Strength of Weak Ties in Massive Online Social Network

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Abstract

Online social networks have permitted us to construct enormous net-works of weak ties: associates and no intimate ties we use all the time to extend information and opinions. On the other hand, strong ties are people we truly trust, persons the majority like us and whose social circles tightly overlie with our own. Regrettably, social media do not incorporate tie strength in the formation and management of relationships, and treat all users the same: friend or stranger, with little or nothing in between. In the present work, we address the challenging issue of detecting on online social networks the strong and intimate ties from the huge mass of such simple social contacts. We studied how weak and strong ties influence the information diffusion process. Our findings suggest that individuals in OSNs self-organize to generate well-connected communities, while weak ties bring about consistency and optimize the exposure of information spread. This paper sets out to achieve two goals. First, we call attention to a model of learning that underscores the importance of weak ties. To do so, we revert to the fundamental tenets of this well-researched model and then review pragmatic cases at both individual and collective levels that demonstrate the contradictory importance of these ties in social exchanges that transpire within and across differentiated contexts. Second, we present a strategy to test two of the model's basic tenets. Using data from an early distributed learning context. We close with a discussion on the ways in which the benefits of strong and weak ties can be leveraged in situations relevant to education organizations.

Keywords:" Online social networks (OSN'S), Weak Ties, Face book, Arguments."

I.INTRODUCTION

Despite the vast potential for communication through social media such as Facebook, users tend to interact mostly with their closest friends [1] .Friends tend to come from similar socio-demographic backgrounds, share common interests and information. This presents evidence of homophily, or the long-standing social truth that "similarity be gets friendship"[2] .While it has interesting implications in social networks in terms of link prediction [3],resilience[4],and preferential attachment[5], homophile also leads to the localization of information and resources into socio-demographic space[6]. Conversely, diversity in social contacts has been shown to be of great importance for social and economic wellbeing, both at individual and community levels [7]. Access to diverse information and resources in social networks can result in easier access to jobs and opportunities. Much of the diversity in information that we experience both offline and online come from weak ties [8]. Social media sites like Facebook have had a profound effect on the way we maintain close and distant social relationships, on their number and their diversity, and the cultivation of our social capital[9][10]. With more weak ties online we have access to more diverse news, opinions and information in general. It increasingly appears that while homophily is strongly present in traditional social networks offline [11], there is an emergence of "heterophily" online, where people are exposed to and engage with information mainly from others who are dissimilar[12]. The analysis and understanding of Online Social Networks (OSNs) such as Facebook finds a theoretical foundation in Social Network Analysis [13]. However, studying a real OSN poses several computer science challenges, given the size, distribution and organization (privacy, visibility rules, etc.) of the data available to the regular OSN subscriber [14].

A challenging problem is the evaluation of the intensity of relations that bind users and how these facilitate the spread of information. These aspects have been extensively studied in social sciences before, notably with the strength of weak ties theory proposed by Mark Granovetter [15].Weak ties are connections between individuals who belong to distant areas of the social graph, i.e., who happen to have most of their relationships in different national, linguistic, age or common-experience groups. Weak ties are a powerful tool for transferring information across large social distances and to wide

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segments of the population. Vice versa, strong ties are contacts between trusted/known persons (e.g., family ties or close friendships). Face book is mainly organized around the recording of just one type of relationship: friendship. This implies that Face book friendship captures(and compresses) several degrees and nuances of human relationships that are hard to separate and characterize through an analysis of online data. Face book is growing in size and complexity, its friendship network is growing denser, not sparser [14]. As OSNs become more and more interconnected, testing Granovetter's theory poses serious scalability challenges. Early research works [16] used a supervised approach, where a panel of Facebook users were asked to assess the strength of their own friendship ties. Large-scale studies of Granovetter's theory in the fashion of [16] would arguably be very hard to conduct, given the sheer size of today's OSNs. Other approaches, notably [13], which accessed to Facebook own data on user activities and computed the tie strength as a function of type and frequency of user interactions. However, a cut-off threshold is required to distinguish strong ties from weak ones and the tuning of that threshold has a crucial impact on the correct identification of weak ties. In this article, we studied a new definition of weak ties which is rooted in the analysis of large OSNs and aware of the computational challenges lying thereof. The starting point is that in both online and off-line social networks participants tend to organize themselves into dense communities [17]. We propose to first identify communities within the network and second to classify as weak ties those edges that connect users located in different communities; strong ties will be those edges between users in the same community.

In the current work, we address the following issue: how to define a tie strength measure that is capable to discriminate between intimate ties and mere online social contacts? Actually, it does not exist a formal, unique and shared definition of tie strength, and literature has often provided very personal interpretations of Granovetter's intuition:"the strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal service which characterize the tie"[18]. The most frequently used measurements of tie strength in OSNs are based on the number of conversations between users [19]. However, in our opinion these common approaches suffer two major shortcomings. Firstly, the number and intensity of

conversations strongly depends from user to user, making it Difficult to understand which of these conversations are dedicated to intimate relationships. Secondly, they do not take into account that strong ties must be powered by a form of social grooming that is mainly based on geographical proximity and face-to-face contacts. In order to overcome such shortcomings, we propose a new dentition for tie strength, which exploits the existence of multiple online social links between two individuals.

II. REVISITING THE STRENGTH OF WEAK TIES ARGUMENT

The core of the weak ties argument first proposed by Granovetter (1973) asserts that our acquaintances (weak ties) are less likely to be socially involved with one another than our close friends (strong ties). Thus, the set of people made up of any individual and his or her acquaintances comprises a low-density network (one in which many of the possible relational lines are absent) whereas the set consisting of the same individual and his or her close friends will be densely unite. To clarify this overall structural picture, consider the situation of some arbitrarily chosen individual referred to as Sou. Sou will have a collection of close friends, most of whom are in touch with one another a densely unite subgroup of social structure. The strength of these interpersonal ties can be intuitively defined as "a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterize the tie" [20] . Moreover, Sou will have a collection of weakly tied acquaintances, few of whom know one another [Figure 1].
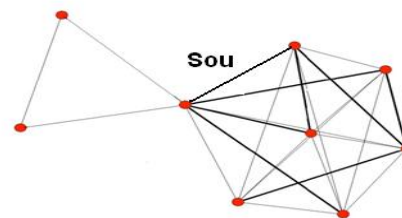

Figure 1: Sou and collection of alters. Line thickness indicates strength of relationship between Sou and alters.

Each of these acquaintances, however, is likely to have close friends in his own right and therefore to be embedded in a densely unite subgroup of social structure, but one different from Sou's [Figure 2].
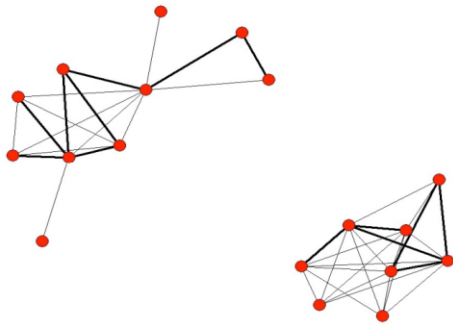
Figure 2: Network of Alters minus Sou. Both clusters represent two fairly tight subsets of individuals that, without Sou, are disconnected.

The weak tie between Sou and his acquaintance, therefore, becomes not just some merely trivial acquaintance tie but rather a crucial bridge relation between the two densely unite subgroups of close friends [Figure 3].
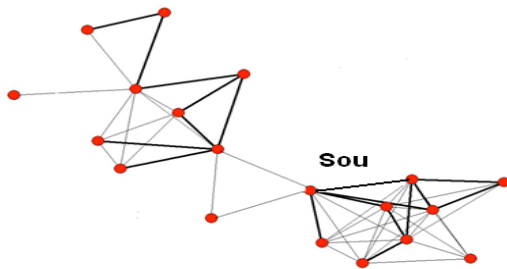

Figure 3: Sou demonstrating a bridge relation that connects two otherwise disparate components of social structure.

To the extent that this assertion is accurate, these subgroups would not, in fact, be connected to one another at all were it not for the existence of weak ties. Through this bridge, and perhaps only through this bridge, a member in one group may learn and gain information about the other group. If that information is useful, then who ever has access to the bridge and uses it will gain an advantage over another member of the same group [21]. The social learning implications of this argument, then, become quite obvious. Individuals with few weak ties will be deprived of information from distant parts of the social system and will be confined to the provincial news and views of their close friends. In other words, the exchanges that occur within such socially isolated subgroups become highly redundant. This deprivation will not only insulate them from the latest ideas and newest practices but may put them at a disadvantaged position in various exchange systems.

This deprivation has been found to be evident in the uneven acquisition of occupational status [22] , cognitive flexibility[23] ,and technical advice[24] .Furthermore, such individuals may be difficult to organize or integrate into political movements of any kind, since membership in movements or goal-oriented organizations typically results from being recruited by friends[25]. While members of two or more subgroups may be efficiently recruited, the problem is that, without weak ties, any momentum generated in this way does not spread beyond the subgroup's boundaries. As a result, most of the population will be untouched.

III. THE EFFECTS OF WEAK TIES ON INDIVIDUALS

The positive effects of weak ties on individuals have been identified in various social systems. These benefits are closely related to certain classic themes in sociology. In the evolution of social systems, perhaps the most important Source of weak ties is the division of labor, since increasing specialization and interdependence result in a variety of specialized role relationships in which one knows only a small segment of the other's personality [26] .One needs to look no further than the modern schooling structure to find evidence in support of this claim. Role segmentation, according to this Durkeimian view [27], does not lead to alienation, as the exposure to a wide variety of different viewpoints and activities is an essential prerequisite for the social construction of individualism. Consider this idea in the context of a learning setting consisting of students with diverse interests and socio-cultural frames [28].Each Sou in this setting has a role set using Merton's[29] term for the plurality of others with whom Sou has role relations, which Coser [23] describes as a "seedbed of individual autonomy."According to[26] ,"the fact that an individual can live up to expectations of several others in different places and at different times makes it possible to preserve an inner core, to withhold inner attitudes while confronting to various expectations." This speaks to Sou's ability to maintain a complex identity, say, as a high achieving male African American student, in spite of cross-cutting pressures to perform for different audiences and their varied expectations simultaneously. In the case of this Sou's role set, these cross-cutting pressures on high achieving male

African American students have been well documented [30][31] .Furthermore, persons deeply embedded in localized relations what Toennies

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referred to as Gemeinschaft may never become aware of the fact that their lives depend on what happens not only within the group but also on social forces beyond their radar and hence beyond their control. The Gemeinschaft may prevent individuals from articulating roles in relation to the complexities of the outside world. As Coser [23] concludes, "there may be a distinct weakness in strong ties." In addition to facilitating instrumental returns on ones' cognitive development, the value of weak ties can also be observed at the individual level in the generation of good ideas. Recent work by Burt[32] has shown that traversing relations across the metaphorical levels of Gemeinschaft and Gesellschaft relies on what he refers to as brokerage, a social mechanism that produces a whole set of favorable individual returns.

Research over the past 30 years has shown that weak ties are beneficial for a varied set of individual outcomes. In addition to cognitive development, creativity and knowledge transfer, weak ties have been shown to be individually advantageous for political consolidation[33] , status acquisition[34] , and innovation adoption[35] . Benefits of weak tie mobilization, however, are not only observable at the level of the individual. Weak ties play an important role in organizing groups larger than the primary groups associated with microsociology. The integration of individuals into large groups depends primarily on these weaker ties.

IV. THE EFFECTS OF WEAK TIES ON SOCIAL ORGANIZATIONS

To demonstrate the effects of weak ties on social organization, more specifically, cohesion, we draw on three studies that show the effects of these ties on macro level integration. The foundation of this argument is best summarized by Blau[36] who stated that "intimate relations [strong ties] tend to be confined to small and closed social circles they fragment society into small groups. The integration of these groups in the society depends on people's weak ties, not their strong ones, because weak ties extend beyond intimate circles and establish the intergroup connections on which macro social integration rests." The integration of diverse groups in schools via weak ties is evident in the work of Karweit, Hansell, and Ricks[37] .Karweit et al[37],consider how the argument of weak ties may be applied to biracial school settings in the United States, suggesting that "racial integration in the classroom can be achieved by arranging classroom structures to produce enough weak contact to connect

black and white cliques, rather than by encouraging strong biracial friendships [the typical strategy] Looking at a case of successful integration demonstrates the value of weak ties in this process. Here, we review Blau's [36] case of a children's psychiatric hospital in New York City. This case shows that integration can only be understood by considering the role of an extensive network of weak ties. This public hospital had a staff of two hundred and served severely impaired children. Then, as now, treatment was difficult and outcomes uncertain. Although comparable institutions elsewhere were marked by high staff turnover and low morale, Blau notes that this was decidedly not the case at the Children's Center. She attributes the high morale at the center to the surprising predominance of weak ties among staff members, with just about all being on a first name basis. Interaction is so evenly distributed that there is an absence of cliques, though she did reveal a highly differentiated system of specialized staff relations forming stable networks.

The research on the advantageous effects of weak ties draws on varied evidence from diverse contexts. Though we have relied on evidence from outside the field of education, we contend that conclusions from other contexts can inform the work of educational researchers. Our review has also considered this breadth of work in regards to both individual effects specifically cognitive development, creativity, and knowledge transfer and group level effects such as social cohesion. The research cited is diverse in origin, and varies in its style of accompanying evidence, but most suggests convincingly that weak ties are indeed strong.

V.CONCLUSION

In this article we studied and analyzed a novel definition of weak ties designed for OSNs like Face book which is based on the community structure of the network itself. We studied weak ties role in information diffusion processes also. Even though several recent works have focused on the Face book social graph [38,14], its community structure [39], and also on weak ties per se [13], we believe that the community-based definition of weak ties better fits Face book and similarly large (and dense) OSNs. The competing forces of weak and strong ties show the complexity of learning in areas where new instrumental knowledge is as important as the transfer of socio-emotional support, highlighting the interplay between both behavior and affect. When it comes to the depth of human relations, it is difficult

to reduce them to any single value. Our work goes one step in the direction of applying more dimensionality to social ties, a direction which will hopefully bring greater understanding to the online and offline aspects of human social life and their interdependence.

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REFERENCES
[1].Backstrom, L.; Bakshy, E.; Kleinberg, J.; Lento, T.; and Rosen, I.2011. Center of Attention: How Facebook Users Allocate Attention Across Friends. In In Proceedings of ICWSM'11.
[2].Plato. 1968. Plato in Twelve Volumes. Number v. 11 in LoebClassical Library. Harvard University Press.
[3]. Aiello, L. M.; Barrat, A.; Schifanella, R.; Cattuto, C.; Markines,B.; and Menczer, F. 2012. Friendship Prediction and Homophily in Social Media. ACM Trans. Web 6(2):9:1–9:33.
[4].Newman, M. E. J. 2003. Mixing Patterns in Networks. Phys. Rev. E 67:026126.
[5]. Papadopoulos, F.; Kitsak, M.; Serrano, M.; Bogu, M.; and Krioukov,D. 2012. Popularity Versus Similarity in Growing Networks.Nature 489:537–540.
[6].McPherson, M.; Smith-Lovin, L.; and Cook, J. M. 2001. Birdsof a Feather: Homophily in Social Networks. Annual Review of Sociology 27:215–444.
[7].Eagle, N.; Macy, M.; and Claxton, R. 2010. Network Diversity andEconomic Development. Science 328(5981):1029–1031.

[8].Granovetter, M. 1983. The Strength of Weak Ties: A Network Theory Revisited. Sociological Theory 1:pp. 201–233.

[9].Vitak, J. 2012. The Impact of Context Collapse and Privacy on

Social Network Site Disclosures. Journal of Broadcasting & ElectronicMedia 56(4):451–470.

[10].Vitak, J. 2014. Facebook Makes the Heart Grow Fonder: Relationship Maintenance Strategies Among Geographically Dispersedand Communication-Restricted Connections. In CSCW, 842–853.

[11].McPherson, M.; Smith-Lovin, L.; and Cook, J. M. 2001. Birdsof a Feather: Homophily in Social Networks. Annual Review of Sociology 27:215–444.

[12].Bakshy, E.; Rosenn, I.; Marlow, C.; and Adamic, L. 2012. The Role of Social Networks in Information Diffusion. In Proceedings of WWW'12, 519–528. New York, NY, USA: ACM.

[13].E. Bakshy, I. Rosenn, C. Marlow, and L. Adamic. The role of social networks in information diffusion. In Proc. of the World Wide Web Conference (WWW 2012), pages 519–528, Lyon, France, 2012. ACM Press.

[14].L. Backstrom, P. Boldi, M. Rosa, J. Ugander, and S. Vigna. Four degrees of separation. In Proc. of the ACM Web Science Conference (WebSci2012), pages 33–42, Evanstone, Illinois, USA, 2012. ACM, ACM Press.

[15] M.S. Granovetter. The strength of weak ties. American journal of sociology, 78(6):1360–1380, 1973.

[16]. E. Gilbert and K. Karahalios. Predicting tie strength with social media.

In Proc. 27th international conference on Human factors in computing

systems, pages 211–220, Boston, USA, 2009. ACM Press.

[17].S. Fortunato. Community detection in graphs. Physics Reports, 486(3-5):75–174, 2010.

[18].Granovetter Mark S. The strength of weak ties. 1973.

[19]. Bruno Gonalves, Nicola Perra, and Alessandro Vespignani. Modeling users' activity

on twitter networks: Validation of dunbar's number. PLoS ONE, 6(8):e22656, 082011.

[20]. Granovetter, M.S. "The Strength of Weak Ties." American Journal of Sociology 78, no. 6 (1973): 1360-80.

[21]. Lin, N. Social Capital: A Theory of Social Structure and Action. New York: Cambridge University Press, 2001.

[22]. Lin, N., W.M. Ensel, and J.C. Vaughn. "Social ReSources and Strength of Ties: Structural

Factors in Occupational Status Attainment." American Sociological Review 46, no. 4(1981): 393-405.

[23]. Coser, R. "The Complexity of Roles as Seedbed of Individual Autonomy." In The Idea ofSocial Structure: Essays in Honor of Robert Merton, edited by L. Coser, 237-64. NewYork: Harcourt Brace Jovanovich, 1975.

[24]. Constant, D., L. Sproull, and S. Kiesler. "The Kindness of Strangers: The Usefulness of

Electronic Weak Ties for Technical Advice." Organization Science 7 (1996): 119-35.

[25]. Gould, R.V. Insurgent Identities: Class, Community, and Protest in Paris from 1848 to the Commune. Chicago: University of Chicago Press, 1995.

[26]. Simmel, G. The Sociology of Georg Simmel. Translated by Kurt Wolff. Glencoe, IL: Free Press, 1950.

[27]. Durkheim, E. Division of Labor in Society. Translated by G. Simpson. New York: The Free Press, 1997.

[28]. Goffman, E. Frame Analysis. New York: Harper and Row, 1974.

[29]. Merton, R. "The Role-Set: Problems in Sociological Theory." British Journal of Sociology 8 (1957): 106-20.

[30]. Fordham, S., and J. Ogbu. "Black Students' Success: Coping with the Burden of "Acting White"." Urban Review 18 (1986): 176-206.

[31].Persell, C. H., and P.W. Cookson Jr. "Race and Class in American Prep Schools: African-Americans as the "Outsiders within"." The Journal of Negro Education 60, no. 12 (1991): 219-28.

[32]. Burt, R.S. "Structural Holes and Good Ideas." American Journal of Sociology 110, no. 2 (2004): 349-99.

[33]. Padgett, J.F., and Ansell, C.K. "Robust Action and the Rise of the Medici, 1400-1434." American Journal of Sociology 98, no. 6 (1993): 1259-319.

[34]. Collins, R.. The Sociology of Philosophies: A Global Theory of Intellectual Change. Cambridge MA: Harvard University Press, 1998.

[35]. Rogers, E. The Diffusion of Innovation. 4th ed. New York: Free Press, 1995.

[36]. Blau, P. "Parameters of Social Structure." American Sociological Review 39, no. 5 (1974): 615-35.

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[37]. Karweit, N., S. Hansell, and M. Ricks. "The Conditions for Peer Association in Schools."Baltimore: Center for Social Organization of Schools, Johns Hopkins University, 1979.

[38] .S. Catanese, P. De Meo, E. Ferrara, G. Fiumara, and A. Provetti. Crawling facebook for social network analysis purposes. In Proc. International Conference on Web Intelligence, Mining and Semantics, pages 52:1–52:8, Sogndal, Norway, 25-27 May 2011. ACM Press.

[39]. E. Ferrara. A Large-Scale Community Structure Analysis In Facebook.
EPJ Data Science, 1(1):1–30, 2012.