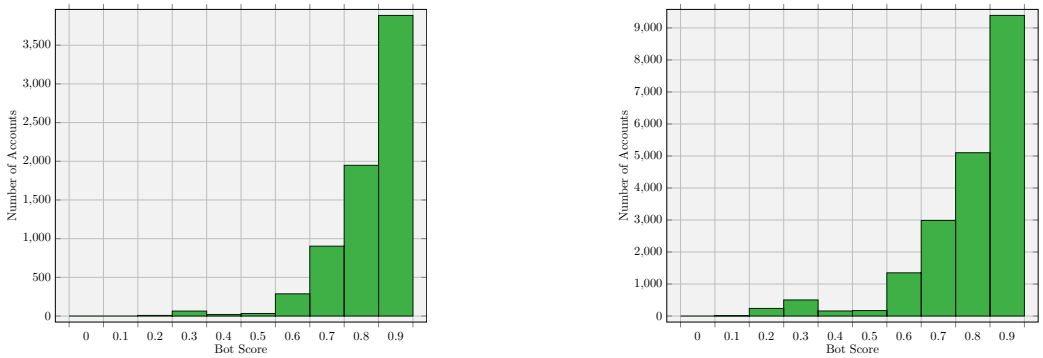

(a) The distribution of bot scores in Anonymous Twitter network for accounts created in 2020.

(b) The distribution of bot scores in Anonymous Twitter network for accounts created prior to 2020.

Figure 7: The distributions of bot scores of Anonymous-affiliated Twitter accounts.

cate changes in the ratio of these two tweet functions, rather than shifts in the stance of Anonymous users. It seems that, despite the group's claims of having no set stances or ideologies (**?**), they appear united on Twitter in their support of BLM. This, in turn, also provides the first evidence of unity not just in topics of interest within the group, but also in the group's stance on the most popular topics being discussed.

6.4 Bot Presence in the Anonymous Network (RQ5)

Finally, in answer to RQ5, we examined the potential presence of automated accounts within the Anonymous network to examine the degree to which bots may have contributed to the resurgence of the group. In turn, we recorded bot scores for 27,059 Anonymous accounts. All scores are on a scale between 0 and 1, with a higher score indicating an account acting in a more automated manner.

In Fig. 7, we show the distribution of bot scores for accounts created in 2020 (Fig. 7a), and accounts created prior to 2020 (Fig. 7b). This allows us to examine whether any presence in automated behaviors has occurred after the spike in Anonymous activity in 2020

Our findings show that the network displays a high degree of automated behavior, with the majority of accounts scoring between 0.9 and 1.0. Moreover, over 50% of all accounts scored above 0.8, indicating that the Anonymous network shows significant signs of bot-like behavior in most of its accounts. This finding helps bring in to doubt the true number of Anonymous users on Twitter. Interestingly, there appears to be little difference between the bot score distribution in 2020 accounts, and in accounts created prior to 2020. Instead, it appears that the majority of accounts in this Anonymous network have always exhibited a large degree of automated behavior.

We then sought to examine the relationship between the number of tweets produced by Anonymous accounts and their bot scores. By doing this, we can begin to try and attain an understanding of whether there are any patterns in tweeting behaviors that distinguish accounts displaying automated patterns, and those seeming more human in nature. Fig. 8 shows the average number of tweets produced by accounts of different bot score ranges. In addition, we also examined the ratio of tweets to retweets in accounts with high and low bot scores, but this too did not identify any noticeable differences between more and less bot-like accounts.

From Fig. 8, we can see that accounts scoring higher in terms of bot score seem, on average, to produce fewer tweets in total. This finding indicates that whilst accounts displaying automated behaviors appear to be present in large quantities within the Anonymous network, it seems that it is the accounts that act in the most human-like manner that are responsible for the majority of the tweets. Thus, whilst accounts exhibiting automated behaviors inflate the apparent size of the Anonymous network, they typically contribute little in the way of content.

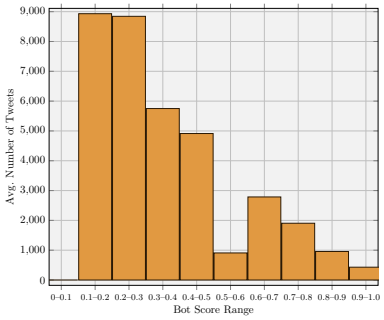

Figure 8: The average number of total tweets for Anonymous accounts in different bot score ranges.

Moving forward, we conducted more specific analysis into the relation between bot scores and BLM tweet topics. In turn, we examined the distribution of bot scores for accounts with at least tweet containing a BLM-related topic, and accounts with at least one police protest tweet. These distributions exhibited an even more considerable skew towards bot-like behavior, with all BLM and police protest tweeting accounts receiving a bot score of more than 0.8. This finding provides further indications that the apparent resurgence of the group in response to the BLM protests has

been inflated by bot accounts. To further help confirm the role of these bot accounts in inflating the apparent size of the Anonymous network, we examined the bot type scores provided by Botometer. These provide an indication of the degree to which a given accounts behaves like a specific form of bot. The results can be found in Fig. 9. From this, we can see that the 'fake follower' bot type is the most commonly identified type present in Anonymous accounts created during the protest period. This provides additional evidence that the mass increase seen in the network during this period is likely the result of bot activity inflating the perceived size of the group's Twitter presence.

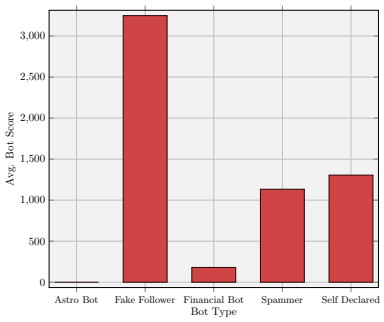

Figure 9: The number of high-scoring Anonymous bot accounts created during the BLM protest period that exhibited behaviors of five specific bot types.

Additionally, we conducted the same analysis for accounts created prior to 2020, finding similar indications that not only do accounts exhibiting bot-like behaviors constitute the majority of the network, but that the bots that they most commonly resemble are 'fake follower'. It must be noted, however, that the majority of high-scoring bot accounts were left unclassified as 'other' bots. Thus, further analysis is needed to complete our understanding of the role of bots in the network. However, these results, taken in conjunction with the other findings in regards to the presence of bots in the network, indicate, in answer to RQ5, that bot activity has played a significant role in inflating the apparent size of the Anonymous Twitter resurgence. We also find indications that the large network identified in (**?**), and Anonymous' sizeable presence on Twitter in general, is likely inflated by bot-like accounts. This finding is also in keeping with established behaviors of central affiliates within the group, as previous studies have noted that key affiliates have previously utilized bots as a means of inflating the group's apparent size to other affiliates (**?**). This finding then, not only supports conjecture in the media that the rapid growth in Anonymous accounts during the 2020 BLM protests is likely suspicious in nature (**?**), but also suggests that the Anonymous Twitter network has also been in large part construed of bot-like accounts prior to these events.

6.5 Limitations

There are some limitations to this study which warrant mentioning. Firstly, we make the assumption that each account is operated by a single user. In reality, it is possible that some accounts could be operated by a single user. An analysis of account behaviours for patterns of similarity might be possible to approximate the number of 'true' users, though the lack of suitable ground-truth makes this a challenging problem. Secondly, although we endeavoured to identify the number of removed accounts in the network, due to the limitations set by Twitter's API we cannot be certain that the number identified reflects the true number of removed accounts. However, given the similarity between our network and the one identified in (**?**), coupled with the degree of growth in the network in 2020, it is unlikely that the loss of these accounts has severely impacted our findings.

Moreover, given our reliance on a generalizable bot detection method, further investigation is needed to validate our initial findings. Ideally, this would be done via the use of a bespoke classifier, trained specifically on Anonymous data. This is particularly needed in terms of the bot type detection.

Finally, due to the limitation of the most recent 3,200 tweets, our sampling is necessarily incomplete, and the results may be biased towards the accounts most active during the BLM protests. Validation of these results using a complete sampling would therefore be of value, as it could not be achieved in this work due to rate limit restrictions set by Twitter's API.

7 Conclusions and Future Work

In summary we find that, contrary to the findings of previous studies (**??**), the group shows evidence of rapid growth in the time-period surrounding the 2020 BLM protests. Moreover, we find that the network as a whole frequently tweeted about BLM-related topics and that these tweets spiked considerably after George Floyd's death, supporting the notion that the Anonymous resurgence was, at least in part, a result of this. We also find indications, however, that this support was short-lived, with Anonymous showing little interest in BLM after the period of significant protest.

We also find evidence of automation across the majority of the accounts in the Anonymous network. This indicates that whilst the Anonymous network received a large amount of growth during the protests, much of this size may be the result of inflation through the use of bot accounts. Moreover, we note that bot accounts seem to constitute a large proportion of the Anonymous accounts that existed prior to 2020. This lends new insights into the group's presence on Twitter, indicating that the large presence of the group noted in past research (**?**) is likely not an accurate representation of the genuine number of Anonymous affiliates.

Our results also indicate the potential power that bot activity has to mask the true extent of a groups presence on social media. A finding which may have implications to the study of other groups with a significant online presence, such as QAnon, emphasizing a need for further research.

In future, the apparent role that automation plays in the Anonymous Twitter network could lead to a reinterpretation of the group's presence on social media. To strengthen our findings, we believe that further research into developing bespoke methods for identifying and analyzing bot activity in the Anonymous Twitter network would be valuable. Furthermore, analysis of the interaction