Social Physics: Data-Driven and Computational Discoveries of Human Social Connectome

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While Information Communication Technology (ICT) has offered us new ways to communicate and socially interact, the usage of which generate digital traces of our individual behaviour as records of ever-growing datasets. The study of such large-scale or Big Data using high-performance computational analysis and modeling with Network Theory approach can give us unprecedented insight into human sociality and to the structures and processes of social life and the society. This is well-demonstrated by our analysis of the dataset of mobile phone communication-logs, confirming the Granovetterian picture for the social network structure, i.e. being modular showing communities with strong internal ties and weaker external ties linking them. More recently the same dataset, but with additional data of the gender and age of the service subscribers, has allowed us to look at the nature of social interaction in more detail and from a different Dunbarian egocentric viewpoint. With this we have got a deeper insight into the gender and age-related social behaviour patterns and dynamics of close human relationships. Our analysis results demonstrate sex differences in the gender-bias of preferred relationships that reflect the way the reproductive investment strategies of both sexes change across their lifespan. We have also investigated the influence of seasonally and geographically related daily dynamics of daylight and ambient temperature on human resting patterns and observed two daily inactivity periods in the population-wide mobile phone calling patterns. The nocturnal resting period was found to be influenced by the length of daylight, and that its seasonal variation depends on the latitude of the phone users. In addition, the duration of the afternoon resting period was found influenced by the temperature, beyond certain threshold value, and that the yearly dynamics of the afternoon and nocturnal resting periods appear to be counterbalancing each other. These empirical findings inspired us to take the next step in network theory, namely developing models to catch some salient features of social networks and processes of human sociality. One of our first models, based on network sociology mechanisms for making friends, turned out to produce many empirically observed Granovetterian features of social networks, like meso-scale community and macro-scale topology formation. The modeling has subsequently been extended to take into account social networks being layered, multiplexing or context based, geography dependent, and having relationships between people changing in time. In sum, the Social Physics' large-scale data-driven analytics and modelling approaches to social systems opens up an unprecedented perspective to gain understanding of human sociality from individual to societal level, which together with the availability of various socially relevant datasets and development of computational methodologies could eventually lead to tools of social and societal design.