

Universal patterns in egocentric communication networks

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Tie strengths in social networks are heterogeneous, with strong and weak ties playing different roles at the network and individual levels. Egocentric networks, networks of relationships around an individual, exhibit few strong ties and more weaker ties, as evidenced by electronic communication records. Mobile phone data has also revealed persistent individual differences within this pattern. However, the generality and driving mechanisms of social tie strength heterogeneity remain unclear. Here, we study tie strengths in egocentric networks across multiple datasets of interactions between millions of people during months to years. We find universality in tie strength distributions and their individual-level variation across communication modes, even in channels not reflecting offline social relationships. Via a simple model of egocentric network evolution, we show that the observed universality arises from the competition between cumulative advantage and random choice, two tie reinforcement mechanisms whose balance determines the diversity of tie strengths. Our results provide insight into the driving mechanisms of tie strength heterogeneity in social networks and have implications for the understanding of social network structure and individual behavior.

Social networks are key to the exchange of ideas, norms, and other cultural constructs in human society¹, influencing the way we communicate², support each other^{3,4}, and form enduring communities⁵. Decades of research have focused on regularities in the patterns of relations among individuals⁶ as well as the drivers and mechanisms behind their origin⁷. One particularly prominent feature of social networks is the diversity of tie strengths⁸, where strong ties are typically embedded within social groups while weak ties are crucial for the cohesiveness of the network as a whole^{9–11}. At the micro level, ego networks—the sets of social ties between an individual (the ego) and their family, friends, and acquaintances (the alters)—commonly feature a small core of close relationships. These close relationships are associated with high emotional intensity and they are surrounded by a larger number of weaker ties. The emergence of this characteristic structural pattern has been associated with

constraints on maintaining social relationships, which include limited information processing capacity¹², social cognition^{13–15}, and time availability^{16–17}.

Studies of human communication via mobile phones have shown that in line with the above picture, there is a consistent, general pattern in egocentric networks where a small number of close alters receive a disproportionately large share of communication. Data on the frequency of mobile phone calls and text messages also indicate that within this general pattern, there are clear and persistent individual differences^{18–22}: some people repeatedly focus most of their attention on a few close relationships, while others tend to distribute communication among their alters more evenly²³. These differences are stable in time even under high personal network turnover. However, the mechanisms that generate such heterogeneity of tie strengths, its individual-level variation, and the generality of this pattern beyond

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Using Egocentric Networks To Understand Communication

**Qilian Liang,Jiasong Mu,Min Jia,Wei
Wang,Xuhong Feng,Baoju Zhang**



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