Unveiling Political Opinion Structures with a Web-experiment

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Abstract: The dynamics of political votes has been widely studied, both for its practical interest and as a paradigm of the dynamics of mass opinions and collective phenomena, where theoretical predictions can be easily tested. However, the vote outcome is often influenced by many factors beyond the bare opinion on the candidate, and in most cases it is bound to a single preference. The voter perception of the political space is still to be elucidated. We here propose a web experiment (laPENSOcosì) where we explicitly investigate participants' opinions on political entities (parties, coalitions, individual candidates) of the Italian political scene. As a main result, we show that the political perception follows a Weber-Fechner-like law, i.e., when ranking political entities according to the user expressed preferences, the perceived distance of the user from a given entity scales as the logarithm of this rank.

1 INTRODUCTION

In the United States hundreds of millions of dollars are yearly spent for presidential campaigns (Buchanan, 2004), but the very mechanisms through which public opinion can be succesfully influenced are not fully understood. Politics is a universal topic of conversation. People express opinions, try to convince their interlocutors, build themselves their believes under the influence of a variety of factors, with different degrees of rationality (Zaller, 1992; Bartels, 2010; Kahneman, 2011; Bendor et al., 2011; Antonakis and Dalgas, 2009). Information from mass media and political campaigns strongly influence the debate, and often in an impredictable way (Berelson et al., 1954; Buchanan, 2004). More at the core of the question, people perception of politics and political subjects follows laws that are largely to be uncovered. Due to the practical as well as theoretical interest in the understanding of political opinion dynamics, available data have been studied seeking for universals (Chatterjee et al., 2013) and experiments have been proposed aiming to highlight different mechanisms influencing voters opinions on candidates (Todorov et al., 2005). Also, models of opinion dynamics inspired from statistical physics, which analyse the mechanics of opinion formation, have been proposed recently (Sirbu et al., 2013b; Castellano et al., 2009; Sirbu et al., 2013a). However, comprehensive and focused databases of political opinions are lacking. While in fact political elections outcomes constitute precious databases to investigate voters behavior (Borghesi and Bouchaud, 2010; Hummel and Rothschild, 2013), the real opinion of voters may be hidden by many different factors, as for instance tactical voting (Arajo et al., 2010) and limitations imposed by the election rules. Moreover, the electoral system usually allows the expression of a single positive vote per elective assembly, so that individuals are called to compress all their interpretation of the political landscape in a single preference. Most importantly, voters are bound to express positive votes, so that only approval and not disappointment can be directly expressed. For all these reasons, elections outcomes only partially represent voter opinions and the study of the political perception of citizens has to rely on different kinds of data.

Here we propose an experiment aiming at overcoming these limitations, providing a more complete picture of the political perception and allowing in this way a quantitative analysis of the complex structure of individuals opinions. In particular, following a

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general trend emerged in the last few years, where web-games are adopted as interesting laboratory to run experiments in the social sciences (Howe, 2006; Lazer and et al., 2009; Salganik and Watts, 2009; Suri and Watts, 2011), we propose a web experiment in which people are directly called to express their opinions on political subjects. The data gathered with the laPENSOcosì experiment reflect the general negative sentiment the italian population has towards its political class. More interestingly, we found that opinions follow a distribution compatible with an exponential distribution, with a negative coefficient whose absolute value decreases with the level of optimism, but that remains almost constant across different political orientations. This result strongly recalls a well known law linking stimuli and perception, i.e., the Weber-Fechner law. This law has been observed in several situations involving physical perceptions, e.g. light brightness (Hecht, 1924) or noise intensity, and also in other less tangible contexts, e.g. numerical cognition (Dehaene, 2003; Nieder and Miller, 2003) and more recently in the subjective perception of the quality of a service (Reichl et al., 2010; Egger et al., 2012). The presence of a Weber-Fechner-like law in political perception is a novel aspect. This finding could foster other experiments in this direction and can have a profound impact on the way models of opinion dynamics are constructed.

2 RESULTS

2.1 The Experiment

In the last few years the Web has been progressively acquiring the status of an infrastructure for social computing that allows researchers to coordinate the cognitive abilities of users in online communities, and to suggest how to steer the collective action towards predefined goals (Howe, 2006; Suri and Watts, 2011; Salganik and Watts, 2009; Fischer and et al., 2012; Gravino et al., 2011). Web games prove to be particularly fruitful whenever the peculiar human computation abilities are crucially required for research purposes (von Ahn and Dabbish, 2004; von Ahn, 2006; Schawinski and et al., 2010; Cooper and et al., 2010; Khatib and et. al, 2011). The laPENSOcosì experiment takes advantage of the Experimental Tribe[1] platform for web-based experiments and social computation (Caminiti et al., 2013; Cicali et al., 2011).

In the laPENSOcosì[2] experiment, people were called to express their opinion on political subjects, including single candidates, parties and coalitions. Opinions are expressed by means of a real number in the interval $[-1,1]$, negative numbers expressing disapproval. Subjects were randomly presented from a pool composed by the 160 most famous italian politicians, parties and coalitions. Data were gathered from middle of January 2013 to the early days of March 2013, exploiting the italian political elections that took place on 24-25th February 2013. We here present results on 39154 opinions expressed by 1038 users, corresponding to the data gathered in the last version of our experiment (refer to the Section 3 for details). People were free to assign to each of the randomly presented political subject a vote in the interval $[-1,1]$. The actual normalization of the interval is arbitrary and does not affect generality, while its extension over a range of both negative and positive values allows people to express both disapproval and approval in a straightforward way. A possibility to abstain is also given, together with a direct link to the wikipedia page describing the politician or the party under evaluation, in the case it would be unknown to the user. As an additional information, the user can also leave an explicit comment on the political entity they are called to judge. A snapshot of the game is given in Fig. 1, while for a detailed description we refer to the Method section.

2.2 Outcomes

A first portrait of the perception of the political world can be drawn by measuring the distribution of the opinions in the whole dataset, referred to any political subject and expressed by any user.

This distribution is reported in Fig. 2, showing the average opinion on any political entities being significantly negative (the mean value of the distribution being -0.472). This simply corresponds to the general negative perception of politics. The distribution shows peaks at the extremes (value -1 and $+1$) and of the center (the zero value) of the interval, with the highest peaks at the extremes. The peaks can be easily explained as due in part to a natural tendency of extremization, and to the visually attractive effect of extremes and natural numbers, and more in particular as an effect of the visualization of the voting interval. More interestingly, the distribution between the peaks seems to follow an exponential law, decreasing when the opinion value is growing.

This behavior reminds of a general property of perception, the Weber-Fechner law, which states that the perception is proportional to the logarithm of the stimuli. In our context, for each user we can rank the

[1] freely available at http://www.xtribe.eu

[2] still available at http://www.lapensocosi.it

Figure 1: Two screenshots of the last version of the interface, before (top) and after (bottom) the interaction. Users were prompted with a photo of a politician or a party logo and were asked to use the scale on the left to express their opinions.

political subjects according to the appreciation they expressed on them, from the most esteemed to the most unappreciated. We can thus interpret the position in this rank as a sort of distance between the user and the given political subject. This allows to directly interpret the exponential form of the opinion distribution in terms of the Weber-Fechner law.

We can define this opinion "distance" as $x_p = (1-o)/2$, where o is the opinion expressed by the user in $[-1,+1]$. To support the hypothesis of the exponential, we performed a fit on the areas of interest (blue and green part of the curve in Fig. 2). In order to have a less noisy curve we converted opinions in distances and used the cumulative distribution represented in Fig. 3.

To perform a χ^2 test we estimated the error for the cumulative distribution as the 1%. The results are strongly supporting the compatibility with an exponential-like law.

In order to more deeply investigate this phenomenon, we looked at the robustness of the opinion distribution against political orientation of the users and against their optimistic or pessimistic attitude, as signalled by the average of the individual opinion distribution (refer to Section 3 section for more details). Results are reported in Figures 4 and 5 respectively, showing how the form of the distribution remains sta-

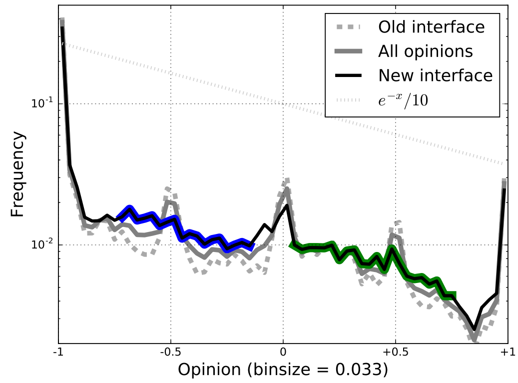

Figure 2: The histogram of the opinions expressed by users in semilog scale. In black, the histogram relative to data gathered with the last version of the interface. We highlighted in blue and in green the exponential-like parts, that appear linear in semilog scale. A simple exponential is reported as a reference. Also, it is reported the histogram of the dataset obtained with the old interface (gray, dashed) and the histogram of the whole dataset (gray). With the old interface, peaks at -0.5 and +0.5 emerged as a consequence of major ticks in the scale where users expressed their opinions.

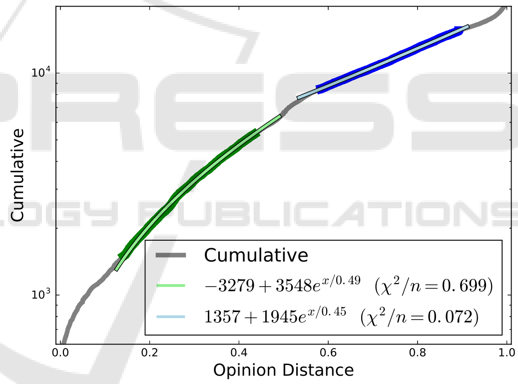

Figure 3: The gray curve represents the cumulative distribution of opinions in the distance space. In green and in blue the area of interest already highlighted in Fig. 2. In light green and in light blue we reported the exponential fits. In the legend we can see the results of the χ^2 test. Relative errors have been estimated to be $\sim 1\%$.

ble against subsampling of the population. Interestingly, when subsampling the population according to the individual level of optimism, the exponent of the exponential law appears to be directly related to the degree of optimism, its absolute value increasing with optimism.

We note that the distributions considered so far are aggregated distributions of many users, while the Weber-Fechner law refers to the perception of each individual. It is thus important to show that the aggregate distribution well reflects an individual property. This point is addressed in Section 3, where we report

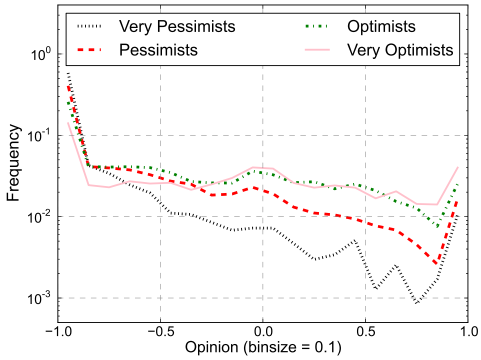

Figure 4: Histograms of the opinions for 4 subsets of users, divided according to their level of "optimism", i.e. the user average opinion.

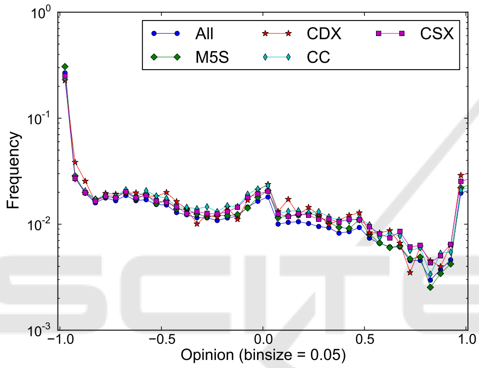

Figure 5: The histogram of the opinions weighted considering 4 different "points of view" relative to the 4 poles of Italian politics. Each histogram is calculated by weighting each user opinion with the user average opinion distance from the entity of the given pole.

that both individual and collective opinion structures, reported in Fig. 8, show some slight differences that disappear if we disaggregate the set depending on the level of optimism of the user. In other words, if we consider groups of users with the same level of optimism, the individual opinion distribution is fairly similar to the collective one. Finally, we built a graph representation of the political space. Each time a user provides opinions about two or more entities, they are actually defining a distance amongst them. By averaging the distances provided between all the pairs of entities we created a graph in which nodes are the entities and the weight of links are the inverse of these distances. The result is reported in Fig. 6 (we tried several spacial disposition algorithms finding similar results). Colors represent different coalitions and the relative clustering spontaneously emerge as a natural consequence of the spacial disposition according to links weight. This network representation points out the distance between traditional left-wing and right-wing parties, and the middle position of center moderate parties. Furthermore, the perception of the novel political force (at the time of the elections considered) "Movimento 5 Stelle" is accurately reproduced and perceived as new and different from all the others. Fig. 6 reproduce the actual overview of the Italian political landscape. The accuracy in the portrait is a very interesting result stemming from a completely bottom-up elaborated representation.

3 Methods

3.1 laPENSOcosì

Experimental Tribe (XTribe in short)[3], is a general purpose platform to help researchers to realize web games/experiments with a very small coding overhead. We released the laPENSOcosì [4] experiment hosted on the XTribe portal in the middle of January 2013. In the default mode (named "Modalità Gioco", Game Mode, GM in the following), subjects were presented randomly 20 political entities to be rated from a pool composed by the 160 most famous italian politicians and all existing parties. Users could also check the list of candidates (in List Mode, LM) or use a search engine. We focused on the dataset obtained in GM because in LM users tended to evaluate their preferred entities. Aiming at a representation of the political space, the random sampling obtained in game mode represents a more effective choice. The experiment exploited the hot topic of political elections in Italy at the end of February 2013 (24-25th February 2013). At the early days of March 2013 the experiment gathered in Game Mode 81,508 opinions expressed by 1,727 users, on our pool of 160 political subjects. In Fig. 7 we reported the daily number of opinions, users and sessions of play.

For the analysis presented in this paper (except the gray dashed curve in Fig. 2), we considered only data gathered with this last version of the interface. This interface has been introduced at the beginning of February 2013 and 39,154 opinions were gathered thanks to 1,038 users. Data obtained with the previous interface were discarded because the interface introduced an optical bias: in the opinion scale, major ticks at -0.5 and +0.5 attracted the attention so that the opinion distribution, reported in Fig. 2, shows peaks at -0.5 and +0.5.

[3] http://www.xtribe.eu
[4] http://www.lapensocosi.it

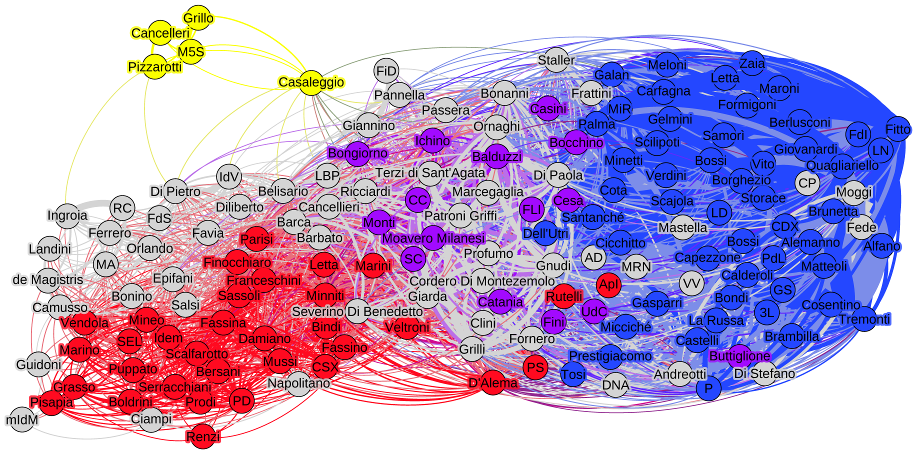

Figure 6: The graph of italian political entities immediately before February 2013 political elections. Nodes are coloured according to the coalition: red for left-wing coalition, blue for right-wing coalition, purple for center coalition and yellow for Movimento 5 Stelle (M5S), a novel formation not belonging to a coalition. The color clustering spontaneously emerges by imposing distances between entities obtained by averaging those defined by users opinion.

3.2 Reliability of the Data

The data gathered with the experiment correctly reproduce the italian political scene, in terms of relations between political subjects, as visible in Figure 6. The accuracy of the reproduction is an indirect validation of the dataset, since the aim was to measure the political opinion structure and not the forecasting of the elections outcome.

3.3 Recruitment

In order to make the experience possibly viral, we implemented some social sharing functionalities, allowing users to publish their opinion on Facebook and Twitter, advertising the experiment. Furthermore, to improve the user experience enjoyability, the request for opinions has been formulated in the shape of a “personality test”: after each session of evaluation (which consisted in 20 evaluation rounds) the user received a profile describing them. According to the average value of opinion in the session the user was classified as an optimist (high average) or a pessimist (low average). Also, depending on the value of the standard deviation of session opinions, the user was labeled as an extremist (high standard deviation) or a moderate (low standard deviation). The result of the test was sharable on Facebook or Twitter, in order to attract other to discover their profile.

3.4 Optimists and Pessimists

We divided the population in 4 parts according to users average opinion: the quarter with the highest averages has been considered “very optimist”, the quarter with the highest average above the remaining has been considered “optimist”, and so on. Then we calculated the opinion distribution for the 4 subpopulation. The result is shown in Fig. 4. It appears clearly how the whole structure is coherent with an exponential law: the only thing changing seems to be the coefficient of the exponential regression. This highlights the importance of the exponential law and also points out that the exponent can be considered a measure of the “structural optimism” about political perception. In fact, differently from the optimism defined as the simple average of the opinions of a given user, the exponent gives us more information. Obviously, from an higher exponent follows an higher average but also a different opinion structure, with deep consequences in terms of resolution in the comprehension of political entities relations, as we will see in the following sections.

3.5 Political Points of View

As anticipated in Section 2, we tested also the distribution stability against differences in the political point of view of the considered population. The italian political forces scheme can be divided in four main political factions: the center-right coalition (will be indicated as CDX); the center coalition (CC); the center-left coalition (CSX); the Movimento 5 Stelle party (M5S). Since in this case there is no clear distinction we managed to define, for each user, an aggregated opinion (agg. op. in the following) about each one of these poles. These opinions have been used to weight all other opinions while recalculating the opinion distribution. In other words, to get the opinion distribution of the CDX supporter we used

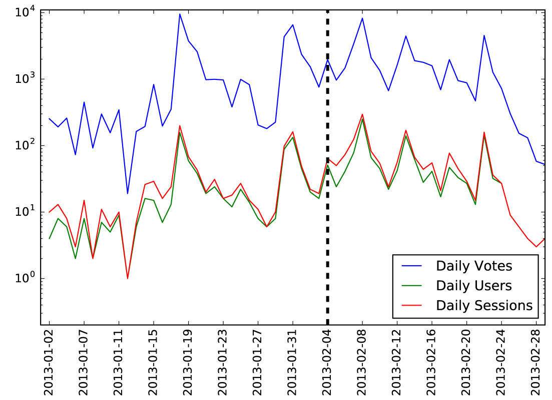

Figure 7: The daily number of opinions, users and session of play.

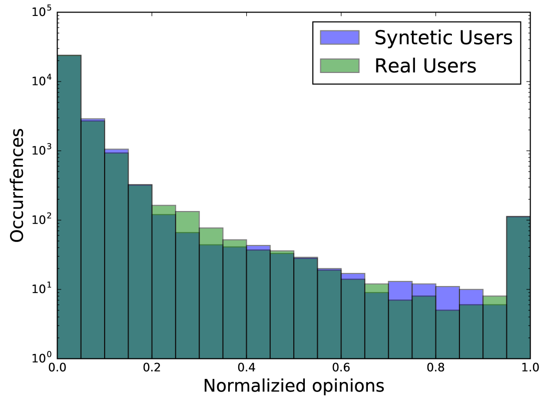

Figure 8: The distribution of opinions rescaled and normalized by user, for real users and for a syntetic set of users. Differences reflect the difference in the opinion structure between single user and the collective result.

the agg. op. about CDX of each user to weight his/her opinions, so that, for example, if a user had a CDX agg. op. $= +1$ then his/her opinions were considered normally while if CDX agg. op. $= -1$ then his/her opinions were not considered at all. The result of this analysis are the four front weighted distributions that are reported in Fig. 5. It is clearly visible how all the distributions are fairly compatible. This graph suggests that the opinion distribution we measured and showed in Fig. 2 is a quite robust feature. Again, in Fig. 5 we can find the exponential shape (with some noise due to the reduction of the statistics, consequence of the weighting procedure). Furthermore, the opinion structure of different voters tends to be similar even if the political point of view is different (and even opposite). This interestingly points out a sort of universality in the perception of the political space.

3.6 Individual vs Collective Opinions Structure

The opinion distribution shown in Fig. 2, which is one of the focal points of this paper, is calculated by aggregating all users opinions. It is a collective measure, but since we want to infer the properties at the individual level, we had to show that individual and collective distribution are compatible. To this purpose we calculated a new distribution of opinions, by rescaling by $+1$ and by normalizing to 1. In other words, the new opinions o' is defined as follows:

$$o' = \frac{o+1}{\sum_{user}(o+1)} \tag{1}$$

where the sum runs on the other opinions of the same user. This novel set of opinions has been compared with a syntetic set representing the collective opinion distribution. For each user, we generated a syntetic user with the same number of opinions randomly picked from the whole set of opinions, in order to destroy correlations. The histrograms of the real and syntetic opinions is reported in Fig. 8. The distribution seems quite similar but some differences emerge. To those differences we performed the two sample Kolmogorv-Smirnov test, for 100 random sampling, finding *p-value* $= 0.065 \pm 0.078$ which gives a quantitative measure of the difference between the collective and individual distribution. This points out that the global aggregation is imperfect to represent individual behaviour. Some level of disaggregation should be introduced. We already reported about the importance of the optimism level so we used this parameter to disaggregate. We divided the population in two sets, according to the user level of optimism. Thus we performed again the same analysis on the two separate sets. The KS test showed a more high *p-value* in both cases: 0.096 ± 0.072 and 0.289 ± 0.119. From these analysis we can state that individual behaviour can be in first approximation represented by the collective behaviour but disaggregating by optimism level improves strongly the compatibility between the single user opinion structure and the global one.

3.7 The Emergence of Weber-Fechner Law

3.7.1 The Opinion Space

In this paragraph, we shall provide the interpretation of the exponential law observed in Fig. 2. In order to understand the implication of the exponentials, let us try to reformulate our problem. To simplify, we will consider a bounded space, an opinion space, whose distribution follows just an exponential law. In the opinion space, each user can place political subjects according to their perception. Our experiment asks for opinions between -1 and $+1$ but we can also translate these opinions in some sort of distance perceived by the user. In this framework, entities near $+1$ can be considered as perceived near the user while those entities near -1 can be considered as far from the user, according to his perception. We can thus say that users assign to each entity a coordinate in this perceptual space, that we will call $x_p(i)$ (as we already did in Section 2, for entity i). Without loss of generality, we shift and normalize the range of the perceptual space to the interval $[0,+1]$, whereas 0 corresponds to opinion $+1$ and 1 corresponds to opinion -1. The exponential law we measured in Fig. 3 represents, in this framework, the density of the political subject in the perceptual space. We can then express the perceived density as an exponential with a proper normalization in the following way:

$$\rho_p(x_p) = \frac{e^{\frac{x_p}{\lambda}}}{e^{\frac{1}{\lambda}} - 1} \quad (2)$$

where λ is a characteristic parameter of the user (or of the subset of similar users considered). As we saw in Fig. 4, this parameter is probably linked to the "optimism". What we described so far is a matter of perception. The situation is similar to what happens with our "normal" senses (sight, hearing, touch, etc). For the five senses, we can measure their efficiency in mapping reality by knowing how a certain stimulus (or a distribution of stimuli) is translated in our perception (or in a distribution of perceptions).

In the present case, we measured the perceived distribution, but what about the stimuli distribution? We measured the perceived density distribution of a set of political entities, but how were they distributed originally? And in what kind of space?

3.7.2 The Rank Space

It is not just a matter of stimuli distribution. If the sensing process we are considering is a sort of mapping, what exactly are we mapping in the opinion space? From what kind of space the mapping starts? So far we considered the evaluation process as a sort of positioning of the entity in the opinion space. Positioning may also be considered a second order process with respect to a ranking process. It sounds reasonable to assume that users have their own personal rank of the political subjects. In this rank, we can consider the first as the nearest to the user, and the last as the farthest. While telling their opinion, the user is basically translating a rank into a position. Thus, we can define a rank space in which entity are placed, sorted by their rank. By definition of rank, entities are simply distributed uniformly, in a discrete sense (one in each rank position). Even if the rank space discrete by definition, in order to analyze the mapping, we will consider it as a continuous space, in which $x_r(i)$ will refer to the rank position of the entity i. The bound of the rank will be 1 and the number of entities N_e. As we said, we consider the density as a continuous uniform density distribution defined as follows:

$$\rho_r(x_r) = \frac{1}{N_e} \quad (3)$$

3.7.3 Mapping and Resolving Power

Now that we have both the perceived and the original distribution we can find the transformation by imposing that:

$$\rho_r(x_r)dx_r = \rho_p(x_p)dx_p \quad (4)$$

This condition is equivalent to require that the transformation from x_r to x_p is essentially a bijection, i.e. to each point x_r there is one and only one corresponding point x_p. This assumption is quite reasonable for a perceptive mapping. In Eq. 4, by substituting Eq. 2 and Eq. 3, we get:

$$\frac{1}{N_e}dx_r = \frac{e^{\frac{x_p}{\lambda}}}{e^{\frac{1}{\lambda}} - 1}dx_p$$
$$\frac{dx_r}{dx_p} = N_e\frac{e^{\frac{x_p}{\lambda}}}{e^{\frac{1}{\lambda}} - 1} \quad (5)$$

and by integrating we obtain:

$$x_r = \frac{\lambda N_e}{e^{\frac{1}{\lambda}} - 1}e^{\frac{x_p}{\lambda}} \quad (6)$$

$$x_p = \lambda \log \frac{e^{\frac{1}{\lambda}} - 1}{\lambda N_e} x_r \propto \log x_r \quad (7)$$

Eq. 7 tells us how the rank space is transformed in the opinion space, i.e. according to a logarithmic law. This law appears similar to others perception mapping law, such that observed for spatial disposition for natural numbers. To investigate the efficiency of the mapping, let us consider Eq. 5. If we substitute Eq. 7 we get:

$$dx_p = \frac{\lambda}{x_r}dx_r \quad (8)$$

which describes how the perception becomes less efficient when x_r is growing. In other words, differences are perceived smaller and smaller as we go far from the user. Hence it is more difficult to distinguish among different but far (from the user) entities. Eq. 8 and Eq. 7 strongly recall a well-known law linking stimuli and perception: the Weber-Fechner law. The presence of a Weber-Fechner-like law in political perception is a novel aspect. The emergence of this sort of "Political Myopia" can have a profound impact on the way models of opinion dynamics are constructed. To complete, let us calculate the resolving power. By considering dx_r as a fixed parameter Δx_r, we can also find an expression for the opinion space, defining the resolving power needed to notice a difference Δx_r as a function of x_r

$$RP(x_r|\Delta x_r;\lambda;N_e) = \frac{1}{\Delta x_r} x_r \log \frac{e^{\frac{1}{\lambda}} - 1}{\lambda N_e} x_r. \quad (9)$$

4 CONCLUSIONS AND PERSPECTIVES

The laPENSOcosì web-experiment aimed to measure the political opinion structure. By exploiting the hot topic of Italian political elections of February 2013, this web application gathered opinions of more than one thousand users in few weeks. Participants were asked to express their opinion about political entities on a continuous scale between $[-1,+1]$, in order to overcome limitations of usual vote procedure. The resulting dataset gave us precious insights about how political entities are distributed in the opinion space. With a novel bottom-up approach, we managed to reproduce the relation between italian political entities, represented by the graph in Fig. 6, in a very accurate way. We also measured the distribution of the opinions, reported in Fig. 2, unfolding how political entities perceptions are distributed. This distribution reflected the main feature of the political scenario in Italy in the early 2013: a general negative feeling and a strong contrast between political players, leading to a negative opinion average and peaks at the extremes. Another interesting feature of the distribution is an exponential-like shape, which recalls a known law linking stimuli and perception, the Weber-Fechner law. The exponential shape has been proved to appear also by disaggregating and resampling the dataset, thus seemed to be quite robust, like a sort of universal law of political perception. Obviously more experimental confirmations are needed to improve the robustness of these conclusions. We plan to repeat the experiment at the next political elections in Italy and also abroad, in order to check if the exponential-like opinion distribution shows traits of universality irrespective of nationality. This can be easily done, because of the experimental procedure adopted. In fact, the laPENSOcosì web-experiment exploited the services of the Experimental Tribe platform, a social computation platform designed to help the implementation of web-experiments. Beside the investigation of the opinions distribution, new experiments can also deal with the opinion structure in a dynamical way, by monitoring a population opinion distribution over time. This kind of experiments could provide direct information about opinion dynamics and precious hints in the design of new models to analyze political opinion dynamics.

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