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Parenting online: analyzing information provided by parenting-focused Twitter accounts

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ABSTRACT

This study investigated the content of parenting information shared on social media by identifying the range and frequency of topics shared by parenting-focused accounts on Twitter. Using the Twitter API, a universe of 675,069 tweets were gathered from 74 of the most-followed parenting-focused accounts, or “hubs,” from January 2016 to June 2018. Using a custom, semi-automated topic modeling approach, we identified the topics – and sub-topics within topics – parenting hubs shared with their followers and investigated whether any meaningful differences in topical focus existed between accounts targeting mothers versus fathers. Results indicate that over one third of tweets were about Parenting Behavior and nearly one quarter about Health, with Entertainment, School and Motherhood and Fatherhood generally as less tweeted topics. Mother-focused accounts tweeted more about Health than father-focused accounts, which tweeted more than others about Entertainment. Implications for future parenting and social media research are discussed.

Introduction

In the latter half of the 20th Century, parents with questions about parenting would typically turn to print media for the answers (Wrigley, 1989). Perhaps they subscribed to a parenting magazine or had the book *Baby and Child Care* (1946) by Dr. Spock. Parents might also call on their own parents or friends for advice on how to handle a tantrum or get their child to sleep. In the last two decades, however, the information environment has changed dramatically. Parents now have a myriad of options on the internet including social media platforms such as Facebook, Twitter, and Reddit, to turn to for information (Deshpande, Deshpande, O'Brien, & McMonagle, 2019; Duggan, Lenhart, Lampe, & Ellison, 2015; Lazard, Capdevila, Dann, Locke, & Roper, 2019; Wilford, Osann, & Wenzel, 2018). As a result, there are more sources of parenting information available today than ever before.

Online, parents have access to multiple accounts or websites that provide immediate information on parenting and child development. Those with large numbers of followers become “hubs” for parenting information, both reflecting and driving popular parenting content. These hubs have far more diverse qualifications for providing parenting advice or opinions than the parenting authorities of the past. When books and magazines were the main media sources for parenting information, those

considered authorities were generally medical practitioners or scientists who had years of training and experience working with children (Brazelton, 1969, 1987; Spock, 1946). In the internet age, hub accounts include those authored by journalists, bloggers, and everyday parents who may have millions of followers but do not come from a profession that might previously have designated them an “authority” on parenting. Hence, the internet allows greater access to a diverse array of information sources than ever before (Manganello, Falisi, Roberts, Smith, & McKenzie, 2016).

How parents use social media

During the transition to parenthood, parents engage in significant information seeking to manage the new and challenging tasks parenthood requires (Montesi & Álvarez Bornstein, 2017). Increasingly, this information seeking takes place on the Internet (Lupton, Pedersen, & Thomas, 2016). Parents have long used both websites aimed at parents (so-called “parenting websites”) and discussion forums where other parents share experiences, questions, and advice (Lupton et al., 2016). Parents use these sites to find information – about their children’s health (Manganello et al., 2016), development (Fleischmann, 2004), and behavior (Holt, 2011), but also to share the frustrations associated with parenting (Jang, Hessel, & Dworkin, 2017; Jarvis, 2017; Newhouse, 2016; Thomas, Lupton, & Pedersen, 2018). In this way, the internet has become a place where parents both get and share information about parenting.

Increasingly, the Information Communication Technology (ICT) that parents use for support and information online includes social media (Lupton, 2017). Parents’ use of social media to share and seek information about parenting is colloquially referred to as “sharenting” (Lazard et al., 2019). A nationally representative survey found that a majority of parents use some type of social media (75%), and many use social media to receive social support (74%) and “useful” parenting information (59%; Duggan et al., 2015). Other studies that analyze social media content find that parents seek information about disparate topics such as food and childhood obesity (Doub, Small, & Birch, 2016), children’s play (McLean, Edwards, & Morris, 2017), and education (Keil, 2016). Twitter, in particular, is often cited as one platform where parents are seeking and sharing parenting information. As of 2015, 23% of parents who are online use Twitter specifically (Duggan et al., 2015). Twitter is endorsed by 59% of its users as being “good” or “extremely good” for sharing preventive health information (Wilford et al., 2018). And Twitter is among the most common social media platforms cited for sharing research (Deshpande et al., 2019). These studies support what popular media had long assumed – that social media plays an important role in most parents’ gathering and sharing of parenting information, beliefs, and practices.

Research on parenting content on social media

Despite the obvious salience of social media for obtaining parenting information, few studies have explored the content of parenting information shared. Twitter data is undoubtedly a rich source of information given that it is comprised of “conversations,” including questions directed to communities asking for information or advice (Ramirez, Walther, Burgoon, & Sunnafrank, 2002). The few studies that have analyzed Twitter for parenting content have gathered data on samples of everyday users and focused on specific issues. For example, Becker et al. (2016) scraped all public Twitter messages on the DTP-HepB-Hib vaccine over nine years and reported that the slight majority of tweets were positive about the vaccine and the vast majority cited a website. Similarly, Massey et al. (2016) gathered and coded tweets relevant to the human papillomavirus (HPV) vaccine for positive, negative and neutral sentiment. Similar methods have been used to assess narratives expressed on Twitter about the influenza A (Salathé, Khandelwal, & Meyers, 2011), the MMR vaccines (Mitra et al., 2016, March), and the common core curriculum (Wang and Fikis, 2017). Others have even predicted the risk of postpartum depression using prenatal tweets (De Choudhury, Gamon, Counts, & Horvitz, 2013). These studies indicate that textual analysis of Twitter data can yield rich, useful variables on

parenting-related content. However, they do not identify the *range* of parenting topics shared online nor the relative *salience* of their target topics to online parenting communities. That is, these types of studies tell us whether people post about specific, pre-selected topics, but not which topics parenting hubs identify as most salient to their followers, nor how common specific topics are among all parenting topics discussed on social media. Identifying these patterns would help parenting researchers anticipate which topics are gaining attention on social media and potentially shaping parenting views or practices.

Historians and sociologists have long analyzed topics in popular parenting literature to illuminate parenting attitudes and practices (Mechling, 1975). For example, by analyzing the topics of parenting advice publications from 1900 to 1985, Wrigley (1989) found that parents' roles were defined almost exclusively in terms of maintaining hygiene and health in the early 20th Century, an unsurprising focus given the relatively high rates of infant mortality at that time; in the ensuing decades, however, advice literature shifted to a focus on promoting children's intellectual and socioemotional development, a shift theorized to partly reflect the increasing economic importance of higher education (Alwin, 1988; Ryan, Kalil, Hines, & Ziolk-Guest, 2020). Social media accounts that serve as hubs for parenting information offer a contemporary version of the parenting literature examined in the past. Analyzing the range and frequency of parenting topics shared by parenting hubs on social media could thus illuminate how sociocultural trends of today are shaping parenting roles and priorities.

In this paper, we begin this analysis by providing a comprehensive description of the topics available to parents on social media using the posts of parenting "hubs" on Twitter. The hubs we identify are accounts that explicitly focus on parenting and have a relatively large following, presumably of parents or other individuals seeking parenting information. Some represent professional organizations or print outlets. Others, however, are mothers or fathers who choose to tweet about their experiences, opinions, and information, and have developed large followings.

Given the diversity of parenting hub authors online, a key question is whether and how parenting information differs across different author types. Specifically, one of the most novel sources of parenting information to emerge with social media are accounts authored by everyday parents. For the first time, mothers and fathers are sharing their parenting experiences and opinions with large audiences of other parents, and many accounts explicitly target either mothers or fathers, specifically. It may be important to distinguish between accounts authored by mothers and fathers to determine if they have different topical foci and if gender-targeted accounts differ in foci from gender-neutral sources. For instance, mother-oriented accounts may tweet more about the biological prerogative of women, such as pregnancy, birthing, and breastfeeding, than father-oriented accounts. Additionally, because mothers spend more of their time with children engaged in basic caregiving tasks than fathers (Bianchi, 2000; Craig, Power, & Smyth, 2014; Sayer, Bianchi, & Robinson, 2004), mother-oriented accounts may focus more on topics related to caregiving activities, such as food and nutrition, sleeping, and child safety. By contrast, father-oriented accounts might focus on those parenting activities that fathers have been found to spend the most time doing – playing with children and taking them to events and social outings (Craig et al., 2014; Hook & Wolfe, 2012; Yeung, Sandberg, Davis-Kean, & Hofferth, 2001). Examining the topical content of mother- and father-oriented Twitter accounts will reveal whether these differences are reflected in how accounts use social media, or if the gendered parenting communities on social media have more non-traditional foci that would be reflected in a survey. More broadly, these comparisons will help us understand how social media, with a diversity of content, is shaping the parenting information that parents can access online.

Materials and methods

Data and sample

To identify the parenting topics shared on social media, we investigate Twitter. Twitter offers a good case study for our purposes for several reasons. First, a substantial number of parents use it – 23% as of 2015 (Duggan et al., 2015). This percentage is lower than Facebook’s, Pinterest’s, or Instagram’s, but still represents a large number of parents. Second, Twitter is more text-based than Pinterest or Instagram, facilitating the sharing of research, information, and links (Deshpande et al., 2019; Wilford et al., 2018). Third, Twitter posts are generally public, making it easier to access and study. Finally, unlike other user-declared networks (e.g. Facebook), Twitter is used by a variety of people for *disseminating* information, in that users subscribe to broadcasts of other users (i.e., it does not require mutuality between two users). For these reasons, Twitter presents itself as an optimal forum for gleaning the types of parenting information hubs provide on social media.

To identify parenting hubs, we began with ten seed sites representing well known parenting-focused magazines and organizations posted in English. These included Today’s Parent, Parenting magazine, Parents magazine, and PBS Parents, all of which had at least hundreds of thousands of followers at the time of selection. From this seed list, we expanded to include additional publication accounts, such as HuffPostParents, and additional organizational accounts, such as Pampers. We also expanded to include the accounts authored by mothers and fathers identified through online lists of parenting blogs and from the follower lists of identified accounts. We then searched online for parenting sites, searching Twitter profiles for words associated with parents or parenting, and checking follower lists of accounts we already selected. Because many Twitter accounts have “parent” or “parenting” (or “mother” or “father”) in their title or profile, we limited our accounts to those with at least 10,000 followers and to those accounts explicitly focusing on parenting content, as determined by their Twitter profile and post history. Using this process, we continued to search for hub accounts until we identified no new sites that fit our criteria. This process resulted in 74 English-speaking hub accounts posting from the US, UK, Canada and Australia. Although our search was thorough, it is possible some parenting hubs that fit our criteria were not selected because we did not identify them or because they emerged after our search concluded. See Table 1 for a list of our top 10 most followed accounts and their follower numbers.

Our 74 hub accounts reflect a variety of authors and sources. Some are accounts of print or online publications, some are accounts of websites, some are accounts of organizations, and others are blogs (see Table 1). The size of accounts’ followers ranged widely from just over 11,000 to over four million, as of June 2018. The average number of tweets per account during the data collection window (January 2016 to June 2018) was approximately 10,000; however, that number varied widely across

Table 1. Top 10 most followed parenting hub accounts on Twitter.

User Name	Parent Focus	Followers	Tweets	Vol (%)	Ads (%)
parentsmagazine	Neutral	4,781,793	13,364	1.98	0.62
Todaysparent	Neutral	2,621,539	25,298	3.75	1.45
parenting	Neutral	2,014,821	711	0.11	0.99
HuffPostParents	Neutral	1,620,687	15,240	2.26	0.86
pbsparents	Neutral	1,019,059	651	0.10	0.64
BabyCenter	Neutral	647,246	6,778	1.00	2.30
ResourcefulMom	Mom	607,124	9,876	1.46	3.22
ScaryMommy	Mom	481,353	17,994	2.67	0.91
TheBloggess	Neutral	466,733	5,966	0.88	1.19
thebump	Mom	451,027	4,527	0.67	2.14

Note. Top ten most followed parenting hubs using Twitter based on total number of followers in June 2018, by user name, parental focus, total number of Twitter followers, total number of tweets, and percentage distribution of tweets (volume) across all users.

sites, from over 50,000 by @procm2, a father-focused blog, to only 44 by @AskDrSears (see Table 1/online supplement). We used the Twitter API to collect timelines for the handle of each account over the study period, thus gathering all tweets in that period from each hub.

The most-followed accounts (listed in Table 1), which were mostly well-known magazines or organizations, were not necessarily among the most frequent tweeters. For example, Parenting magazine's account had over two million followers when we began collecting its tweets but only tweeted 711 times in 30 months. The most prolific account, procm2, tweeted over 50,000 times but had only 21,152 followers. Even among the 10 most followed accounts, the range of tweet frequency was wide, from 651 by PBSParents to over 25,000 by TodaysParent. In short, less well-known accounts with fewer followers, such as those authored by parent bloggers, drove more content than the most popular accounts.

Next, we coded whether accounts targeted mothers, fathers, or neither gender specifically, which we refer to as "neutral." We distinguished accounts in this way to determine if the information directed at mothers and fathers differed. To code this variable, we began with the information provided in the account's Twitter profile. If the profile did not contain descriptors that unequivocally defined its target, we consulted any links listed in the profile, referring specifically to the "about" section of the site. If still unsure, we looked up the account on Wikipedia. We defined mother-focused accounts as those that directed content to mothers explicitly in the account name (e.g. @urbanmommies) or published profile; this definition includes accounts authored by self-described "mothers" or "moms," for example. We defined father-focused accounts as those that direct content to fathers explicitly in its name (e.g. @Canadiandadblog) or published profile. If an account did not explicitly identify as targeting moms or dads in this way, we coded it as "neutral." Three independent coders categorized accounts with agreement on 85% of accounts. For accounts that were differentially categorized, the coders discussed their profiles and came to consensus. This process yielded 26 accounts that were mother-focused, 16 accounts that were father-focused, and 32 accounts that were neutral. Most of the mother- or father-focused accounts were blogs by everyday parents, although not all. For example, the Good Men Project and Life of Dad are accounts of websites, and Mother and Baby is an organization.

Topic identification

Because Twitter data is noisy and posts are short, state of the art topic modeling algorithms perform poorly. Therefore, to identify the topic of each tweet we used a custom semi-automated, iterative approach for identifying topics and words/phrases associated with each topic. We began by generating topics using a well-known generative topic modeling algorithm, Latent Dirichlet Allocation (LDA) (Blei, Ng, & Jordan, 2003). Because LDA did a poor job placing words into the correct topics and also contained a number of overly general words, we manually regrouped the most meaningful words into topics and added important topic words. Using this seed set of topic words, we identified a set of frequently co-occurring words to determine if other words or other topics should be added to the initial set (see Figure 1).

This step resulted in substantial increases in topic words, and new topics. When manually surveying the topics, the research team noticed that some of the topics were significantly narrower than others. We then regrouped topics into a two-level hierarchy, refining the more detailed topics and adding more general parenting words into the first hierarchy. For each tweet and topic word, we preprocessed the text by lowercasing, removing punctuation, and stemming each word to its root. At this stage, our topics still only labeled 55% of tweets. Again, we used our set of topic words and identified frequently co-occurring words and frequent words to identify important missing words. We then manually examined a random sample of 1000 tweets that were unlabeled. In this analysis, we identified tweets on topics that were not principally about parenting, such as politics and professional sports. We declined to add those words or topics to our topic list because they did not illuminate the types of *parenting* information shared on Twitter by parenting hubs.

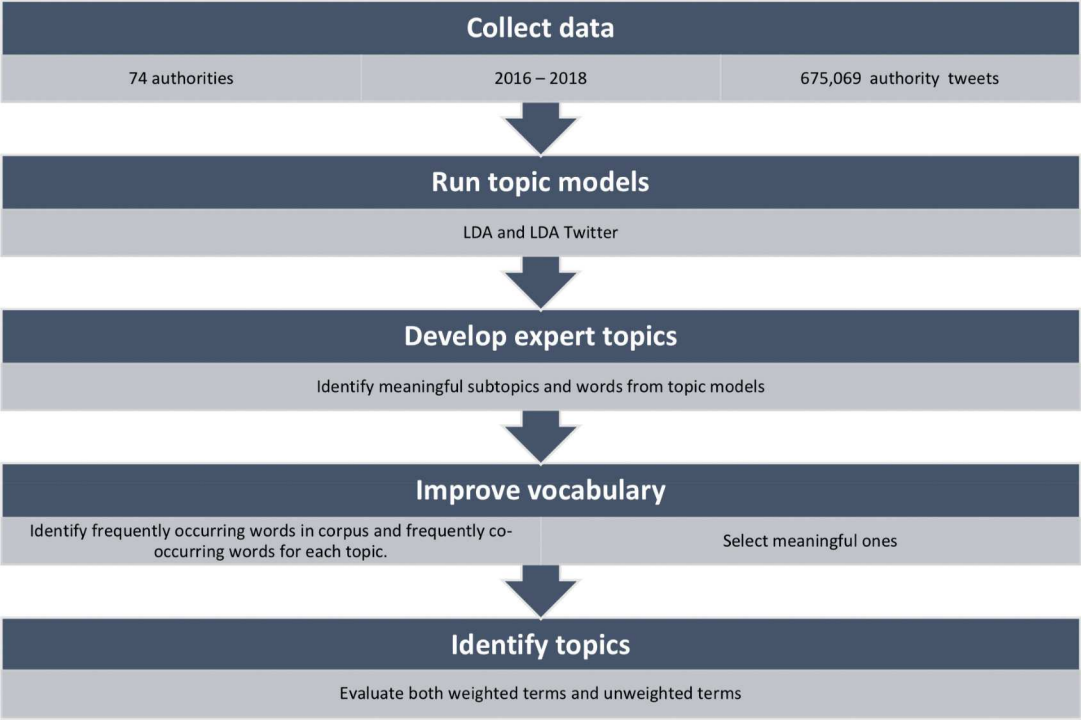


Figure 1. Iterative topic modeling approach.

This process yielded six higher level, or level 1, topics: Parenting Behavior, Health, School, Entertainment, as well as general Motherhood and Fatherhood categories. The Parenting Behavior topic contained tweets about how parents interact with children, that is, decisions parents make about parenting or their parenting roles. The School topic contained tweets discussing children’s schooling including those about types of schools (“public schools”), parents’ involvement in schools (“PTA”) and school issues such as bullying (“bullying”). The Entertainment topic contained tweets about children’s outings, including movies (“theater”), vacations (“family trip”), holidays (“Halloween”), and activities (“playground,” “crafts”). The general Motherhood and Fatherhood topics included tweets that referred to motherhood or fatherhood terms but were not coded into a more specific topical category. Finally, it was necessary to create an “ad” topic to account for the advertisements or spam that hubs pushed or allowed on their accounts. These tweets were identified by their inclusion of clear product or marketing words such as “deal” and “bargain.” Within the four specific level 1 categories, we identified between 3 and 7 lower level topics, or level 2 topics. Note, these subtopics were comprehensive, that is, all tweets in a level 1 category were also coded into one of these subtopics. See [Table 2](#) for topic hierarchy and sample words.

At the completion of this process, we were able to label 71% of the tweets ($n = 481,049$). Because 27% of tweets in the sample were coded with more than two topics, we used a proportional approach to coding, which best captured the aim of our project – to identify the salience of different parenting topics within the parenting information shared online. To calculate the weighted proportion of tweets on each topic, we first identified higher weight terms in each topic list by consensus as those most salient to that topic. We used a simple two-level weighting scheme in which each term, phrase or hashtag was given a high importance or a regular importance weight. Our weighting scheme was a simple linear combination of topic weights (high weight words were given twice the weight) for each tweet. So, for example, consider the tweet, “I am really making sure I eat enough veggies while I am nursing.” To determine the topic for this tweet we count the number of words (or weighted words)

Table 2. Parenting topics and subtopics identified through topic modeling and 5 sample words.

	5 Sample Words				
<i>Parenting Behavior</i>	parent	responsive	snuggle	nurture	mind
Parenting style	permissive	helicopter	nurture	warmth	strict
Discipline	rules	time-out	punish	limits	spank
Potty Training	potty	pull-ups	diaper	poop	toilet
Sleep	sleep	nap	co-sleep	bedtime	sleep train
Breastfeeding	breastfeed	nursing	pump	lactation	breast milk
Employment	working	maternity	leave	stayathomedad	stayathomemom
Safety	accident	baby proof	fire	injury	safety
Health	healthy	sick	ill	nutritious	wellchild
Nutrition	nutrition	healthy	picky eater	lunch	diet
Illness	ill	flu	doctor	fever	vomit
Mental Health	postpartum	baby blues	depressed	Sad	wellness
Vaccines	vaccination	vaccine	MMR	alternative	HPV
School	education	teacher	school	grades	homework
School type	school	choice	charter	school lottery	private school
Involvement	PTA	PTO	staff	auction	volunteer
Performance	grades	test scores	GPA	report	excel
Bullying	bullying	hit	kick	name calling	racist
Entertainment	playground	vacation	ball	reading	movie
Vacations	trip	plane	park	summer	camping
Activities	crafts	swimming	playground	movie	Lego
Parties	birthday	cake	presents	decorations	guests
<i>Motherhood General</i>	mother	mom	motherhood	Son	daughter
<i>Fatherhood General</i>	father	dad	fatherhood	Son	daughter

that match each topic. In this hypothetical tweet, veggies and nursing are content-rich topic words. The other words are ignored because they are not listed within a topic. Using these words, we would want to label this tweet with two topics, nutrition and breastfeeding. But, we would also want a word like ‘nursing’ to have a high weight in the breastfeeding topic and thus for the proportional weight of this tweet to be higher for breastfeeding than for nutrition.

Empirical analysis

After identifying the topical focus (or foci) of each tweet, we examined the distribution of tweets addressing each topic across all accounts. First, we calculated the percentage of all tweets about each topic. Next, we calculated the percentage of each account’s tweets about each topic, then examined the mean percentages of tweets on each topic across all accounts. This approach addresses the fact that some accounts tweeted more frequently than others and thus ensures that prolific accounts were not overrepresented in results. More importantly, this approach allows us to identify the topics parenting hubs deem most salient for their followers rather than what high-frequency tweeters deem most salient. We examined this distribution for all level 1 and 2 topics and then compared those frequencies across mother-focused, father-focused and neutral accounts. Note, we did not conduct inferential tests to determine the “significance” of any differences in topical frequencies across account types because accounts were not sampled from a population of parenting “hubs” but rather reflect the comprehensive list of accounts available in the study period.

Finally, a K-means cluster analysis was conducted to identify naturally occurring patterns in topic percentages at the multivariate level. This analysis explored whether and how patterns of topical foci exist across accounts, and whether those patterns differed among account types. That is, are certain topics likely to co-occur (e.g. health and motherhood) on certain types of sites? And do these clusters help us identify “types” of sites more effectively than the topic models on their own? The K-means method was preferable to a hierarchical clustering method because K-means has an optimization function that identifies clusters considering the global distribution of the data. In contrast, hierarchical clustering has a local optimization function, meaning that clusters are optimized based on their local neighborhoods. Because we are interested in a global partitioning, we selected K-Means.

The average width between cluster nodes stopped increasing substantially after five clusters and the total sum of squares stopped decreasing substantially after seven. Among the five, six and seven cluster solutions, we selected the 5-cluster solution as it allowed for the most distinct, theoretically meaningful groups to emerge. Once the optimal clustering solution was identified, we compared the frequency of mother-, father- and neutrally-targeted accounts in each cluster, to determine if different account types have different topical patterns.

Results

Topic distributions

The percentages of all tweets coded as relating to each level 1 topic are displayed in Figure 2. The number of categorized tweets equals our total number of tweets because a single tweet could be placed in multiple topics, with the fractional proportion totaling 1. Of all the nearly 700,000 tweets, over one third were coded as being about Parenting Behavior. That is, the tweet addressed decisions parents make about how to parent or their parenting role. The next most common tweet topic was Health; over one-fifth of tweets were health-related, including words such as “flu,” “nutrition,” or “vaccines.” Next, over 15% of tweets related to Entertainment, including movies, vacations, or birthdays and birthday parties. About 8% concerned School, including school choice, children’s grades or test scores, and parent involvement in school, and the same amount related to Fatherhood generally. Approximately 7% of tweets related to Motherhood generally. Less than 5% of tweets were coded as Ads.

All level 1 topics were further distinguished into two or more subtopics, except Fatherhood, Motherhood, and Ads. The results are displayed in Figure 3. The most common level 1 topic, Parenting Behavior, contained 7 subtopics (see Table 2). Parenting Style, the most commonly tweeted of all subtopics, related to the way parents interact with children and included words specifying a particular parenting style, such as “permissive” or “helicopter parent,” or way of interacting, including “nurturing” and “supportive.” The next most common Parenting Behavior subtopic was Discipline, which included words such as “setting limits,” “time out” and “spank.” The subtopic Sleep included words about children’s sleep, including “naptime,” “bedtime,” and “sleep training,” and described about 4% of all tweets. Less often tweeted Parenting Behavior topics were Potty Training, Breastfeeding, Parental Employment, and Safety.

Subtopics within the larger topic of Health were the next most commonly tweeted. Specifically, the second and third most commonly tweeted subtopics were Nutrition and Pregnancy, both health-related topics. Nearly 12% of all tweets related to Nutrition, including tweets with recipes, diets, and

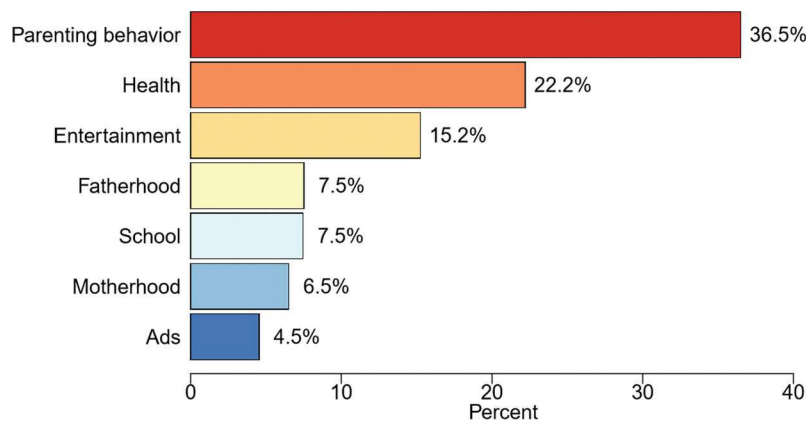


Figure 2. Distribution (%) of tweets coded into level 1 topics.

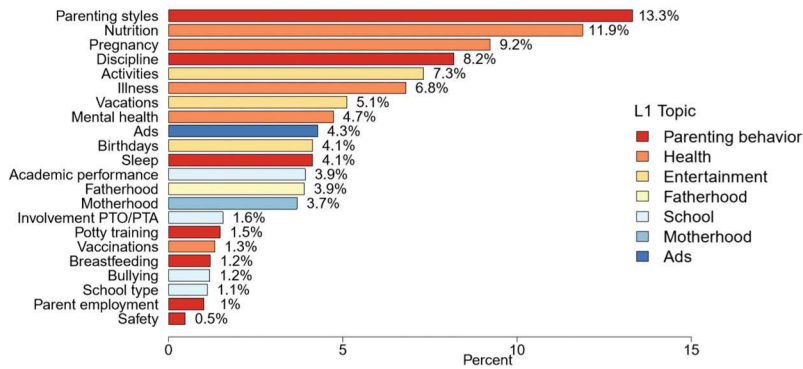


Figure 3. Distribution (%) of tweets coded into level 2 subtopics.

comments about the nutritional content of foods. About 9% of tweets were about Pregnancy, including tweets containing words like “pregnant,” “expecting,” “due date,” “trimester,” and “birth plan.” Tweets about Illness and Mental health comprised about 7% and 5% of tweets, respectively. Surprisingly, the subtopic of Vaccinations, about which there has been the most substantial social media research (Becker et al., 2016; Massey et al., 2016), comprised only a little over 1% of all tweets.

Tweets on subtopics related to Entertainment and School were less common than the most common Parenting behavior or Health subtopics. Specifically, hubs tweeted about Vacations about 5% and Birthdays about 4% of the time. Within the School topic, Academic Performance was tweeted about most (4%), with Parent involvement, School type, and Bullying appearing less often.

Topic frequencies by parent-focus

Next, we compared the frequency of tweets on each level 1 topic by the parent-focus of the account. The results are displayed in Figure 4. The distributions of topics were similar for mother-focused, father-focused and parent-neutral accounts, with the exception of Health, Entertainment, and Fatherhood. Specifically, although all account types tweeted most about Parenting Behavior and least about Activities, mom-focused accounts tweeted slightly more and father-focused accounts tweeted far less about Health than neutral accounts. Father-focused accounts tweet slightly more about Entertainment, and not surprisingly about Fatherhood, than neutral or mother-focused accounts.

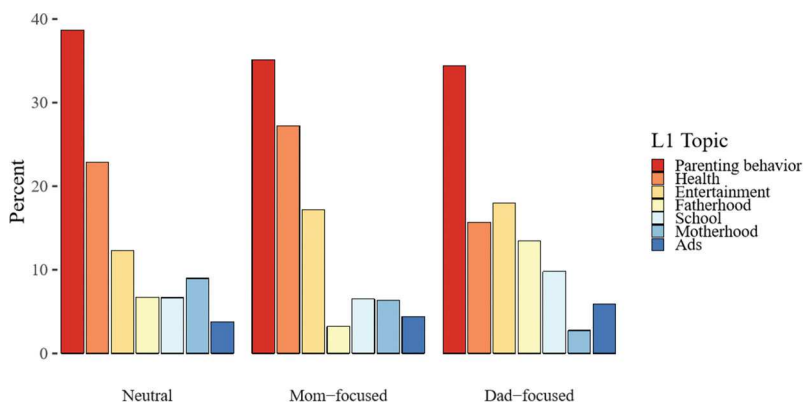


Figure 4. Distribution (%) of tweets coded into level 1 topics by parent-focused account type.

When examining level 2 topics, additional differences emerged across parent-focus types. The results are displayed in Figure 5. Among tweets about Parenting Behavior, neutral accounts tweeted more about Parenting Style than mother- or father-focused accounts, and mother- and father-focused accounts tweeted more about Discipline than neutral accounts. With regard to Health-related tweets, neutral and mother-focused accounts tweeted more about Pregnancy than father-focused accounts, which tweeted more about Mental Health than the other account types. Interestingly, neutral accounts tweeted about Vaccination more than mother- or father-focused accounts. With regard to Entertainment and School-related tweets, father-focused accounts tweeted more about Activities and Academic Performance than neutral or mother-focused accounts.

Topic typologies

To explore whether parenting accounts exhibit certain topical patterns in their tweeting, we conducted k-means cluster analyses on each account's topic distribution (Figure 6). The first cluster most closely resembles the distribution of topics across all tweets, with the plurality of tweets about Parenting Behavior, then Health and Entertainment. We call this cluster *Parenting behavior-focused* because it contains the largest percentage of tweets about Parenting behavior. The second cluster is *Health-focused* because it is the only cluster in which the plurality of tweets is about Health, not Parenting behavior. The third cluster is relatively *Entertainment-focused* because it contains the highest percentage of tweets about Entertainment. Interestingly, the Entertainment cluster also tweeted the largest percentage of Ads of any cluster. The fourth and fifth clusters, respectively, are *Motherhood-focused* and *Fatherhood-focused* because they contain the highest percentage of tweets on those topics.

When we compared the number of accounts within each cluster by parent-focused type, interesting differences emerged (Figure 7). Neutral accounts were overrepresented in Parenting Behavior and Health clusters, whereas mother-focused accounts were overrepresented in the Motherhood and Entertainment clusters. Father-focused were overrepresented in both the Parenting Behavior and

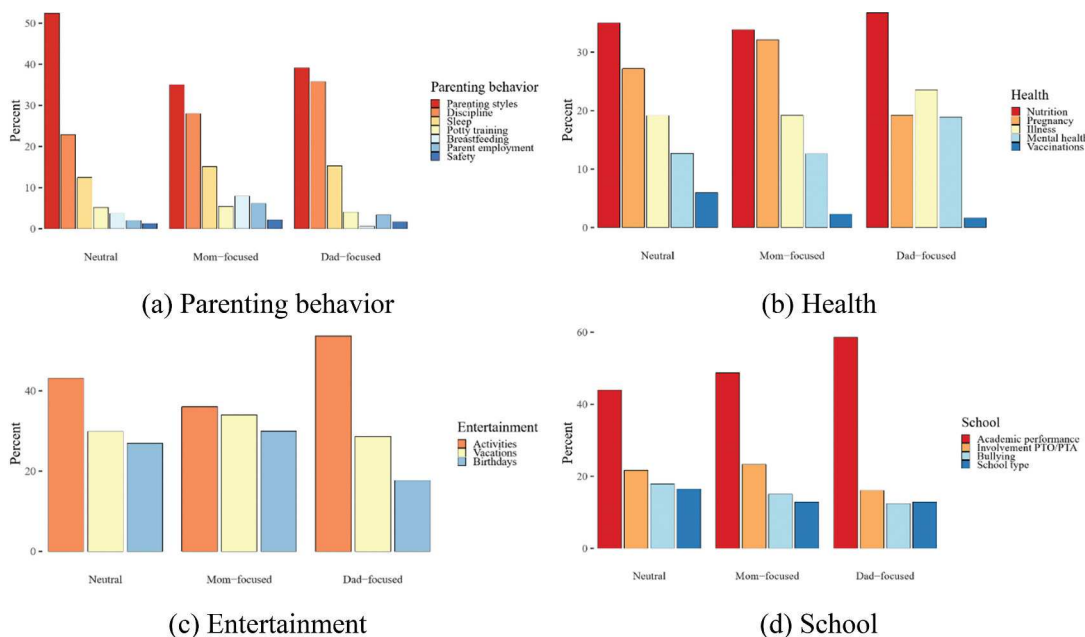


Figure 5. Distribution (%) of tweets coded into level 2 subtopics by parent-focused account type. (a) Parenting behavior (b) Health (c) Entertainment (d) School

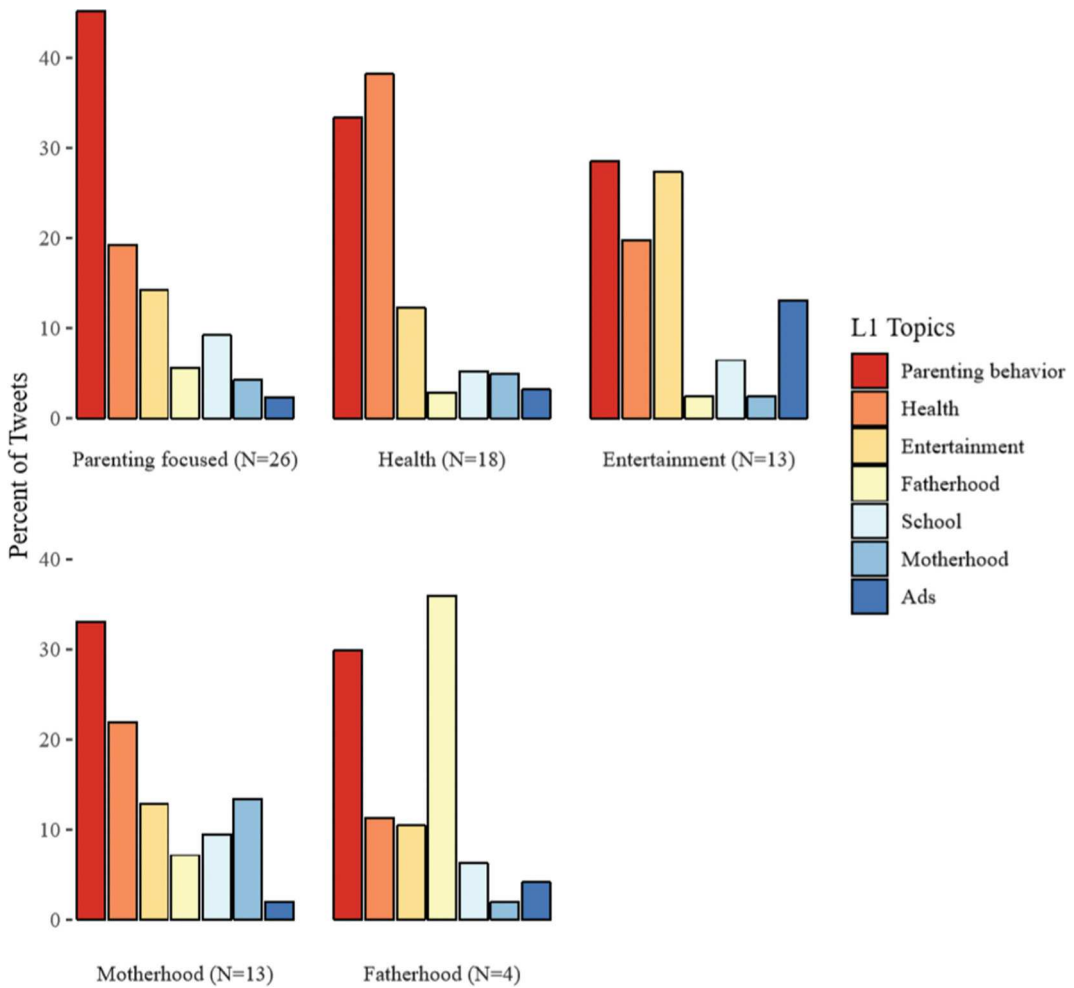


Figure 6. Distribution (%) of tweets coded into level 1 topics across 5 topic clusters.

Fatherhood clusters relative to Mother-focused accounts, but *none* of the father-focused accounts fell into the Health cluster. These results reflect the overall means for the frequency of Level 1 tweet topics, with father-focused accounts tweeting less about Health and more about Fatherhood than the others.

Discussion

Because a majority of parents look online for parenting information, it is essential that researchers and practitioners understand the nature of the information shared (Duggan et al., 2015). The present study took the first step in doing so by identifying the parenting topics shared on social media, a popular medium for sharing parenting information online, using Twitter as a case study (Deshpande et al., 2019; Lazard et al., 2019; Wilford et al., 2018). We focused on parenting hubs because unlike a typical parent sharing information online with a handful of followers, these accounts both reflect and could drive parenting discourse. In this way, these accounts mirror the parenting experts authoring parenting advice in periodicals and books in the past. A key question is whether topics discussed on social media mimic those that developmental researchers and practitioners also study; if so, social media

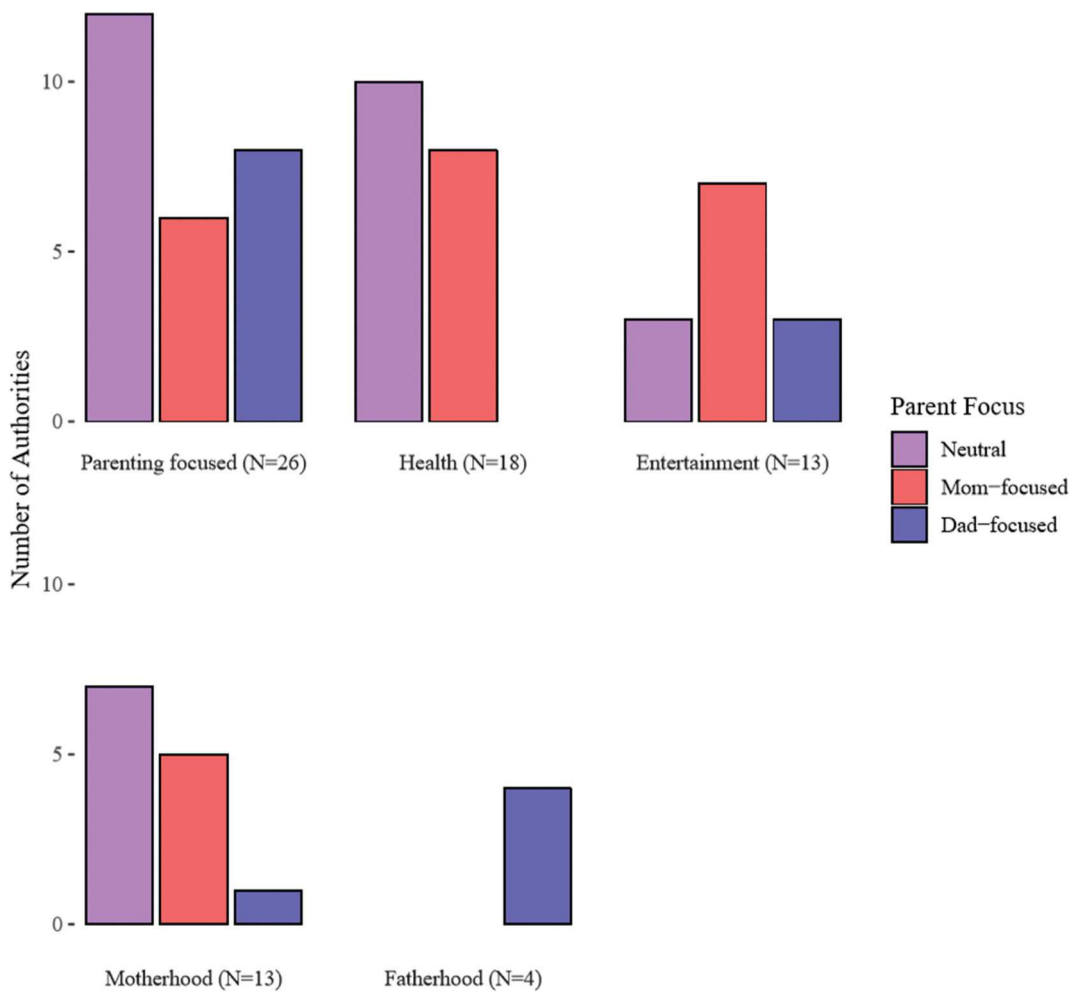


Figure 7. Distribution (n) of parent-focused accounts within each of the 5 topic clusters.

could present a rich and untapped source of information about parents' interests and behaviors that resembles the objective nature of observations but also reflects the everyday lives of a large number of parents.

Parenting hubs' followers and tweet frequency

Our approach allowed us to identify not only who is pushing out parenting information, but the volume of information different types of accounts share. An interesting discrepancy emerged: well-known print publications and companies, such as *Parenting* magazine and Pampers, tended to garner the highest numbers of followers (in the millions), but these accounts did not tweet nearly as much as the less followed, less well-known accounts typically authored by untraditional sources. For example, the *Good Men Project* is a nonprofit organization that aims to generate dialogue, particularly online, about modern fatherhood. With roughly 190,000 followers, it was only a moderately trafficked account, however, it tweeted nearly 50,000 times during our data collection window, far more than *Parenting* at only 711 tweets or *Pampers* at roughly 5600 tweets. Likewise, the account of the fatherhood blog *procm2* had only 21,000 followers when we began following it, but tweeted over 50,000 times. The accounts that both had a large number of followers and tweeted

relatively frequently included blogs, such as *ScaryMommy*, and traditional print outlets like *Today'sparent*. Combining information about the number of followers and frequency of tweeting reveals that alongside the traditional outlets for parenting information, new voices have emerged online that have a reach and likely influence everyday parents and other non-experts never had before.

Parenting hubs' parenting topics

More importantly, our approach allows researchers and practitioners to understand not only who is pushing out parenting information online but whether their topical priorities reflect traditional or new parenting topics. To be sure, our findings suggest parenting information online covers topics developmentalists and practitioners typically study, including Parenting Behavior and Health, Parenting styles and Discipline, as well as medical topics such as Nutrition, Vaccinations, and Child Illness, suggesting that social media conversation could offer a new, rich source of data for research. For example, copious research has identified the negative effects of corporal punishment on children's social and emotional development (Gershoff & Grogan-Kaylor, 2016), and survey research has identified a sharp decline in parents' reported use of physical discipline over the past 30 years (Ryan, Kalil, Ziol-Guest, & Padilla, 2016). Nonetheless, approximately 15% of parents still report regularly spanking their children (Ryan et al., 2016). Understanding the persistence of this form of punishment through survey research may be limited, as parents' responses to survey questions are subject to social desirability bias (Tourangeau & Yan, 2007). On social media, by contrast, it is possible that parents discuss discipline more frankly. Other rich topics for academic research identified include Sleep, Breastfeeding, and Vaccinations. Data from social media on parenting topics thus present a new opportunity for a range of scholars to identify those parenting topics most salient to parents and track attitudes toward topics of importance to researchers.

Equally important is the appearance of topics that academics typically ignore but are nonetheless potentially important to parents online. The level 1 topics of this kind were Entertainment and School. Entertainment was the third most frequently tweeted parenting topic, and included sub-topics such as Vacations and Birthdays. By analyzing tweets on these seemingly mundane topics, researchers of various fields could gain insight into family spending patterns, cultural priorities, and family wellbeing; more generally, these tweets provide a window into how parents define the parenting role and the most salient tasks in that role. With regard to tweets about School, our data suggest social media might offer a rich source of information on patterns of parental involvement in schooling and reasons behind parents' school choices, important education topics in an age when school choice has proliferated in many communities and is hotly debated (Betts & Atkinson, 2012). In short, these data suggest that social media offers a unique insight into the nature and spread of information on social media among parents in a way that would be impossible with any existing survey data.

Variation in tweet topic by account type

One salient distinction that emerged when identifying parenting hubs on Twitter was that some accounts explicitly targeted a type of parent – mother or father – whereas others were neutral in their stated audience. We asked whether accounts targeting different types of parents focused on different topics, a distinction that could indicate differences in mothers' and fathers' parenting interests or perceived differences in parents' roles. Some anticipated differences emerged across mother- and father-focused accounts. For example, mother-focused accounts tweeted more often about Health than father-focused accounts, whereas father-focused accounts tweeted far more about Fatherhood itself. Given that Health included subtopics related to the biological prerogative of women, such as pregnancy, mother-focused accounts' relative focus on that topic is not surprising. But other aspects of Health, including Nutrition and Child Illness, say more about the gendered role mothers often play.

Notably, only father-focused accounts tweeted substantially about the general topic of Fatherhood, whereas very few father-focused accounts tweeted about mothers, suggesting these gender-focused accounts offer parents space to discuss their specific roles with, perhaps, other similar parents.

Another notable finding to emerge when comparing topics shared by different account types was the similarity across neutral and mother-focused accounts and the uniqueness of father-focused accounts. Both neutral and mother-focused accounts tweeted most often about Parenting Behavior and second most often about Health. Father-focused accounts, by contrast, tweeted more often about Entertainment and Fatherhood than either other type. These patterns suggest that neutral accounts focus on topics that mothers prioritize whereas only father-focused accounts address unique topics most important to men. Like the survey research on parenting, fathers appear to behave in unique ways relative to mothers online (Craig et al., 2014; Yeung et al., 2001).

These patterns also suggest that social media data could illuminate fathers' parenting attitudes and roles in a way that has eluded parenting surveys. The vast majority of surveys about parenting attitudes and behavior are answered by mothers as the 'primary caregiver' (Cabrera, Volling, & Barr, 2018); when fathers are surveyed specifically, response rates tend to be far lower than for mothers (Ryan, Kalil, & Ziol-Guest, 2008). Social media data from father-focused accounts offer a window into men's attitudes and behaviors that surveys, therefore, cannot tap. From this data alone, we know that fathers tweet relatively more about School – particularly children's Academic Performance – than mothers and to the extent father-focused accounts discuss Health, they focus relatively more on Mental Health than Nutrition. Father accounts' focus on Entertainment is not surprising given that fathers spend relatively more time with children in play and social activities than mothers (Craig et al., 2014). Our data reveal that these different roles correspond to different parenting interests and concerns online.

Results from cluster analyses of accounts' topic frequencies largely reflect the overall topic modeling results. In all but one cluster, Parenting Behavior was the most frequently tweeted topic, and Health was the second most tweeted. A Health cluster emerged, however, in which across accounts Health was the most frequently tweeted topic. Variation in cluster membership by account type also reinforced the overall topic findings. Mother and father-focused accounts were similarly likely to be in the Parenting Behavior cluster, whereas mother-focused accounts were far more likely to be in the Motherhood cluster and father-focused accounts were practically the only accounts in the Fatherhood cluster. Overall, mother focused accounts and father focused accounts are not talking about the other parents' experience. Moreover, no father-focused accounts emerged in the Health cluster, reinforcing the findings that father-focused accounts tweeted far less about Health generally than mother- or neutrally-focused accounts.

Limitations

By gathering data from parenting hubs, we aimed to identify the topics available to parents online, not topics parents themselves might necessarily tweet about or seek on social media. As a result, our study cannot reveal what information parents who use social media to obtain and share parenting information actually value. The topics shared by hub accounts theoretically proxy those interests, but they are not likely identical. For example, the accounts we identified as father-focused may not reflect the topics that a representative group of fathers might share online; our father-focused accounts included those authored by men reflecting smaller groups of fathers including stay-at-home dads and gay fathers whose parenting priorities might differ from those of an average father. In the future, we will explore what parents themselves share about parenting and how they discuss those topics.

It is also important to note that our data collection period was necessarily time-limited. With internet content constantly changing and responding to new events, and with new hubs likely emerging all the time, our findings cannot be generalized beyond our data collection window. This limitation describes any analyses of online data and means that new data need to be collected and topic modeling redone to understand how parenting topics may shift in salience over time.

Our results hinge on the topic modeling strategy we employed. Therefore, it is important to note that standard topic modeling approaches, such as LDA, performed poorly with Twitter data, motivating us to use a more manual, iterative approach. Similar to traditional topic models, our topic frequencies related closely to the words placed in each topic list. If those words were incomplete or misplaced, we might not have captured content accurately. However, after looking at the results of different automated topic models, it became clear that our list had higher coverage and more topic coherence than those produced by the automated approaches. Our experience suggests that more research is needed to develop methods that adequately model noisy data streams like Twitter.

Future research

The present study aimed to identify the topics shared on social media about parenting. The next question is what parenting hubs are actually saying about these topics. The content of tweets on topics of scientific interest are particularly relevant. Researchers and practitioners alike need to understand the extent to which parenting accounts are sharing scientifically accurate information on topics like Parenting Behavior and Health. A number of studies have examined misinformation shared on social media about important health topics such as vaccines (Becker et al., 2016; Massey et al., 2016; Mitra et al., 2016, March, March). Our study suggests these investigations could extend to important parenting behaviors, including discipline and sleep, as well as health topics such as influenza and autism. Future research should also analyze our corpus of tweets to determine the emotional valence or sentiment used by the authors and examine how sentiment might determine the way followers spread the information through online networks. Overall, we know that developmental scholars typically use a handful of nationally representative studies to understand trends in parenting attitudes and behaviors. Despite the potential richness of Twitter data, virtually no studies have investigated how people use it to convey and acquire parenting information beyond a few specific issues (e.g., Mitra et al., 2016, March, March; Salathé et al., 2011). Our data and findings indicate that social media conversation could help answer important, novel questions about parenting attitudes and behavior, questions that traditional survey research cannot.

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