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ORIGINAL ARTICLE

Modeling social support in autism community on social media

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Abstract With the high prevalence of autism spectrum disorder (ASD) among the younger generation, there is a shortage of adequate resources to deliver care for the individuals dealing with autism. Families dealing with autism face huge economic costs and emotional stress to provide care for personnel diagnosed with ASD. Globally almost two billion people use social media regularly. Social media have many advantages such as it connects a large group of individuals with the same subject of interest located across geographical miles. For the families dealing with autism, social media sites provide an open and easily accessible platform to share, gather and exchange information. Social science and information science literature lacks any mathematical definition of social support assessment; our proposed information-theoretic model to assess social support leverages theoretical definitions of social support from social science, linguistics, and social network theory. The proposed methodology enables us not only to estimate social support in a health community, but also to evaluate the effectiveness of communities. The research design used in the study is also generic and applies to other online healthcare communities as well as general online or virtual communities, such as gaming, education, and learning. In the study, we systematically analyze the interactions among families of autism communities on different social media platforms to extract knowledge and to assess the support propagated via those interactions within the autism community. The study found that the autism community provides significant social support to its members both in Twitter and blogs. Social support facilitated by community members can help caregivers surmount challenges and be effective in reducing psychological stress and enhancing the quality of life for individuals diagnosed with ASD.

Keywords Autism · Autism spectrum disorder (ASD) · Social support · Twitter · Blogger · Community · Sentiment analysis · Health 2.0 · Social media

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1 Introduction

Social support has been linked to the well-being of individuals by social scientists. Durkheim (1915) in his ground-breaking theory considered suicide rate as a measure of the health of a community and found linkage between high suicides rate to low social integration within a community. In another study, researchers concluded that despite terrible health habits such as lack of exercise, chain smoking, excessive drinking residents of Roseto, Pennsylvania, in the 1950s who worked mainly in coal mines were very healthy with one-sixth the heart diseases as compared to rest of the country (Egolf et al. 1992). Twenty years later the findings about Roseto are being confirmed in the studies by other investigators. What they found was fascinating, despite the fact that community members were now more health conscious, there were more reported cases of health disorders (Bruhn et al. 1982). Rest of the conditions were same as before, except that the community members exhibited significantly lower social support for

each other. The society had become less communal. Social support provided by the small community members to each other by looking out for their neighbors was the secret of well-being for the residents of Roseto in the 1950s as concluded by the researchers (Wolf et al. 1974).

Although the societies are becoming more isolated (less communal), the new social information systems, like social media provides new modes of communication and staying in touch with each other, if not physically, then at least virtually. With the emergence of new ways to interact with individuals, social media have become a new medium of communication. Communities in the Age of Internet have adopted the new communication mode of interaction in online social media to reach out to its members who live in isolation by providing the sense of belonging and care. Providing the sense of social support and care dramatically improve health and well-being for the concerned individuals of the community like breast cancer (Reynolds and Perrin 2004), eating disorder (Eichhorn 2008), and depression (De Choudhury et al. 2014).

Autism spectrum disorder (ASD) is a group of complex developmental disability that occurs during the early years of life and affects a person's ability to communicate and interact with others (Panhandle Autism Society 2015). A new government study conducted by the National Center for Health Statistics of parents in the USA, suggests that children of ages 3 through 17, approximately 1 in 45 are diagnosed with ASD (CDC 2015). ASD occurs in all ethnicities while boys are four to five times more likely to have autism as compared to girls (CDC 2014). Presently, there is no medication to treat the core cause or symptoms of autism, and there is an ongoing in-depth research for the understanding of ASD. Study on costs for supporting an individual with ASD during their lifespan estimated to be $2.4 million in the USA (Buescher et al. 2014). Increased autism awareness can help families coping with the daily challenges of autism (Plimley 2007). Steve Silberman, a journalist and an author, in his 2015 Samuel Johnson prize-winning book on the historical journey on autism, is rallying for the broader model for societal acceptance in dealing with people with autism. Autism advocates like Silberman are advocating for the need of greater access to the resources especially knowledge for the families dealing with autism to help them live happier, healthier, more secure, and have more meaningful lives (Silberman 2015).

Social media has provided Internet users an open platform for discussions and knowledge exchange on various topics. Families with a member diagnosed with autism share their experiences on social media, and this has become an immense source of knowledge for other members of the community dealing with same or similar challenges. Organizations, such as Autism Speaks, are working on increasing autism awareness, encouraging individuals to form communities in social media where members share their experiences and get advice from other members (Autism Speaks 2015). Presently, there are more than a thousand advocates of autism awareness on social media and discussion forums where people dealing with autism get to benefit from the collective knowledge (Autistic Self Advocacy Network 2015; Saha and Agarwal 2015). Experiences shared by family members on social media, especially blogs, Twitter, and Facebook, shed light on various aspects of autism. Autism advocates share their viewpoints on various challenges with autism, what needs to be heard in the community, and raise awareness about these matters. For families coping with autism-related challenges, such communities provide a sense of belonging and general know-how that helps them better understand the situation.

The research study provides an information science-theoretic and social science-driven social support assessment methodology. For family members or caregivers of people diagnosed with autism, social support plays a crucial role in reducing depression and anxiety (Weiss 2002). The purpose of the current study is to offer a research-based understanding of the conversations in social media among families dealing with autism and shed light on how autism community provides social support towards its members. Cobb (1976) defined social support as "information leading the subject to believe that he is cared for and loved, esteemed, and is a member of a network of mutual obligations". The research focus on interdisciplinary approaches on social network influences on health behaviors. The proposed model and the methodology of the study can be used to measure social support for an interaction in other disciplines like health science. The study is a tiny step towards narrowing the gap between information science and social science discipline. The research considers Twitter along with blogs as data sources to compare the different modalities autism community uses for its awareness and afford social support mechanisms. In this study, the sentiment is quantitatively analyzed from the conversations of the autism community on Twitter and blogs to understand how autism blogger community engages with social support. We observed, members of the autism community disseminate active and upbeat messages on social media platforms to counter stress and anxiety experienced by other members. We found the amount of social support provided by members of the autism community to its community members was higher in the Twitter medium as compared to blogs in social media.

This paper is organized as follows: the prior related works are described in Sects. 2 and 3 depicts the proposed model for measuring online social support. Section 4 describes methodology and data collection, Sect. 5 shows the result, Sect. 6 discusses the inferences drawn from the

study. Limitation of the study is outlined in Sect. 7 and finally, in Sect. 8, we draw conclusions and possible future works.

2 Related work

Several clinical studies have been performed on ASD. These studies shed light on the effectiveness of various intervention strategies, genetics, and impact of autism. Intervention and efficient treatment such as specialty services and early detection can help people with autism to lead a better quality of life (Gupta et al. 2007; Sigman et al. 2004). Clinical trials are costly and time-consuming. However, the vast amount of information available widely on the Internet, especially social media, about autism yet remains to be fully tapped. A recent study by (Bianco et al. 2013) found 84.5 % of parents use the Internet for searching information about their own or family member's medical condition. Parents with low-income, predominantly Hispanic parents use social media to seek information about their children's health (Stroever et al. 2013). Autism came out as one of the top health-related information in freely available mommy's blog (Burton et al. 2013). Caregiver's preference for using social media platform as compared to any other communication platform was also established by Hamm et al. (2013). Although there are benefits of online knowledge gathering on various health topics, there are many misinformation online about various health topics like autism. Kata (2010) in her study details the various misinformation present on the internet about vaccination effects on autism. Crocco et al. (2002) in their analysis study explored various potential harm of using misinformation about health available on the internet. Bode and Vraga (2015) in their findings suggest that misperceptions are significantly reduced when related stories correct a post that includes misinformation in social media.

Research by Gallant et al. (2011) indicates that social media platforms like blogs, Twitter act as new and convenient platforms of communication within healthcare communities. Hamm (2013) found in their study that caregivers and patients started using social media to gather health information and exchange information related to health informatics. Bambina (2007) in his research study on Internet communications within community members found that online support groups have become a familiar feature of the Internet's landscape where individuals with needs seek social support without any geographical limitation.

Sociologists published many research works on the social support concept. The link between social support and health is addressed mainly by two different hypothesis: the buffering hypothesis and the direct effects hypothesis. The buffering effect hypothesis, predicts social support enhance good health by reducing the impact of stressful life events (Wallace 2005), while the better health provided by high social support is predicted by direct effect hypothesis (Berkman and Breslow 1983).

White and Dorman (2001) found the usefulness of receiving social support as compared to the traditional method for many users who do not have the desire or ability to attend the face-to-face session. Arora et al. (2007) found the positive impact of social support provided by family, friends and health care provider to the women newly diagnosed with breast cancer. Coulson (2005) found evidence of online social support in the form of informational support received by an individual with irritable bowel syndrome helped them to deal with the situation. Kummervold et al. (2002) indicated in their study on Norwegian mental-health related online discussion forums that online interactions are beneficial for people suffering from mental disorder.

Boyd (2002) found the effectiveness of formal social support in comparison to the informal social support for reducing stress in parents of children with autism. Bambina (2007) in a study sheds light on the behavioral characteristics of the users seeking online support in social media platform they desire. A study by Jordan et al. (2010) on the evolution of autism support over the Internet found the benefits of the Internet technology in spreading the education and awareness of autism using Internet technologies. The study by Shaw and Gant (2002) found the use of the Internet helps to reduce loneliness and depression while increases self-esteem and social support among users with psychological health. Study on the online smoking community by Zhang and Yang (2013) established online support community members provides reasonable confidence among individual that in turn helps them to meet a beneficial intervention outcome. Mothers of children with autism had attributed to the enhanced role of advocacy and activism among community members as analyzed by Ryan and Cole (2009). Coulson et al. (2007) in their analysis study on the online support of Huntington's disease found a significant impact of online forum support. Carlislie (2014) used freely available social media forums data to show a positive effect on the life of autistic kids by pet dogs. Studies of Coulson et al. (2007); White and Dorman (2001); Carlislie (2014); Burton et al. (2013) indicate the enormous potential for harvesting the freely available social media data facilitated by various healthcare communities and topics.

Our study does not intend to provide a substitute for clinical research on the different intervention strategies on autism. On the contrary, our methodology would provide a justification to build a knowledge base of the know-how on different aspects of intervention strategies for health

condition from a receiver's perspective, which would help prioritizing resources in the testing procedures of intervention strategies for dealing with various health issues. Furthermore, it is important to assess the effectiveness of online communities regarding providing social support to its members. Toward this direction, in this study, we seek answers to the following research questions,

- Does health communities like online autism community provide a feeling of solidarity to other community members?
- Are there differences in social support across various categories of online autism community (i.e., autistic members, moms with autistic kids, dads with autistic kids, and autism advocacy groups blogs) and different social media platforms (e.g., blogs and Twitter)?
- Can we objectively measure social support in a community, by leveraging the interaction, content, and network ties observed within the social media platforms?

Answers to these questions will help conduct a more systematic evaluation of interactions occurring on various online platforms, especially the social media, and thereby helping us evaluate the effectiveness of an online community regarding providing support to its members.

3 Social support: proposed model

Even though literature in social science domain contains extensive work on social support concept, there is a lack of a formal mathematical definition of social support for online interactions. Hence, we leverage various empirical definitions of social support available in computational science and social science literature that overlap with application domain, i.e., healthcare along with the online mode of interaction for our study. Cobb (1976) defined social support is "information leading the subject to believe that he is cared for and loved, esteemed, and is a member of a network of mutual obligations". Using the broader definition of social support by Cobb, social support in an online interaction between individuals can be approximately deduced from relevant statistics when influential psychological factors groups along with metrics from social network analysis.

3.1 Model parameters

Below we examine the factors that indicate social support followed by the mechanism by which we can objectively measure these factors using relevant statistics from the social media interactions.

1. *Positive attitude* Study by Fredrickson (2001) found that positive emotion signals well-being of an individual and are the vehicle for individual growth and social connection. Ryff and Burton (2001) in their work on emotional and social relations for health indicated that positive emotion is implicit in social support. A measure of positive attitude can be estimated using sentiment analysis methods.

2. *Association of friends and family* Ross and Mirowsky (2002) in their study with 20,137 Americans ages 18–95 found the correlation between personal relationship and social support which in turn increases life expectancy. The positive association between social support and relation-type (partner, family, and friend) was established in the study of Walen and Lachman (2000). Association of friends and family within a text can be measured by estimating the rating in the social process of family and friends using sentiment analysis methodology.

3. *Spiritual* Multivariate analysis by Olphen et al. (2003) found evidence of positive effects for religious involvement and social support. The finding by Krause et al. (1999) reveals the relationship between religiosity and social support. Expression of spiritual feeling within a text can be measured using rating in the religious process with the help of sentiment analysis methodology.

4. *Assent or consent* Sarason et al. (1987) in their analysis study on the social support questionnaire established that social support perceived by an individual is a reflection of the acknowledgment. Expression of consent to a text can be measured by evaluating the degree of assent in the informal part of speech.

5. *Social position* Social support, provided by a valued individual or group helps to reduce the psychological consequences of the stress of a person as per buffering hypothesis (Wallace 2005). Social networks, like support groups or of friends and family members provide a sense of belonging and security for its members of the community. Presently with easy accessibility of the internet, people in need of help are supported by friends, family, or fellow members of the church, or other support groups. Cobb (1976) defined social support as information leading the subject to believe that he is cared for and loved, esteemed, and a member of a network of mutual obligations. Cohen and Wills (1985) in his work on buffering hypothesis found the correlation between assessed support measure with a person's degree of integration in a large social network. The metrics to determine the position of individuals in a community could be many. We choose the metrics that are relevant to online community interactions. Social network

metrics selected in the study are "Betweenness Centrality" or Broker influence, "Influence of Social Position" or Authority and "Focus of Social Position" or Hub. Betweenness Centrality was defined by Freeman (1977) is an indication of node's importance in a network. It is equal to the number of shortest paths from all vertices to all other nodes that pass through that node. Authority score is a measure of the level of the powerfulness of a node in a social network. Hub score is the measure of the ability to identify other powerful actors in a social network. Betweenness centrality, authority, and hub scores are measured using social network analysis application.

6. *Personal relevance* Young (2006) in his study on the relationship between social support and life satisfaction found a correlation between individual concern and social support provided to a person. A study by Lakey and Cassady (1990) established the reference of perceived support with concern on the well-being of an individual. The expression of personal relevance within a text can be measured by rating in concern of work, home and money with the help of sentiment analysis methodology.

The above six factors indicating social support with the corresponding relevant statistics of the influence weight using sentimental analysis methodology and social network analysis are summarized in Table 1.

Our proposed model uses sentiment analysis along with social network analysis methodology to assess the aforementioned various factors to get an approximation numerical value of social support for online interactions. Social support in an interaction can be estimated using the eight factors (or parameters): λ; χ; θ; γ; η; ε; δ and β. Hence, social support measure denoted by S in an online interaction is given by,

$$Support\ support(S) = w_1\lambda + w_2\chi + w_3\theta + w_4\gamma + w_5\eta \\ + w_6 5_\varepsilon + w_7\delta + w_8\beta, \quad (1)$$

where $w_1, w_2, w_3, w_4, w_5, w_6, w_7$ and w_8 are the weights that can determine the influence of the factors on social support. To determine the degree to which the factors influence the assessment of social support, we consider the Google distance approach. Google distance uses Google search association between a pair of concepts (Cilibrasi and Vitanyi 2007). Using the Google similarity distance algorithm, corresponding values of $w_1, w_2, w_3, w_4, w_5, w_6, w_7$ and w_8 were evaluated. For each dictionary word, the Google distance is calculated between the dictionary word and 'social support' for each six factors. For example, to get the value of w_1 for 'positive attitude' the average Google distance is calculated between each 396 dictionary word and 'social support'. For 'social position' all the words from thesaurus having the same meaning are used as the list of dictionary words. The values of $w_1, w_2, w_3, w_4, w_5, w_6, w_7$ and w_8 are normalized to ensure the score of 'social support' falls between 0 and 1. The result of the Google similarity measure is shown in Table 1 in the influence weight column.

$$Support\ support(S) = 0.217\lambda + 0.163\chi + 0.057\theta + 0.098\gamma \\ + 0.082\eta + 0.095\varepsilon + 0.093\delta + 0.145\beta \quad (2)$$

Therefore, the mathematical formula used in the study to determine Social support (S) for online interaction is evaluated using the Eq. (2). The influence of each factor on the social support calculated using Google similarity measure is shown in Fig. 1. All the individual factors influencing weights are normalized to ensure the score of social support lies within the values 0 and 1, where 1 indicates the maximum amount of social support provided while 0 indicates absence of social support.

Table 1 Factors indicating social support and their corresponding relevant statistics

Factors	Example	Factor influence/weight	Notation
Positive attitude	Cheerfulness, positive feeling, enthusiasm (396)	0.217	λ
Social process	Family, siblings, associate (186)	0.163	χ
Spiritual	Sacred, religious (172)	0.057	θ
Assent	Acknowledgment, affirmation (76)	0.098	γ
Social position as broker, i.e., centrality	Intermediate, mediator (28)	0.082	η
Influence of social position, i.e., authority	Influence, esteem (21)	0.095	ε
Focus of social position, i.e., hub	Core, focus (26)	0.093	δ
Personal relevance	Assignment, convenience (372)	0.195	β

Numbers indicated in the example column denote the total number of dictionary words used to define the various factors for social support. *Influence weight* denotes the percentage influence of the factor on social support

Fig. 1 The influence of each psychological or network factors on social support assessment

"values of all the above mentioned factors range between 0 and 1"
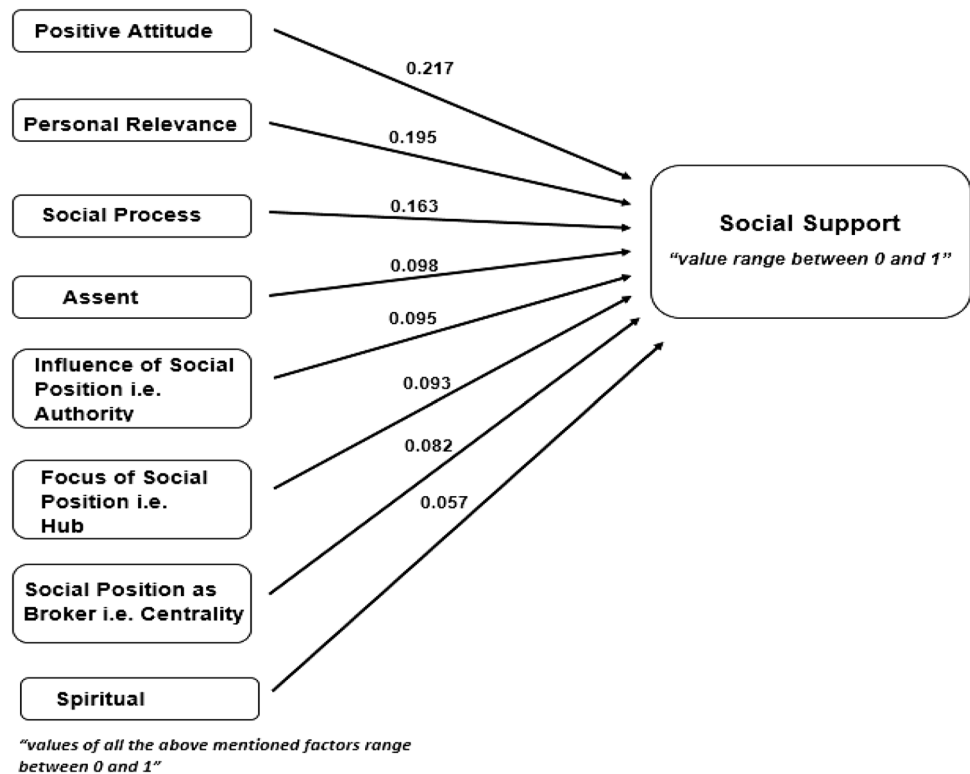
4 Data collection and research methodology

The study examines the social support via sentiments expressed in information exchange during interactions among members of the online autism community. Furthermore, the social network analysis is utilized to evaluate social support at the structural network level. Due to the lack of a formal mathematical definition of social support in social science literature for online interactions, we leverage various empirical definitions available in computational science and social science literature that overlap with or application domain, i.e., online healthcare for our study. Our research methodology consists of the following steps:

1. Identify and collect data from members of autism online community in different social media platforms (blogs and Twitter).
2. Pre-process and filter noise.
3. Perform topic analysis to verify the subject of discussion is autism.
4. Construct social networks for autism community for the different social media platform.
5. Compute the social support provided by the interaction among the autism community members.
6. Analyze the level of social support provided by the interaction of the autism online community members

and compare it with the one provided by online support groups.

The research workflow for the research study is shown in Fig. 2.

With more than a million active autism community members, choice of individuals engrossed with autism for analysis is the key. We initially selected members of the autism community using a recommended list of popular bloggers who are active in blogs and Twitter by Autism Speaks (www.autismspeaks.org). As part of earlier study, bloggers recommended by Autism Speaks were selected to the autism community member list (Saha and Agarwal 2015). In total, 40 autism community members who are popular bloggers were part of the earlier study. We expanded the list of autism community members in the study by selecting the active members of the online autism community in Twitter platform based on the biographical description of the Twitter user which mentions the key interest of the user. For our study Twitter user search using Twitter API based on keyword 'Autism' referred to in biographical description in their profile that led us to more than 10,000 users. In our study, we randomly selected 260 Twitter users based on the Twitter user's that measures a user's influential content on Twitter and users who mentioned autism as their subject of interest in their Twitter profile. A total number of participants used in this study is
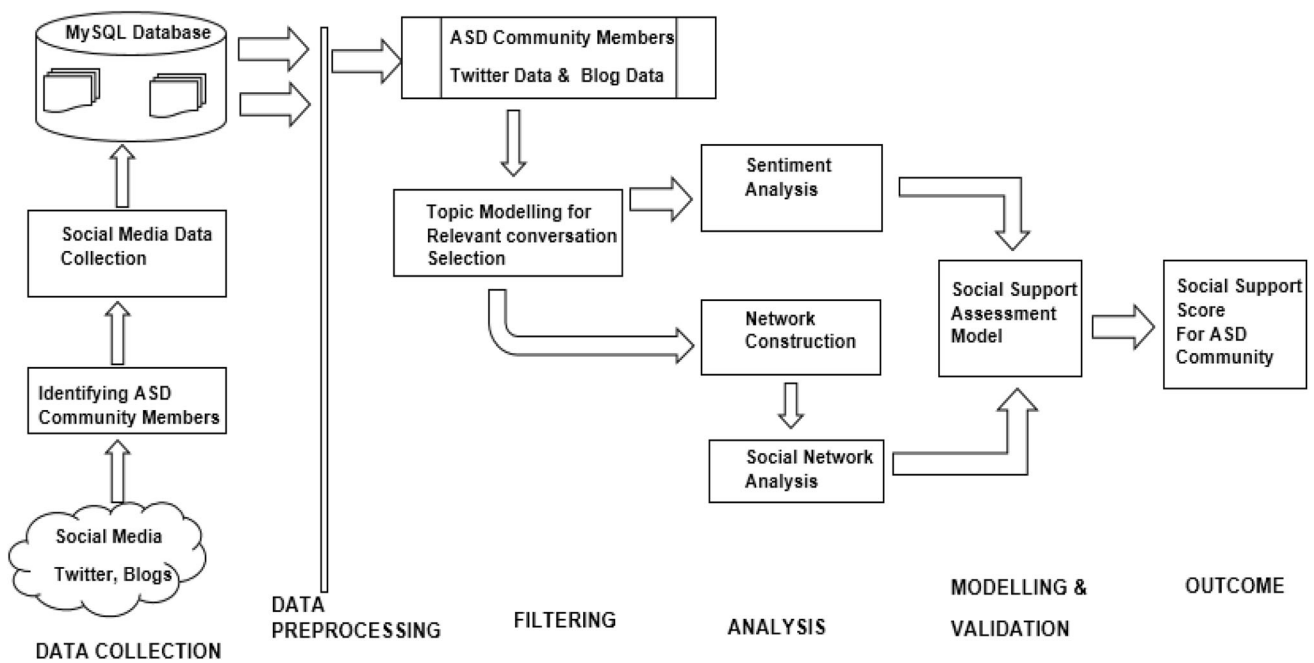
Fig. 2 Research workflow to study social support in autism community

300. The interaction content for members of the online autism community in Twitter and blogs was extracted and analyzed.

To determine network characteristics of autism community members on Twitter their friends and followers data were extracted using Twitter API. Twitter handles that are not active for a significant period on Twitter were excluded in our social network analysis. For social network analysis and visualization, Gephi (gephi.github.io) an interactive visualization platform for network graph was used. Twitter interaction data collected for the study is publicly available and posted on Twitter between the years 2009 and 2015. Twitter data includes tweets, friends, followers, mentions, hashtag among other publicly available information. We retrieved the most recent permissible tweets (up to 3200 each) for the 300 autism community members, resulting in 713,486 tweets. All the tweets are found to be in the English language. Some of the tweets by autism community members are as follows,

Autism and writing: how to teach your child to write,

Tips For When Children With Autism,

People don't always need advice. Sometimes all they need is a hand to hold, an ear to listen & a heart to understand them #WonerofAutism,

I have autism. It is not a disorder or a disease. IGNORANCE is a disorder AND a disease. IT needs to be eradicated #AutismAwareness".

A study by Hastings et al. (2005) on the behavioral difference of parents with autistic kids reported mothers with more depression and more positive perception in comparison to fathers of autistic child. Inspired by Hastings et al. (2005), autism community members are categorized by analyzing their social media profiles. Classification of autism community members into different categories is done to deduce various capacities of social support provided by the members based on defined community member categories. The 300 autism community members analyzed in the study were grouped into four categories, as shown in Table 2.

Tweets of the online autism community members collected and analyzed for the study shows signs of sentiments associated. Few examples of tweets with positive sentiments are provided as follows,

Good Morning to all autistic persons & their friends & well wishers around the world— I love you all #AutismAwareness,

A child with autism enjoys looking at the sky just like any other five year old,

I dont know what other skill is hiding in me-I may be worth of many things which world cant imagine—I know I am NOT a COMMON man #Autism

The content of the tweets of members of autism community is categorized into psychological groups utilizing Linguistic Inquiry and Word Count (LIWC) program (Pennebaker et al. 2001). LIWC application analyzes

Table 2 Autism community member's classification based on distinct characteristics

Categories	Termed	Numbers of members in Twitter	Total number of tweets	Numbers of members in blogs	Total number of blog posts
Female member of the autism community with autistic kids	Mom	84	216,255	13	294
Male member of the autism community with autistic kids	Dad	67	177,648	10	238
Member of the autism who blogged or Twitter as a group to advocate for autism	Autism advocacy group	98	199,886	10	226
Individuals diagnosed with autism and blogs or tweet for themselves	Autistic member	51	119,727	10	182

written text on a word by word basis calculates the percentage words in the text that match up to 82 language dimensions. The output of the LIWC application is the percentage of the total number of all recognized words that belong to the 80 pre-defined categories. An analytical study by Alpers et al. (2005) on several hundred online posts on breast cancer support group found a moderate correlation between LIWC score and human rating. A study by Tov et al. (2013) found a consistent correlation between emotion rating values of LIWC with self-reported values for interaction within community health forum.

To deduce social support, dictionaries of various LIWC categories were selected based on resemblance with social support concepts. For example, words from the social process like family and friends signify feeling of solidarity, whereas negative emotion denotes anxiety, anger or sadness. The scale of social support in the content of the text was derived primarily from the scores in different social categories of LIWC and social network metrics and described in proposed model.

Many studies have been conducted on the online exchange of social support for various health communities like breast cancer (Reynolds and Perrin 2004), eating disorder (Eichhorn 2008), and depression (De Choudhury et al. 2014). Chuang and Yang in their study on online alcohol community found the presence of social support in forms of emotional support, but no instrumental support was provided. With motivation from various research studies using LIWC and social support diagnostics on online health discussion forums, we considered score of social support based on our model for the text content of the interaction between different members of online health discussion forum, viz., alcohol support forum and autism support forum as the baseline scale values to decide the existence of social support in an online interaction.

5 Results

Various analysis were conducted on the collected data based on an individual member's characteristics to get an insight into online autism community. These characteristics correspond to the category the member belongs to and the media (blogs and Twitter) used for interaction. Twitter activities of the Autism community members were analyzed to extract the network features of the online autism community. Friend and follower network of online autism community network is shown in Fig. 3. A thick edge indicates more interactions by the community member. Different colors indicate various communities based on the network modularity. Figure 3 shows distinct characteristics of the online autism community on Twitter. Despite being a directed network, a member of the community can reach any other member within an average of 3 hops (average geodesic distance) with maximum distance being 7 hops (diameter of the network), as compared to the widely believed 6° of separation in social networks (Milgram 1967) and average 4.74° of separation in Facebook network of active users (Backstrom et al. 2012). *These findings indicate the online autism community members in social media are easily reachable and tightly knit.* The maximum value of out-degree (number of outward-directed graph edges from a given graph vertex) is 2080 that *shows the reaching out tendency of the online autism community.* While the maximum value of in-degree (number of inward-directed graph edges from a given graph vertex) is 2987 that *shows the listening tendency of the online autism community members in the social media.*

As observed from Fig. 3, there exist several subcommunities within the autism blogger community, which makes the *autism blogger community network look fragmented in its efforts of information dissemination and sharing, but it is highly concentrated in terms of the topics and themes of discussion that largely revolves around*
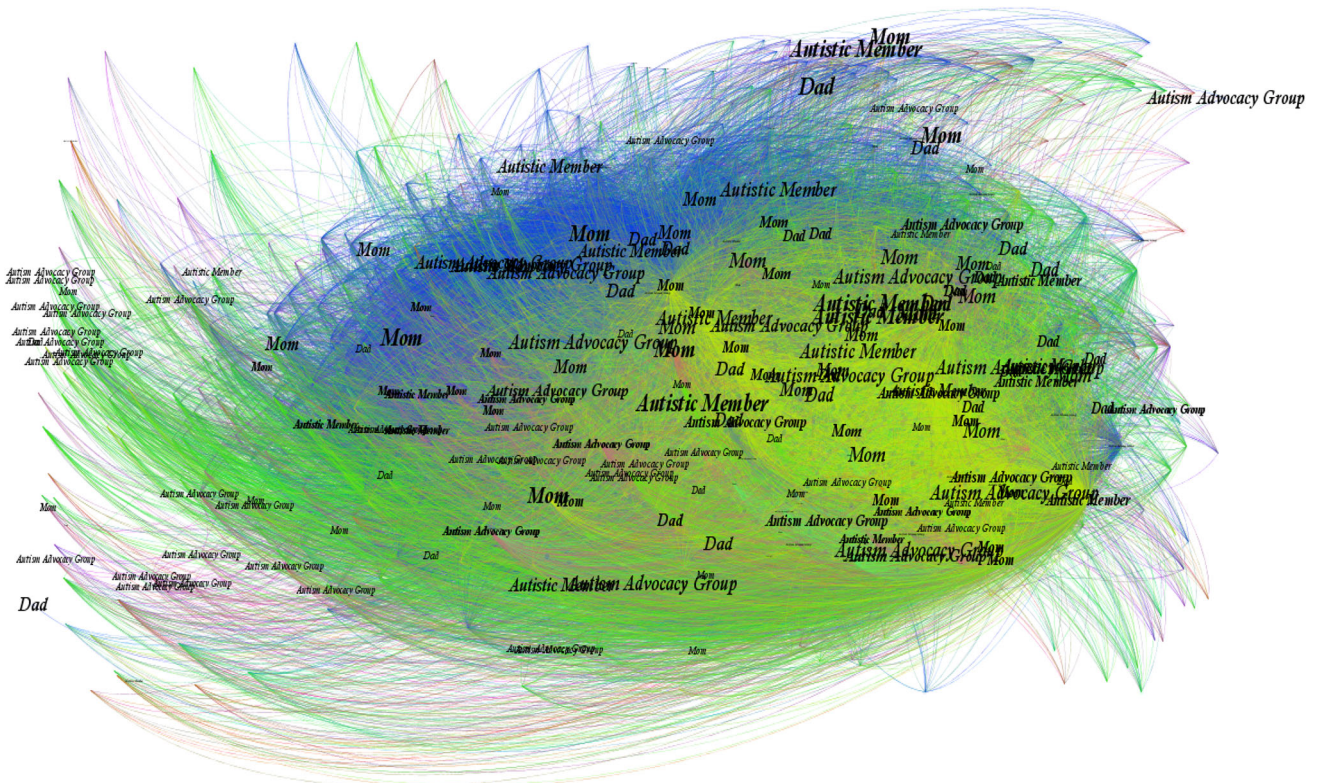
Fig. 3 Friend and Follower network of online autism community network. The members of the autism community are annotated based on the classification defined in Table 1. Their real identity is anonymized. *Colors* indicate different communities based on the network modularity

autism. The friend and follower network of the online autism community in Twitter reflects a dense nature of communication, where *each member of the community responds to several other members of the community—a behavior that is highly unusual to microblogging platforms*. The highly concentrated support provided by the autism blogger community to its members is evident by the connectedness (49 connected component) of the network. *The tweet content of the autism bloggers found to be involved in many topics related to autism, and the goal of the community seems to be raising autism awareness.*

Overall analyzed metrics of the Twitter friends and followers network of the online autism community are shown in Table 3.

To study community characteristics of the online autism community for social support, the Twitter content of interaction by members is analyzed with the help of LIWC. LIWC provides several baseline data for comparison, e.g., emotional writings, novels and science articles. Emotional writing data consisted of the writings of people when they were randomly assigned to write either about deeply emotional topics. Science articles data were based on 113 highly technical articles in the journal Science published in 1997 or 2007. Novels refer to either portions or complete works of American and British fiction published between

1800 and 2005. For the baseline data point, the score of social support provided in online health communities, viz. alcohol support forum and autism support forum was also computed. Coulson (2014) in his quantitative analysis of alcohol support forum indicated the presence of online social support tendered by the forum members. For the alcohol support forum, (www.medhelp.com) reply for each post by the forum members that sought help on alcoholism for the period of July 2014—Dec 2014 (part of the preliminary study) was extracted, and corresponding scores of social support using the Eq. (2) (Sect. 3.1) were determined. Jordan (2010) studied the evolution of autism online support via autism support forum that have changed the autism society, widely affecting communication and the availability of information. For the autism support forum (www.autismweb.com), reply posts for each post that sought help from the forum members on autism or ASD for the period of Jan 2015—July 2015 were extracted, and corresponding scores of social support were determined. Study of Coulson (2014) and Jordan (2010) justifies the use of alcohol and autism support forum as baseline references for social support.

Social support provided by the online interaction was estimated using the Eq. (2) of Sect. 3.1 with scores of assent, positive sentiment, social process, spiritual,

Table 3 Overall Twitter data characteristics of the online autism community network

	Friends and followers network
Number of users	122,142
Total edges	282,529
In-degree	2987 (max), 6.531733 (average)
Out-degree	2080 (max), 5.742343 (average)
Degree	7.65 (average), 7.756 (weighted average)
Connected components	49 with 87,323 maximum vertices
Geodesic distance (diameter)	3.89 (average), 7.576 (max)
Top hashtag in Tweet	#autism, #autismawareness, #asd, #vote, #autistic
Top domain in Tweet	Facebook.com, Twitter.com, Youtube.com
Top bigram in Tweet	'Check out', 'autism awareness', 'stories via', 'out stories', 'children autism', 'autism speaks', 'autism spectrum'

personal relevance and betweenness centrality, authority, and hub. Variation of social support based on different categories is shown in Fig. 4 box plot chart. *Results suggest that social support provided in tweets by the online autism community members are higher compared to the blogs by members of the autism community across all the groups, i.e., mom, dad, autistic members, and autism advocacy groups. Social support provided by the autism advocacy group is the highest among all the categories, i.e., higher than mom or dad of an autistic kids or autistic members of the community.* Another noteworthy observation from the results is that the variation in the score for social support is

consistently larger in Twitter data as compared to the blog data. The significant variance could be explained due to highly noisy nature of the Twitter environment.

Variation of social support with various categories of the autism community members in the different social medium is shown in Table 4. The amount of social support provided in online support forum of autism and alcohol along with benchmark score for social support of emotional writing, science article and novels is also shown in Table 4. Social support provided in the Twitter medium by the autism advocacy group is higher than the value of social support provided for online support forum of autism and alcohol or
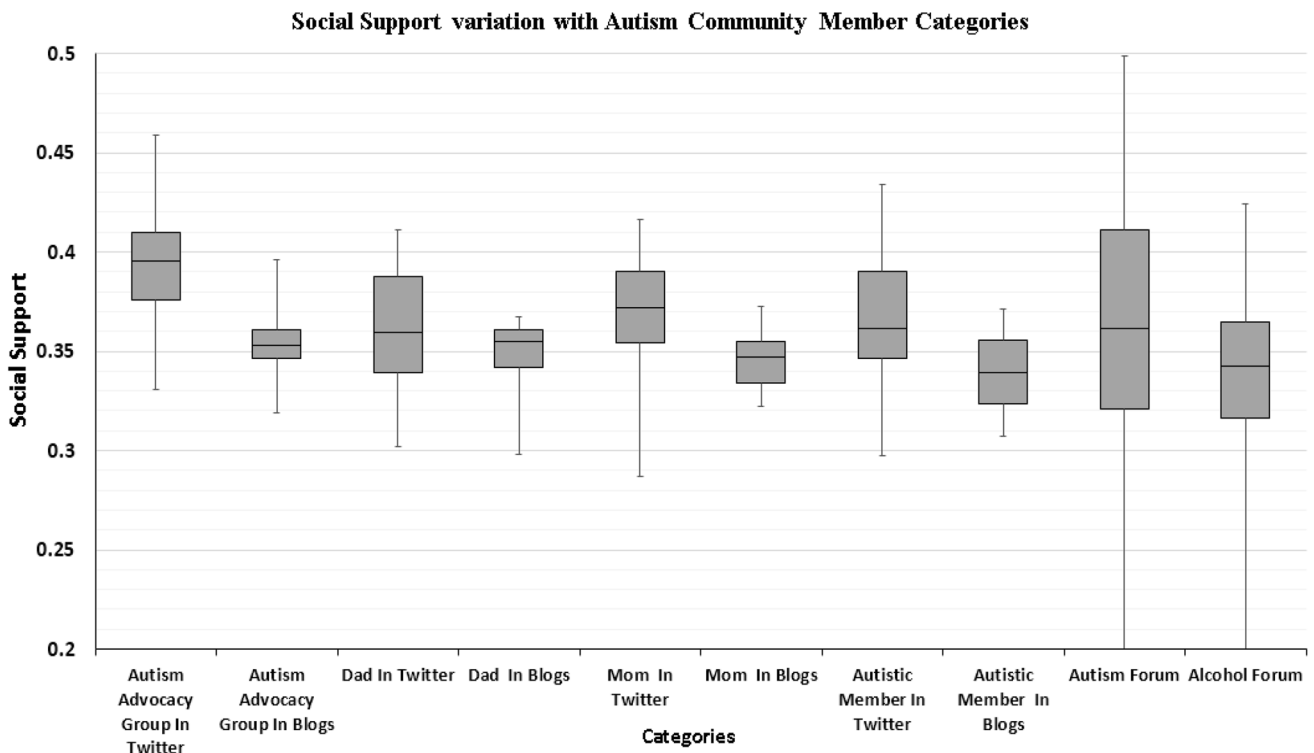

Fig. 4 *Box plot* for the variation of social support based on different member categories. The *vertical axis* shows the amount of social support and the *horizontal axis* represents different categories of members of the online autism community

Table 4 Comparison of social support between different categories of autism community members

Media	Categories	Social support	
		Average	Standard deviation
Blogs	Autism advocacy group	0.356	0.024
Blogs	Mom	0.346	0.016
Blogs	Dad	0.348	0.021
Blogs	Autistic member	0.339	0.021
Twitter	Autism advocacy group	0.391	0.026
Twitter	Mom	0.371	0.026
Twitter	Dad	0.361	0.027
Twitter	Autistic member	0.366	0.031
Support forum	Autism support forum	0.359	0.07
Support forum	Alcohol support forum	0.331	0.082
Baseline data	Novels	0.318	
Baseline data	Science articles	0.335	
Baseline data	Emotional writing	0.338	

For baseline data LIWC reported score was used

6 Discussion

This research sheds light on characteristics of social support provided by the online community of autism on Twitter and blogs. We attempted to bridge the gap in comparing the activities of support communities in the different social media platforms. The social support provided by interactions within online autism community by identifying the popular autism bloggers and the members was unfolded. The research study considers members of the autism community their blogging and Twitter activities and analyzes their friends, followers, tweets, retweets, mentions, and hashtags. In our study, it is observed that the autism blogging community is tightly knit among its members. The community provides extensive social support to its members, both in the form of information sharing and emotional support. Autism communities have distinct characteristics, where community empathetically provides support to other members by sharing a feeling of solidarity with other members and families with autism. Informational support in the interaction between autism community members is observed since the top bigram is 'check out' and 'autism awareness'. Members connect with each other to gain information about raising kids with autism, coping with daily challenges (informational as well as emotional), and raise awareness around autism.

The online autism community provides more social support to other members as compared to online support forums of alcohol and other writing mediums. Social support provided by the autism advocacy group in both social media of blogs and Twitter are higher than autistics participants or dads and moms of an autistic child. That may be because of the nature of autism advocacy group whose goal is to promote autism awareness and provide help to other members of the autism community. Our study found social support provided in the Twitter medium is higher than blogs for any characteristics of the autism member's community. The reason for higher social support in twitter as compared to blogs may be due to limit of 140 characters in Twitter that makes the Twitter text denser as compared to blogs. It is observed that social support provided in the Twitter medium by autism advocacy group is higher as compared to the value for online support forum of autism and alcohol. Higher social support provided by autism advocacy groups is justified by the fact that the main reason to form an autism community group within individuals involved in autism is to spread autism awareness and to support fellow members.

Statistical analysis of our model for social support determination based on various psychological groups of LIWC scores shows impressive results. The p value for the t test is shown in Table 5. For the autism advocacy group score of the social support came out to be statistically highly significant for Twitter and blogs ($p \leq 0.001$) at 99.9 % confidence level. For a mom with autistic kids and autism community members who blogs or tweets about themselves the amount of social support tendered came out to be statistically significant for twitter and blogs ($p \leq 0.05$) at 95 % confidence level. The F value ($F = 14.89$) of ANOVA (analysis of variance) test for

Table 5 *t* test results for autism community

Autism community categories	p value	Note
Dad	0.132063	Not statistically significant
Mom	0.001723	Statistically significant at $p = 0.05$
Autistic member	0.011105	Statistically significant at $p = 0.05$
Autism advocacy group	0.000086	Statistically highly significant at $p < 0.001$

advocacy group, mom of an autistic kid, dad of an autistic kid and for autism community members who blogs or tweets about themselves came out to be higher than F critical ($F_{\text{critical}} = 2.12$) at 95 % confidence interval which indicated strong difference in social support characteristics between each group. The ANOVA test results indicate behavioral difference regarding social support among autism community members based on member categories and also social media platform.

7 Limitation

The research utilizes the interdisciplinary approaches with a focus on social network influences on individual health behaviors. The proposed model and the methodology of the study can be used to measure social support for interaction. The research study enables us not only to estimate social support in a health community, but also to evaluate the effectiveness of communities. This study is limited in different manners. The selection of members of the autism community has limitation since many individuals who even though are engaged with autism awareness don't have a complete Twitter bio. Also, a limitation of this case study is the use of different social media platforms like Facebook, Reditt by various members of the autism community. However, the fact that many users often browse others' tweets, but do not post any themselves limits the number of participants for the study. It would be interesting to extend our study by additionally considering different types of users like the ones who lurk on social media but did not actively participate. The Twitter API limitation to collect a maximum of 3200 tweets of an individual limits the data collection effort for the study. Another limitation of this study is the sentiment analysis tool. Even though LIWC tool has been used in many studies, with fast evolving language and use of emoticons and acronyms like LOL to denote joyful expression pose a limitation on the ability to LIWC. To overcome this limitation, we are currently expanding the existing LIWC dictionary to incorporate familiar words and emoticons used in different social media platforms.

8 Conclusion and future work

In this research, the interaction among members of the autism community in various online social media platform is studied. The study focus on interdisciplinary approaches is focusing on social network influences on online health behaviors. Since social science and information science literature lacks any mathematical definition for online social support, in our study we have designed a methodology that can be used to tweak social support assessment model for other areas of applications like health science and social science discipline. The study connects life course and network dynamics. The signification contribution of our study is building a bridge that was rarely done earlier in any research study between various disciplines like information science, health science, and social science disciplines.

In the study, we identified members of the autism community by the individuals who mentioned 'Autism' as their subject of interest in social media platform. By identifying the individuals who mentioned 'Autism' as their subject of interest in social media platform as members of the autism community, we studied the interaction among members of the online autism community. Activities of the autism community members in different social media platform are studied in this research. The study considers members of the online autism community, their blogging, and Twitter activity and analyzes their friends, followers, tweets, retweets, mentions, and hashtagging behaviors. Our study revealed that the autism blogging community is tightly knit among its members. Families with members diagnosed with autism rely on the community support to reduce their depression and connects to other members of the community to gain knowledge to deal with autism. It was observed that the autism blogger community provides extensive social support to its community members on blogs and Twitter. A significant finding of our study is the amount of social support provided by members of the autism community is higher in the Twitter medium as compared to blogs in social media. Social support provided by autism community to its members is greater as compared to what is provided in alcohol support forums.

The interdisciplinary research approach with multidisciplinary implications model and the methodology proposed in this study can be used to measure many social interaction scores like social support in an interaction by other disciplines like health science. The study enables us not only to estimate social support in a health community, but also to evaluate the effectiveness of communities. The proposed model as well as the methodology to derive the social support assessment model is generic and applicable to other healthcare communities as well as general online or virtual communities, such as gaming, education, and learning. The proposed methodology and model in the study is a tiny step towards narrowing the gap between information science and social science discipline. We envision that the study would help to enhance a research methodology to explore further the assessment of social support mechanisms in various online healthcare communities.

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