

# Viral Misinformation: The Role of Homophily and Polarization

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## 1. INTRODUCTION

Nowadays, everyone can produce and access a variety of information by actively participating in the diffusion and reinforcement of narratives. The spreading of unsubstantiated rumors, whether intentional or unintentional, could have serious consequences; the World Economic Forum has listed *massive digital misinformation* as one of the main risks for the modern society [1]. An interesting example is the popular case of Senator Cirenga's law, proposing to fund policy makers with 134 million of euros (10% of the Italian GDP) in case of defeat in the political competition. This was an intentional joke—the text of the post was explicitly mentioning its provocative nature—which became popular within online political activists. In this work we focus on two distinct types of news—science and conspiracy—differing in the possibility of verifying their content. Science news aim at diffusing scientific knowledge and scientific thinking, whereas conspiracy news provide alternative arguments that are difficult to be verified. Conspiracists tend to reduce the complexity of reality by explaining significant social or political events as secret plots conceived by powerful individuals or organizations. Misinformation can be particularly difficult to correct [2, 3]. Recently [4] it has been shown that conspiracist and mainstream information reverberate in a similar way on social media and that users generally exposed to conspiracy stories are more prone to like and share satirical information [5]. We analyze a sample of 1.2M Facebook Italian users consuming scientific and conspiracy news. Our findings reveal that users' engagement on a specific content correlates with the number of friends having similar con-

	Total	Science	Conspiracy
Pages	73	34	39
Posts	271,296	62,705	208,591
Likes	9,164,781	2,505,399	6,659,382
Comments	1,017,509	180,918	836,591
Shares	17,797,819	1,471,088	16,326,731
Likers	1,196,404	332,357	864,047
Commenters	279,972	53,438	226,534

Table 1: Breakdown of Facebook dataset.

sumption patterns (*homophily*). Moreover, we show the relationship between the usual exposure—i.e., *polarization*—to unverified rumors (conspiracy stories) and the permeability to intentionally false information—4,709 intentional satirical false claims. We define the space of our investigation with the help of some Facebook groups very active in debunking conspiracy theses (*Protesi di Protesi di Complotto, Che vuol dire reale, La menzogna diventa verità e passa alla storia*). As a further control, we use the self-description of a page to determine its focus. The resulting dataset contains 73 public Facebook pages; 34 of such pages are related to scientific news and the other 39 to news that can be considered conspiratorial; we refer to the former as *science pages* and to the latter as *conspiracy pages*. Notice that the dataset used in the analysis is the same used in [3] and [5]. In Table 1 we summarize the details of our data collection. In addition, we have collected the ego networks of users who liked at least one post on science or conspiracy pages, that is, for each user we have collected her list of friends and the links between them. Then we are able to build a social network of users and the (publicly declared) connections between them for a total of about 1.2M nodes and 34.5M edges. Furthermore, we use 4,709 posts from two satirical Facebook pages (to which we will refer as *troll posts* and *troll pages*) promoting intentionally false and caricatural version of the most debated issues.

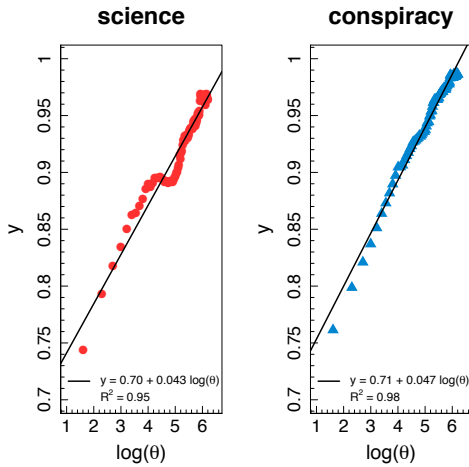


Figure 1: Predicting the fraction of friends of users polarized on science (left) and on conspiracy (right).

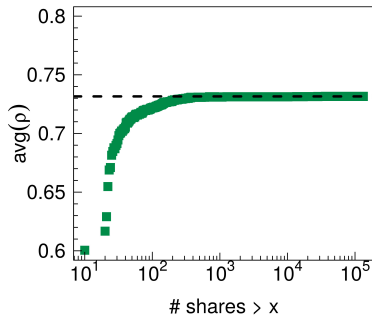


Figure 2: Average polarization of users who liked troll posts (intentionally false information). Notice that the polarization increases with the number of shares, indicating that very popular posts containing false information are mostly supported by conspiracy users.

## 2. RESULTS AND DISCUSSION

Homophily—i.e., the tendency of users to aggregate around common interests—has been already pointed out as a factor in rumor spreading [6]. In Figure 1 we show the linear relationship between the fraction of friends polarized on the same category of the user and the logarithm of her activity. Thus, we check whether for a polarized user the fraction of polarized friends in her category can be predicted by means of a linear regression model where the explanatory variable is a logarithmic transformation of the number of likes  $\theta$  i.e.,

$$y = \beta_0 + \beta_1 \log(\theta).$$

Coefficients are estimated using ordinary least squares and they are—with the corresponding standard errors inside the round brackets—  $\hat{\beta}_0 = 0.70$  (0.005) and  $\hat{\beta}_1 = 0.043$  (0.001),

with  $R^2 = 0.95$ , for users polarized towards science, and  $\hat{\beta}_0 = 0.71$  (0.003) and  $\hat{\beta}_1 = 0.047$  (0.0006), with  $R^2 = 0.98$ , for users polarized towards conspiracy.

Figure 2 illustrates the average value of the polarization,  $\text{avg}(\rho)$ , for increasing levels of shares; more precisely, we compute the average polarization of all the users who liked troll posts with a number of shares greater than  $x$ . We find an increasing trend that starts from an average polarization of  $\sim 0.6$  and asymptotically stabilizes at about  $\sim 0.73$ ; the average polarization starts to increase sharply at  $x \sim 20$  and saturates at  $x \sim 200$ . Users exposed to conspiracy stories seem to be more prone to diffuse intentionally false information.

In summary, we find that Facebook users (at least in the Italian dataset) tend to be very polarized with respect to science or conspiracy subjects, by forming two distinct groups. Such groups are very similar: they present a strong homophily (their users tend to interact with users with a similar polarization) and consume information with similar patterns. Moreover, the internal social network structure is statistically similar. Therefore, homophily and polarization could be the key metrics to identify the communities of a social network where false or misleading rumors are more likely to spread.

## 3. ACKNOWLEDGMENTS

Funding for this work was provided by EU FET project MULTIPLEX nr. 317532, EU project SIMPOL nr. 610704 and EU HOME/2013/CIPS/AG/4000005013 project CI2C. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. Special thanks for building the atlas of pages to *Protesi di Protesi di Complotto, Che vuol dire reale, La menzogna diventa verità e passa alla storia, Simply Humans, Semplicemente me*. Finally, we want to mention Salvatore Previti, Elio Gabalo, Titta, Morocho, and Sandro Forgiere for interesting discussions.

## 4. REFERENCES

- [1] L. Howell. Digital wildfires in a hyperconnected world. In *WEF Report 2013*. World Economic Forum, 2013.
- [2] R. K. Garrett and B. E. Weeks. The promise and peril of real-time corrections to political misperceptions. In *Proceedings of the 2013 conference on Computer supported cooperative work*, Proceedings of CSCW '13, pages 1047–1058. ACM, 2013.
- [3] A. Bessi, G. Caldarelli, M. Del Vicario, A. Scala, and W. Quattrociocchi. Social determinants of content selection in the age of (mis)information. In *Social Informatics*, Lecture Notes in Computer Science. Springer International Publishing, 2014.
- [4] D. Mocanu, L. Rossi, Q. Zhang, M. Karsai, and W. Quattrociocchi. Collective attention in the age of (mis)information. *Computers in Human Behavior*, 2015.
- [5] A. Bessi, M. Coletto, G. Davidescu, A. Scala, G. Caldarelli, and W. Quattrociocchi. Science vs Conspiracy: Collective Narratives in the Age of Misinformation. *PLoS ONE*, 10(2), 02 2015.
- [6] L. M. Aiello, A. Barrat, R. Schifanella, C. Cattuto, B. Markines, and F. Menczer. Friendship prediction and homophily in social media. *ACM Transactions on the Web (TWEB)*, 6(2):9, 2012.