dependent variable *MaxVote*  $\Delta$ , presented in the last column of Table 1. *MaxVote*  $\Delta$  is significantly correlated with almost all the variables. The votes on  $\Delta$  posts are significantly positively correlated with the dependent variable but not as much as it might have been expected. Moreover, while the  $\Delta_g$  post activity is significantly negatively correlated with *MaxVote*  $\Delta$ , the  $\Delta_r$  post activity is positively correlated but not significantly: the activity in the discussion by the  $\Delta$  giver should have a higher impact on the vote power than the  $\Delta$  receiver activity, in terms of posting action. Likewise, while the level of experience of the  $\Delta_g$  and the crowd have a significant negative impact on *MaxVote*  $\Delta$ , the  $\Delta_r$  experience is not correlated with the dependent variable. Finally, the Gini diversity of experience of the crowd and the numbers of authors in the sub-thread have a significant positive correlation with *MaxVote*  $\Delta$  but the Crowd Experience is significantly negatively correlated with the dependent variable. On the one hand, the wiser the crowd is, the less it will comply with the  $\Delta_g$  author. On the other hand, the more diverse it is, the more it will comply.

**Table 1: Descriptive Statistics**

	Mean	Std. Dev.	Pearson Corr. with <i>MaxVote</i> $\Delta$
<i>MaxVote</i> $\Delta$	58.56% †	n.a.	1.00
$\Delta_g$ OP	39.96% †	n.a.	-0.03
Post Bfr. $\Delta$	1.33	1.95	-0.71***
Post Inbtw. $\Delta$	6.86	13.57	0.22***
Post $\Delta_g$	1.70	1.27	-0.24***
Post $\Delta_r$	2.22	1.82	0.07
Mean vote	13.41	26.73	0.01
Vote $\Delta_g$	4.75	9.33	0.12***
Vote $\Delta_r$	43.08	83.65	0.31***
$\Delta_g$ Experience	0.52	0.93	-0.09**
$\Delta_r$ Experience	2.15	0.88	0.06
Crowd Experience	1.02	0.77	-0.14***
Gini Diversity	0.66	0.14	0.13***
Authors	6.28	5.77	0.18***
Posts	10.19	13.20	0.12***

Note: †: we provide the percent of threads where *MaxVote*  $\Delta$  and  $\Delta_g$  OP variables are equal to one; \*p<0.1; \*\*p<0.05; \*\*\*p<0.01 – p-value for the Pearson correlation test.

### 3.3 Consent of the Crowd

To test assumption **H1**, we apply a logistic regression as defined in the following model:

$$P(\text{MaxVote } \Delta = 1) = \frac{e^{\alpha + \beta X}}{1 + e^{\alpha + \beta X}},$$

with  $X$  the covariates matrix including the variables described above with some modifications in order to take into account the size of the discussions. We divided the four variables *Post* by the total number of posts in the sub-threads. Moreover, we divided the average score of post by the total number of authors. After this normalization, we can remove *Authors* and *Posts* variables. Besides, *Vote*  $\Delta_g$  and *Vote*  $\Delta_r$  votes are also removed because they give a perfect separation of the dependent variable, which prevents the regression from being applied.

Table 2 presents the results of the regression. Once a coefficient is significant (the more \* it has, the more it is significant), if it is positive, then the corresponding variable increases the probability for the post which received the most vote to be a  $\Delta$  post. As a robustness check, we provide the results of different covariates combinations.

First, the global vote activity of the challengers does not impact the *MaxVote*  $\Delta$  outcome, the coefficient of *Vote/Authors* being non significant. Concerning the global post activity in the discussion, we observe that the crowd behaves like the blind justice: it does not take into account who gives the  $\Delta$  reward or her post activity – neither  $\Delta_g$  OP nor *Post*  $\Delta_g$ /*Posts* coefficients are significant in the models 5 and 6. By contrast,  $\Delta_r$  author post activity has a negative impact on the crowd – significantly negative coefficient. An additional post from the  $\Delta_r$  author implies that her post has 196<sup>9</sup> times less chances to get the maximum vote score. Those results contradict the correlation analysis.

This is confirmed by the structure of the discussion. In the regressions, the variable *Post Bfr.*  $\Delta$  has the highest coefficient, which is significantly negative<sup>10</sup>. The more the number of posts before the  $\Delta_r$  post is important, the more the crowd will up-vote for another post. More surprisingly, the coefficient of *Post Inbtw.*  $\Delta$ /*Posts* is negative, which might imply a negative impact on the *Consent of the Crowd*. Nevertheless, the coefficient is non significant. In other world, if the thread structure is close to the *Branch* type<sup>11</sup>, the crowd will have a higher probability to disagree with the  $\Delta$  reward, while the *Side discussion* type seems to do not impact the *Consent of the Crowd*.

Besides, the experience variables provide us with valuable mechanisms. The experience of  $\Delta$  authors has no impact upon the consent of the crowd. By contrast, even with a low impact, the wiser and the more diverse the crowd is, the less it will agree with the reward – significant negative coefficients with respective odds ratio equal to 1.75 and 10.07, confirming previous results [26, 38, 41].

Finally, we investigate if the author of the maximum vote score post is one of the  $\Delta$  posts, we look at it in discussions type by types and present the results in Table 3. It shows the difference between the *Side discussions* on one hand, and the *Branch* and *Complex* types

<sup>9</sup>To get the odds ratio, one converts a variable coefficient  $b$  by the following formula:  $O.R._b = \exp(b)$ , we analyze the inverse  $1/\exp(b)$  if  $b$  is negative.

<sup>10</sup>Odd Ratio = 162 754

<sup>11</sup>Important number of posts before the  $\Delta_r$ .

**Table 2: Regression results**

	<i>Dependent variable:</i>					
	MaxVote $\Delta = 1$					
	(1)	(2)	(3)	(4)	(5)	(6)
Vote/Authors		0.001 (0.01)		-0.004 (0.003)		0.0004 (0.01)
$\Delta_g$ OP	-0.54* (0.31)	-0.54* (0.31)			-0.44 (0.32)	-0.44 (0.32)
Post $\Delta_g$ /Posts	0.48 (1.34)	0.51 (1.35)			0.72 (1.40)	0.73 (1.41)
Post $\Delta_r$ /Posts	-4.58*** (1.28)	-4.58*** (1.28)			-5.28*** (1.34)	-5.28*** (1.34)
Post Bfr. $\Delta$ /Posts	-12.54*** (1.64)	-12.55*** (1.64)			-12.30*** (1.72)	-12.30*** (1.72)
Post Inbtw. $\Delta$ /Posts	-2.35* (1.21)	-2.34* (1.21)			-1.93 (1.31)	-1.92 (1.31)
$\Delta_g$ Experience			-0.17* (0.10)	-0.18* (0.10)	0.04 (0.16)	0.04 (0.16)
$\Delta_r$ Experience			0.14 (0.10)	0.14 (0.10)	0.23 (0.15)	0.23 (0.15)
Crowd Experience			-0.30** (0.13)	-0.32** (0.14)	-0.56*** (0.22)	-0.56*** (0.22)
Gini Diversity			0.69 (0.80)	0.76 (0.80)	-2.31* (1.40)	-2.31* (1.40)
Constant	4.91*** (1.14)	4.88*** (1.15)	-0.01 (0.65)	0.05 (0.65)	6.34*** (1.48)	6.33*** (1.49)
Observations	543	543	542	542	542	542
Log Likelihood	-190.65	-190.64	-359.44	-358.69	-185.81	-185.80
McFadden $R^2$	0.482	0.482	0.024	0.026	0.496	0.496
Akaike Inf. Crit.	393.31	395.28	728.89	729.38	391.61	393.61

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01 – pvalue for the significance test of the coefficients.

on the other hand. Again, when the crowd does not get the chance to express its ideas before the  $\Delta$  attribution (like in *Branch*), and reports its votes on another post, it will be in 90% (more than two third for *Complex* types) of the cases, a different author than the  $\Delta$  authors. In *Side discussions*, even if a non- $\Delta$  post attracts the maximum upvote score, in 97% of the cases, it will be another post from one of the  $\Delta$  authors.

**Table 3: Repartition of authors who received the maximum vote score by discussion types**

	$\Delta_r$ author	$\Delta_g$ author	non- $\Delta$ author
<i>Branch</i>	4.21%	5.32%	89.47%
<i>Side discussions</i>	81.25%	15.62%	3.13%
<i>Complex</i>	29.59%	3.06%	67.35%

Those results confirm our hypothesis **H1**: if the crowd could not participate in the debate through posts, it will disagree with the  $\Delta$  reward and express itself through the vote system.

### 3.4 Result discussion

The obtained results indicate the power of votes in the open forum CMV. Comparing a discussion to an one-against-all game, if one challenger plays alone and wins a reward before enough other challengers have the time to argue, the crowd will punish her by voting for another argument. Moreover, the crowd acts like the blind justice: it will not take into account who are the  $\Delta$  authors, but rather whether the author awarded with  $\Delta$  leaves free room to other challengers and whether the author who attributed a  $\Delta$  gives enough time for others to intervene. Besides, the wiser and more diverse the crowd is, the more prone to disagree it is. The OP would really benefit from a discussion with different challengers about the same argument. The more challengers have the possibility to

express themselves, deliberating among them and with the OP, the more they will consent with the ultimate reward: the  $\Delta$ . The *Consent of the Crowd* (CoC) reflects a quality measure on the reward  $\Delta$ .

Even if important mechanisms emerged from that analysis, we need to investigate some limitations of our analysis. First, in this work we estimate the vote mechanism as a response to the  $\Delta$  reward. Data at our disposal is, however, a snapshot. We do not know the timestamp nor the author of a vote. Therefore, another possibility is that the crowd highlights a pertinent argument with upvotes in order to help the OP to find it. The question is whether the vote of the  $\Delta$  occurred before the  $\Delta$  attribution.

A complementary limitation concerns the meaning of upvoting. We assume that numerous upvotes on a post reflects the quality of a post [16]. However, as mentioned in the CMV rules<sup>12</sup>, moderators encourage to upvote an argument which one finds not good enough, in order to attract other challengers to refute it.

#### 4 CONCLUSION AND FURTHER WORK

We defined the *Consent of the Crowd* in an open forum taking as a use case Reddit – Change My View. Focusing on a particular period of the discussion, from the beginning up to the first reward, our results bring in evidence the use of the upvote reward system as a punishment against the challenger rewarded with the  $\Delta$ . This happened when crowd members do not get the chance to join the discussion before the  $\Delta$  attribution. From the research point of view, we explain how a crowd takes actions if it perceived an injustice. We embedded this in a new concept: the *Consent of the Crowd*. Moreover, this result should urge CMV moderators to foster multi-challengers sub-discussions.

Our future work will focus on the extension of the analysis on different kinds of fora, such as StackOverflow. This Q&A forum is this not concerned by the first limitation mentioned in Section 3.4. It does not suffer from the second limitation as the down-votes are fully accepted. Moreover, we will confront the texts of  $\Delta$  posts and *MaxVote* post when they differ [1].

In particular for this Q&A site, we have access to the timestamp of the vote, and thus might be able to investigate the first limitation we mentioned in . Moreover, we will investigate the second limitation by confronting the texts of  $\Delta_r$  post and *MaxVote* post, when they differ

As a general conclusion, our results show a form of collective intelligence in open fora, increasing the comprehension of participants interactions in online forums.

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<sup>12</sup>[http://www.reddit.com/r/changemyview/wiki/guidelines#wiki\\_upvoting\\_2fdownvoting](http://www.reddit.com/r/changemyview/wiki/guidelines#wiki_upvoting_2fdownvoting)

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