

# The scale-free distribution of electronic communication and the "Gravitational Law of Social Interaction".

Jacob Goldenberg<sup>1</sup> & Moshe Levy<sup>2</sup>

<sup>1</sup>*The Hebrew University, Jerusalem 91905, Israel.* <sup>2</sup>*The Hebrew University, Jerusalem 91905, Israel. These authors contributed equally to this work*

Email, cellular phones, and other types of electronic communications that have become very widely used in recent years, provide extensive quantitative data on social interactions. These data have been employed lately to investigate the structure of social networks [1-3], and the dynamics of human mobility [4]. One important aspect of social interaction which has not yet been studied, and which may be a key to understanding the development of social networks, is the dependence of the interaction intensity on physical distance. We investigate this dependence by analyzing two sets of data: email communications, and the records of 100,000 Facebook users. We find that both email volume and the number of Facebook links decrease inversely with the physical distance between the users. This finding can be interpreted as a "gravitational law of social interaction" asserting that the probability of a social link between two people who live at a distance  $r$  one from the other is proportional to  $1/r^2$ .