



First-Time Mothers: For Vaccine Questions, Consult Your Peers on Facebook

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Abstract

Despite numerous scientific studies affirming the safety and efficacy of vaccinations, decreased parental uptake has led in part to disease resurgence in the United States (Ventola, 2016). A systematic review of 42 studies revealed that exemption rates for vaccination requirements to enter public schools or daycares have been increasing and occur in geographic “clusters,” where vaccination rates fall dangerously below the national average (Wang, Clymer, Davis-Hayes, & Bутtenheim, 2014). At the transition to parenthood, mothers rely on Facebook with increased intensity for health information-seeking purposes.

In a rejection of the health information deficit model, the purpose of this study was to propose a conceptual model which describes how first-time mothers’ dependence on Facebook may lead to childhood vaccine avoidance, in accordance with social network theory. A model is presented and propositions are offered to explain why discerning first-time mothers, who are consistently more vaccine hesitant, may seek and rely on information from peers in closed Facebook groups rather than from health professionals. While research has separately explored both vaccine hesitancy and social network utilization for health information seeking, no conceptual model to date has linked these concepts with first-time mothers’ childhood vaccine avoidance. Published research supports the constructs included in the proposed causal pathway, and this “Maternal Facebook Dependence-Childhood Vaccine Avoidance Model” will act as a springboard for advancement in operationalization of this complex relational construct.

Keywords: childhood vaccine hesitancy, Facebook dependence, social network theory

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Stacy, a first-time mother to a baby boy, finds herself thrust into an infinite loop of feedings and diaper changes. Her college degree and career promotions haven't prepared her for sleepless nights and an acute case of colic. Overwhelmed, Stacy logs on to Facebook seeking support and information. The likes and comments from friends in her news feed affirm her fledgling parenting skills. Stacy discovers private Facebook mommy groups containing parenting advice from breastfeeding to vaccination. She checks in multiple times per day and shares her deepest fears about parenting, which she would not feel comfortable telling friends or family in person. As Stacy's dependence on this social network deepens, she approaches parenting differently: obligations she took for granted such as pediatrician visits and childhood vaccinations are no longer assumed. Did Stacy know vaccines could poison her baby, lead him to develop SIDS, autism, or worse? Stacy is bombarded by information overload, but whom could she trust more than other moms? She cancels her baby's next doctor's appointment; after all, what could the pediatrician tell Stacy that she can't learn from Facebook?

Seven in 10 adults use social network sites, and especially Facebook (Pew Research Center, 2016). Of mothers using social media, 78 percent used Facebook the most. Further, compared to the average Facebook user who checks the site 7 times per day, mothers turn to Facebook 10 times a day (Edison Research Moms and Media Report, 2016). New moms perceive Facebook to be the most neutral, authentic, and trustworthy source of information (Djafarova & Trofimenko, 2017), and 44 percent of mothers reported greater use of Facebook after giving birth (Bartholomew, Schoppe-Sullivan, Glassman, Kamp Dush, & Sullivan, 2012). "Stacy," a composite drawn from first-hand observation of a Facebook group for vaccine-avoiding mothers, reflects one of the more pressing and unresolved public health issues of the day. Inoculating children against serious and sometimes fatal childhood diseases was one of the

triumphs of the latter 20th century. Yet in today's social media era, vaccination rates have declined to dangerous levels and diseases like measles are spreading, sometimes with fatal effect (World Health Organization, 2018). Research has examined the factors associated with vaccine acceptance and refusal (Dubé & MacDonald, 2016), parents' perceptions of the safety and efficacy of childhood vaccination (Gesser-Edelsburg, Walter, Shir-Raz, Bar-Lev & Rosenblat 2017), and anti-vaccination advocates (Kata, 2012). However, no published research has looked holistically at the potential that the increasing rate of vaccine avoidance and the rise of social media are mutually reinforcing. Therefore, the purpose of this paper was to propose a conceptual model that could explain why well-educated, information-seeking mothers choose to reject the advice of pediatricians and reject vaccinations for their children.

This paper contributes to academic understanding of the vaccination health crisis by building a conceptual model that is heuristically stimulating and explanatory while offering testable propositions for future research. In presenting a conceptual model as data, this paper follows the example of studies like one in the *Journal of Health Communication* postulating a pathway and moderators for health literacy (Squiers, Peinado, Berkman, Boudewyns, & McCormack, 2012). Another example is a study in *Media Psychology*, which proposed a "mediated moderation" model to enhance consideration of third variables in interactivity research and information technology effects (Bucy & Tao, 2007). Likewise, a study in *Communication Theory* proposed a theoretical framework for investigating the effects of exposure to graphic media violence (Riddle, 2014).

What differentiates this current work from other published studies investigating childhood vaccination and increasing vaccine hesitancy is the postulation of a linear causal relationship that could explain the link between first-time mothers' Facebook dependence and

childhood vaccine avoidance. Propositions are offered, as opposed to hypotheses, to lay the groundwork for future testing of this model. Theoretical implications include a rejection of the health information deficit model, which at the heart of medical practice presumes that if individuals had complete information they would change their behavior, despite a growing body of evidence demonstrating that passive assimilation of knowledge is an ineffective approach (Marteau, Sowden, & Armstrong 1998). In the case of childhood vaccination, more knowledge is not likely to impact parents who are extremely vaccine hesitant.

First-time mothers who have any hesitation or are considered to be “on the fence” about vaccinating, may be more likely to turn to Facebook to identify more experienced peers from which to glean advice. Since anti-vaccination content consistently receives more attention, likes, and shares (Covolo, Ceretti, Passeri, Boletti, & Gelatti, 2017), social media users may quickly develop knowledge, attitudes, and beliefs which are consistent with an anti-vaccination viewpoint. Selective exposure theory postulates that individuals are more likely to select messages that match their beliefs and are less likely to seek out contradictory information. “The availability of so many choices makes selectivity likely in the modern communication environment” (Stroud, 2014, p. 1). As mothers begin to doubt the safety and efficacy of vaccinations based on their Facebook research, which has been described as a “hotbed of anti-vaccine activism” (Kata, 2012), they are more likely to reject or delay childhood vaccinations in accordance with the schedule recommended by the Centers for Disease Control and Prevention and endorsed by the American Academy of Pediatrics. As an example highlighting the increasing number of parents declining or delaying vaccines for their children, a retrospective cohort study of 222,628 children found that 25% or 1 in 4 children in New York state appeared to be deviating from the vaccine schedule, thus increasing the potential for disease outbreaks

(Nadeau, 2015). In addition, the most predictive variable of parents' vaccination decisions in a study in Washington was identified as the percent of parents' social network members who advocated partial, delayed, or no vaccines (Brunson, 2013).

Characteristics of Target Population

First-time mothers are those who, for the first time, fill a maternal role for a child, whether biological, adopted, or step-child. Mothers are more involved with child-rearing as compared to fathers and typically have a greater imbalance in the workload of raising a child, especially relationship-focused care (Riina & Feinberg, 2012). Whether the maternal role is filled by a male or female, or whether the family structure is nuclear or nonbinary, those in that role face pressure to achieve ideals for motherhood and seek to avoid being perceived as a "bad" mother (Harrison, Hepworth, & Brodribb, 2018).

First-time mothers are more undecided or hesitant about vaccines than mothers with multiple children (Danchin et. al, 2017). Vaccine hesitancy involves a delay in or a refusal of some or all recommended vaccinations (MacDonald, 2015). A baseline survey of 200 first-time mothers in their second trimester of pregnancy found that 75% were acceptors, meaning they planned to have their child receive all recommended vaccinations; about 15% were delayers/decliners who would space out the vaccines or accept some but not all; and 10% were undecided about vaccinations. Most first-time mothers classified as delayers/decliners or undecided relied primarily on vaccination information from socially available sources (such as Internet search engines, friends and family, online parenting websites, and blogs) rather than a healthcare professional (Weiner, Fisher, Nowak, Basket, & Gellin, 2015). New mothers are more active on social media than are fathers, and the increased use of Facebook continues through a child's pre-school years, covering the period when most childhood vaccines are administered

(Djafarova & Tofimenko, 2017; Tomfohrde & Reinke, 2016). Not to be confused with the Bergen Facebook Addiction Scale, Facebook dependence in this case can be measured based on first-time mothers' expressed active use of this platform at least once per day. The proposed conceptual model aims to investigate mothers who reside in the United States, where vaccine-preventable diseases have been mostly eradicated, making the potential risks and complications of vaccines seem paramount for mothers who have never seen the devastating effects of polio firsthand (McCarthy, 2016). Similarly, the United States scored the highest in individualism compared to other countries in an international World Values Survey (Hofstede, Hofstede & Minkov, 2010). In contrast to collectivist nations which value decision making in accordance with societal good, parents in the United States choose what is best for their own child(ren). Some forego vaccinations based on the tragedy of the commons: other parents will have their children vaccinated to such an extent to achieve herd immunity and protection for all, making a single unvaccinated child seem less at risk.

In the U.S., in some cases, income serves as a proxy for education. Thus, the mothers in this model with higher levels of disposable income are also likely to have attained higher levels of education, reinforcing the idea that under education is not the primary issue in childhood vaccine avoidance. The mothers in this model are likely to have sufficient material resources to provide organic foods, pursue alternative medicine, and potentially enroll children in private education (Ward, Attwell, Meyer, Rokkas, & Leask, 2017). For example, a California study of kindergarten students found an association between parental income and the frequency of parents claiming vaccination exemptions (McNutt et al., 2016). One salient implication of this homogenous group of affluent mothers choosing not to vaccinate their children includes free ridership, a political science concept meaning the less privileged end up bearing a

disproportionate responsibility for disease prevention through achievement of herd immunity (McNutt et al., 2016).

Finally, it should be understood that mothers in this model view vaccinating as an open decision as opposed to *fait accompli*, which may explain some of the disconnect in health communication between practitioners and questioning parents. The mothers in this model do not have an intuitively strong trust in scientific recommendations, do not follow them without question, or take the necessity and decision to vaccinate for granted, instead choosing to do their own research to make a perceived informed decision.

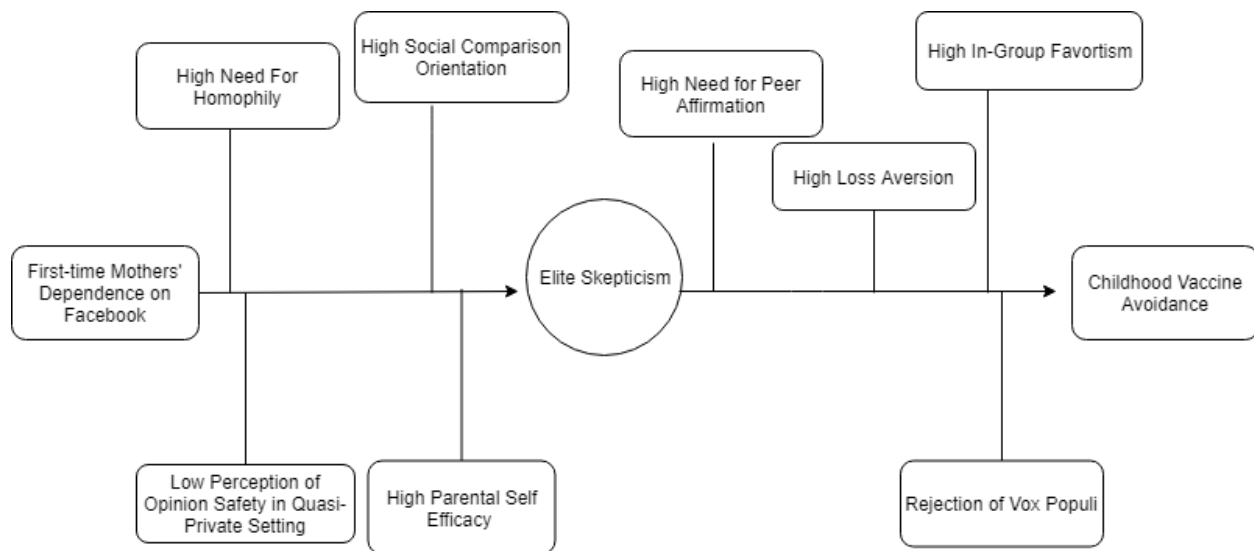
Theoretical Foundation

Social network theory originally focused on sociometric analysis, interpersonal relations, and anthropology (Liu, Sidhu, Beacom, & Valente, 2014; Scott, 1991). Over time, social network theory synthesized structural centrality (Freeman, 1979), network cohesion (Burt, 1987), and personal influence (Friedkin, 1993). Actors sharing equivalent positions (in this case, two Facebook friends, neither of whom is in a position of authority) may influence behavior adoption (Burt, 1987). Networks contain two mechanisms for communication: a two-step flow process initiated by opinion leaders followed by a contagion process whereby nodes with structural equivalence spread adopted behaviors within the group (Burt, 1999; Liu et al., 2014).

In 1973, Granovetter's "The Strength of Weak Ties" defined bridging ties as providing the only pathway between two distinct clusters (e.g. people who sought employment through distant contacts as opposed to friends and family.) The strength of these ties was found not in the number of connections or frequency of contact but rather the ability of an individual to gain novel information from those outside their homogenous network center (Granovetter, 1973). Thus, the theoretical framework developed to encompass versions of computer-mediated

network theory, which focused on the overall properties of the network, and media effects research, which investigated the flow of Facebook messages and their effects on the audience (Liu et al., 2014). As people are the center of all networks, early studies focused on social influence at an individual level, but since then this theoretical foundation has been applied more holistically and in numerous contexts including health communication. Instead of simply studying individual egos, direct observation of the interaction between egos and alters, or one's social contacts, is salient to uncover novel insights about social network dynamics without possibility of participants' self-report bias. By organically studying interactions on Facebook, it is possible to trace the extent of influence among group members through the contagion of a bio behavioral trait (Smith & Christakis, 2008). For example, a person's likelihood of becoming obese is found to increase by 57% if a friend becomes obese, and network obesity clusters extend to three degrees of separation (Christakis & Fowler, 2007).

Maternal Facebook Dependence-Childhood Vaccine Avoidance Model



High Need for Homophily as Related to Elite Skepticism

Merriam Webster defines homophily as “a theory in sociology that people tend to form connections with others who are similar to them in characteristics such as socioeconomic status, values, beliefs, or attitudes.” At its essence, homophily is likemindedness, or “the principle that contact between similar people occurs at a higher rate than among dissimilar people”

(McPherson, Smith-Lovin, & Cook, 2001, p. 416), and the reason that the popular cliché claims that “birds of a feather flock together.”

Although online social networks may not coincide with face-to-face networks, the extent of homophily may be similar in both networks (Salathé & Khandelwal, 2011). Value-based homophily bonds individuals who share the same beliefs regardless of demographic characteristics (Lönqvist & Ikonen, 2016). One study investigated this tendency to interact with similar individuals in communications on social networks and found that social media may be a force for increasing exposure to like-minded information for all groups through ideological homophily and selective exposure to information (Halberstam & Knight, 2016). Facebook facilitates the formulation of virtual sub-groups of like-minded individuals that can act as echo chambers such as closed anti-vaccination Facebook groups whose members advocate for a natural or “crunchy” parenting style, which involves natural solutions to build up a child’s immunity rather than medical interventions. Just as the market-leading Google search engine personalize search results for each user, thereby promoting homophily (Passe, Drake, & Mayger, 2017), joining one natural parenting Facebook group will prompt the Facebook algorithm to suggest additional groups with the same membership network, such as anti-vaccination groups.

Homophily is particularly important for new mothers (Suitor & Keeton, 1997). Facebook fills this need by providing immediate and convenient connections to parents whom can offer

advice and support in child-rearing (Dávid-Barrett et al., 2016). Network dynamics affecting the diffusion of health information is a critical factor when considering the effects of social networks such as Facebook on health behavior such as vaccine avoidance (Smith & Christakis, 2008).

Members of these closed Facebook groups centered on one perspective of a health topic, such as advocating against vaccination, are perceived to share at least one value in common: the idea that vaccines are toxic and bad for one's child. Discussion in these groups often revolves around this core belief, and dissenters are removed from the group.

An assessment for perceived homophily (McCroskey, Richmond, & Daly, 1975) has sometimes suffered from low inter-item agreement. Therefore, using this scale as a starting point, a six-item scale with statements such as "My peers on Facebook also believe that a natural parenting style is superior" and "I am a member of a private Facebook group with other knowledgeable parents similar to me" should be tested. After data collection, the scale can be tested for validity, and the Cronbach's alpha test would indicate which items should be deleted.

P1: Facebook dependence is likely to lead to elite skepticism if mothers have a high need for homophily.

Low Perception of Opinion Safety in Quasi-Private Setting as Related to Elite Skepticism

User-generated Facebook groups may be categorized as open, closed, or secret. Content in closed Facebook groups may be viewed only by group members, and self-appointed administrators must approve content, leading to the perception of greater privacy (Facebook, 2018). Closed Facebook groups provide a safe space for new mothers to seek support outside of their personal social contacts. Mothers have said they feel freer to address sensitive topics in private groups because family and friends cannot read their interactions, and they believe they are getting reliable answers from trusted sources (Bäckström et al., 2017). Nearly nine in 10

mothers reported interacting with no more than half of their Facebook friends outside the platform, and most new parents reported that the majority of their Facebook friends were not relatives (Bartholomew et al., 2012). Thus, new mothers utilize this weak-ties network to acquire or maintain social capital including resources, advice, and kinship (Belsky, 1984; Holtz, Smock, & Reyes-Gastelum, 2015).

Mothers may feel safer in private Facebook groups due to an illusion of anonymity (Drentea & Moren-Cross, 2005; Lankton, McKnight, & Tripp, 2017). Mothers' names and pictures are attached to their posts, but the closed group is structured to give members a perception of privacy, that the information they share will not be disclosed outside the group, even if members number in the thousands. Interactions between moderators and group members leads to system-based trust and perceived protection (Pan, Wan, Fan, Liu, & Archer, 2017). On the other hand, mothers who may have great privacy concerns and less trust in Facebook are less likely to engage in these closed groups to exchange personal health information with other mothers.

To measure perception of opinion safety, a four-dimensional privacy orientation scale designed for measuring privacy attitudes of social network site users should be adapted and implemented (Baruh & Cemalcılar, 2014). The scale included statements such as "I am concerned with the consequences of sharing identity information on Facebook, even in closed groups" and "I worry about sharing information with more people than I intend to and don't trust people on Facebook."

P2: First-time mothers who have a high dependence on Facebook are less likely to express high skepticism of elites if they have a low perception of opinion safety in a quasi-private Facebook setting.

High Social Comparison Orientation as Related to Elite Skepticism

Comparing one's self to an idealized version of others they see on Facebook can lead to feeling worse about one's self and lower health and well-being (Coyne, McDaniel, & Stockdale, 2017). Higher levels of Facebook use have been correlated with higher stress for new parents (Bartholomew et al., 2012). This could be a result of mothers feeling pressure to present themselves as ideal parents online but perceive themselves to fall short in comparison to their peers on Facebook.

First-time mothers may feel especially inadequate when comparing themselves to a more experienced mother with multiple children. Published research supports that parents who decide to decline (or partially decline) vaccinations for their children most often engage in a time-intensive parenting style dubbed "salutogenic;" salutogenic parenting involves breastfeeding, eating organic and/or homegrown foods, and reducing exposure to toxins in an effort to boost the natural immunity of their children and reduce the overall need for vaccinations (Ward et al., 2017). On Facebook, the presentation of an ideal mom is often touted to be salutogenic or colloquially referred to as "crunchy." Observations of an anti-vaccination Facebook group uncovered vocalizations of shaming the idealized mother's counterpart, a "silky" mother who is seen to value convenience and perhaps even selfishness above the well-being of her baby. First-time mothers may experience a feeling of role overload as they see peers balancing a crunchy parenting style via their Facebook newsfeed and perceive that, in comparison, they are falling woefully short (Bartholomew et al., 2012). Notably, Facebook-dependent users believe Facebook influences everyone except themselves, a phenomenon known as the third-person effect. Thus, new mothers using Facebook often draw unfavorable comparisons, which erodes their own maternal self-confidence (Buturoiu, Durach, Udrea, & Corbu, 2017; Coyne et al., 2017).

Social comparison should be measured on a five-point scale that consists of 11 statements such as “I often compare myself with others with respect to what I have accomplished in life” and “If I want to learn more about something, I try to find out what others think about it” (Gibbons & Buunk, 1999).

P3: Facebook dependence is more likely to lead to elite skepticism if mothers have a high social comparison orientation.

High Parental Self-Efficacy as Related to Elite Skepticism

Self-efficacy is confidence or belief in one’s ability to perform a specific task or behavior (Bandura, 1977). Self-perceptions of competency are self-efficacy expectations, while outcome expectations stem from the environment and depend on actual knowledge of the skill combined with perception of social support for one’s actions (Coleman & Karraker, 1998). Individuals with high self-efficacy are less likely to experience online addiction, while individuals with low self-efficacy are more likely to feel lonely or suffer from depression and thus engage in more digital social interactions (İskender & Akin, 2010). Although many first-time mothers may be active on Facebook regardless of self-efficacy, mothers with high self-efficacy may use Facebook in a more positive way. For example, mothers with high self-efficacy may enjoy sharing photos of their newborn, but they may be less likely to actively seek parenting advice or to engage in unfavorable social comparisons.

Self-efficacy has been found to affect personal satisfaction levels during the adjustment to parenthood. Because parents with low self-efficacy experience more anxiety and self-doubt, see environmental demands as threats, and struggle to cope with challenges, they may need more outside support and thus choose to join a private parenting group on Facebook (Coleman & Karraker, 1998). Self-efficacy may be developed through vicarious experiences; first-time

mothers may wish to observe the comments of others on Facebook to feel more confident in their own stance on a particular parenting issue such as vaccination.

To measure parental self-efficacy, an adaptation of a four-item Maternal Self-Efficacy Scale should be used (Alghamdi, Horodyski, & Stommel, 2017). The scale measures statements such as “I feel confident that I am knowledgeable about childhood vaccinations and am making the correct decision for my child” and the inverse, “My knowledge about childhood vaccinations may not be adequate to make the right choice for my child without asking other moms, who may know more, for advice.”

P4: Facebook dependence is less likely to lead to elite skepticism mothers express high parental self-efficacy.

Elite Skepticism as Mediator Between Facebook Dependence and Vaccine Avoidance

Elite skepticism is the mediator between the independent variable, first-time mothers' dependence on Facebook, and the dependent variable, vaccine avoidance. Elite skepticism is distrust in powerful institutions and authority figures such as physicians, the government, or pharmaceutical companies to act as a primary source and gatekeeper of information about childhood vaccines. Skepticism about the wisdom of elites can encourage first-time mothers to express skepticism about widely accepted wisdom regarding the safety and efficacy of vaccines.

Elite skepticism can be encouraged both by the rejection of dominant narratives inherent in postmodernism as well as radical egalitarianism that rejects any notion of a superiority in viewpoint. Just as the Renaissance democratized religious texts that had previously been available only in Latin and were controlled by the Roman Catholic Church, the democratization of health care through websites such as WebMD and social network sites allows mothers today to access health information once reserved for medical school curricula. In such a setting, a

physician's opinion is simply one of many and should not be seen as the absolute right course of action (Drentea & Moren-Cross, 2005).

Mothers skeptical of elite authority have only to log on to Facebook to seek advice from anonymous individuals, creating their own sources of expertise through peer-to-peer connections. If a discrepancy exists between medical providers' recommendations and information found on Facebook, skeptical mothers may prefer advice from other mothers and welcome professional advice only if the messages are supportive and consistent (Harrison et al., 2018). Expectant mothers also report viewing digital sources such as Facebook as more trustworthy than information from medical professionals (Bäckström et al., 2017) and may be skeptical of doctors, whom they see receiving financial incentives for administering childhood vaccines. Some mothers in an anti-vaccine Facebook group alleged corruption among health care professionals and expressed fear of "stealth vaccinating," or secretly vaccinating a newborn in the hospital against the parents' expressed wishes (Bradshaw, Shelton, Wollney, Treise, & Auguste, 2018)

To measure elite skepticism, a six-item scale should be developed with statements such as "I always listen to my doctor when making health care decisions for my child" and inversely "I never believe people on social network sites who question the advice of my child's doctor."

P5: Facebook dependence is more likely to result in vaccine avoidance if mothers express a higher degree of elite skepticism.

High Need for Peer Affirmation as Related to Vaccine Avoidance

First-time mothers crave assurance they are performing their new maternal role competently and often seek affirmation that they are measuring up to an indeterminate, relative benchmark of a "good mother." New mothers who are active on Facebook believe they need to

live up to others' expectations and look for validation of their identities as mothers, worrying when their child's a posted photo does not gain a suitable number of likes and comments (The Conversation, 2017). This positive reinforcement is powerful when coming from peers.

Expectant parents report feeling recognition and belonging when they share their experiences with other expectant parents (Bäckström et al., 2017). Emotional support and receiving the encouragement and empathy of peers when facing an issue such as postpartum depression was critical for many new mothers (Evans et al., 2012).

To measure need for peer affirmation, a six-item scale should be created with statements such as "I feel unsure of myself as a new mother and look to Facebook for validation of my parenting skills" and "I have a strong desire to see what my peers are doing on Facebook and make sure they agree with my parenting decisions."

P6: Elite skepticism is more likely to lead to vaccine avoidance if the mother has a high need for peer affirmation.

High Loss Aversion as Related to Vaccine Avoidance

Anti-vaccination websites with fear appeals and anecdotes about vaccine injury increase users' risk perception and leads to increased negativity toward vaccines for vaccine-hesitant parents (Dubé & MacDonald, 2016). One example of such a claim is Andrew Wakefield's discredited and retracted claim linking the measles, mumps, and rubella (MMR) vaccine to autism spectrum disorder, which has persisted on some websites despite repeated scientific refutations (CNN Wire Staff, 2010). Although a majority of Americans vaccinate their children for measles, mumps, and rubella, parents with children ages 4 or younger reported more concern than did other Americans about potential adverse effects from the vaccine and are less inclined to believe the benefits outweigh the risks (Funk, 2017).

Prospect Theory explains how framing of messages can skew decisions because people have a greater aversion to risk when posed as a possible loss rather than as a potential gain (Kahneman & Tversky, 1979). Loss framing of vaccination messages has been effective when messaging emphasizes the risk of disease (Abhyankar, O'Connor & Lawton 2008). However, on anti-vaccination Facebook groups, mothers may encounter loss-framed messages of adverse side effects and ignore the losses associated with a disease that few encounter in daily life. Anti-vaccine posts include obituaries, anecdotes of diagnostic injury, and videos showing children with autism, hospitalization, and epilepsy as side effects of having received vaccines. These loss-framed posts may convince parents that vaccines are dangerous and more risky than vaccine-preventable diseases (Ma & Stahl, 2017). According to prospect theory, people tend to embrace framing of potential gains without loss, such as having healthy and unvaccinated children (Harrington & Kerr, 2017). Risk aversion is more salient for major events such as marriage or childbirth (Decker & Schmitz, n.d.), and unvaccinated children are often purported to be healthier, with the caveat that a mother will not have to feel guilty for actively doing something to cause harm to her child

To measure loss aversion, a six-item scale should adapt a related survey (Jones et al., 2012) with questions such as “Measles is a dangerous disease” and “My child has a much higher chance of developing autism from the MMR vaccine than developing measles.”

P7: Elite skepticism is more likely to lead to childhood vaccine avoidance if the mother has a high loss aversion.

High In-Group Favoritism as Related to Vaccine Avoidance

In-group favoritism, or the tendency to favor members of one's own group, is determined by preferences and beliefs (Everett, Faber, & Crockett, 2015). This helps to develop one's social

identity or “that part of an individual’s self-concept which derives from his knowledge of his membership of a social group (or groups) together with the value and emotional significance attached to that membership” (Tajfel, 1974, p. 69). Closed Facebook groups promote knowledge sharing and social interaction among individuals with shared beliefs, common interests, or preferences. Facebook group members are favorable toward social media (Chu, 2011), and a sense of belonging influences users’ knowledge sharing in private spaces (Chai & Kim, 2012). Group members feel they know one another in closed Facebook groups so they identify with the group in a way that is not found in online blogs or parenting discussion forums. Facebook group members foster in-group identity with verbiage and expressions (Welbers & De Nooy, 2014). For example, one anti-vaccination Facebook group refers to its members not as “anti-vaxxers” but as “ex-vaxxers.” Those who deviate from group norms are seen as “trolls” and are often removed from the group. By excluding nonconformists, these groups promote a bubble that exposes members to a one-sided view of the world or a singular idea of what it means to be a good mother. Omission of diverse points of view can shape attitudes and ideologies (Ditrich & Sassenberg, 2017).

To measure in-group favoritism, the collective self-esteem scale (Luhtanen & Crocker, 1992) should be used with statements such as “I am a worthy member of the social groups I belong to” and “In general, I’m glad to be a member of the social groups I belong to.”

P8: Elite skepticism is likely to lead to vaccine avoidance if the mother has high in-group favoritism.

Rejection of Vox Populi as Related to Vaccine Avoidance

Vox populi, a Latin phrase translated literally to “voice of the people,” is a preference for the perceived wisdom of the crowd as superior to the wisdom of any individual, including an

expert. Mothers who prefer vox populi confer authority on the opinions of strangers regarding childhood vaccination due to a preference for crowd-sourced wisdom (Ma & Stahl, 2017) in lieu of seeking and following the advice of a trained physician. Discussions on anti-vaccination Facebook groups often attribute the knowledge of trained medical professionals as “just another opinion” or discount a physician’s education. Conversely, parents who reject vox populi are more willing to accept the specialized knowledge that physicians possess and less likely to see the wisdom of the crowd as equal.

To measure acceptance or rejection of vox populi, a content analysis approach with binary coding schema has been implemented in previous studies to determine whether mothers express a preference for the wisdom of the crowds (Lin & Hauptmann, 2008) with varying degrees of success. For the purposes of this model, and to maintain consistency with other proposed measures, a 5-point, 5-item Likert scale should be developed to measure the vox populi construct, with statements such as “I trust medical advice from “Mama blogs” with many likes, positive comments, and shares” and “I believe that advice from other mothers is more trustworthy when multiple people agree that it is true.”

P9: Elite skepticism is less likely to lead to vaccine avoidance if the mother rejects vox populi.

Discussion and Conclusion Through instant access to medical information anytime and connections with an extensive peer support network on Facebook, individuals may research their symptoms, postulate a diagnosis, and even discover treatment options prior to a doctor’s appointment, where they may feel more fully equipped to dictate the course of action to the physician as opposed to the other way around. Or, parents may circumvent the doctor’s office altogether. Facebook dependence was chosen as the independent variable in this model

because this SNS remains the most widely used. Many participants embrace social networking sites for the first time during pregnancy and utilize Facebook to develop a social support network built on the strength of weak ties (Sundstrom, 2016). Mothers of infants report finding advice and information from a variety of lay and professional sources, but learning from other mothers was universally cited as an important source of information (Harrison, Hepworth, & Brodribb, 2018).

Over the last decade, SNSs have been found to predict behavioral health outcomes, and conversely, shared behaviors have been found to affect the selection of social network members (Lönnqvist & Itkonen, 2016). Additionally, Web 2.0 has been described as a ‘hotbed’ for anti-vaccination activism, and parents who choose to delay or avoid vaccines are more likely than other parents to have utilized online resources, such as social media for health information (Kata, 2012). Facebook gives the vocal minority of anti-vaccine advocates a digital megaphone to share their user-generated messages about adverse vaccine side effects, such as autism, with new, questioning, first-time parents who may be seeking advice from more experienced parents (Dubé & MacDonald, 2016).

Despite high vaccination rates in the United States overall, Kurosky, Davis, and Krishnarajah (2016) suggested that 75 percent of children do not receive all recommended vaccines at age-appropriate times despite the Advisory Committee on Immunization Practice’s recommendations for routine vaccination by two years of age. Consequently, diseases such as measles, which was declared virtually eliminated in the United States in 2000, have occurred in 12 states from Jan. 1 to March 7, 2019 with 228 confirmed individual cases (CDC, 2019), and vaccine hesitancy has been identified as one of the top 10 global health threats in 2019 by the World Health Organization. Notably, countries with higher levels of schooling and good access

to health services, including the United States, are associated with lower rates of positive vaccine sentiment, indicating an emerging inverse relationship between vaccine sentiments and socio-economic status (Bocquier et al., 2018; Larson et al., 2016) potentially due to elimination of vaccine preventable diseases in these more affluent areas and an increased focus on side effects of the vaccines themselves.

In peer-to-peer Facebook groups, parents do not desire or expect scientific reliability. Instead, cognitive authority is given to strangers' second-hand knowledge about vaccination because these individuals share the same worldview (e.g. parenting style ideal) and Facebook group membership (Ma & Stahl, 2017).

Facebook, by its very essence, must be explored beyond the individual social influence level of which much research has been comprised of. Ideas and norms flow through thousands of individuals, and the cumulative impact of collateral health effects among social contacts can be positive or negative (e.g. uptake in individual vaccination decisions to either reinforce or dispel herd immunity). Patients' embeddedness in Facebook groups should be analyzed in terms of potential health interventions. For example, as obesity has been shown to spread from person to person through social networking sites, it might be possible to harness the same platform to spread positive health messages (Smith & Christakis, 2008).

As articulated throughout this current work, Facebook offers a distinctively powerful influence on first-time mothers because it supplies needed affirmation and support. It fosters community through groups, both public and private, that enables both the like-minded and the curious to seek advice from peers. Thus, it is particularly well-suited to serve as an information conduit and reinforcement mechanism for parental guidance on whether to accept vaccination advice from professionals or rely on the perceived wisdom of other mothers.

This model serves as a conceptual response postulating a link between first-time mothers' dependence on Facebook and childhood vaccine avoidance in response to calls for research to further examine the role of online communities in the transmission of health information and how group members may influence one another in health-related decision making (Sundstrom, 2016). The current work proposed a conceptual model that can help to explain how reliance on Facebook for its sense of community can lead, unwittingly, to deviance from or rejection of accepted vaccination schedules. The model postulated that this relationship is mediated by elite skepticism, a hallmark of U.S. culture and its preference for individual autonomy. Distrust of physicians is widespread on some anti-vaccination Facebook groups, and some mothers express a desire for more candid conversation with health care providers regarding possible risks of vaccines. Providers may take the safety and efficacy of vaccines for granted based upon scientific knowledge, but some vaccine-hesitant first-time mothers may feel confused when encountering conflicting information from Facebook and the pediatrician's office. They then turn to the collective wisdom of the crowd to gain immediate consensus in establishing a range of normalcy for correct parental decision-making for a child (Drentea & Moren-Cross, 2005). Extended, safe-space dialogue and a risk-benefit analysis may cause parents to perceive risk as coming from the vaccination rather than the disease, thereby decreasing childhood vaccination uptake.

This study also contributes to academic understanding by rejecting the health information deficit model, which implies that individuals will make the correct decision when given adequate information. Although information may be essential to initiate any behavioral change, it is rarely sufficient, as patients are consistently noncompliant with medical advice. As opposed to passively receiving and implementing health information, patients are active learners who seek

out external information and are engaged in health decision-making (Marteau, Sowden, & Armstrong, 1998). The health information deficit model cannot explain how educated mothers who seek and carefully weigh information would fail to accept the standard vaccination scales. Rather, in accordance with social network theory, the influence of a first-time mother's Facebook affiliations and selected group memberships should not be downplayed. Social network theory has been applied in a variety of health settings and illustrates that an individual's own health decisions are heavily influenced, whether consciously or subconsciously, by her contacts online. Similarly, in the vein of selective exposure theory, mothers may choose to find more evidence to build a case against vaccination after being first exposed to anti-vaccination propaganda messages on social media. Instead of searching for contradictory messages that might induce cognitive dissonance, first-time mothers may instead feel inclined to seek additional support and feedback against vaccination, after first encountering the most prevalent anti-vaccination arguments in closed Facebook communities. The model presented in this paper takes a step toward supplying that information. For instance, the explicated concepts of high need for homophily and high social comparison orientation could be tested for salience in conjunction with elite skepticism for first-time mothers who are active Facebook users against a population with these associated traits who do not actively use Facebook (due to a low perception of opinion safety, privacy concerns, or other issues) to determine how maternal Facebook group membership can influence childhood vaccine avoidance. Likewise, maternal dependence on Facebook moderated by a high need for peer affirmation and high levels of loss aversion could be tested to help explain how an underlying distrust in physicians, the government, and Big Pharma perpetuates vaccine conspiracy theories online in regards to vaccine safety and efficacy, thus leading to decreased childhood vaccination uptake. This is

especially timely, with some social network platforms, such as Pinterest, blocking search results for certain misleading anti-vaccine content, and other social networks determining what responsibility that have, if any, to curb the spread of misinformation (Caron, 2019). Building on the foundations of this model, researchers may discern which communication approaches are most effective in combating anti-vaccine beliefs in accordance with social network theory and the rumors that are spread on Facebook as opposed to simply hoping to correct misinformation with scientific evidence, a common strategy of the health information deficit model, which has been found to produce a backfire effect in the case of vaccination education specifically.

Limitations and Future Research

The model is limited by necessity to a parsimonious identification of key variables involved in that thought process, and thus cannot include all factors in the decision-making process. Another limitation is that exogenous variables may have greater influence than the ones identified here. That, in turn, suggests a future study that could determine which variables are most salient for this model. Multiple studies could be conducted to test the model in sections or in its entirety to determine whether the variables identified hold the most weight.

In a practical application, the understudied latent variables that significantly affect first-time mothers' decision-making about childhood vaccines may provide a foundation of understanding to help medical professionals better communicate with vaccine skeptical mothers. Pediatricians confident in medical wisdom about vaccinations may wish before prescription to engage parents in a discussion to ascertain their hesitancy or confusion (e.g. listening uncritically to information mothers present from Facebook as opposed to automatically dismissing it, an action that might erode a first-time mother's trust). By thoroughly addressing questions and concerns rising from Facebook dialogue and expressing an appreciation and understanding for a

mother's utilization of her Facebook network to help make the parenting decisions, the provider has a better chance of developing a positive rapport with the first-time mother. By thoroughly addressing questions and concerns rising from Facebook dialogue and expressing an appreciation and understanding rather than contempt for a mother's utilization of her Facebook network to help make the best parenting decisions in light of her simple desire to be a "good mom," the provider can engage in patient-centered, two way communication, which could open a dialogue that identifies current gaps in childhood vaccination education and questions that the provider could answer. Finally, providers and governmental agencies may wish to become better informed about private Facebook groups devoted to childhood vaccination and the role that they play in this information-seeking and decision-making process. Future research may include the design of more effective pro-vaccination resources that would reach this same target population on a channel where they are most comfortable and actively engaged, and experiments may be conducted to determine vaccination messaging that is effective for those who prefer the safe harbor of closed Facebook groups. Rather than attempt to thwart the perceived superiority of vox populi and weak ties networks as a credible source of health advice, it may be possible to capitalize on the possibilities of peer-to-peer pro-vaccination advocacy on Facebook. Finally, beyond the context of vaccination, relying on information from closed, online communities (e.g., Facebook groups of like-minded people) as well as elite skepticism and maternal preference for vox populi can influence maternal decision making on myriad health issues from cancer to diabetes to disabilities. Closed groups, in particular, foster rich open discussions due to the perception of a quasi-private setting. Conversations in these groups are more robust than those on open social media channels, and further investigation is warranted.

References

- Abhyankar, P., O'Connor, D.B., & Lawton, R. (2008). The role of message framing in promoting MMR vaccination: evidence of a loss-frame advantage. *Psychology Health & Medicine, 13*(1), 1-16. doi:10.1080/13548500701235732.
- Alghamdi, S., Horodyski, M., & Stommel, M. (2017). Racial and ethnic differences in breastfeeding, maternal knowledge, and self-efficacy among low-income mothers. *Applied Nursing Research, 37*, 24-27. doi://doi-org.lp.hscl.ufl.edu/10.1016/j.apnr.2017.07.009
- Bäckström, C., Larsson, T., Wahlgren, E., Golsäter, M., Mårtensson, L. B., & Thorstensson, S. (2017). 'It makes you feel like you are not alone': Expectant first-time mothers' experiences of social support within the social network, when preparing for childbirth and parenting. *Sexual and Reproductive Healthcare, 12*, 51-57. doi://doi.org/10.1016/j.srhc.2017.02.007
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. Retrieved December 3, 2017, from <https://pdfs.semanticscholar.org/e8af/4369e0533210860587b7add0c566b74b963a.pdf>.
- Bartholomew, M. K., Schoppe-Sullivan, S., Glassman, M., Kamp Dush, C. M., & Sullivan, J. M. (2012). New parents' Facebook use at the transition to parenthood. *Family Relations, 61*(3), 455-469. doi:10.1111/j.1741-3729.2012.00708.x
- Baruh, L., & Cemalcılar, Z. (2014). It is more than personal: Development and validation of a multidimensional privacy orientation scale. *Personality and Individual Differences, 70*, 165-170. doi: 10.1016/j.paid.2014.06.042

- Belsky, J. (1984). The determinants of parenting: A process model. *Child Development*, 55, 83–96.
- Bradshaw, A. S., Shelton, S. S., Wollney, E., Treise, D. & Auguste, K. (2018). Pro-Vaxxers Get Out: How Anti-Vaccine Advocates Influence Questioning Pregnant, First-Time, & New Moms on Facebook. Association for Marketing and Health Care Research Proceedings.
- Bocquier, A., Fressard, L., Cortaredona, S., Zaytseva, A., Ward, J., Gautier, A., . . . Barometre Sante, 2. G. (2018). Social differentiation of vaccine hesitancy among french parents and the mediating role of trust and commitment to health: A nationwide cross-sectional study. *Vaccine*, 36(50), 7666-7673. doi:10.1016/j.vaccine.2018.10.085
- Brunson, E. K. (2013). The impact of social networks on parents' vaccination decisions. *Pediatrics*, 131(5), e1397–e1404.
- Bucy, E. P., & Tao, C. C. (2007). The mediated moderation model of interactivity. *Media Psychology*, 9(3), 647-672. doi:10.1080/15213260701283269
- Burt, R. S. (1987). Social contagion and innovation: Cohesion versus structural equivalence. *American Journal of Sociology*, 92(6), 1287–1335. doi: 10.1086/228667
- Burt, R. S. (1999). The social capital of opinion leaders. *Annals of the American Academy of Political and Social Science*, 566(1), 37–54. doi: 10.1177/0002716299566001004
- Buturoiu, R., Durach, F., Udrea, G., & Corbu, N. (2017). Third-person perception and its predictors in the age of facebook. *Journal of Media Research*, 10(2), 18-36. doi:10.24193/jmr.28.2
- Caron, C. (2019, Feb. 23). Pinterest restricts vaccine search results to curb spread of misinformation. Retrieved on April 1, 2019 from: <https://www.nytimes.com/2019/02/23/health/pinterest-vaccination-searches.html/>.

CDC. (2019). Measles cases and outbreaks. Centers for Disease Control and Prevention.

Retrieved on March 9, 2019 from: <https://www.cdc.gov/measles/cases-outbreaks.html>.

Centers for Disease Control Glossary. (2015). Retrieved October 29, 2017, from

<https://www.cdc.gov/vaccines/terms/glossary.html>.

Christakis N. A., Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *New England Journal of Medicine*, 357(4), 370–79.

Chai, S. Kim, M. (2012). A socio-technical approach to knowledge contribution behavior: An empirical investigation of social networking sites users. *International Journal of Information Management*, 32(2), 118-126.

Chu, S. C. (2011). Virtual advertising in social media: Participation in Facebook groups and responses among college-aged users. *Journal of Interactive Advertising*, 12(1), 30-43.

CNN Wire Staff. (2010). Autism study doctor barred for 'serious misconduct'. Retrieved October 29, 2017, from

<http://www.cnn.com/2010/HEALTH/05/24/autism.vaccine.doctor.banned/index.html>.

Coleman, P. K., & Karraker, K. H. (1998). Self-efficacy and parenting quality: Findings and future applications. *Developmental Review*, 18(1), 47-85.

[doi://doi.org/10.1006/drev.1997.0448](https://doi.org/10.1006/drev.1997.0448)Covolo, L., Ceretti, E., Passeri, C., Boletti, M., &

Gelatti, U. (2017). What arguments on vaccinations run through YouTube videos in Italy? A content analysis. *Human Vaccines & Immunotherapeutics*, 13(7), 1693-1699.

[doi:10.1080/21645515.2017.13061](https://doi.org/10.1080/21645515.2017.13061)

Coyne, S. M., McDaniel, B. T., & Stockdale, L. A. (2017). “Do you dare to compare?”

associations between maternal social comparisons on social networking sites and

- parenting, mental health, and romantic relationship outcomes. *Computers in Human Behavior*, 70. doi://doi.org/10.1016/j.chb.2016.12.081
- Danchin, M. H., Costa-Pinto, J., Attwell, K., Willaby, H., Wiley, K., Hoq, M., . . . Marshall, H. (2017). Vaccine decision-making begins in pregnancy: Correlation between vaccine concerns, intentions and maternal vaccination with subsequent childhood vaccine uptake. *Vaccine*, 36(44), 6473-6479. doi:10.1016/j.vaccine.2017.08.003
- Dávid-Barrett, T., Behncke Izquierdo, I., Carney, J., Nowak, K., Launay, J., & Rotkirch, A. (2016). Life course similarities on social networking sites. *Advances in Life Course Research*, 30, 84-89. doi:10.1016/j.alcr.2016.04.002
- Decker, S., & Schmitz, H. (n.d.). Health shocks and risk aversion. *RUHR Economic Papers*. <http://dx.doi.org/10.4419/86788673>
- Ditrich, L., & Sassenberg, K. (2017). Kicking out the trolls – antecedents of social exclusion intentions in facebook groups. *Computers in Human Behavior*, 75, 32-41. doi://doi.org/10.1016/j.chb.2017.04.049
- Djafarova, E., & Trofimenko, O. (2017). Exploring the relationships between self-presentation and self-esteem of mothers in social media in Russia. *Computers in Human Behavior*, 73, 20-27. doi:10.1016/j.chb.2017.03.021
- Drentea, P. & Moren-Cross, J. L. (2005), Social capital and social support on the web: The case of an internet mother site. *Sociology of Health & Illness*, 27, 920–943. doi:10.1111/j.1467-9566.2005.00464.x
- Dubé, E., Vivion, M., Sauvageau, C., Gagneur, A., Gagnon, R., & Guay, M. (2015). “Nature does things well, why should we interfere?”: Vaccine hesitancy among mothers. *Qualitative Health Research*, 26(3), 411-425.

- Edison Research Moms and Media 2016 Report. (2016). Retrieved October 27, 2017, from <http://www.edisonresearch.com/wp-content/uploads/2016/05/Moms-and-Media-2016-Report.pdf>
- Evans, M., Donelle, L., & Hume-Loveland, L. (2012). Social support and online postpartum depression discussion groups: A content analysis. *Patient Education and Counseling*, 87(3), 405-410. doi://doi.org/10.1016/j.pec.2011.09.011
- Everett, J. A. C., Faber, N. S., & Crockett, M. (2015). Preferences and beliefs in ingroup favoritism. *Frontiers in Behavioral Neuroscience*, 9, 1-21.
<http://doi.org/10.3389/fnbeh.2015.00015>
- Facebook. (2018). What are the privacy settings for groups? Retrieved on February 10, 2018 from: https://www.facebook.com/help/220336891328465?helpref=about_content.
- Freeman, L. (1979). Centrality in social networks: Conceptual clarification. *Social Network*, 1, 215–239. doi: 10.1016/0378-8733(78)90021-7
- Friedkin, N. E. (1993). Structural bases of interpersonal influence in groups: A longitudinal case study. *American Sociological Review*, 58(6), 861–872. doi: 10.2307/2095955
- Funk, C. (2017). Parents of young children are more ‘vaccine hesitant’. Retrieved October 29, 2017, from <http://www.pewresearch.org/fact-tank/2017/02/06/parents-of-young-children-are-more-vaccine-hesitant/>.
- Gesser-Edelsburg, A., Walter, N., Shir-Raz, Y., Bar-Lev, O. S., & Rosenblat, S. (2017). The behind-the-scenes activity of parental decision-making discourse regarding childhood vaccination. *American Journal of Infection Control*, 45, 267-271.
<http://dx.doi.org/10.1016/j.ajic.2016.10.009>

- Gibbons, F.X. & Buunk, B.P. (1999). Individual differences in social comparison: The development of a scale of social comparison orientation. *Journal of Personality and Social Psychology*, 76, 129-142.
- Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360–1380. doi: 10.1086/225469
- Halberstam, Y., & Knight, B. (2016). Homophily, group size, and the diffusion of political information in social networks: evidence from Twitter. *Journal of Public Economics*, 143, 73-88. doi.org/10.1016/j.jpubeco.2016.08.011
- Harrington, N. G., & Kerr, A. M. (2017). Rethinking risk: Prospect theory application in health message framing research. *Health Communication*, 32(2), 131-141.
doi:10.1080/10410236.2015.1110004
- Harrison, M., Hepworth, J., & Brodribb, W. (2018). Navigating motherhood and maternal transitional infant feeding: Learnings for health professionals. *Appetite*, 121.
doi://doi.org/10.1016/j.appet.2017.11.095
- Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). *Cultures and Organizations Software of the Mind*. McGraw Hill. doi:http://testrain.info/download/Software%20of%20mind.pdf
- Holtz, B., Smock, A., & Reyes-Gastelum, D. (2015). Connected motherhood: Social support for moms and moms-to-be on Facebook. *Telemed J E Health*, 21(5), 415-421.
doi:10.1089/tmj.2014.0118
- İskender, M., & Akin, A. (2010). Social self-efficacy, academic locus of control, and internet addiction. *Computers & Education*, 54(4). doi://doi.org/10.1016/j.compedu.2009.10.014
- Jones, A. M., Omer, S. B., Bednarczyk, R. A., Halsey, N. A., Moulton, L. H., & Salmon, D. A. (2012). Parents' source of vaccine information and impact on vaccine attitudes, beliefs,

- and nonmedical exemptions. *Advances in Preventative Medicine*, 1-8doi: [10.1155/2012/932741](https://doi.org/10.1155/2012/932741)
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47, 263–291. doi:10.2307/1914185
- Kata, A. (2012). Anti-vaccine activists, Web 2.0, and the postmodern paradigm an overview of tactics and tropes used online by the anti-vaccination movement. *Vaccine*, 30(25), 3778-3789. doi:10.1016/j.vaccine.2011.11.112
- Kurosky, S. K., Davis, K. L., & Krishnarajah, G. (2016). Completion and compliance of childhood vaccinations in the united states. *Vaccine*, 34(3), 387-394. doi:10.1016/j.vaccine.2015.11.011
- Lankton, N. K., McKnight, D. H., & Tripp, J. F. (2017). Facebook privacy management strategies: A cluster analysis of user privacy behaviors. *Computers in Human Behavior*, 76, 149-163. doi://doi.org/10.1016/j.chb.2017.07.015
- Larson, H. J., de Figueiredo, A., Xiaohong, Z., Schulz, W. S., Verger, P., Johnston, I. G., . . . Jones, N. S. (2016). *The state of vaccine confidence 2016: Global insights through a 67-country survey*. doi://doi.org/10.1016/j.ebiom.2016.08.042
- Lin, W., & Hauptmann, A. (2008). Vox populi annotation: Measuring intensity of ideological perspectives by aggregating group judgments. *Proceedings of the Sixth Language Resources and Evaluation Conference (LREC)*, 1-7. Retrieved December 7, 2017, from <http://repository.cmu.edu/cgi/viewcontent.cgi?article=1937&context=compsci>
- Liu, W., Sidhu, A., Beacom, A. M., & Valente, T.W. (2017). Social network theory. in P. Rössler, C. A. Hoffner and L. Zoonen (Eds) *The International Encyclopedia of Media*

- Effects*. doi:10.1002/9781118783764.wbieme0092Lönqvist, J., & Itkonen, J. V. A. (2016). Homogeneity of personal values and personality traits in Facebook social networks. *Journal of Research in Personality*, 60, 24-35.
doi://doi.org/10.1016/j.jrp.2015.11.001
- Luhtanen, R., & Crocker, J. (1992). A collective self-esteem scale: Self-evaluation of one's social identity. *Personality and Social Psychology*, 18(3), 302-318. Retrieved from http://stelar.edc.org/sites/stelar.edc.org/files/Luhtanen_Crocker_1992_A_Collective_Self-Esteem_Scale_Self-Evaluation_of_One's_Social_Identity.pdf
- Ma, J., & Stahl, L. (2017). A multimodal critical discourse analysis of anti-vaccination information on Facebook. *Library and Information Science Research*, 39(4), 303-310.
doi://doi.org/10.1016/j.lisr.2017.11.005
- MacDonald, N. (2015). Vaccination hesitancy: Definition, scope, and determinants. *Vaccine*, 33, 4161-4164. <http://dx.doi.org/10.1016/j.vaccine.2015.04.036>
- Marteau, T., Sowden, A., & Armstrong, D. (1998). Implementing research findings into practice: Beyond the Information Defecit Model. In *Getting Research Findings Into Practice* (pp. 68-77). London: BMJ Publishing Group.
- McCarthy, C. (2016). Why we need to make it harder for parents to refuse vaccines. Retrieved from: <https://www.health.harvard.edu/blog/why-we-need-to-make-it-harder-for-parents-to-refuse-vaccines-2016090610258>.
- McCroskey, J. C., Richmond, V. P., & Daly, J. A. (1975). The development of a measure of perceived homophily in interpersonal communication. *Human Communication Research*, 1(4), 323. Retrieved from

[http://lp.hscl.ufl.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=e
db&AN=61815624&site=eds-live](http://lp.hscl.ufl.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=e
db&AN=61815624&site=eds-live)

McNutt, L., Desemone, C., DeNicola, E., El Chebib, H., Nadeau, J. A., Bednarczyk, R. A., & Shaw, J. (2016). Affluence as a predictor of vaccine refusal and underimmunization in California private kindergartens. *Vaccine*, *34*, 1733-1738.

doi:10.1016/j.vaccine.2015.11.063

McPherson, M., Smith-Lovin, L., & Cook, J.M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, *27*, 415-444.

Nadeau, J., Bednarczyk, R., Masawi, M. R., Meldrum, M.D., Santilli, L., Zansky, S.M., ...

McNutt, L.A. (2015). Vaccinating my way—Use of alternative vaccination schedules in New York state. *The Journal of Pediatrics*, *166*(1), 151-156. doi:

<https://doi.org/10.1016/j.jpeds.2014.09.013>.

Pan, Y., Wan, Y., Fan, J., Liu, B., & Archer, N. (2017). Raising the cohesion and vitality of online communities by reducing privacy concerns. *International Journal of Electronic Commerce*, *21*(2), 151-183. doi:10.1080/10864415.2016.1234281

Passe, J., Drake, C., & Mayger, L. (2017). Homophily, echo chambers, & selective exposure in social networks: What should civic educators do? *Journal of Social Studies Research*.

doi://doi.org/10.1016/j.jssr.2017.08.001

Pew Research Center. (2016). Facebook remains the most popular social media platform.

Retrieved from: [http://www.pewinternet.org/2016/11/11/social-media-update-
2016/pi_2016-11-11_social-media-update_0-01/](http://www.pewinternet.org/2016/11/11/social-media-update-2016/pi_2016-11-11_social-media-update_0-01/)

- Pi, S., Chou, C., & Liao, H. (2013). A study of Facebook Groups members' knowledge sharing. *Computers in Human Behavior*, 29(5), 1971-1979.
doi:10.1016/j.chb.2013.04.019
- Riddle, K. (2014). A theory of vivid media violence. *Communication Theory*, 24(3), 291-310.
doi:10.1111/comt.12040
- Riina, E. M., & Feinberg, M. E. (2012). Involvement in childrearing and mothers' and fathers' adjustment. *Family Relations*, 61(5), 836-850. Retrieved from
<http://lp.hscl.ufl.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ985162&site=eds-live> <http://dx.doi.org/10.1111/j.1741-3729.2012.00739.x>
- Salathé, M., & Khandelwal, S. (2011). Assessing vaccination sentiments with online social media: implications for infectious disease dynamics and control. *PLoS Computational Biology*, 7(10), e1002199. <https://doi.org/10.1371/journal.pcbi.1002199>
- Scott, J. (1991). *Social network analysis: A handbook*. London, UK: Sage.
- Smith, K. P., & Christakis, N. A. (2008). Social networks and health. *Annual Review of Sociology*, 34, 405-429. doi:10.1146/annurev.soc.34.040507.134601
- Stroud, N. J. (2014). Selective Exposure Theories. In *The Oxford Handbook of Political Communication* (pp. 1-21). Oxford Handbooks Online.
doi:10.1093/oxfordhb/9780199793471.013.009_update_001
- Squiers, L., Peinado, S., Berkman, N., Boudewyns, V., & McCormack, L. (2012). The health literacy skills framework. *Journal of Health Communication*, 17(supplement 3), 30-54.
doi:10.1080/10810730.2012.713442

- Suitor, J., & Keeton, S. (1997). Once a friend, always a friend? Effects of homophily on women's support networks across a decade. *Social Networks*, *19*(1), 51-62. doi:10.1016/S0378-8733(96)00290-0
- Tajfel, H. (1974). Social identity and intergroup behaviour. *Social Science Information*, *13*, 65–93. doi:10.1177/053901847401300204
- The Conversation (2017, May 14). Why Facebook May Fuel New Mothers' insecurity. Retrieved May 14, 2017 from: <http://neurosciencenews.com/facebook-mother-insecurity-6669/>
- Tomfohrde, O. J., & Reinke, J. S. (2016). Breastfeeding mothers' use of technology while breastfeeding. *Computers in Human Behavior*, *64*, 556-561. doi://doi.org/10.1016/j.chb.2016.07.057
- Ventola, C. L. (2016). Immunization in the US: Recommendations, barriers, and measures to improve compliance: Part 1: Childhood vaccinations. *Pharmacy and Therapeutics*, *41*(7), 426–436.
- Wang, E., Clymer, J., Davis-Hayes, C. & Buttenheim, A. (2014). Nonmedical exemptions from school immunization requirements: A systematic review. *American Journal of Public Health*, *104*(11), e62–e84.
- Ward, P. R., Attwell, K., Meyer, S. B., Rokkas, P., & Leask, J. (2017). Understanding the perceived logic of care by vaccine-hesitant and vaccine-refusing parents: A qualitative study in Australia. *PLoS One*, *12*(10). <https://doi.org/10.1371/journal.pone.0185955>.
- Weiner, J. L., Fisher, A. M., Nowak, G. J., Basket, M. M., & Gellin, B. G. (2015). Childhood immunizations: First-time expectant mothers' knowledge, beliefs, intentions, and

behaviors. *American Journal of Preventative Medicine*, 49(6)(Suppl. 4), S426-S434.

doi://doi.org/10.1016/j.amepre.2015.07.002

Welbers, K. & De Nooy, W. (2014). Stylistic accommodation on an internet forum as bonding:

Do posters adapt to the style of their peers? *American Behavioral Scientist*, 58, 1361-

1375. doi:10.1177/0002764214527086

World Health Organization. (2018). *Measles fact sheet*. World Health Organization. Retrieved

from: <https://www.who.int/news-room/fact-sheets/detail/measles>.