# USES AND GRATIFICATIONS OF SCIENTIFIC SUBREDDITS: AN EXAMINATION OF ONLINE MESSAGE TYPOLOGIES AND THEIR IMPACT

by

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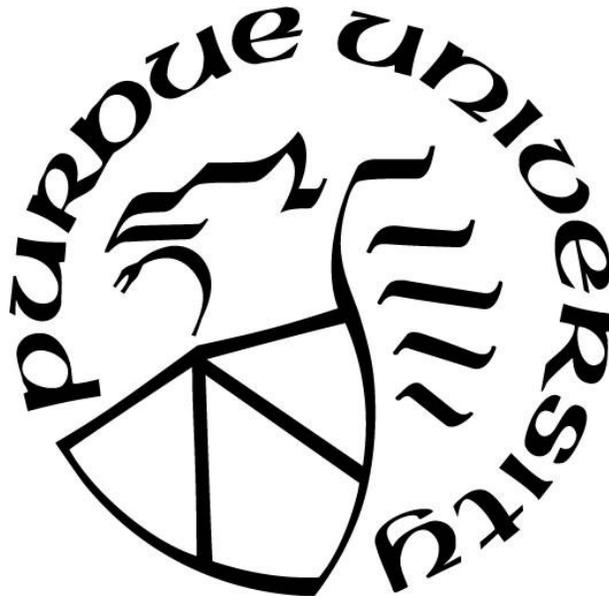
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ABSTRACT

This study uses Incivility Spirals and Uses and Gratifications frameworks to explore how people discuss scientific topics on the social media site Reddit. Specifically, the goals of this project were to develop a new typology of online messages, examine how different factors influence online discourse, and determine whether uses and gratifications vary between Subreddits. The dataset consisted of comments on the top ten posts of 2019 from r/EverythingScience and r/Science. These Subreddits were examined because, although they both focus on science, they differ in terms of group rules and moderator style. Human coders and the text analysis software Linguistic Inquiry and Word Count were used to evaluate the comments on a series of dichotomous and continuous variables. These variables were used in a two-step cluster analysis to identify message typologies. Results indicate that there were three types of messages in the dataset: Polite Participation, Emotional Interrogation, and On Topic Information. Further analysis demonstrated that group norms and the first comment in a conversation impact the quality of discourse that takes place. Conversations on r/Science (the more strict Subreddit) that begin with an On Topic Information comment are more likely to be extremely deliberative, while conversation on r/EverythingScience that begin with an Emotional Interrogation comment are more likely to result in incivility spirals. Results also suggest differences in gratifications between Subreddits, with Redditors using r/Science for productive discussion and r/EverythingScience for heated debate. Theoretical and practical implications of these findings are discussed, along with avenues for future research.

CHAPTER ONE: OVERVIEW

This chapter provides an overview of the current project by summarizing relevant literature, introducing two theoretical frameworks, and discussing the goals of the study. The study methodology, including a summary of data collection, analysis, and results, is also presented.

Online Knowledge Production

The ubiquity of the Internet has led to a more decentralized form of knowledge production (Arazy, Morgan, & Patterson) wherein more individuals are becoming creators, rather than just consumers, of information (Halpern & Gibbs, 2013). Information is dispersed in society, with many people having bits of direct knowledge that would be beneficial to others (Sunstein, 2006). The Internet provides the opportunity for individuals to connect with a wide range of these others and learn vicariously from their experiences. The Internet also makes it possible to interact with diverse groups and form heterogenous networks that can serve as a valuable source of vicarious learning (Brundidge, 2010). Many people live in "information cocoons" and can use the Internet to broaden their horizons through dialogue with people who hold differing points of view (Sunstein, 2006). This online dialogue is essential for knowledge construction and learning (Rafaeli & Kent, 2015). Because the Internet is open-access, anyone can share anything they want at any time. The Internet allows interaction with diverse groups of people, leading to discussion and collaboration with individuals with varying experiences and points of view.

Deliberation

One method for maximizing productive collaboration and knowledge sharing online is deliberation. Deliberation is a communicative process during which people analyze a topic and weigh the pros and cons of each argument (Black, Burkhalter, Gastil, & Stromer-Galley, 2013). Engagement in deliberation is beneficial both for individuals and for society as a whole. Engaging in deliberation allows individuals to reflect on their opinions, which results in the development of well-reasoned ideas (Cappella, Price, & Nir, 2002). Deliberation is beneficial to

society because it leads to better ideas and decision making (Cappella, Price, & Nir, 2002; Habermas, 1989/1962).

Deliberation is also important because it leads to learning (Sagoff, 1998). Deliberation is an effective method for disseminating information because it forces deliberators to confront their differences (Barabas, 2004; Chappell, McGregor, & Vermilyea, 2012). Effective deliberation can help individuals to see all aspects of an issue, allowing them to weigh the pros and cons of each choice. In this way, the process of deliberation allows participants to better understand the issue being discussed by learning from the knowledge and experience of others (Daniels & Walker, 1996). For individuals who have no previous knowledge of the topic being discussed, deliberation gives them the opportunity to construct an opinion through dialogue (Sagoff, 1998). Some scholars claim that the Internet contributes to productive deliberation by providing a platform on which groups of people can share their ideas, learn from their peers, and build knowledge collectively (Brundidge, 2010; Coffey & Woolworth, 2004; Rafaeli & Kent, 2015).

Online Incivility

The existence of a space where productive discourse *can* occur does not mean that it necessarily *will* occur, and online discussions often do not meet the expectations of deliberation (Stroud, Scacco, Muddiman, & Curry, 2014). The process of deliberation emphasizes equality and mutual respect (Black, et. al., 2013) but studies have found significant levels of incivility in online discussions (Hmielowski, Hutchens, & Cicchirillo, 2014; Papacharissi, 2004). On social media, the absence of social niceties often encourages the use of insults and extreme language rather than productive dialogue that could lead to vicarious learning. This behavior is caused by the Online Disinhibition Effect which states that people tend to be more uncivil when interacting through computer-mediated communication rather than face-to-face partially because online incivility typically lacks offline consequences (Anderson, Brossard, Scheufele, Xenos, & Ladwig, 2014; Shepherd, Harvey, Jordan, Srauy, & Miltner, 2015).

Past research has identified a number of factors that impact the quality of online interaction. These include group moderation, group rules and norms, and discussion topic. Past research has found that online incivility is more likely to occur when there is a lack of supervision (Hinduja & Patchin, 2006), and that policing online discussions may decrease instances of hostility (Hmielowski, Hutchens, & Cicchirillo, 2014). Group norms play an

important role in the quality of interaction because communities that permit or normalize incivility are likely to experience lower quality discussions and attract members who behave rudely (Andersson & Pearson, 1999; Phillips, 2016). On the other hand, groups that normalize civil interaction encourage future civil behavior from their members (Robinson & O'Leary-Kelly, 1998). Therefore, creating rules and reinforcing norms that promote civility and discourage incivility can reduce the likelihood of incivility spirals (Andersson & Pearson, 1999). Finally, studies have found that discussions about sensitive or "hot button" topics tend to be more hostile (Hmielowski, Hutchens, & Cicchirillo, 2014; Ksiazek, 2018; Kushin and Kitchener, 2009). This occurs because people feel more strongly about "hot button" issues and process them at a more visceral level (Coe, Kenski, & Rains, 2014).

Incivility Spirals

One effect of uncivil behavior is the formation of incivility spirals. Incivility spirals refer to escalating patterns of behavior that begin with a mildly impolite act followed by a series of increasingly aggressive behaviors which culminate in an act out of proportion with the original event (Cortina, Kabat-Farr, Magley, & Nelson, 2017). In their paper on incivility spirals in the workplace, Andersson and Pearson (1999) give the example of Party A engaging in uncivil behavior toward Party B, such as forgetting to say please or thank you. Party B interprets this behavior as uncivil, which creates the desire to reciprocate. Party A perceives the uncivil act performed by Party B and goes through the same response sequence that Party B experienced after the original act. This sequence of events is due to individuals' desire to retaliate for uncivil treatment (Penney & Spector, 2005). The escalation of the event is the result of nonproportional revenge because, when people reciprocate uncivil behavior, their behavior is typically more uncivil than the original act (Felson & Steadman, 1983; Helm, Bonoma, & Tedeschi, 1972; Youngs, 1986). Past research on incivility spirals has focused primarily on their formation face-to-face and in the workplace. This project extends this framework to explore whether incivility spirals occur online and what factors encourage or discourage them.

Uses and Gratifications

One factor that may influence the formation of incivility spirals is individuals' motivation for using the platform. Therefore, this study applies the Uses and Gratifications to understand how users behave in different contexts on Reddit and how that behavior impacts the development of incivility spirals. Uses and Gratifications is a media use theory originating in mass communication research that guides the examination of consumers' motivation for using different types of media (Stafford, Stafford, & Schkade, 2004). This theory proposes that communication behavior is goal-driven and purposeful in that people choose which media to use based on their needs, wants, and expectations.

Early Uses and Gratifications studies focused solely on media consumption, but scholars are now beginning to reexamine the Uses and Gratifications approach in light of new forms of media (Moore & Chuang, 2017). The previous notion of "media" referred to mass communication tools like newspapers, radio, and television, but the current understanding of media is much broader. The term "media" is now used to refer to a variety of technologies and channels including smart phones, apps, social media sites, and wearable technology (Sundar & Limperos, 2013). Uses and Gratifications is particularly useful in studying how individuals engage with new technology because it is easily adaptable (Moore & Chuang, 2017). In fact, many scholars believe that it is inherently suited for Internet study because of the user-directed nature of that medium (Bumgarner, 2007; Chung & Kim, 2008; Hollenbaugh, 2010; Johnson & Yang, 2009; Stafford, Stafford, & Schkade, 2004).

A New Typology of Online Messages

Past research on online interaction has focused primarily on the dichotomy of civility versus hostility (Anderson, et. al., 2014). For example, Ksiazek (2018) measured the quality of comments based on whether they were civil or hostile. Civility and hostility were measured with word lists and proportions were then calculated so that comments with a greater proportion of civil words were considered quality comments. Another study attempted to create a more nuanced measure of incivility by differentiating between mildly and extremely uncivil messages. Su and colleagues (2018) coded each comment as either impolite or extremely uncivil based on

its level of profanity and the presence or absence of aggression. Comments that did not fit in either of these categories were coded as civil.

A better understanding of the content of online comments has the potential to reveal patterns in uncivil discussions, which will allow site owners and moderators to identify and minimize antisocial behavior (Cheng, Danescu-Niculescu-Mizil, & Leskovec, 2015). Identifying these antisocial messages and educating individuals about the consequences of the comments they post online may lead to healthier online communities where productive discussion is possible (Weinberger, 2011). Given the range of messages that are posted online, and their potentially severe negative effects, it is necessary to develop a more nuanced classification of the types of messages that users post. Therefore, this study will use message characteristics to develop a typology of online messages.

In addition to developing a message typology, one goal of this study is to determine what factors impact the quantity and quality of online interaction. Specifically, this project examines how comment type, the topic being discussed, and the Subreddit the comment is posted on influence user interaction. Past research indicates that group norms and discussion topic impact the quantity and quality of interaction, but I hypothesize that adding comment type will improve the model's predictive power. The presence of deliberation and formation of incivility spirals are two variables of particular interest regarding conversation quality. Finally, this project explores differences in Uses and Gratifications between Subreddits.

Methods

In this study, these questions and hypotheses are examined through a computer-assisted content analysis of comments posted on the social media site Reddit. Comments and metadata on the top ten posts of 2019 were collected from two subgroups, called Subreddits. The Subreddits chosen were r/Science and its sister Subreddit r/EverythingScience. The topic of science was chosen because it includes topics that are considered hot-button issues like vaccines and climate change, and non-sensitive issues like new scientific discoveries (Collins & Nerlich, 2015; Schafer, 2012; Stroud, et. al., 2015). These specific Subreddits were examined because, although they both focus on science, they differ in terms of group rules and moderator style.

Human coders and the text analysis software Linguistic Inquiry and Word Count were used to evaluate the comments on a series of dichotomous and continuous variables. These codes

were then used to create a typology of online messages using cluster analysis. Additional analyses examined which factors influence the quantity and quality of online interaction, including the presence of deliberation and incivility spirals. Differences in Uses and Gratifications between Subreddits were also explored.

Results

A two-step cluster analysis resulted in a three-cluster solution based on six variables (Positive Emotion, Negative Emotion, Vulgarity, Questions, On Topic, Informative). The three comment types were: Polite Participation, Emotional Interrogation, and On Topic Information. Polite Participation is the largest cluster with 63.2% of cases. Comments in this category are low in emotion and vulgarity, are moderately on topic, and generally do not include new information or questions. On Topic Information includes 30.8% of cases and is the only category where the majority of comments provide new information. Comments in this cluster are low in emotion, vulgarity, and questions, but are the most on topic. Emotional Interrogation is the smallest cluster with 6% of cases. These comments are the least on topic and highest in emotion (positive and negative) and vulgarity. Comments in this category tend to include the most questions but no new information.

Regarding the impact of Subreddit, topic sensitivity, and comment type on interaction, results demonstrated that adding comment type to a hierarchical regression significantly improves the ability of the model to predict the number of replies and upvotes a comment receives. Specifically, On Topic Information comments posted in response to sensitive posts received the most replies and upvotes. Comment type also significantly improved the model's ability to predict the hostility of interaction. In a hierarchical regression, Block 1 included Subreddit, Block 2 included Topic Sensitivity, and Block 3 added the comment type for the first comment in a conversation. Results indicated that comments posted to r/EverythingScience (the less strict Subreddit), about sensitive topics, and in response to Emotional Interrogation comments are the most hostile.

Results for deliberation and incivility spirals were also significant. Emotional Interrogation comments are significantly more likely to lead to non-deliberative conversations and significantly less likely to lead to extremely deliberative conversations. Polite Participation tends to discourage non-deliberative and extremely deliberative conversations, but encourage

moderate deliberation. Finally, On Topic Information comments are significantly more likely to encourage extremely deliberative conversations and less likely to encourage moderate deliberation. To summarize, the best comment type for encouraging deliberation is On Topic Information and the type least likely to encourage deliberation is Emotional Interrogation.

Findings for the formation of incivility spirals demonstrate that Subreddit, topic sensitivity, and the hostility of previous comments all impact how hostile a comment is. Specifically, comments appearing on the r/EverythingScience Subreddit (the Subreddit with less stringent rules) are more hostile and posts about sensitive topics lead to more hostile comments. The first comment in a conversation was not a significant predictor, but the hostility level of the parent comment was the most significant predictor in the model. These findings demonstrate that Subreddit, topic sensitivity and previous comments all influence the formation of incivility spirals. Incivility spirals are more likely to form on a Subreddit with less stringent rules when a sensitive topic is being discussed and previous comments are hostile.

Significant differences were found in uses between the two Subreddits, which suggests differing gratifications. First, there were significantly more question marks in comments on r/EverythingScience while comments on r/Science were more likely to be informative. This indicates that individuals may use r/EverythingScience to seek out information and r/Science to provide information. This is further supported by differences in comment type between Subreddits which found that there are significantly more On Topic Information comments on r/Science. Comments on r/Science were also significantly higher on the On Topic variable and conversations were more likely to be highly deliberative. This suggests that a gratification of r/Science use is to have productive discussions about scientific topics. On the other hand, r/EverythingScience comments included more Disagreement, Hostility, Vulgarity, and Negative Emotion. It could be that many of that Subreddit's users are trolls and get enjoyment from provoking the more serious users. On the other hand, users may want to engage in productive discussion but, because of the less stringent rules, incivility spirals are permitted to form when disagreement occurs.

The following chapters include a review of literature, data collection and analysis procedures, results, and discussion. More specifically, Chapter 2 provides a summary of online knowledge production, social media discourse, and online incivility. Hypotheses and research questions are also proposed. Chapter 3 provides an overview of the website Reddit and presents

the methods used to collect and analyze data. Chapter 4 discusses the statistical analyses used to address hypotheses and research questions, and presents the findings. Finally, Chapter 5 summarizes the theoretical and practical implications of this project and provides suggestions for future research.

CHAPTER TWO: LITERATURE REVIEW

This chapter provides an overview of relevant literature including online knowledge production, deliberation and discourse on social media, and the causes and effects of online incivility. The three most common forms of online incivility are discussed, as well as research on the formation of Incivility Spirals. The chapter ends with a summary of Uses and Gratifications theory and its applicability to the current project. Hypotheses and research questions are also proposed.

Online Knowledge Production

As Weinberger (2011) claims, when we transform the medium through which we develop, preserve, and communicate knowledge, we transform knowledge. The ubiquity of the Internet has led to a more decentralized form of knowledge production (Arazy, Morgan, & Patterson) wherein more individuals are becoming creators, rather than just consumers, of information (Halpern & Gibbs, 2013). Information is dispersed in society, with many people having bits of direct knowledge that would be beneficial to others (Sunstein, 2006). The Internet provides the opportunity for individuals to connect with a wide range of these others and learn vicariously from their experiences. The Internet also makes it possible to interact with diverse groups and form heterogenous networks that can serve as a valuable source of vicarious learning (Brundidge, 2010). Many people live in "information cocoons" and can use the Internet to broaden their horizons through dialogue with people who hold differing points of view (Sunstein, 2006). This online dialogue is essential for knowledge construction and learning (Rafaeli & Kent, 2015). Because the Internet is open-access, anyone can share anything they want at any time. The Internet allows interaction with diverse groups of people, leading to discussion and collaboration with individuals with different experiences and points of view. Proponents of this form of knowledge production claim that it will lead to a more informed public that is prepared to make better decisions (Rafaeli & Kent, 2015; Sunstein, 2006). Skeptics argue that the Internet encourages echo chambers and the dissemination of Fake News (Brundidge, 2010; Papacharissi, 2002).

Diverse Online Networks

Supporters of Internet knowledge production stress the benefits of the Internet being diverse and open access. First, some scholars claim that a major benefit of knowledge produced on the Internet is that it is the result of dialogue and collaboration among diverse groups (Black et al., 2013; Papacharissi, 2002; Rafaeli & Kent, 2015; Sunstein, 2006). For example, Brundidge (2010) argues that the Internet has the power to weaken social boundaries and bridge geographical divides, bringing people together. Habermas (1962/1989) argued that discussion among groups leads to learning and better decision-making. Weinberger (2011) agrees, claiming that knowledge is produced through open and reasonable encounters among people who disagree. Group discussion is vital because it provides alternative points of view, leading to high-quality knowledge production (Cappella, Price, & Nir, 2002). Virtual spaces have the power to enhance this discussion (Papacharissi, 2002, Weinberger, 2011). Online discussion can lead to collaborative knowledge construction, where participants share their expertise and learn from that of others. This type of knowledge construction has the benefit of allowing individuals to play the role of both learner and teacher (Rafaeli & Kent, 2015). This decentralized knowledge production leads to a better understanding of ideas because exposure to alternative positions encourages people to reflect on what they already know (Sunstein, 2006). Although face-to-face communication also allows for exposure to alternative positions, it requires significantly more time, effort, and resources to bring large groups together for in-person discussions. On the other hand, individuals only need access to an Internet connection and computer or smart phone to be able to interact with large groups online. The Internet overcomes many of the obstacles that make face-to-face discussion with large, diverse groups difficult to organize. With social media, individuals who may never have the opportunity to engage in face-to-face discussions with diverse groups are able to easily interact with people from all over the world.

As the size of someone's virtual social network grows, their probability of encountering differing viewpoints also increases (Halpern & Gibbs, 2013). Due to the ease of connectivity, the Internet provides opportunities for individuals to form networks which can act as virtually unlimited sources of information (Brundidge, 2010). Internet users are more likely than nonusers to be exposed to a variety of viewpoints, including those that contradict their own (Brundidge, 2010). Access to people with varying skills and expertise allows individuals to expand their knowledge through vicarious learning. Even the most informed people have direct knowledge of

only a tiny portion of information and must rely on the expertise of others (Sunstein, 2006). In fact, when making decisions, people often look to others for advice rather than consulting more traditional forms of information (Cross, Parker, Prusak, & Borgatti, 2000). In this way, how much information a person has access to relies significantly on the number of connections they have. Based on Granovetter's (1977) idea of the strength of weak ties, what you know or are able to learn depends on the size and diversity of your network. There are four variables that are important for knowledge creation in networks: knowing what others know, having access to those others, knowing people that are willing to actively engage in problem solving, and having a safe space to promote learning (Cross, et. al., 2000). The Internet has the ability to enhance these aspects because people are now more connected than ever before.

In particular, Internet use can increase the number of weak ties that individuals have. According to Granovetter (1977), the degree of overlap in two individuals' networks is directly correlated to how strongly they are tied to one another. The strength of a tie is dependent on the amount of time, the emotional intensity, and the reciprocal services which characterize it. A weak tie would be someone like an ex-coworker who an individual keeps sporadic contact with. The strength of weak ties comes from their diversity. Weak ties move in different circles than our own and therefore have access to different information than we have. The Internet, and particularly social media, allow us to easily connect to a plethora of weak ties and learn vicariously from their experiences. According to this argument, the Internet provides an opportunity for ideal knowledge production, wherein the voices of groups are aggregated to create the best possible understanding of topics.

Open Access

A second significant characteristic of the Internet is that it is open access, allowing everyone to participate in knowledge production and consumption, even anonymously. Proponents tout the Internet's ability to provide vast amounts of information to everyone. Because of the Internet, people have easier access to more information than ever before. The Internet has increased the reach of information, ideally leading to a more informed public who will make better decisions (Weinberger, 2011).

Unlike with more traditional methods, the Internet allows people to participate in knowledge production anonymously. A significant positive consequence is that everyone's ideas

can be valued equally (Christopherson, 2007). People tend to evaluate others' ideas based on factors like age, gender, race, and attractiveness. Contributing anonymously to knowledge production online gives a voice to people who traditionally have less power in society. Anonymity can also increase individual autonomy, allowing people to share ideas without the risk of social consequences. Fear of social repercussions can silence minority opinions, leading to the production of biased knowledge. Anonymity removes this threat and provides the opportunity to share thoughts and opinions freely (Christopherson, 2007), which promotes a more effective exchange of ideas (Papachrissi, 2002).

Critics hold a less idealistic view of the quality and consequences of knowledge production online. First, they argue that the Internet does not level the playing field for underrepresented individuals as significantly as many scholars claim. Inequality in access to technology and technological literacy undermine how truly representative and diverse knowledge produced online actually is (Papachrissi, 2002). Many scholars argue that, without equal access, the Internet is nothing more than an illusion of equality (Papachrissi, 2002; Pavlik, 1994; Williams, 1994). Furthermore, access alone does not guarantee a more informed public. Many individuals may lack the motivation or the ability to consume or produce information online (Hart & Nisbet, 2011; Kahan, 2012; Kahan & Braman, 2006; Scheufele & Lewenstein, 2005). Locating and analyzing the mass amounts of information available requires abilities and time that many people do not possess (Papachrissia, 2002). In fact, some argue that the Internet has made information overload a part of our daily lives (Weinberger, 2011).

Some scholars also argue that anonymity online does more harm than good. Specifically, anonymity online has been linked to aggression and other anti-social behaviors (Coffey & Woolworth, 2004), decreased concern for social-evaluation, and increased group polarization (Christopherson, 2007). Comments on anonymous websites also tend to be less civil and are generally supported by less evidence (Halpern & Gibbs, 2013). People often tend to be skeptical of information that is shared anonymously, countering the previous argument that anonymity allows everyone's ideas to be valued equally (Christopherson, 2007). Generally, anonymity may encourage information sharing but ultimately leads to less knowledge production.

Finally, skeptics express concern about the quality of knowledge that is produced and consumed online. The open-access nature of the Internet allows anyone to produce knowledge, so that unreliable and noncredible people can produce knowledge just as publicly available as

trained researchers (Weinberger, 2011). The Wisdom of the Crowd phenomenon assumes that a large group of ordinary people can be wiser than any one expert (Arazy, Morgan, & Patterson; Sunstein, 2006). Unfortunately, not all crowds are wise and the Internet "contains people who know much less than they think" (Weinberger, 2011, p. 63). In fact, Papachrissi (2002) argues that much of what is shared online are "hasty opinions" rather than knowledge. Groups whose members demonstrate systematic bias can produce knowledge that is, at best, incorrect and, at worst, dangerous. Due to the ease of sharing information online, these falsehoods can quickly gain many believers (Weinberger, 2011). This process differs greatly from past methods of knowledge production wherein information was vetted for quality and accuracy before being dispersed.

The positions discussed thus far have represented the extreme sides of the debate regarding the usefulness of the Internet as a platform for knowledge production. It is likely that reality falls in a continuum between these arguments. Regarding the debate on whether the Internet encourages collaboration with diverse groups or the formation of echo chambers, despite some research indicating that people often seek out information that confirms their beliefs (Festinger, 1957; Frey, 1986), there is little evidence that Internet users actively avoid contradictory messages (Brundidge, 2010). Furthermore, Wojcieszak and Mutz (2009) found that Internet users typically encounter diverse political opinions in apolitical environments, indicating that people *are* exposed to differing viewpoints online, even if it is inadvertently. Clusters of people naturally form online and, while they may become echo chambers, there is also evidence that naturally formed groups bring the Internet most of its value in terms of knowledge production (Weinberger, 2011). As Sunstein (2006) writes:

> Every day, like-minded people can and do sort themselves into echo chambers of their own design, leading to wild errors, undue confidence, and unjustified extremism. But every day, the Internet also offers exceedingly valuable exercises in information aggregation, as people learn a great deal from the dispersed bits of information that other people have (p. 8).

The debate regarding the quality of knowledge produced online is also shrouded in shades of grey. While it is true that the Internet makes it easier than ever before to spread Fake News, it has also increased the reach of legitimate research (Weinberger, 2011). Depending on the situation, scientists may find their work enhanced by the efforts of the public or they may need to defend the reliability of their research against overconfident amateurs. Whereas information consumers in the past could rely on book and journal editors to vet the quality of

their information, the plethora of reliable knowledge and incorrect "knowledge" produced online suggests that it is now the individual's responsibility to decide what information to trust. It is clear that the Internet can provide a platform for collaboration and knowledge production among diverse groups, but it is also clear that this ability is not unlimited (Coffey & Woolworth, 2004).

Deliberation

One method for maximizing productive collaboration and knowledge sharing online is deliberation. Deliberation is a communicative process during which people analyze a topic and weigh the pros and cons of each argument (Halpern & Gibbs, 2013). Deliberation is a multi-step process that begins with building an information based. Participants then prioritize values, identify and analyze solutions, and finally come to the best possible conclusion (Black et. al., 2013). Engagement in deliberation is beneficial both for individuals and for society as a whole. Engaging in deliberation allows individuals to reflect on their opinions, which results in the development of well-reasoned ideas (Cappella, Price, & Nir, 2002). Deliberation is beneficial to society because it leads to better ideas and decision making (Cappella, Price, & Nir, 2002; Habermas, 1989/1962).

Deliberation is also important because it leads to learning (Sagoff, 1998). Deliberation is an effective method for disseminating information because it forces deliberators to confront their differences (Barabas, 2004; Chappell, McGregor, & Vermilyea, 2012). Effective deliberation can help individuals to see all aspects of an issue, allowing them to weigh the pros and cons of each choice. This idea assumes that individuals will learn from each other and refine their opinions as they deliberate (Chappell et. al., 2012). In this way, the process of deliberation allows participants to better understand the issue being discussed by learning from the knowledge and experience of others (Daniels & Walker, 1996). For individuals who have no previous knowledge on the topic under discussion, deliberation gives them the opportunity to construct an opinion through dialogue (Sagoff, 1998). On the other hand, particularly in politics, individuals may cling rigidly to certain values (Heifetz & Sinder, 1988). In this instance, the deliberation process encourages learning by allowing participants to define and solve problems by discussing the merits of competing ideas (Daniels & Walker, 1996).

Some scholars claim that the Internet contributes to productive deliberation by providing a platform on which diverse people can share their ideas, learn from their peers, and build

knowledge collectively (Brundidge, 2010; Coffey & Woolworth, 2004; Rafaeli & Kent, 2015). The utopian perspective of the Internet is that online communication will facilitate deliberation, bring people from around the globe closer together, and increase civic participation (Papachrissi, 2002).

Online Incivility

The existence of a space where productive discourse *can* occur does not mean that it necessarily *will* occur, and online discussions often do not meet the expectations of constructive deliberation (Coe, Kenski, & Rains, 2014; Diakopoulos & Naaman, 2011; Papacharissi, 2002; Rafaeli & Kent, 2015; Stroud et. al., 2014). The process of deliberation emphasizes equality and mutual respect (Black, et. al., 2013; Prochazka, Weber, Schweiger, 2018) but research has found that online there tends to be too much talk and not nearly enough respectful listening (Dahlberg, 2001). "Listening" online refers to individuals carefully reading and thoughtfully responding to each other's comments. The Internet can decrease the range and quality of human discussion so that text-based computer mediated interaction often results in more disagreements and increased polarization on issues than face-to-face interaction (Nguyen & Alexander, 1996). Furthermore, the comments that users post are sometimes low in quality in terms of spelling and grammar, may have an aggressive or obscene tone, and may be intentionally or unintentionally factually incorrect (Park, Sachar, Diakopoulos, & Elmqvist, 2016).

Not only are comment sections often characterized by low-quality comments that do not lead to productive deliberation and learning, but studies have found significant levels of incivility in these online discussions (Hmielowski, Hutchens, & Cicchirillo, 2014; Papacharissi, 2004). Civil behavior is characterized by treating others with dignity, acting with regard to others' feelings, and observing the social norms for mutual respect even during disagreements (Andersson & Pearson, 1999; Sobieraj & Berry, 2011). On the other hand, incivility is defined as a type of offensive message that prevents deliberative discussion and can range from rude comments and name calling to outrageous or misleading claims (Anderson, et., al., 2014). While civil behavior is expected and therefore generally goes unnoticed, uncivil behavior is conspicuous (Andersson & Pearson, 1999).

On social media, the absence of social niceties often encourages the use of insults and extreme language rather than productive dialogue that could lead to vicarious learning. For

example, Hmielowski, Hutchens, and Cicchirillo (2014) found that engaging in online political discussions socializes users to see incivility as acceptable, which increases their intention to post uncivil comments online. People are particularly likely to resort to using personal attacks online when faced with opposing opinions (Hmielowski, Hutchens, & Cicchirillo, 2014). This behavior is caused by the Online Disinhibition Effect which states that people tend to be more uncivil when interacting through computer-mediated communication rather than face-to-face (Shepherd et. al., 2015), partially because online incivility typically lacks offline consequences (Anderson et. al., 2014).

Types of Online Incivility

Scholars have conducted extensive research on uncivil online behaviors and divided them into three common types of behavior: flaming, cyberbullying, and trolling.

Flaming

Flaming dates back to the days of Usenet when users would engage in prolonged, quickly escalating conflicts called flame wars (Baker, 2001). The term originates from the idea of a metaphorical flamethrower that individuals use to roast each other verbally (O'Sullivan & Flanagin, 2003). Definitions of flaming are inconsistent across studies, but most definitions include personal insults as a major characteristic. Some common definitions of flaming are: the use of aggressive language in an online context (Hmielowski, Hutchens, & Cicchirillo, 2014), hostile verbal behavior (Thompsen & Foulger, 1996), uninhibited expressions of hostility, insults, and ridicule (Kayany, 1998), and an insult intended to provoke or rebuke (Herring, Job-Sluder, Scheckler, & Barab, 2002). The ambiguity of these definitions, combined with their focus on hostility, means that online hate speech is often mislabeled as flaming. Hate speech is defined as speech that is likely to incite violence or prejudicial actions against individuals or groups (Webb, et. al., 2017).

Cyberbullying

Cyberbullying existed beginning in the 1990s when personal computers became affordable, but the term did not become mainstream until the suicide of 13-year-old Megan

Meier in 2006. Lori Drew, the mother of one of Megan's former friends, created a fake MySpace account under the name Josh Evans and began an online friendship with Megan, intending to obtain personal information about her and humiliate her (Fichman & Sanfilippo, 2016). Megan and "Josh" communicated online for several months until the tone of "his" messages changed. On October 16, 2006, "Josh" began sending cruel messages, including a last message that read "Everybody in O'Fallon knows who you are. You are a bad person and everybody hates you. Have a shitty rest of your life. The world would be a better place without you." Megan then hung herself with a belt in her bedroom closet while her parents were downstairs making dinner (Fichman & Sanfilippo, 2016). After her death, a self-proclaimed online "troll" created a blog that satirized Megan's suicide called "Megan Had it Coming" (Fichman & Sanfilippo, 2016).

Although cyberbullying and trolling are often collapsed into the same category, cyberbullies are generally considered more malevolent than flamers or trolls (Fichman & Sanfilippo, 2016; Shepherd et. al., 2015). Like flaming, the definition of cyberbullying is inconsistent across studies, but it has been defined as an "aggressive, intentional act carried out by a group or individual, using electronic forms of contact, repeatedly and over time against a victim who cannot easily defend himself or herself" (Smith, 2008, p. 376). Scholars generally differentiate cyberbullying from trolling because cyberbullies tend to know their victims, while trolls do not (Craker & March, 2016). Fichman and Sanfilippo (2016) claim that the major difference between cyberbullying and trolling is that cyberbullies target individuals but trolls target communities. Finally, Craker and March (2016) claim that trolls disrupt online communities for pure entertainment, while cyberbullies have more sinister goals. Because past definitions differentiate cyberbullying from other antisocial behaviors based primarily on individuals' motivations and offline relationship with the victim(s), it is virtually impossible to identify cyberbullying by looking at the content of online messages alone. This is made more difficult by individuals' tendency to engage in multiple antisocial online behaviors. For example, Zezulka and Seigfried-Spellar (2016) found that people who cyberbully are also likely to troll.

Trolling

Although many people associate trolls with the creatures who live under bridges, in this context the word trolling is based on the fishing practice where a baited line is dragged behind a boat with the intent of catching prey (Herring, et. al., 2002). Trolls originated on the website

4chan's /b/board and, as the popularity of the site grew, so did the use of the word troll (Phillips, 2016). The term trolling first entered mainstream use in the 1990s and was originally used to describe online mischief (Bishop, 2014; Leaver, 2013). This more harmless type of trolling took advantage of humans' tendency to be entertained by conflict and was characterized by trolls provoking arguments for the sake of argument (Hardaker, 2010). Originally, trolling resembled a one-sided game of deception where trolls fake sincerity in order to waste other users' time and cause confusion and chaos (Dahlberg, 2001; Hmielowski, Hutchens, & Cicchirillo, 2014; Vera-Gray, 2017). In this way, scholars use motivation as a major differentiator between flaming and trolling. Flamers have agendas and strong views on issues, while trolls disrupt conversations for "lulz," or amusement derived from someone else's anger (Phillips, 2016). A popular example of the original type of trolling was called "Rickrolling" which was a type of bait and switch using a disguised hyperlink that leads to the music video "Never Gonna Give You Up' by Rick Astley (Phillips, 2016). The victims click the hyperlink believing that they are accessing different material but are instead directed to the music video. A more recent example that demonstrates the prankster nature of original trolls is the trolling of Texas Governor Rick Perry following his statements supporting controversial requirements for abortion (Fichman & Sanfilippo, 2016). In his statements, he claimed to be an expert in women's health, leading (particularly women) trolls to post questions on his Facebook page asking for sexual health advice. In general, the term trolling originally referred to lulz-motivated behavior that did not result in any extreme consequences for victims (Fichman & Sanfilippo, 2016).

However, the definition of trolling is evolving and is now commonly used as a catch-all term for all online antisocial behavior (Coles & West, 2016; Hardaker, 2010). Scholars, journalists, and the public all use the term troll with significantly different meanings, and lack of agreement about the meaning of the word is intensified by the media's tendency to use trolling to describe a range of negative online behaviors (Fichman & Sanfilippo, 2016). Various definitions of trolling include: the use of deception, baiting, and aggressive language (Hardaker, 2010), using provocative language (Fichman & Sanfilippo, 2016), intentionally disseminating poor advice, and dominating online discourse through abusive posting, monopolizing conversations, and controlling the agenda and style of discourse (Dahlberg, 2001). Hardaker (2010) developed one of the most widely-cited definitions of trolling, which includes four elements: aggression,

deception, disruption, and success, operationalizing success as whether the troll was able to fool their victims.

In an effort to create more precise definitions for specific antisocial online behaviors, some scholars have divided trolling into more rigid categories, including RIP trolling and gendertrolling. RIP trolling typically happens anonymously and is characterized by trolls posting abusive comments on pages dedicated to the deceased (Kern & Gil-Egui, 2017). Gendertrolling includes misogynistic comments and threats posted by men and directed at women (Baker, 2001; Shepherd et. al., 2015). Still, not all trolling is equal in terms of severity, and innocuous online pranks continue to fall under the same category as behaviors that meet the legal definition of harassment (Fichman & Sanfilippo, 2016; Phillips, 2016). For example, a troll created the Facebook page "I was Raped by Zdenek Sverak," which contained accusations of rape by the Czech actor/writer (Kopecky, 2016). The page stated that he had abused children while filming a children's program, including paying minors for sexual favors. The accusations were false and the page was removed a day after its publication, but the libel put Sverak unwillingly into the spotlight and he pressed criminal charges. In a more extreme example, during Webcam Trolling, an individual misuses a webcam to attack other users, usually on the video website Chatroulette (Kopecky, 2016). A troll uses a fake video, typically of an attractive person, to persuade their victim to expose themselves on camera. They then record the footage, which can be used to blackmail, humiliate, or otherwise threaten their victim. Webcam trolls often target children, with boys 13-18 years old being the most common targets. Trolls' motivation may include obtaining money from the victim through blackmail or fulfilling their own sexual fantasies. They may also post the child pornography online (Kopecky, 2016).

In whatever form incivility takes, it represents a violation of social norms and disrupts the equilibrium of groups and organizations (Goffman, 1967). One form of disruption is the development of incivility spirals.

Incivility Spirals

> It started with whose turn it was to clean up after the cat. Jerry Demilte confronted
> Michael Hulsey, his roommate, over this matter. As the evening went on, the cat
> incident was forgotten, but the hard feelings were not. According to witnesses, the
> quarrel between the two men turned into a shoving match. Ultimately, Hulsey

pulled out a gun from his dresser and fired six times into Demilte's chest (Kim & Smith, 1993, p. 37).

The account above represents a classic case of an incivility spiral. Incivility spirals refer to escalating patterns of behavior that begin with a mildly impolite act followed by a series of increasingly aggressive behaviors which culminate in an act out of proportion with the original event (Cortina et. al., 2017; Kim & Smith, 1993). For example, in their paper on incivility spirals in the workplace, Andersson and Pearson (1999) give the example of Party A engaging in an uncivil behavior toward Party B, such as forgetting to say please or thank you. Party B interprets this behavior as incivility, which creates the desire to reciprocate. Party A perceives the uncivil act performed by Party B and goes through the same response sequence that Party B experienced after the original act. This sequence of events is due to individuals' desire to retaliate for uncivil treatment (Penney & Spector, 2005). The escalation of the event is the result of nonproportional revenge because, when people reciprocate uncivil behavior, their behavior is typically more uncivil than the original act (Felson & Steadman, 1983; Helm, et. al., 1972; Youngs, 1986). When the revenge is an overreaction to the original act, it grants victim status to the other party so that both parties believe they are the victim and have the right to engage in counter-revenge (Bies & Tripp, 1995; Kim & Smith, 1993; Youngs, 1986). As the escalation progresses, the perceived stakes of the conflict rise for both parties, and inhibitions are lowered (Pruitt & Rubin, 1986). In this way, mildly uncivil acts can serve as a first step to more intense forms of hostility (Baron & Neuman, 1996).

The level of revenge for the original act is based on the severity of the behavior and the importance of the norm that has been violated (Tedeschi & Felson, 1994). For example, people tend to behave more aggressively when they have been insulted because their desired identity has been threatened, leading them to engage in protective self-presentation (Felson, 1982; Kim & Smith, 1993). Feelings of self-worth are often diminished by uncivil behavior because the victim perceives the act as indicating that they are inferior to the perpetrator and undeserving of respect (Kim & Smith, 1993). Revenge may restore the victim's self-worth and deter future uncivil acts by showing the perpetrator that bad behavior will not go unanswered (Axelrod, 1984). These incivility spirals represent what Goffman (1967) labeled a "character contests," where opponents attempt to maintain face at the other's expense. In their study on incarcerated males, Felson and Steadman (1983) found that the sequence of events begins with a rude comment that is perceived

as an attack on identity and eventually culminates in a physical attack. Retaliation for insults is also more likely when an audience is present because there is more pressure to save face (Felson, 1982).

Incivility spirals can include any number of parties and, in a group setting, the initial spiral can lead to secondary incivility spirals among additional actors (Andersson & Pearson, 1999; Masuch, 1985). For example, Party C may observe an incivility spiral between Parties A and B and may model that behavior with Party D (Foulk, Woolum, & Erez, 2016). In other situations, an observer may involve themselves in the incivility spiral by retaliating against the perpetrator to get justice for the victim (Cortina et. al., 2017). Being a victim of incivility also predicts an individual's likelihood of engaging in uncivil acts in the future (Glomb & Liao, 2003). For example, in their study on workplace incivility, Gallus and colleagues (2014) found that 70% of participants reported being both a victim and perpetrator of incivility. In this way, group norms for civil behavior may become eroded (Carter, 1998).

Incivility spirals are closely related to Gouldner's (1960) theory of the universal norm of reciprocity which states that 1) people should help those who help them and 2) people should not harm those who have helped them. Building on this theory, Helm, Bonoma, and Tedeschi (1972) found evidence for a negative norm of reciprocity that asserts "an eye for an eye." According to the negative norm of reciprocity, 1) people will harm those who harm them and 2) will not help those who harm them. This negative reciprocity norm applies to both magnitude of harm and frequency of harm. Online incivility has a number of negative effects in addition to incivility spirals.

Effects of Online Incivility

Uncivil online behavior can negatively affect other users and online communities by altering readers' perceptions of topics, making individuals less receptive to new information, and eventually persuading members to remain silent or leave the community (Coe, Kenski, & Rains, 2014; Fichman & Sanfilippo, 2016). On news organizations' sites specifically, user comments on articles influence readers' perceptions of the article itself (Houston, Hansen, & Nisbett, 2011). In a study on SacBee.com, an online newspaper in Sacramento, Diakopoulos and Naaman (2011) found that 65% of participants read comments on news articles all the time or often. If a news article is accompanied by comments that include vulgar language or lack logical reasoning,

readers tend to rate the quality of the article more negatively. Specifically, when incivility targets a user's ideological beliefs, it may make them less receptive to new information and encourage a negative attitude about the topic under discussion. Similar to how watching politicians engage in uncivil discourse on television can cause polarization among individuals, uncivil online comments can polarize Internet users on important issues (Anderson, et. al., 2014). On the other hand, when readers see positive comments accompanying online content, they tend to rate that content as more effective (Shi, Messaris, & Cappella, 2014).

Not only do readers evaluate the quality of news articles partially based on the accompanying comments, but the comments can shape their personal opinion about the issue at hand (Hmielowski, Hutchens, & Cicchirillo, 2014; Lee, 2012). Individuals who read comments that include uncivil language may make judgments about the topic based on the comments, rather than the content of the article (Anderson et. al., 2014). Hostile language may make individuals less receptive to new information, which is particularly concerning when scientific topics are involved, and past research demonstrates that perceptions of science are shaped by the civility of related discourse (Anderson, et. al., 2014; Coe, Kenski, & Rains, 2014). Specifically, if low-quality comments accompanying scientific articles go unchecked, it can lead to harmful and polarized risk perceptions of scientific information (Park, Sachar, Diakopoulos, & Elmqvist, 2016). Readers also infer public opinion on an issue based on comments on news stories (Lee, 2012). Comments can provide social cues about what content is fair/unfair or accurate/inaccurate (Houston, Hansen, & Nisbett, 2011). In this way, uncivil comments can lead to greater polarization of an issue (Anderson, et. al., 2014).

The tone of comments accompanying news stories also has a significant impact on journalists' ability to report a story (Diakopoulos & Naaman, 2011). For example, uncivil comments on news stories can scare away journalists' sources (Braun & Gillespie, 2011; Gillespie, 2010). Specifically, if potential sources are afraid of the social ramifications of being named in a news article, it becomes more difficult for journalists to persuade them to speak on the record, and therefore more difficult to get the information they need to report the story (Diakopoulos & Naaman, 2011).

Antisocial online behavior also has the potential to harm online communities by silencing their members (Fichman & Sanfilippo, 2016). In general, low quality discourse makes users less motivated to comment (Ksiazek, 2018). The presence of uncivil or aggressive comments may

create a hostile and unwelcoming space, which inhibits the development of new communities (Coles & West, 2016). Binder, Howes, and Smart (2012) found that experiencing online harassment discourages users from engaging on social networking sites, which could reduce positive outcomes like vicarious learning. Incivility and deception in online communities leads to an atmosphere of distrust, where participants may be suspicious of other users and even keep silent or withdraw completely from the community (Bishop, 2014; Dahlberg, 2001). For example, if users worry that they may be ridiculed for sharing their opinions, they may be hesitant to post comments online (Sunstein, 2006). Women are some of the most common targets for online incivility, and they may grow tired of being intimidated by online discourse, instead choosing to leave the community and start women-only groups (Hmielowski, Hutchens, & Cicchirillo, 2014; Sunstein, 2006). Feminist and other nonmainstream online forums are particularly vulnerable to online incivility and, if left unchecked, uncivil comments negatively impact the interaction that takes place (Herring, et. al., 2002; Park et. al., 2016). In the long term, antisocial comments have adverse effects and decrease the overall activity of users in online communities (Kumar, Hamilton, Leskovec, & Jurafsky, 2018). In this way, negative messages can prevent productive online discourse (Dahlberg, 2001). On the other hand, positive messages can minimize conflict and encourage participation in online communities (Cheng, Danescu-Niculescu-Mizil, & Leskovec, 2015).

The negative effects of uncivil online behavior can also extend to individuals' daily lives (Coles & West, 2016). Online abuse can be very upsetting for participants of online discourse, and research has found that the psychological effects from encountering deviant messages like trolling and flaming are similar to experiencing offline harassment (Craker & March, 2016; Dahlberg, 2001). Some scholars claim that cyberbullying is actually more harmful than traditional bullying because cruel comments can remain online indefinitely (Mkono, 2018). Effects of these antisocial online messages include depression, social anxiety, and low self-esteem (March, Grieve, Marrington, & Jonason, 2017). In more extreme circumstances, online harassment can lead to fear for individual safety, self-harm, and suicide (Fichman & Sanfilippo, 2016). Not only can uncivil comments harm users psychologically, but they can also cause legal issues such as litigation for libelous attack on companies (Mkono, 2018).

A New Typology of Online Messages

Past research on online interaction has focused primarily on the dichotomy of civility versus hostility (Anderson, et. al., 2014). For example, Ksiazek (2018) measured the quality of comments based on whether they were civil or hostile. Civility and hostility were measured with word lists and proportions were then calculated so that comments with a greater proportion of civil words were considered quality comments. Another study attempted to create a more nuanced measure of incivility by differentiating between mild and extreme uncivil messages. Su and colleagues (2018) coded social media comments as either impolite or extremely uncivil based on their level of profanity and the presence or absence of aggression. Comments that did not fit in either of these categories were coded as civil. Cortina and colleagues (2017) argue that civility is associated with positive outcomes, but it is the bare minimum for fostering positive relationships. Therefore, research should examine positive behavior above and beyond mere civility.

A better understanding of the content of online comments has the potential to reveal patterns in uncivil discussions, which will allow site owners and moderators to identify and minimize antisocial behavior (Cheng et. al., 2015). Identifying these antisocial messages and educating individuals about the consequences of the comments they post online may lead to healthier online communities where productive discussion is possible (Weinberger, 2011). Given the range of messages that are posted online, and their sometimes severe negative effects, it is necessary to develop a more nuanced classification of the types of messages that users post. Therefore, this study will use message characteristics to develop a typology of online messages.

RQ1: What underlying characteristics differentiate types of messages in online discussions?

Factors Impacting Online Interaction

Given the prevalence of incivility online it is imperative to understand why people engage in uncivil discourse (Hmielowski, Hutchens, & Cicchirillo, 2015). Because it takes multiple positive behaviors to overcome a single negative behavior, efforts should be made to understand what factors discourage incivility and promote civil, productive discussion (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Cortina and colleagues (2017) indicated a

need for additional research examining what behaviors and contexts lead to different types of interaction online. Therefore, this study examines how four factors (group moderators, group rules and norms, discussion topic, message type) impact the quantity and quality of online discussion.

Group Moderators

Andersson and Pearson (1999) argue that groups that wish to discourage incivility should address uncivil acts quickly and hold all individuals behaving uncivilly accountable. Past research has found that online incivility is more likely to occur when there is a lack of supervision (Hinduja & Patchin, 2006) and that policing online discussions may decrease instances of flaming (Hmielowski, Hutchens, & Cicchirillo, 2014). However, most research on the impact of group moderators focuses on preventing trolling, flaming, and cyberbullying rather than promoting positive interaction (Diakopoulos & Naaman, 2011). Furthermore, these studies primarily compare comment quality among sites with moderators and those without moderators, rather than examining the impact of different types of moderation. Therefore, this study explores how two different moderation styles influence the types of discourse that takes place. Specifically, the civility of discussions on a Subreddit with heavy moderation is compared to the civility of discussions on a less-moderated Subreddit to determine whether heavier moderation encourages more civil discussion.

Group Rules and Norms

Group norms are the norms of a community which consist of basic moral standards and other norms that are created based on the specific needs of that community, including formal and informal policies (Feldman, 1984). In many situations, group norms are not written down or discussed, but they still have a powerful influence on members' behavior (Hackman, 1976). Groups try to function in a way so that chances of success are maximized and chances of failure are minimized, and norms play a significant role in this process (Feldman, 1984). Groups do not have sufficient resources to regulate every behavior, so norms apply only to those actions that ensure group survival, contribute to morale, and reflect the group's primary values (Feldman,

1984). For example, certain conversation topics may be discouraged and specific behaviors may be explicitly prohibited.

Individuals adapt their behavior to specific contexts, so group norms can encourage or discourage uncivil behavior (Andersson & Pearson, 1999; Robinson & O'Leary-Kelly, 1998). Group members receive social cues which indicate what type of behavior is acceptable, so groups that display high levels of uncivil interaction encourage future uncivil behavior from their members (Robinson & O'Leary-Kelly, 1998). Past research has found that online aggression is caused by the norms under which particular groups are operating (Phillips, 2016) and the prevalence of flaming in online groups may lead people to see aggressive behavior as normal (Hmielowski, Hutchens, & Cicchirillo, 2014). In general, an organization that allows rude and aggressive behavior will attract others who behave similarly (Andersson & Pearson, 1999). On the other hand, groups that normalize civil interaction encourage future civil behavior from their members (Robinson & O'Leary-Kelly, 1998). Therefore, creating rules and reinforcing norms that promote civility and discourage incivility can reduce the likelihood of incivility spirals (Andersson & Pearson, 1999)

Discussion Topic

Past research has found that the topic under discussion impacts the type of interaction that occurs online (Braun & Gillespie, 2011; Diakopoulos & Naaman, 2011). Ksiazek (2018) claims that the quantity and quality of comments will vary based on the topic of a news story. For example, studies have found that messages including insults and extreme language are more common when emotionally sensitive issues are being discussed (Halpern & Gibbs, 2013; Stroud, et. al., 2015). This occurs because people feel more strongly about "hot button" topics and process them at a more visceral level (Coe, Kenski, & Rains, 2014). Topics that often elicit more antisocial comments include politics (Hmielowski, Hutchens, & Cicchirillo, 2014), the economy and foreign affairs (Coe, Kenski, & Rains, 2014), immigration and gun control (Ksiazek, 2018), and crime and welfare (Diakopoulos & Naaman, 2011). Kushin and Kitchener (2009) warn specifically about the incivility of political discussions on social networking sites. Although controversial topics lead to more hostility in comments, they also lead to more comments overall (Ksiazek, 2018). Hutchens, Cicchirillo, and Hmielowski (2015) indicated a need for research that compares the quality of online interaction during discussions on a variety of topics. Therefore,

this study examines how a range of discussion topics influence the type of interaction that takes place.

Message Type

Based on incivility spirals and the norm of reciprocity, it is likely that early messages in an online discussion influence the quality of discourse that occurs (Cortina et. al.; Gouldner, 1960). Much of the incivility research to date has focused on face-to-face interactions (Cortina, et. al., 2017) and Schilpzand, De Pater, and Erez (2016) noted that the theoretical tenets of Andersson and Pearon's (1999) incivility spiral have received little empirical examination. Furthermore, an act of incivility does not inevitably lead to an incivility spiral. The victim of the behavior may choose to ignore the perpetrator, give them the benefit of the doubt, or deescalate the situation in another way (Andersson & Pearson, 1999). With the goal of understanding what factors encourage different types of online interaction, the following hypotheses and research questions are proposed:

> **H1: Comment type will predict the quantity of interaction above and beyond group rules and topic sensitivity.**
>
> **H2: Comment type will predict the quality of interaction above and beyond Subreddit and Topic sensitivity.**
>
> **RQ2: What factors encourage the formation of incivility spirals?**

Uses and Gratifications

Another factor that may influence a user's behavior online is their motivation for using the platform. Therefore, this study applies a Uses and Gratifications framework to understand how users behave on both Subreddits and how that behavior provides evidence for their sought and obtained gratifications. Uses and Gratifications is a media use theory originating in mass communication research that guides the examination of consumers' motivation for using different types of media (Stafford, Stafford, & Schkade, 2004). This theory proposes that communication behavior is goal-driven and purposeful in that people choose which media to use based on their needs, wants, and expectations. According to Katz, Blumler, and Gurevitch (1974), Uses and Gratifications research is concerned with:

> The social and psychological origins of needs which generate expectations from the mass media or other sources, which lead to differential patterns of media exposure (or engagement in other activities), resulting in need gratifications and other consequences, perhaps mostly unintended ones. (p. 20)

In the context of this theory, "uses" refer to how people behave when using the medium of their choice. Gratifications, on the other hand, are conceptualized as the satisfaction of needs, which are obtained when an individual's needs are met by the medium they are using (Sundar & Limperos, 2013). More recently, a distinction has been made between gratifications sought and gratifications obtained (LaRose et. al., 2001). The underlying process is now considered a continuous one where expectations about the outcomes of media use are modified through observation of the gratifications that are actually obtained. Sought gratifications do not have significant predictive power when it comes to media use. They are much more effective in explaining behavior when compared with obtained gratifications (LaRose, Mastoro, & Eastin, 2001). On the other hand, obtained gratifications are good predictors of continuing media use (Kaye & Johnson, 2002; Palmgreen & Rayburn, 1979). Specifically, an individual's needs lead them to use media to gratify those needs and, if the gratification is obtained, they are more likely to use that medium again (Weibull, 1985). A single medium is capable of satisfying multiple needs, so people tend to use media that can satisfy the most needs simultaneously (Katz, Blumler, & Gurevitch, 1974).

The Uses and Gratifications approach originated in studies of radio and comics in the 1940s (Katz, Blumler, & Gurevitch, 1974). Other early studies covered topics such as motivations for reading newspapers (Berelson, 1949), watching soap operas (Herzog, 1942), and children's interest in comic books (Wolfe & Fiske, 1949). Originally, Lasswell (1948) claimed that the gratifications sought through media use could be divided into four main categories: surveillance, correlation, entertainment, and socialization.

However, as new media emerges, new needs and gratifications may also be created. People today not only choose media to gratify traditional needs, but they also have the ability to create, share, and shape the media that they use (Moore & Chuang, 2017). The early Uses and Gratifications studies focused solely on media consumption, but scholars are now beginning to reexamine the Uses and Gratifications approach in light of new forms of media (Moore & Chuang, 2017). Rubin (2009) noted that medium-specific gratifications emerge when a new

technology is introduced which then become routinely sought-after gratifications. For example, the gratification of "mobility" first appeared when cell phones were introduced, but is now an important gratification for other forms of communication technology (Kim, Sundar, & Park, 2011). Photo sharing was recognized as a new gratification from Facebook use, but is now sought and obtained through a variety of social media sites and applications (Wortham, 2011). The widespread use of mobile dating apps has resulted in new sought gratifications such as finding convenient and casual sexual partners (Welch & Morgan, 2018).

Uses and Gratifications is particularly useful in studying how individuals engage with new technology because it is easily adaptable (Moore & Chuang, 2017). In fact, many scholars believe that it is inherently suited for Internet study because of the user-directed nature of that medium (Bumgarner, 2007; Chung & Kim, 2008; Hollenbaugh, 2010; Johnson & Yang, 2009; Stafford, Stafford, & Schkade, 2004). Recently, researchers have used Uses and Gratifications to explore many aspects of Internet use, including what gratifications are obtained through Twitter use (Chen, 2011), why people read and write comments on news websites (Diakopoulos & Naaman, 2011), social media use during natural disasters (King, 2018), bridging and bonding social capital on social media sites (Phua, Jin, & Kim, 2017), motivation for Wikipedia use (Rafaeli & Ariel, 2008), and reasons for sharing news on social platforms (Lee, Ma, & Goh, 2011).

Because Uses and Gratifications is considered a natural paradigm for understanding the Internet, and has been widely used in studies on other social media platforms, the following research question is proposed:

RQ3: How do uses and gratifications differ between Subreddits?

This chapter has provided a review of literature related to the current project and summarized two theoretical frameworks that will be used in this study. Hypotheses and research questions were also proposed. The following chapter presents an overview of the social media site Reddit and summarizes the methods used to address the key questions in this study.

CHAPTER THREE: METHODS

This chapter begins with a detailed description of the social media site Reddit. Next, the data selection and collection processes are described, followed by a summary of the coding schemes at the comment, conversation, and post level. Preliminary findings, including frequencies and descriptive statistics, are also presented.

Reddit

Reddit is a social media site and online community that was created in 2003 by Steve Huffman and Alexis Ohanian (Lagorio-Chafkin, 2018). Deemed "the front page of the Internet," it began primarily as a social news aggregation site, but quickly expanded to cover a plethora of diverse topics. With over 430 million monthly active users, Reddit is the fourth most visited website in the United States, behind Google, YouTube, and Facebook (Djordjevic, 2020; Record, Silberman, Santiago, & Ham, 2018). It consists of a network of subgroups called "Subreddits" based on various topics and interests (reddit.com, 2020). Subreddits are labeled with "r/" followed by the overarching topic of that page. Subreddits can range from huge communities like r/worldnews with almost 24 million members, to more narrow topics like r/Purdue with 28,000 members. A Subreddit consists of a newsfeed of relevant posts shared by community members. Other members can then comment in response to the post or upvote/downvote it. Upvoting a post is similar to a "Like" on Facebook and indicates that the user approves of the post, or at least finds it interesting. Downvoting a post indicates disapproval or dislike. Comments can also be upvoted and downvoted. This voting system allows community members to police each other's behavior because the more upvotes a post receives, the higher on the newsfeed it rises, making it more visible. On the other hand, downvotes push posts farther down the feed where less people will see them. Reddit is publicly available, so an account is not required to view content, but you must be a registered user in order to post, comment, or vote (Record, et. al., 2018). Users can elect to "join" a Subreddit if they want to see posts from it in their personal newsfeed. Joining a Subreddit is similar to following someone on Facebook or Instagram. The posts for all Subreddits you join appear in your newsfeed.

Below is an example of the Reddit interface and a post on the r/farming Subreddit. Users can click the up arrow to upvote and the down arrow to downvote. The number between the arrows indicates how many more upvotes a post has received than downvotes. You can see that

this particular post has a "score" of 101 and, of all the votes it received, 96% were upvotes. Reddit will also tell you when the post was shared and who shared it. Reddit allows users to be completely anonymous and create usernames which are always preceded by "u/" (Record, et. al., 2018).
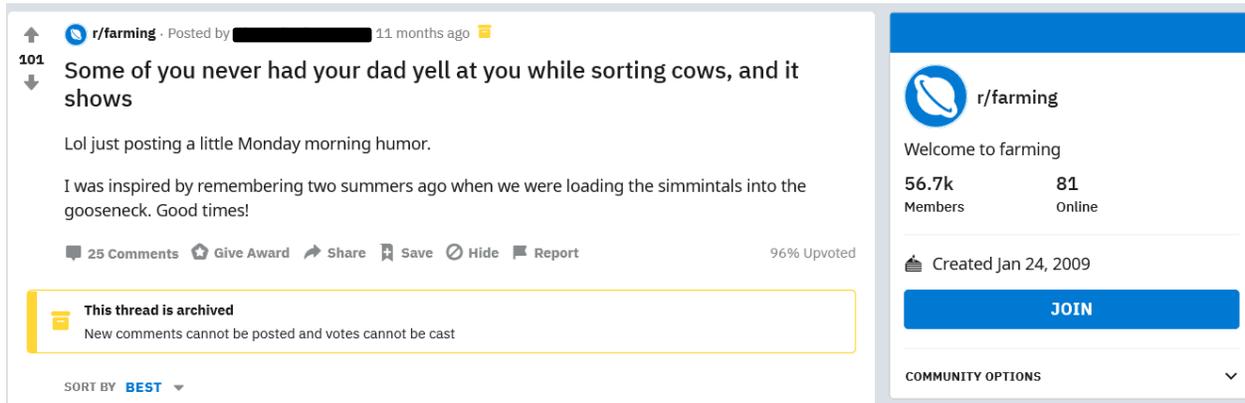
Figure 1. Sample Reddit Post

Unlike Facebook and many other social media platforms, Reddit does not limit the depth of comment replies. For example, on Facebook, users can reply to a comment, but they cannot reply to a reply. On Reddit, users can reply to a reply to a reply and so on. In this project, the reply level of a comment is referred to as its "depth." Figure 2 includes a series of comments in response to a post on the United States' response to COVID-19, and illustrates how comment depth is visualized. The blue oval is the first comment in the conversation and has a depth of one. The red oval is a direct reply to that comment and has a depth of two. The blue oval is called the "parent" comment of the red oval. Both the yellow and pink ovals have a depth of four. The green oval is both of their parent comments because they are both direct responses to it. The conversation should not be read as though the pink comment is a reply to the yellow comment just because it comes after it. All true comment replies are at one depth lower than their parent comment.
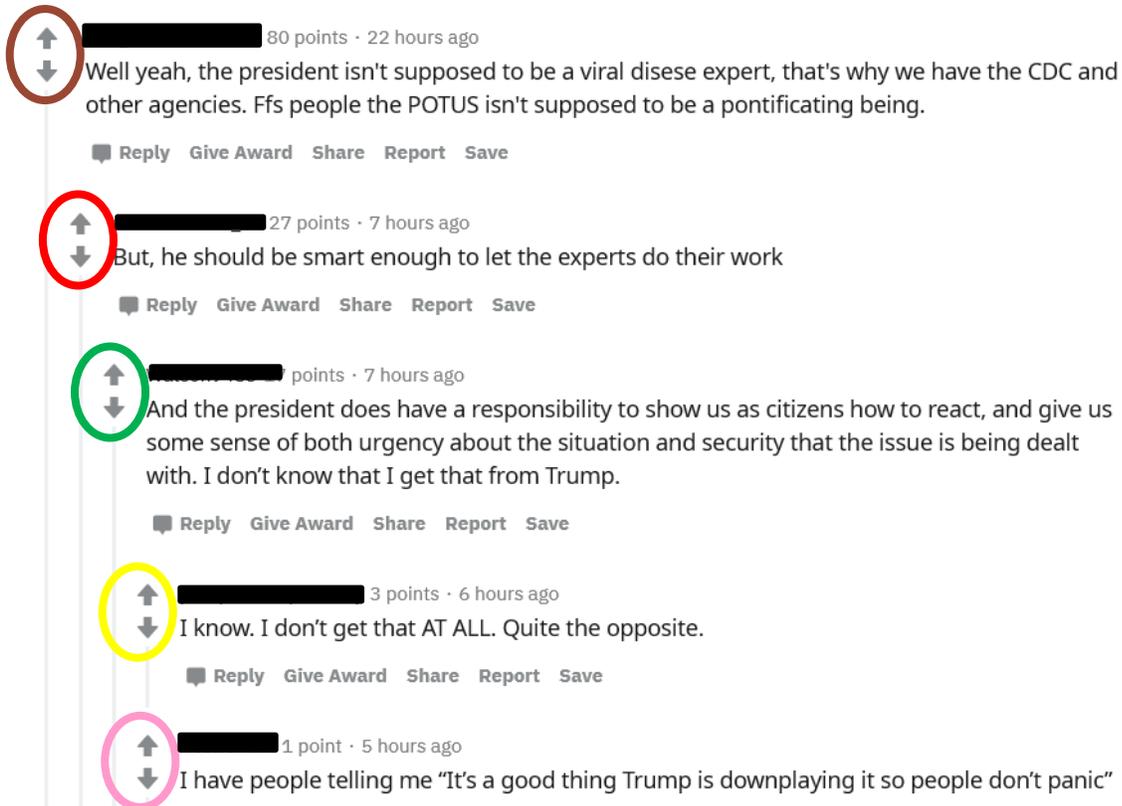
Figure 2. Comment Depth on Reddit

Each Subreddit has a list of rules dictating user behavior. These rules act as guidelines for what type of content can be posted and how users should behave in the comments. Subreddits vary significantly in their number and specificity of rules. All Subreddits also have a team of moderators who enforce the rules by removing comments and posts that violate them and occasionally posting reminders of certain rules if many users have violated them recently. Moderators also have the ability to ban repeat offenders. When comments are removed, they can no longer be viewed and it is impossible to tell who wrote them. However, the page keeps track of where comments were removed. It will also indicate how many "children," or replies, a removed comment had. For example, see the series of removed comments in Figure 3 that were also posted in response to the article about the United States' response to COVID-19.
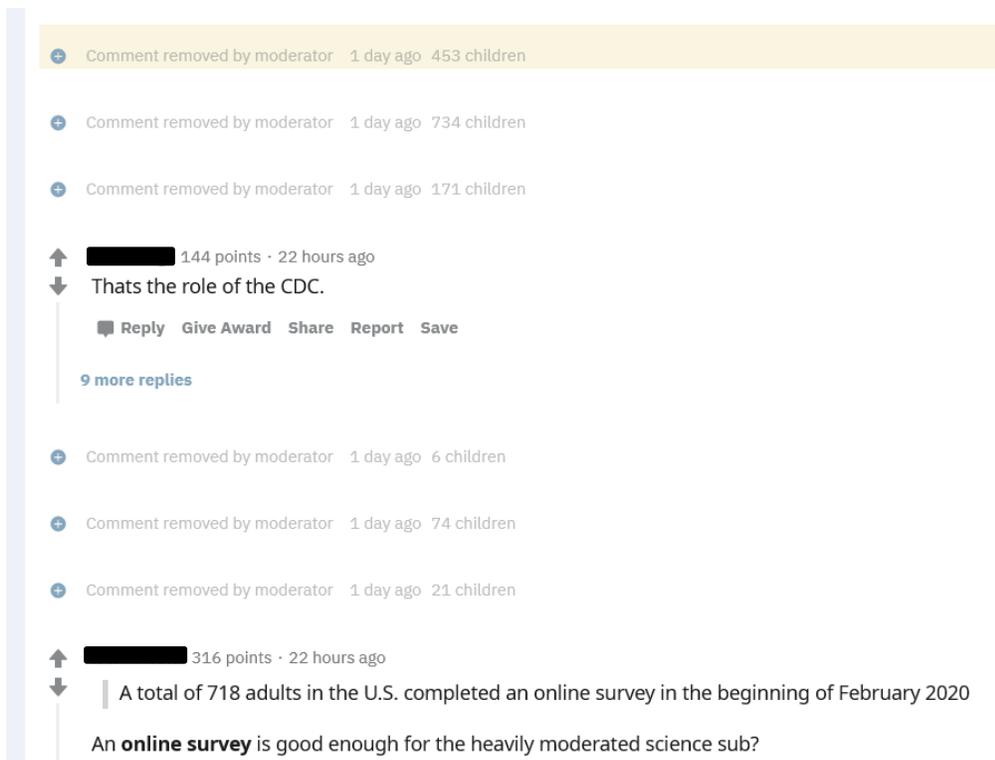
Figure 3. Removed Comments

Now that the basic functions and interface of Reddit have been described, the following section will summarize how Reddit data was collected for this project.

Data Collection

A worker was hired through the website Upwork to collect comments and metadata from two Subreddits. Upwork is a freelancing platform where individuals can connect to collaborate remotely (upwork.com, 2020). The two Subreddits selected were r/Science and its sister Subreddit r/EverythingScience. In other words, r/Science was the original scientific Subreddit, then r/EverythingScience was created for users who were interested in scientific topics but did not want to be limited by the stringent rules on r/Science. The topic of science was chosen because it includes topics that are considered hot-button issues like vaccines and climate change, and non-sensitive issues like new scientific discoveries (Collins & Nerlich, 2015; Schafer, 2012; Stroud, et. al., 2015). These specific Subreddits were examined because, although they both

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focus on science, they differ in terms of group rules and moderator style. Although some users serve as moderators for both Subreddits, r/Science has more stringent guidelines and requires that all articles shared must be peer-reviewed and from the last six months. It also has more strict rules regarding what types of comments are permitted. On the other hand, r/EverythingScience does not require that articles are peer-reviewed and, although comments on that Subreddit must remain civil, there is more flexibility for what types of comments are allowed. (See Appendix A for the complete description and list of rules for both Subreddits).

Comments and metadata on the top ten posts of 2019 for both Subreddits were collected. "Top" posts on Reddit are those that have received the highest number of upvotes. The metadata collected included the comment author, the number of upvotes/downvotes the comment received, how many replies the comment received, and comment depth. Conversation structure was maintained during the collection process so it was possible to identify which comments came first in each conversation, which comments were replies to others, etc. A total of 29,859 comments were collected; 2,875 from r/EverythingScience and 26,984 from r/Science. The reason for the discrepancy in number of comments between Subreddits is that r/Science has 24 million members, while r/EverythingScience only has 232,000. For this project, only comments up to a depth of three were examined, bringing the total number of comments down to 13,697 (1,754 from r/EverythingScience and 11,943 from r/Science). Comments up to a depth of three were examined so that analyses could still be conducted at the conversation level. Mooi and Sarstedt (2011) also recommend a sample size of at least 2^m for cluster analysis, where m is the number of clustering variables. Because the cluster analysis for this project was going to include ten variables, a sample size of at least 1,024 was required.

Computer-Assisted Content Analysis

Comments were coded for 13 variables using a combination of human coders and the text analysis software Linguistic Inquiry and Word Count (LIWC). The variables were: Clarity, Ad Hominem, Informative, On Topic, Agreement, Disagreement, Questions, Positive Emotion, Negative Emotion, Vulgarity, Civility, Hostility, and Deliberation.

Human Coders

Two undergraduate research assistants were recruited and trained for coding. They coded for whether comments were clear (Clarity), included personal insults (Ad Hominem), and included new information (Informative). (See Appendix B for the complete codebook). The research assistants were paid $10 per hour for their work. All variables were dichotomous with a zero indicating that the comment lacked that variable and a one indicating that the comment included the variable. Training began in early January 2020 with a one-hour meeting where the research assistants reviewed the codebook and practiced coding 20 comments together. Disagreements were discussed and additional items were added to the codebook to improve reliability. Once agreement on all codes was reached, the researcher and research assistants coded 923 comments (approximately 6% of the dataset) independently over the next week.

Krippendorff's alpha was used to calculate reliability between the researcher and both coders. Values for Krippendorff's alpha range from zero to one, with zero indicating perfect disagreement and one representing perfect agreement. An alpha greater than .80 is typically required and an alpha of .67 is the lowest acceptable value (Krippendorff, 2004). After the first round of coding, reliability for the Ad Hominem variable was acceptable (α=.88), but reliability for Clarity and Informative were too low (Clarity α=.78, Informative α=.60). Therefore, another training session was arranged where the researcher and coders discussed disagreements and added additional items to the codebook. Everyone then coded 1370 comments (8.5% of dataset) independently. After that round of coding, the reliability for Clarity and Ad Hominem increased significantly (Clarity α=.93, Ad Hominem α=.97) but the reliability for Informative was still low (α=.63). Therefore, a final training session was held during which the researcher and coders discussed discrepancies and edited some items in the codebook. Everyone then coded 500 comments independently for only the Informative variable. After this round, reliability for Informative reached an acceptable level (α=.89).

Linguistic Inquiry and Word Count

The text analysis software LIWC was used to code the remaining comment-level variables. LIWC comes pre-loaded with dictionaries which were used to code for: Positive Emotion, Negative Emotion, Vulgarity, and Questions (See Appendix C for sample words from

pre-loaded dictionaries). All variables were continuous and scores represent the percent of a comment that includes each variable. The percent is calculated by dividing the number of words in the comment that appear in each variable's dictionary by the total number of words in the comment. LIWC was also used to code for the use of question marks and exclamation marks in each comment. These variables were also continuous with the scores indicating the percent of characters in each comment that were a question mark/exclamation mark. Civility and Hostility were coded using custom dictionaries created by Ksiazek (2015) in his study of news organizations' commenting policies. (See Appendix D for sample word from custom dictionaries) Finally, custom dictionaries were created to code for whether the comments were On Topic with the post they responded to. A separate dictionary was developed for each post and consisted of names and topic-specific words that appeared in the article, along with synonyms to those words. For example, a dictionary for an article mentioning climate change also included the words "global warming." (See Appendix E for samples of the On Topic dictionaries).

Conversation-Level Coding

Deliberation was coded manually by research assistants at the conversation level. A conversation consisted of a comment with a depth of one and all two- and three-level comments beneath it. A new conversation started with the next level-one comment. Conversations were coded as either Non-Deliberative (0), Moderately Deliberative (.5), or Extremely Deliberative (1). All comments in a single conversation received the same code. A conversation was considered Non-Deliberative if any comment included Ad Hominem and/or there was more Hostility than Civility in the conversation. The conversation-level Hostility/Civility score was calculated by averaging the Hostility/Civility scores for each comment in the conversation, then subtracting Hostility from Civility so that a negative score represented a conversation with more Hostility than Civility. A Moderately Deliberative conversation was one where no comments included Ad Hominem and there was greater Civility than Hostility, but no comments were coded as Informative and/or no Reddit user commented more than once. A conversation was coded as Extremely Deliberative if there were no Ad Hominem comments, there was more Civility than Hostility, at least one comment was Informative, and at least one user commented more than once. The research assistants coded for Deliberation but, because it was based on LIWC codes and codes that had already achieved reliability, reliability for this variable did not

need to be calculated. See Table 1 for the frequencies of dichotomous variables between Subreddits and Table 2 for the descriptive statistics of continuous variables.

Table 1. Frequencies of Dichotomous Variables

		r/EverythingScience	r/Science	Total Dataset
Clarity	0	19 (1.1%)	15 (.1%)	34 (.2%)
	1	1,687 (98.9%)	11,976 (99.9%)	13,663 (99.8%)
Ad Hominem	0	1,660 (97.3%)	11,960 (99.7%)	13,620 (99.4%)
	1	46 (2.7%)	31 (.3%)	77 (.6%)
Informative	0	1,335 (78.3%)	7,816 (65.2%)	9,151 (66.8%)
	1	371 (21.7%)	4,175 (34.8%)	4,546 (33.2%)
Deliberation	0	430 (41.1%)	1,022 (15.9%)	1,452 (19.4%)
	.5	368 (35.2%)	2,015 (31.3%)	2,383 (31.8%)
	1	248 (23.7%)	3,410 (52.9%)	3,658 (48.8%)

Table 2. Descriptive Statistics of Continuous Variables

	r/EverythingScience		r/Science		Total Dataset	
	M	SD	M	SD	M	SD
Positive Emotion	4.06	9.01	3.44	6.98	3.51	7.27
Negative Emotion	4.65	9.76	1.94	4.43	2.28	5.46
Vulgarity	2.26	8.78	.29	2.07	.54	3.71
Questions	2.30	5.81	2.02	4.66	2.06	4.81
Q. Marks	2.69	12.22	2.00	9.47	2.09	9.85
Exclam. Marks	1.42	8.36	.81	5.51	.89	5.94
Civility	6.74	10.42	6.37	9.13	6.42	9.30
Hostility	5.11	10.89	1.98	4.53	2.37	5.81
On Topic	6.61	9.91	9.18	8.69	8.86	8.89

Coding for Topic Sensitivity

Finally, the sensitivity of the post was coded dichotomously with zero indicating that the topic was not sensitive and one representing a sensitive topic. A list of sensitive topics was compiled based on many past studies examining online discourse (See Table 3). If the headline of the post included any of these topics, it was coded as sensitive. A Chi-square analysis revealed that there was a significant relationship between post sensitivity and Subreddit, so that was taken into consideration in relevant analyses ($\chi^2[1]=7.20$, p=.007). See Table 4 for headlines and their sensitivity codes.

Table 3. List of Sensitive Topics

Study	Sensitive Topics Mentioned
Braun & Gillespie, 2011	Graphic images
	Politics
Coe, Kenski, & Rains, 2014	Politics
	Economy
	Law and order
	Taxes
	Foreign affairs
	Sports
Collins & Nerlich, 2015	Climate change
Diakopoulos & Naaman, 2011	Immigration
Halpern & Gibbs, 2013	Politics
	War
	LGBTQ+ issues
Hmielowski, Hutchens, & Cicchirillo, 2014	Politics
Ksiazek, 2018	Economy
	Government inefficiency
	Immigration
	Gun control
	Foreign policy
	Defense
	Intelligence agencies
	Politicians' personality traits/characteristics
Kushin and Kitchener, 2009	Politics
Schafer, 2012	Climate change
Stroud, Scacco, Muddiman, 2015	Healthcare
	Abortion

Table 4. Post Headlines and Sensitivity Score

Subreddit	Headline	Sensitivity Score
r/EverythingScience	CDC whistleblower says he was told not to use phrase "climate change" after Trump elected	1
	Climate scientists say Greta Thunberg's efforts are building real momentum: "She is getting people to listen, which we have failed to do," one climatologist said.	1

Table 4 Cont.

	I'm a scientist. Under Trump I lost my job for refusing to hide climate crisis facts. I was a climate scientist in a climate-denying administration	1
	Judge rules that Trump can't ignore 'inconvenient facts' about climate change.	1
	Michele Bachmann: Climate Change Is a Fraud Because 'God Says We Will Never Be Flooded'	1
	Nestlé plan to take 1.1m gallons of water a day from natural springs sparks outcry - to sell back to the public as bottled water. "A big threat to this diversity is habitat degradation, which will happen with reduced flows."	0
	'So they knew': Ocasio-Cortez questions Exxon scientist on climate crisis denial – Hoffert testified that in 1982, Exxon scientists predicted how carbon dioxide levels would rise and heat the planet as humans burned more fossil fuels	1
	The Bee Is Declared the Most Important Living Being on the Planet	0
	The man who advised the GOP to drop "global warming" for the less scary-sounding "climate change" now calls for climate action. "I'm here before you to say that I was wrong in 2001. Just stop using something that I wrote 18 years ago, because it's not accurate today."	1
	USDA Indefinitely Suspends Honeybee Tracking Survey as States Get Approval to Use Bee-Killing Pesticide: "Yet another example of the Trump administration systematically undermining federal research on food safety, farm productivity, and the public interest writ large."	1
r/Science	Having kids makes you happier, but only when they move out, according to a new study, which suggests that parents are happier than non-parents later in life, when their children move out and become sources of social enjoyment rather than stress (n=55,000).	0
	Industrial methane emissions are 100 times higher than reported, and have been vastly underestimated, finds a new study using a Google Street View car equipped with a high-precision methane sensor. They also were substantially higher than the EPA estimate for all industrial processes in the US.	0

Table 4 Cont.

	In Seattle, Washington, delaying the start time of two high schools by nearly an hour lengthened students' daily sleep by more than half an hour, and was associated with reduced sleepiness and increased academic performance.	0
	MMR vaccine does not cause autism, another study confirms	1
	Scientists believe that the function of zebras' stripes are to deter insects, so a team of researchers painted black and white stripes on cows. They found that it reduced the number of biting flies landing on the cows by more than 50%.	0
	Self-driving cars will "cruise" to avoid paying to park, suggests a new study based on game theory, which found that even when you factor in electricity, depreciation, wear and tear, and maintenance, cruising costs about 50 cents an hour, which is still cheaper than parking even in a small town.	0
	The first picture of a black hole opens a new era of astrophysics. The supermassive beast lies in a galaxy called M87 more than 50 million light-years away	0
	The United States, on a per capita basis, spends much more on health care than other developed countries; the chief reason is not greater health care utilization, but higher prices, according to a new study from Johns Hopkins.	1
	Tree stumps that should be dead can be kept alive by nearby trees, discovers new study, which found a tree stump that should have died is being kept alive by neighbouring trees through an interconnected root system, which may change our view from trees as individuals to forests as 'superorganisms'.	0
	Woman with 'mutant' gene who feels no pain and heals without scarring discovered by scientists. She reported numerous burns and cuts without pain, often smelling her burning flesh before noticing any injury, as published in the British Journal of Anesthesia, and could open door to new treatments.	0

This chapter has described this study's data collection process and coding scheme, as well as some preliminary results. The following chapter will discuss the analyses used to test the research questions and hypotheses, and summarize the results.

CHAPTER FOUR: RESULTS

This chapter describes the analyses used to test hypotheses and answer research questions. Each section summarizes the tests used for each hypothesis or question and presents results.

Research Question One

A two-step cluster analysis was conducted to determine which underlying characteristics differentiate types of online messages (RQ1). Cluster analysis is the process of grouping data cases into similar categories based on a collection of variables (Alnajran, Crockett, McLean & Latham, 2017). It is a prominent component of exploratory data analysis and should be used when there is no prior understanding of groups' structure or labels (Alnajran, et. al., 2017). In the past, cluster analysis has been used to categorize types of social media users (Amaro, Duarte, & Henriques, 2016; Go & Han You, 2016), types of Facebook functions during a political revolution (Marzouki, Skandrani-Marzouki, Be´jaoui, Hammoudi, & Bella, 2012), divide languages into different dialects (Goncalves & Sanchez, 2014), and analyze political Tweets (Tumasjan, Sprenger, Sandner, & Welpe, 2010).

For this study, two-step clustering was used because it allows the inclusion of metric and nominal variables in the same analysis (Chiu, Feng, Chen, Wang, & Jeris, 2001). The Hostility variable was removed from analysis due to its high correlations with Negative Emotion ($r=.92$, p<.001) and Vulgarity ($r=.64$, p<.001) (Mooi & Sarstedt, 2011). Civility was also removed because it was highly correlated with Positive Emotion ($r=.76$, p<.001). (See Table 5 for all variable correlations). Finally, Ad Hominem and Clarity were removed from analysis due to low variance. Specifically, of the 13,697 comments in the dataset, only 77 (.6%) included Ad Hominen and 13,663 (99.8%) were clear.

Table 5. Correlations of Clustering Variables

	1	2	3	4	5	6	7
1 On Topic	-						
2 Questions	-.05**	-					
3 Positive Emotion	-.05**	-.06**	-				
4 Negative Emotion	-.08**	-.01	-.05**	-			
5 Vulgarity	-.07**	.03*	.01	.45**	-		
6 Civility	-.11**	-.05**	.76**	-.05**	-.01	-	
7 Hostility	-.08**	-.01	-.02*	.92**	.64**	-.03**	-

*Note: *p<.01; **p<.001*

In order to test the validity of the results, the dataset was randomly split in half so that the cluster analysis could be conducted on both halves separately (Mooi & Sarstedt, 2011). Results from the first dataset indicate a three-cluster solution with a Silhouette of .6 and a Cluster Ratio of 18.01. Cluster analysis on the second dataset resulted in the same three clusters with a Silhouette of .6 and a Cluster Ratio of 10.58. Both results indicated good fit, so the three-cluster solution was retained. Analyses were performed on the complete dataset. See Table 6 for a comparison of variable descriptive statistics across the three clustering solutions.

Table 6. Descriptive Statistics of the Three Clustering Solutions

Variable Means	First Random Sample			Second Random Sample			Complete Dataset		
	PP	EI	OTI	PP	EI	OTI	PP	EI	OTI
Positive Emotion	2.02	4.07	2.57	3.21	19.59	2.45	3.83	7.00	2.54
Negative Emotion	1.43	15.76	1.97	1.81	12.08	1.94	1.63	17.32	1.92
Vulgarity	0.14	8.17	0.16	0.25	9.53	0.16	.19	10.31	.16
Questions	1.82	8.77	1.46	2.05	8.03	1.47	1.97	9.13	1.46
On Topic	8.66	3.63	10.18	8.40	4.62	10.01	8.55	3.32	10.04
% Informative (categorical)	0%	0%	100%	0%	2%	100%	0%	2.9%	100%

Cluster One: Polite Participation

Cluster One is the largest cluster with 63.2% of cases. Comments in this category are low in emotion and vulgarity, are moderately on topic, and generally do not include new information or questions. See Table 7 for descriptives of all cluster centroids and Figure 4 for a visualization of variables means among clusters. Table 8 provides examples of comments from each cluster. Numbers indicate the percent of each comment represented by each variable.

Cluster Two: Emotional Interrogation

Cluster Two is the smallest cluster with 6% of cases. Cluster Two comments are the least on topic and highest in emotion (positive and negative) and vulgarity. Comments in this category tend to include the most questions but no new information.

Cluster Three: On Topic Information

Cluster Three includes 30.8% of cases and is the only category where the majority of comments provide new information. Comments in this cluster are low in emotion, vulgarity, and questions, but are the most on topic.

Table 7. Cluster Centroids Descriptive Statistics

Cluster	Variables	Minimum	Maximum	Mean	SD
Polite Participation (N=8,683)	Positive Emotion	0	66.67	3.83	7.15
	Negative Emotion	0	25	1.63	3.33
	Vulgarity	0	11.11	.19	.99
	Questions	0	20	1.97	3.52
	On Topic	0	100	8.55	9.35
	0% Informative				
Emotional Interrogation (N=482)	Positive Emotion	0	100	7	20.99
	Negative Emotion	0	100	17.32	17.82
	Vulgarity	0	100	10.31	16.39
	Questions	0	100	9.13	18.28
	On Topic	0	42.86	3.32	7.67
	2.9% Informative				
On Topic Information (N=4,532)	Positive Emotion	0	40	2.54	3.53
	Negative Emotion	0	25	1.92	3.21
	Vulgarity	0	12.5	.16	.82
	Questions	0	17.39	1.46	2.26
	On Topic	0	66.67	10.04	7.76
	100% Informative				
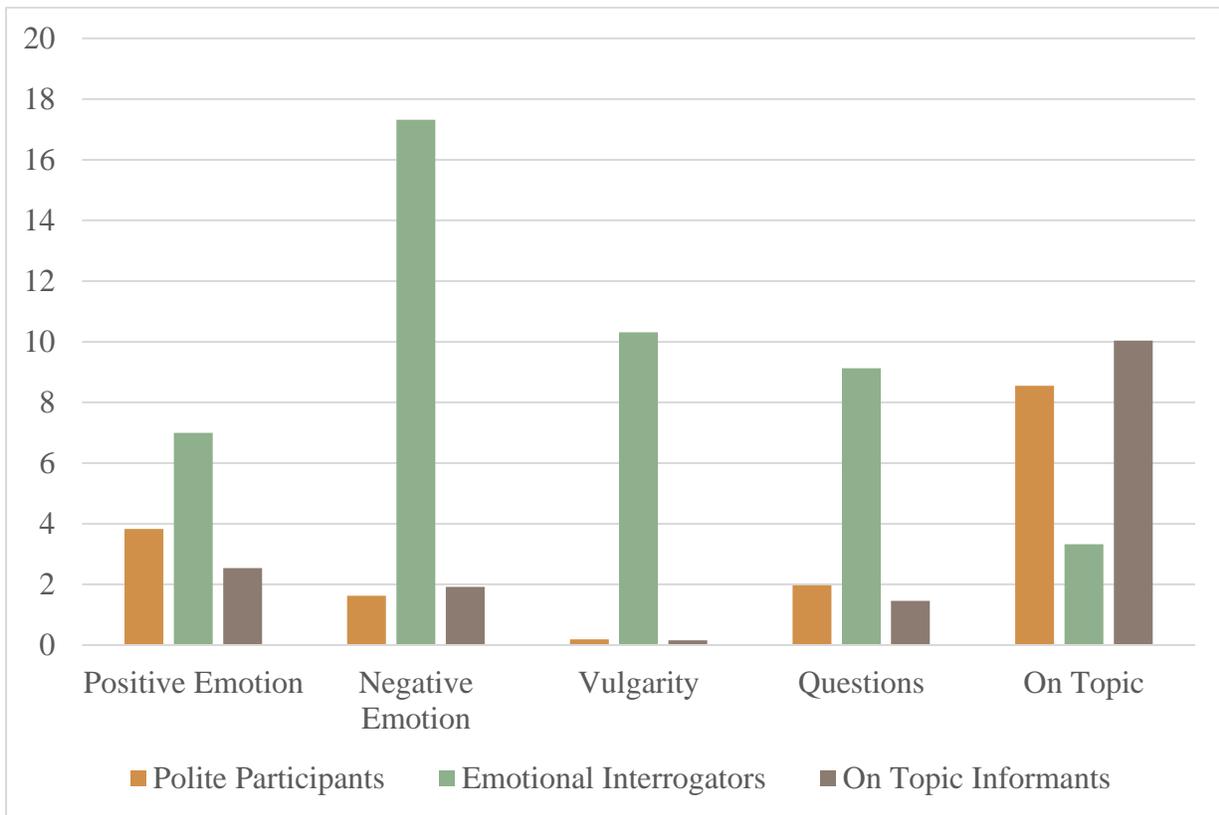
Figure 4. Means of Clustering Variables

Table 8. Representative Comments

Cluster	Sample Comments
1 Polite Participation	"I've been saying this since before the election. I recognized Putin as very dangerous and smart and ambitious years ago."
	"'When he was resigned' sounds a lot like 'when he got himself murdered.' I know this doesn't add a lot to this particular discourse, but it says a lot about how the media is normalizing nonsense language. He was fired. For backing science."
	"I can't tell what you are mad at."
	"Greta [Thunberg] I admire her! She has conviction also she's right. The future generations have the right to live in a free and verdant world, not a wasteland full of catastrophic weather patterns."
	"Literally everyone knows about global warming or climate change, almost no one is willing to do what is needed to combat it."
2 Emotional Interrogation	"It's hard to believe that this single POS [piece of shit] in the WH has power over all these people. One. Fucking. Dumb. Piece. Of. Shit."
	"How does this bible thumping idiot say this after one of the first things taught to her in bible thumping school was Noah and the great flood. What a fucking moron."
	"What the fuck do you think the Climate protests she [Greta Thunberg] initiated are for?"
	"LMAO [laughing my ass off], its hilarious when a idiot says they won't take your opinion seriously. Who gives a shit about your opinion?
	"Why tf [the fuck] is climate change political?"
3 On Topic Information	"The funny thing is 'climate change' was the focus-group-tested and Republican-approved alternative to 'global warming.' Now they don't even want to use that."
	"Yep, [here's a link to a PDF of Frank Luntz's report where he recommended using the term "climate change."] (http://web.archive.org/web/20121030085144/http://www.ewg.org/files/ LuntzResearch_environment.pdf) As it states: 'Climate change' is less frightening than 'global warming'; As one focus group participant noted, climate change 'sounds like you're going from Pittsburgh to Fort Lauderdale.' While global warming has catastrophic connotations attached to it, climate change suggests a more controllable and less emotional challenge."

Table 8 Cont.

"The IPCC report includes sections on the estimated economic impacts of warming scenarios, and these estimates especially refute the apocalypse fear mongering. The report predicts that in a worst case scenario where we do nothing to stop climate change, the economic damage will only be the same as a single global recession: >Under the no-policy baseline scenario, temperature rises by 3.66°C by 2100, resulting in a global gross domestic product (GDP) loss of 2.6% (5–95% percentile range 0.5–8.2%), compared with 0.3% (0.1–0.5%) by 2100 under the 1.5°C scenario and 0.5% (0.1–1.0%) in the 2°C scenario. If you think that the world is doomed, then surely it is worth your time to read it for yourself (https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15 Chapter3_Low_Res.pdf). Page 256."
"That's an obvious rejection of scientific evidence. Hansen's 1981 climate model predicted +0.5°C by 2015 and actual warming was +0.6°C. Secondly, the CO2 greenhouse effect doesn't exclude the continuing influence of natural factors in global temperature."
"And what does climate change have to do with the keystone pipeline? One way or another the oil from western Canada is going to get dug out and piped out. BTW [by the way], the CO2 emissions from Alberta are something like 8% of Canada's emissions and Canada's emissions are 1.7% of world emissions. Do the math. World CO2 levels have risen 40% since 2000, not because of the Alberta oil sands but because the third world is rapidly electrifying, and they're doing it with the cheapest fuel they have - coal. Coal power plants are being built in their hundreds all over the third world. India increased its CO2 emissions last year by approximately 10 times the total emissions Alberta and its oil sands puts out. And it will do the same this year and next year and the year after and the year after. And yet American environmentalists are bug-eyed about Alberta and its oil sands."

In order to determine whether clusters are significantly different from each other, the cluster centroids must be examined. Cluster centroids are the clustering variables' average values of all cases in a specific cluster (Mooi & Sarstedt, 2011). An ANOVA was performed to determine whether cluster centroids of the continuous variables differed significantly. Brown-Forsythe F was used due to heterogeneity of variance and unequal group sizes among clusters. The overall ANOVA for each variable was significant (p<.001 for all variables).

Bonferroni post hoc tests were used to explore the differences among the clusters for all variables. Findings show that Emotional Interrogation comments include significantly more Positive Emotion than Polite Participation and On Topic Information. On Topic Information also

includes significantly less Positive Emotion than Polite Participation. In other words, the three groups differ significantly regarding Positive Emotion with Emotional Interrogation having the most, Polite Participation being in the middle, and On Topic Information having the least Positive Emotion. The pattern changes slightly regarding the Negative Emotion variable. Emotional Interrogation still has significantly more Negative Emotion than Polite Participation and On Topic I Information, but On Topic Information includes significantly more negative emotion than Polite Participation. For Vulgarity, there were significant differences only between Polite Participation and Emotional Interrogation, and Emotional Interrogation and On Topic Information. The difference in Vulgarity between Polite Participation and On Topic Information was not significant. There were significant differences among all groups for the Questions variable. Emotional Interrogation asked significantly more questions than the other two groups and On Topic Information asked significantly fewer questions than Polite Participation. Finally, each group differed significantly on the On Topic variable. Specifically, Emotional Interrogation was the lowest on this variable, Polite Participation was in the middle, and On Topic Information was significantly higher than the other two groups. To summarize, there were significant differences among all groups for each variable except for Vulgarity, where only Emotional Interrogation differed significantly from the other two groups. See Table 9 for complete results.

Table 9. ANOVA for Grouping Variables

Grouping Variable		Sum of Squares	df	Mean Square	Brown-Forsythe F
Pos. Emo.	Between Groups	11,036.69	2	5,518.35	24.41**
	Within Groups	712,057.94	13,694	52	
	Total	723,094.63	13,696		
Neg. Emo.	Between Groups	113,249.19	2	56,624.60	356.77**
	Within Groups	295,694.76	13,694	21.59	
	Total	408,943.95	13,696		
Vulgarity	Between Groups	47,708.48	2	23,854.24	183.53**
	Within Groups	140,777.04	13,694	10.28	
	Total	188,485.52	13,696		
Questions	Between Groups	25,757.13	2	12,878.57	77.95**
	Within Groups	291,745.45	13,694	21.31	
	Total	317,502.58	13,696		
On Topic	Between Groups	21,975.14	2	10,987.57	170.25**
	Within Groups	1,060,626.74	13,694	77.45	
	Total	1,082,601.88	13,696		

*Note: *p<.01, **p<.001*

A Chi-Square analysis was conducted to determine whether the dichotomous variable Informative differed significantly between clusters. The overall test was significant (χ^2[df=2]=13,634.7, p<.001) indicating that the informativeness of comments differed significantly among clusters. Results of the overall test also suggestion a strong relationship between comment type and the informativeness of comments (Cramer's V=.99, p<.001). Following Beasley and Schumacker's (1995) approach to analyzing contingency tables, post hoc tests were conducted (See Table 10). Results indicate that On Topic Information had significantly more informative comments than the other two groups, while Polite Participation had significantly more informative comments than Emotional Interrogation. In other words, all groups differed significantly on the Informative variable, with On Topic Information being highest in Informativeness, Polite Participation falling in the middle, and Emotional Interrogation being the least Informative.

Table 10. Chi-Square Analysis of Nominal Grouping Variable

		Non-Informative	Informative
Polite Participation			
	Observed Count	8,682.00	0.00
	Expected Count	5,800.26	2,881.74
	Adj. Stand. Residual	108.55	-108.55
	χ^2	11,783.10***	11,783.10***
Emotional Interrogation			
	Observed Count	468.00	14.00
	Expected Count	322.01	159.99
	Adj. Stand. Residual	14.38	-14.38
	χ^2	206.78***	206.78***
On Topic Information			
	Observed Count	0.00	4,532.00
	Expected Count	3,027.73	1,504.27
	Adj. Stand. Residual	-.116.76	116.76
	χ^2	13,632.90***	13,632.90***

*Note: *p<.05; **p<.01; ***p<.001 (Bonferroni Adjusted value=.008)*

Hypothesis One

Hierarchical linear regressions were conducted to test hypothesis one, which stated that message type would predict the quantity of user interaction above and beyond Subreddit and

topic sensitivity. Quantity of interaction was measured by number of replies and number of upvotes/downvotes (DVs). Hierarchical regressions were run with Subreddit in Block 1, Topic Sensitivity in Block 2, and Comment Type in Block 3. Comment Type was dummy coded into two dichotomous variables with Cluster One (Polite Participation) as the base variable to allow for easy interpretation of results. Although the data were nested, hierarchical regressions were conducted rather than multi-level modeling due to the large number of groups (conversations) and the small number of cases in many groups (comments). Specifically, there were thousands of conversations and many contained only between one and three comments. Furthermore, users posted comments in multiple conversations, so they were not unique to any one group.

Number of replies was the dependent variable for the first regression. (See Table 11). Blocks 2 and 3 were significant, indicating that topic sensitivity and comment type have a significant impact on the number of replies that a comment receives. Specifically, comments made in response to sensitive posts receive more replies than comments responding to non-sensitive posts. The comment type also significantly impacts how many replies a comment receives. On Topic Information receives significantly more replies than Polite Participation and Emotional Interrogation. Emotional Interrogation receives slightly fewer replies than Polite Participation, but that relationship is not significant. Block 1 was not significant, indicating that there is no relationship between which Subreddit a comment is posted on and how many replies it receives.

Table 11. Hierarchical Regression for Number of Replies

Predictor	ΔR^2	F	β
Block 1	.000	.09	
Subreddit			-.003
Block 2	.001**	5.50**	
Subreddit			.016
Topic Sensitivity			.034**
Block 3	.003***	13.07***	
Subreddit			.012
Topic Sensitivity			.037***
Emotional Interrogation			-.011
On Topic Information			.053***
	Total R^2=.004		

*Note: *p<.05, **p<.01, ***p<.001*

The second analysis explored quantity of interaction through a comment's "score," or ratio of upvotes to downvotes (See Table 12). The blocks for the hierarchical regression remained the same as the previous analysis (Block 1 included Subreddit, Block 2 added Topic Sensitivity, Block 3 added Comment Type). Results demonstrate that Blocks 1 and 3 were significant predictors for comment score. This indicates that the Subreddit on which a comment is posted influences that comment's score, with comments posted to r/Science receiving higher scores than comments posted on r/EverythingScience. Block 2 was not significant, indicating that there is no relationship between a comment's score and whether it was posted in response to a sensitive or non-sensitive article. Finally, Block 3 was significant and illustrates that On Topic Information comments have significantly higher scores than Emotional Interrogation or Polite Participation (the dummy coding convention described above was also used for this analysis). This variable is the most significant predictor in the analysis and actually causes Subreddit to lose its significance when it is added to the model, indicating collinearity. Emotional Interrogation has slightly lower comment scores than Polite Participation, but this effect is not significant.

Table 12. Hierarchical Regression for Comment Score

Predictor	ΔR^2	F	β
Block 1	.0003*	4.16*	
Subreddit			.017*
Block 2	.000	2.57	
Subreddit			.012
Topic Sensitivity			-.010
Block 3	.001**	4.44**	
Subreddit			.009
Topic Sensitivity			-.009
Emotional Interrogation			-.004
On Topic Information			.030**
	Total R^2=.0013		

*Note: *p<.05, **p<.01, ***p<.001*

For both regressions, adding comment type increased the predictability of the model, demonstrating that comment type can predict the quantity of user interaction above and beyond Subreddit and topic sensitivity. Thus, Hypothesis 1 was supported.

Hypothesis Two

H2 stated that comment type can predict the quality of interaction above and beyond Subreddit and topic sensitivity. For this study, quality is measured by the civility or hostility of comments and which of the three clusters response comments belong to. Hierarchical regressions were used to assess the impact on civility and hostility. Block 1 included Subreddit (r/EverythingScience or r/Science), Block 2 included topic sensitivity (non-sensitive or sensitive) and Block 3 included the comment type of the first comment in the conversation. The goal of Block 3 was to determine if the first comment in a conversation impacts the quality of later comments. Comment type was dummy coded into two dichotomous variables with Cluster One (Polite Participation) as the base variable to allow for easy interpretation of results.

The results for civility were not significant, indicating that Subreddit, topic sensitivity, and first-comment type do not predict how civil the following comments are. (See Table 13).

Table 13. Hierarchical Regression for Civility

Predictor	ΔR^2	F	β
Block 1	.000		
Subreddit		.19	-.004
Block 2	.000		
Subreddit		2.42	-.015
Topic Sensitivity			-.020
Block 3	.000	2.21	
Subreddit			-.023
Topic Sensitivity			-.020
Emotional Interrogation			-.021
On Topic Information			.006
	Total R^2=.000		

*Note: *p<.01, **p<.001*

All Blocks were significant in predicting the hostility of comments (See Table 14). Results indicate that comments posted to the r/EverythingScience Subreddit (the Subreddit with less stringent rules) are significantly more hostile than comments posted to r/Science. Furthermore, comments in response to sensitive posts are more hostile than comments on non-sensitive posts. Finally, the significance of Block 3 indicates that the comment type of the first

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comment in a conversation impacts the hostility of later comments. Specifically, Emotional Interrogation comments elicit significantly more hostile comments than Polite Participation or On Topic Information. On Topic Information comments lead to slightly less hostile comments than Polite Participation, but this effect is not significant. To summarize, this analysis indicates that first-comment type predicts the hostility of following comments above and beyond Subreddit and topic sensitivity.

Table 14. Hierarchical Regression for Hostility

Predictor	ΔR^2	F	β
Block 1	.010***	88.18***	
Subreddit			-.099***
Block 2	.003***	45.51***	
Subreddit			-.087***
Topic Sensitivity			.057***
Block 3	.001**	24.84***	
Subreddit			-.073***
Topic Sensitivity			.055***
Emotional Interrogation			.031**
On Topic Information			-.022
	Total R^2=.014		

*Note: *p<.05; **p<.01; ***p<.001*

A Chi-Square analysis was performed to determine whether the comment type of the first comment in a conversation impacts the type of comments that follow. The overall test was significant (χ^2[df=4]=128.62, p<.001) indicating that first comment type impacts the type of following comments. However, the effect size was small (Cramer's V=.10). Following Beasley and Schumacker's (1995) approach to analyzing contingency tables, post hoc tests were conducted (See Table 15). Results indicate that Polite Participation comments are significantly more likely to lead to other Polite Participation comments than Emotional Interrogation or On Topic Information comments. Emotional Interrogation is more likely to encourage other Emotional Interrogation. On Topic Information is significantly more likely than Emotional Interrogation to lead to other On Topic Information comments. Polite Participation comments are most likely to lead to more Polite Participation and least likely to lead to On Topic Information,

indicating that Polite Participants tend to communicate with each other. Similarly, Emotional Interrogation is most likely to encourage more Emotional Interrogation comments and least likely to lead to On Topic Information. In other words, a conversation that begins with an Emotional Interrogation comment is likely to consist primarily of those types of comments. Finally, On Topic Information is most likely to lead to more On Topic Information and least likely to encourage Polite Participation. Taken together, the results of this analysis indicate that the first comment sets the tone for the entire conversation because the following comments are likely to be the same type.

Table 15. Chi-Square Analysis of the Influence of Comment Type on Interaction Quality

		First Comment Type		
		Polite Participation	Emotional Interrogation	On Topic Information
Following Comment Type				
Polite Participation				
	Observed Count	2,118.00	134.00	1010.00
	Expected Count	1,966.95	124.84	1,170.20
	Adj. Stand. Residual	7.93	1.23	-8.58
	χ^2	62.8***	1.51	73.62***
Emotional Interrogation				
	Observed Count	229.00	30.00	97.00
	Expected Count	214.66	13,62	127.71
	Adj. Stand. Residual	1.60	4.66	-3.50
	χ^2	2.56	21.72***	12.25*
On Topic Information				
	Observed Count	1,324.00	69.00	1,077.00
	Expected Count	1,489.38	94.53	886.06
	Adj. Stand. Residual	-8.82	-3.47	10.39
	χ^2	77.79***	12.04*	107.95***

*Note: *p<.05; **p<.01; ***p<.001 (Bonferroni Adjusted Value=.006)*

Hypothesis 2 stated that comment type can predict the quality of interaction above and beyond Subreddit and topic sensitivity. Of the three analyses conducted, two found significant results for comment type. The first comment in a conversation has a significant impact on the

hostility and comment type of the following comments. However, comment type did not predict the civility of following comments. Thus, H2 was partially supported.

Research Question Two

RQ2 asked what factors encourage the formation of incivility spirals. To answer this question, first a Chi-Square analysis was conducted to examine whether the comment type of the first comment in a conversation encourages/discourages deliberation. The overall test was significant (χ^2[df=4]=758.85, p<.001) indicating that first comment type is related to the level of deliberation that takes place. Cramer's V=.25, suggesting that there is a moderate relationship between the type of comment that begins a conversation and what level of deliberation takes place. Post hoc tests were conducted (See Table 16) and revealed that Emotional Interrogation comments are significantly more likely to lead to non-deliberative conversations and significantly less likely to lead to extremely deliberation conversations. Polite Participation tends to discourage non-deliberative and extremely deliberative conversations, but encourage moderate deliberation. Finally, On Topic Information comments are significantly more likely to encourage extremely deliberative conversations and less likely to encourage moderate deliberation. To summarize, the best comment type for encouraging deliberation is On Topic Information and the type least likely to encourage deliberation is Emotional Interrogation.

Table 16. Chi Square Analysis of the Impact of Comment Type on Deliberation

First Comment Type		Deliberation Level		
		Not Deliberative	Moderately Deliberative	Extremely Deliberative
Polite Participation				
	Observed Count	543.00	1,378.00	1,750.00
	Expected Count	600.77	1,035.07	2,035.16
	Adj. Stand. Residual	-4.09	19.97	-15.03
	χ^2	16.73**	398.80***	225.90***
Emotional Interrogation				
	Observed Count	133.00	59.00	41.00
	Expected Count	38.13	65.70	129.17
	Adj. Stand. Residual	1.13	-.99	-11.85
	χ^2	1.28	.98	140.42***
On Topic Information				
	Observed Count	320.00	279.00	1,583.00
	Expected Count	357.09	615.23	1,209.67
	Adj. Stand. Residual	-2.68	-19.97	20.08
	χ^2	7.18	398.80***	403.21***

*Note: *p<.05, **p<.01; ***p<.001 (Bonferroni Adjusted Value=.006)*

Pearson's correlations showed significant correlations between a comment's hostility level and the hostility of previous comments (See Table 17). Therefore, a hierarchical regression was conducted to examine which factors encourage the formation of incivility spirals. For this analysis, the dependent variable was the hostility of comments with a depth of three, meaning that they were a reply to a reply. The regression included four blocks; Block 1 controlled for Subreddit, Block 2 controlled for topic sensitivity, Block 3 was the hostility level of the first comment in the conversation, and Block 4 was the hostility level of the comment's "parent," or the comment that it was a direct reply to. Each block was significant, indicating that Subreddit, topic sensitivity, and the hostility of previous comments all impact how hostile a comment is (See Table 18). Specifically, comments appearing on the r/EverythingScience Subreddit (the Subreddit with less stringent rules) are more hostile and posts about sensitive topics lead to more hostile comments. The first comment in a conversation was a significant predictor in Block 3, but that significance disappeared when the hostility level of the parent comment was included in the model. The parent comment was the most significant predictor in the model. Specifically, parent comment hostility accounts for 2.1% of the hostility of a comment. For every one-percent

increase in the hostility of a parent comment, a comment's own hostility will increase .15%. These findings demonstrate that Subreddit, topic sensitivity and previous comments all influence the formation of incivility spirals. Incivility spirals are more likely to form on a Subreddit with less stringent rules when a sensitive topic is being discussed and previous comments are hostile.

Table 17. Correlations of Comment and Previous Comments' Hostility

	1	2	3
1 Comment Hostility	-		
2 First Comment Hostility	.08**	-	
3 Parent Comment Hostility	.18**	.24**	-

*Note: *p<.01, **p<.001*

Table 18. Hierarchical Regression of Incivility Spirals

Predictor	ΔR^2	F	β
Block 1	.014***	49.90***	
Subreddit			-.120***
Block 2	.004**		
Subreddit		28.11***	-.109***
Topic Sensitivity			.063**
Block 3	.003**	19.94***	
Subreddit			-.095***
Topic Sensitivity			.062**
First Comment Hostility			.056**
Block 4	.021***	22.65***	
Subreddit			-.080***
Topic Sensitivity			.049**
First Comment Hostility			.024
Parent Comment Hostility			.151***
	Total R^2=.042		

*Note: *p<.05; **p<.01; ***p<.001*

Pearson's correlations for a comment's civility level and the civility of former comments was also statistically significant (See Table 19), so a hierarchical regression was conducted to examine what factors encourage civility spirals. Blocks 2-4 were significant, indicating that topic

sensitivity and the civility level of previous comments impact the civility of a comment, but Subreddit does not have a significant effect (See Table 20). In other words, there is no difference in the civility of comments posted on r/Science and r/EverythingScience. Topic sensitivity was the biggest predictor in the model and demonstrated that sensitive topics lead to less civil comments. The civility of previous comments is positively related to the civility of a comment. In Block 3, the civility of the first comment in a conversation was a significant predictor of the civility of following comments. Specifically, for every 1% increase in the civility level of the first comment in a conversation, the third-level comment's civility increases .04%. However, the significance of that variable disappeared in Block 4 when parent comment civility was added to the model. This indicates that parent comments have a greater impact on following comments than the first comment in a conversation. However, the effect is very small. Findings show that 1% increase in a parent comment's civility will lead to a .05% increase in a comment's civility.

Table 19. Correlations of Comment and Previous Comments' Civility

	1	2	3
1 Comment Civility	-		
2 First Comment Civility	.045*	-	
3 Parent Comment Civility	.053**	.170**	-

*Note: *p<.01, **p<.001*

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Table 20. Hierarchical Regression of Civility Spirals

Predictor		ΔR^2	F	β
Block 1		.000	1.88	
	Subreddit			.016
Block 2		.004**	4.22*	
	Subreddit			.004
	Topic Sensitivity			-.064**
Block 3		.002*	5.39**	
	Subreddit			.004
	Topic Sensitivity			-.062*
	First Comment Civility			.042*
Block 4		.002*	4.36**	
	Subreddit			.008
	Topic Sensitivity			-.063**
	First Comment Civility			.034
	Parent Comment Civility			.050*
		Total R^2=.008		

*Note: *p<.05; **p<.01; ***p<.001*

Research Question Three

RQ3 asked how uses and gratifications differ between Subreddits. First, a one-way MANOVA was conducted to examine the differences in continuous variables between Subreddits. The overall test was significant (Pillai's Trace=.03, F=25.55, p<.001). Pillai's Trace was reported because Box's Test of Equality of Variance Matrices was significant (Box's M=4457.92, F=80.78, p<.001) and Pillai's Trace is the most robust to violation of assumptions. Partial η^2=.003, indicating that approximately 3.3% of the variance across all dependent variables is accounted for by Subreddit. (See Table 21 for complete MANOVA results; The numbers reported in the table are the percent of each comment that contains each variable). Results reveal that comments on r/EverythingScience have significantly more question marks, but do not include more question words (i.e. how, what, when). r/EverythingScience comments also include significantly more hostility, vulgarity, and negative emotion. Comments on r/Science tend to be more on topic, while r/EverythingScience comments include more disagreement.

Table 21. MANOVA Variables' Descriptive Statistics

Variable	Subreddit	Mean	SD	F	Partial η^2
Question Marks				8.90*	.001
	r/EverythingScience	3.01	14.49		
	r/Science	1.80	11.76		
Exclamation Marks				.01	.000
	r/EverythingScience	1.12	8.23		
	r/Science	1.09	6.44		
Civility				2.16	.000
	r/EverythingScience	6.62	9.34		
	r/Science	6.12	10.35		
Hostility				113.77**	.015
	r/EverythingScience	4.07	8.20		
	r/Science	2.10	5.01		
On Topic				42.63**	.006
	r/EverythingScience	6.43	9.25		
	r/Science	8.28	8.39		
Disagreement				3.90*	.001
	r/EverythingScience	2.79	4.80		
	r/Science	2.46	4.96		
Questions				2.32	.000
	r/EverythingScience	2.33	6.19		
	r/Science	2.05	5.22		
Positive Emotion				1.15	.000
	r/EverythingScience	3.61	6.93		
	r/Science	3.34	7.62		
Negative Emotion				126.23**	.017
	r/EverythingScience	3.73	6.92		
	r/Science	1.85	4.63		
Vulgarity				102.92**	.014
	r/EverythingScience	1.37	5.90		
	r/Science	0.35	2.21		

*Note: *p<.05, **p<.001*

Next, Chi-Square analyses were conducted to examine differences in comment type and informativeness between the two Subreddits. Results indicate that, when controlling for the sensitivity of posts, there are differences in the most common comment type between r/EverythingScience and r/Science. The overall test was significant for both non-sensitive posts (χ^2[df=2]=113.55, p<.001) and sensitive posts (χ^2[df=2]=123.28, p<.001). The effect size for non-sensitive posts was small (Cramer's V=.10), but it was moderate for sensitive posts (Cramer's V=.20). Post hoc tests revealed that there is no significant difference in the number of

Polite Participation comments between Subreddits (See Tables 22 and 23). On the other hand, Emotional Interrogation comments are significantly more likely on r/EverythingScience for both sensitive and non-sensitive posts. Finally, On Topic Information comments are significantly more likely on r/Science for both sensitive and non-sensitive posts.

Table 22. Chi-Square Analysis of Differences in Comment Type between Subreddits for Non-Sensitive Topics

Comment Type		Subreddit	
		r/EverythingScience	r/Science
Polite Participation			
	Observed Count	151.00	6,336.00
	Expected Count	144.20	6342.80
	Adj. Stand. Residual	.93	-.93
	χ^2	.86	.86
Emotional Interrogation			
	Observed Count	31.00	249.00
	Expected Count	6.20	273.80
	Adj. Stand. Residual	10.18	-10.18
	χ^2	103.63***	103.63***
On Topic Information			
	Observed Count	51.00	3664.00
	Expected Count	82.60	3632.40
	Adj. Stand. Residual	-4.37	4.37
	χ^2	19.10***	19.10***

*Note: *p<.05, **p<.01; ***<.001 (Bonferroni Adjusted Value=.008)*

Table 23. Chi-Square Analysis of Differences in Comment Type between Subreddits for Sensitive Topics

Comment Type		Subreddit	
		r/EverythingScience	r/Science
Polite Participation			
	Observed Count	988.00	1,208.00
	Expected Count	1,006.10	1,189.90
	Adj. Stand. Residual	-1.38	1.38
	χ^2	2.19	2.19
Emotional Interrogation			
	Observed Count	166.00	36.00
	Expected Count	92.50	109.50
	Adj. Stand. Residual	10.71	10.71
	χ^2	114.70***	114.70***
On Topic Information			
	Observed Count	319.00	498.00
	Expected Count	374.30	442.70
	Adj. Stand. Residual	-4.50	4.50
	χ^2	20.25***	20.25***

*Note: *p<.05, **p<.01; ***p<.001 (Bonferroni Adjusted Value=.008)*

As a follow-up to these analyses, a binary logistic regression was conducted to determine whether comment type could predict which Subreddit a comment appeared on. In the output (see Table 24) SPSS made Cluster 3 (On Topic Information) the baseline category. Because r/EverythingScience is coded as zero and r/Science is coded as one, the analysis is testing the likelihood that a comment appeared on the r/Science Subreddit. The omnibus test was significant (p<.001), indicating that comment type is a significant predictor of Subreddit. According to Nagelkerke R^2, cluster type accounts for 4.6% of the variation of which Subreddit a comment appears on. Results show that Polite Participation comments and Emotional Interrogation comments are significantly less likely to appear on r/Science than On Topic Information comments. Specifically, Polite Participation comments are approximately half as likely to appear on r/Science and Emotional Interrogation comments are about one tenth as likely to appear there.

Table 24. Logistic Regression for Comment Type as a Predictor of Subreddit

Cluster	B	Exp(B)	Wald(df=1)
Polite Participation	-.53	.59	70.96**
Emotional Interrogation	-2.05	.13	364.89**

*Note: *p<.01, **p<.001; r/EverythingScience=0, r/Science=1*

A second logistic regression was conducted to explore which of the cluster variables (Positive Emotion, Negative Emotion, Vulgarity, Questions, On Topic, Informative) were the best predictors of which Subreddit a comment appears on (See Table 25). Because r/EverythingScience is coded as zero and r/Science is coded as one, the analysis is testing the likelihood that a comment appeared on the r/Science Subreddit. The omnibus test was significant, indicating that some of the variables had predictive power (p<.001). Nagelkerke R^2=.077, so 7.7% of the variability in which Subreddit a comment appears on can be explained by the clustering variables. Results show that all variables are significant predictors of Subreddit besides Questions. Comments with Positive Emotion, Negative Emotion, and Vulgarity are more likely to appear on r/EverythingScience, while comments that are On Topic and Informative are more likely to appear on r/Science. Specifically, comments that are Informative are 64% more likely to appear on r/Science. Furthermore, for every one percent increase in the On Topic variable, comments are 3% more likely to be on r/Science. On the other hand, a 1% increase in Vulgarity makes comments 8% less likely to be from r/Science. Both Positive and Negative Emotion also play a significant role in predicting Subreddit. A 1% increase in Positive Emotion makes a comment 1% more likely to be on r/EverythingScience and 1% increase in Negative Emotion makes a comment 4% more likely to appear there.

Table 25. Logistic Regression for Clustering Variables as a Predictor of Subreddit

Variable	B	Exp(B)	Wald(df=1)
Positive Emotion	-.01	.99	5.65*
Negative Emotion	-.04	.96	68.63**
Vulgarity	-.08	.92	81.98**
Questions	-.003	1.00	.34
On Topic	.03	1.03	70.34**
Informative	.50	1.64	60.96**

*Note: *p<.05, **p<.001; r/EverythingScience=0, r/Science=1*

The relationship between Subreddit and the informativeness of comments was also assessed using Chi-Square analysis. The overall test results were significant for non-sensitive topics (χ^2[df=1]=19.44, p<.001) and sensitive topics (χ^2[df=1]=20.14, p<.001) indicating that there is a difference in comment informativeness between Subreddits. The effect sizes for non-sensitive and sensitive posts were small (Cramer's V=.043; Cramer's V=.08 respectively). Specifically, post hoc tests indicate that r/Science has significantly more informative comments, while r/EverythingScience has significantly more uninformative comments, regardless of topic sensitivity (See Tables 26 and 27).

Table 26. Chi-Square Analysis of Differences in Comment Informativeness between Subreddits for Non-Sensitive Topics

		Not Informative	Informative
r/EverythingScience			
	Observed Count	182.00	51.00
	Expected Count	150.10	82.90
	Adj. Stand. Residual	4.41	-4.41
	χ^2	19.45***	19.45***
r/Science			
	Observed Count	6,572.00	3,676.00
	Expected Count	6,603.90	3,644.10
	Adj. Stand. Residual	-4.41	4.41
	χ^2	19.45***	19.45***

*Note: *p<.01; **p<.01; ***p<.001 (Bonferroni Adjusted value=.013)*

Table 27. Chi-Square Analysis of Differences in Comment Informativeness between Subreddits for Sensitive Topics

		Not Informative	Informative
r/EverythingScience			
	Observed Count	1,153.00	320.00
	Expected Count	1,097.80	375.20
	Adj. Stand. Residual	4.49	-4.49
	χ^2	20.25**	20.25**
r/Science			
	Observed Count	1,243.00	499.00
	Expected Count	1,298.20	443.80
	Adj. Stand. Residual	-4.49	4.49
	χ^2	20.25**	20.25**

*Note: *p<.01, **p<.001 (Bonferroni Adjusted value=.013)*

The final Chi-Square analyses examined the impact of Subreddit on a conversation's level of deliberation. (See Tables 28 and 29). Results were significant for both non-sensitive (χ^2[df=2]=106.97, p<.001) and sensitive topics (χ^2[df=2]=387.35, p<.001). The effect size for non-sensitive topics was small (Cramer's V=.14), but the effect size for sensitive topics was large (Cramer's V=.45. Post hoc tests indicate that, for both sensitive and non-sensitive topics, conversations on r/EverythingScience are more likely to represent non-deliberative conversations and least likely to be highly deliberative. Alternatively, conversations on r/Science are typically highly deliberative. Topic sensitivity only played a role in moderate deliberation. Specifically, when posts are sensitive in nature, conversations are more likely to be moderate on r/EverythingScience. To summarize, Reddit users hoping to engage in highly productive deliberation about science should join the r/Science Subreddit and can discuss both sensitive and non-sensitive topics. Individuals looking for moderately deliberative discussions should participate in conversations about sensitive topics on r/EverythingScience. Finally, Reddit users who prefer to engage in generally impolite, non-deliberative conversations should join r/EverythingScience and can discuss both sensitive and non-sensitive topics.

Table 28. Chi-Square Analysis of Differences in Deliberation between Subreddits for Non-Sensitive Topics

Subreddit		Deliberation Level		
		Low	Moderate	High
r/EverythingScience				
	Observed Count	67.00	59.00	26.00
	Expected Count	25.10	50.90	76.00
	Adj. Stand. Residual	9.27	1.42	-8.23
	χ^2	85.93***	2.02	67.73***
r/Science				
	Observed Count	828.00	1,753.00	2,681.00
	Expected Count	869.90	1,761.10	2,631.00
	Adj. Stand. Residual	-9.27	-1.42	8.23
	χ^2	85.93***	2.02	67.73***

*Note: *p<.05; **p<.01; ***p<.001 (Bonferroni Adjusted value=.008)*

Table 29. Chi-Square Analysis of Differences in Deliberation between Subreddits for Sensitive Topics

Subreddit		Deliberation Level		
		Low	Moderate	High
r/EverythingScience				
	Observed Count	363.00	309.00	222.00
	Expected Count	214.00	257.70	422.40
	Adj. Stand. Residual	15.90	5.16	-18.27
	χ^2	252.81***	26.63***	333.79***
r/Science				
	Observed Count	102.00	251.00	696.00
	Expected Count	251.00	302.30	495.60
	Adj. Stand. Residual	-15.90	-5.16	18.27
	χ^2	252.81***	26.63***	333.79***

*Note: *p<.05; **p<.01; ***p<.001 (Bonferroni Adjusted value=.008)*

This chapter has described the analyses used to test hypotheses and answer research questions, and summarized results. RQ1 asked what underlying characteristics differentiate types of online messages. A two-step cluster analysis resulted in a three-cluster solution based on six variables. The clusters were: Polite Participation, Emotional Interrogation, and On Topic Information. Hypothesis 1 stated that message type would predict the quantity of user interaction above and beyond Subreddit and topic sensitivity. This hypothesis was supported and results indicated that On Topic Information receives significantly more replies and upvotes than Polite Participation and Emotional Interrogation. Hypothesis 2 stated that comment type can predict the quality of interaction above and beyond Subreddit and topic sensitivity. This hypothesis was partially supported. Results demonstrated that initial comment type does not significantly predict the Civility of following comments, but it does predict their Hostility and comment type. RQ2 asked what factors encourage the formation of incivility spirals. Findings showed that Subreddit, topic sensitivity and the hostility level of a parent comment can all encourage incivility spirals. Specifically, incivility spirals are most likely during a conversation on r/EverythingScience when the topic being discussed is sensitive and parent comments are high in hostility. Finally, RQ3 asked about the differences in uses and gratifications between Subreddits. Analyses showed multiple differences in comment and conversation characteristics between r/EverythingScience and r/Science, which indicates differences in gratifications. The following chapter will describe

these potential differences and discuss the practical and theoretical implications of the other results.

CHAPTER FIVE: DISCUSSION

The purpose of this project was to explore the quantity and quality of discourse on two Subreddits: r/Science and r/EverythingScience. More specifically, this study was designed to develop a typology of online messaging, identify which factors encourage certain types of messages, and explore how message type influences user interaction. Regarding the quality of user interaction, the presence of deliberation and the formation of incivility spirals were of particular interest. An additional goal of this project was to determine differences in Uses and Gratifications between Subreddits. This chapter summarizes results, further explains the meaning of the Uses and Gratifications findings, discusses the theoretical contributions of this study, and summarizes the practical implications. Limitations of the project are discussed, as well as plans for future research that will address them.

Summary of Results

A Typology of Online Messages

A major goal of this study was to develop a typology of online messages using a series of dichotomous and continuous variables. A two-step cluster analysis resulted in a three-cluster solution based on six variables (Positive Emotion, Negative Emotion, Vulgarity, On Topic, Questions, and Informative). Of the variables retained in the analysis, only Informative was dichotomous and coded by research assistants. The other variables were continuous and coded by the text analysis software Linguistic Inquiry and Word Count. The three types of messages identified through the cluster analysis were: Polite Participation, On Topic Information, and Emotional Interrogation.

Polite Participation. This is the largest cluster with 63.2% of cases. Comments in this category are low in emotion and vulgarity, are moderately on topic, and generally do not include new information or questions.

On Topic Information. This cluster includes 30.8% of cases and is the only category where the majority of comments provide new information. Comments in this cluster are low in

emotion, vulgarity, and questions, but are significantly more on topic than comments in the other two groups.

      Emotional Interrogation. This is the smallest cluster with 6% of cases. These comments are the least on topic and highest in emotion (positive and negative) and vulgarity. Comments in this category tend to include the most questions but no new information.

      Past research on online interaction has focused primarily on the dichotomy of civility versus hostility (Anderson, et. al., 2014). For example, Ksiazek (2018) measured the quality of comments based on whether they were civil or hostile. Civility and hostility were measured with word lists and proportions were then calculated so that comments with a greater proportion of civil words were considered quality comments. Another study attempted to create a more nuanced measure of incivility by differentiating between mildly and extremely uncivil messages. Su and colleagues (2018) coded each comment as either impolite or extremely uncivil based on its level of profanity and the presence or absence of aggression. Comments that did not fit in either of these categories were coded as civil.

      A better understanding of the content of online comments has the potential to reveal patterns in uncivil discussions, which will allow site owners and moderators to identify and minimize antisocial behavior (Cheng, Danescu-Niculescu-Mizil, & Leskovec, 2015). Identifying these antisocial messages and educating individuals about the consequences of the comments they post online may lead to healthier online communities where productive discussion is possible (Weinberger, 2011).

Factors Impacting the Quantity of Online Interaction

      An additional goal of this study was to determine what factors lead to more interaction online. Past research demonstrates that many of the factors that lead to hostile interaction also lead to more interaction overall. For example, Ksiazek (2018) found that sensitive topics encourage more hostility, but also more comments. Therefore, this study investigated how group norms, discussion topic, and comment type impact interaction quantity. It was hypothesized that comment type would predict interaction quantity above and beyond group norms and discussion topic.

      A hierarchical regression was used to explore the impact of group norms (which Subreddit a comment was posted on), discussion topic sensitivity, and comment type on

interaction quantity. Interaction quantity was operationalized as the number of replies a comment receives. Results indicate that group norms do not impact the number of replies a comment receives. However, topic sensitivity and comment type were significant predictors. Specifically, comments made in response to sensitive topics receive more replies than comments made in response to non-sensitive topics. This aligns with previous research indicating that sensitive topics receive more comments (Ksiazek, 2018). Regarding comment type, On Topic Information received significantly more replies than Polite Participation or Emotional Interrogation. Comment type was able to predict the quantity of user interaction above and beyond group norms and topic sensitivity, so Hypothesis 1 was supported.

Factors Impacting the Quality of Online Interaction

Cortina and colleagues (2017) indicated a need for additional research examining what behaviors and contexts lead to different types of interaction online. Past research has found that moderators, group norms and rules, and discussion topic impact the quality of interaction that occurs online. Regarding website moderation, studies have found that online incivility is more likely to occur when there is a lack of supervision (Hinduja & Patchin, 2006), and that policing online discussions may decrease instances of flaming (Hmielowski, Hutchens, & Cicchirillo, 2014). In terms of group norms and rules, past research has found that online aggression is caused by the norms under which particular groups are operating (Phillips, 2016) and the prevalence of flaming in online groups may lead people to see aggressive behavior as normal (Hmielowski, Hutchens, & Cicchirillo, 2014). In general, an organization that allows rude and aggressive behavior will attract others who behave similarly (Andersson & Pearson, 1999). On the other hand, groups that normalize civil interaction encourage future civil behavior from their members (Robinson & O'Leary-Kelly, 1998). Therefore, creating rules and reinforcing norms that promote civility and discourage incivility can reduce the likelihood of incivility spirals (Andersson & Pearson, 1999). Finally, discussion topic also influences interaction quality. Specifically, studies have found that messages including insults and extreme language are more common when emotionally sensitive issues are being discussed (Halpern & Gibbs, 2013; Stroud, et. al., 2015). This occurs because people feel more strongly about "hot button" topics and process them at a more visceral level (Coe, Kenski, & Rains, 2014). Topics that often elicit more antisocial comments include politics (Hmielowski, Hutchens, & Cicchirillo, 2014), the economy

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and foreign affairs (Coe, Kenski, & Rains, 2014), immigration and gun control (Ksiazek, 2018), and crime and welfare (Diakopoulos & Naaman, 2011).

Based on this previous research, this study sought to determine how group norms, the sensitivity of discussion topic, and comment type impact the quality of conversations. It was hypothesized that comment type would predict interaction quality above and beyond group norms and topic sensitivity. Hierarchical regressions were used to explore how group norms (Subreddit), topic sensitivity, and comment type influence civility and hostility in user interaction. Results for civility were nonsignificant, indicating that Subreddit, discussion topic sensitivity, and comment type do not influence the level of civility that occurs in a conversation. One explanation for this non-significant result is that over one third (33.5%) of comments did not contain any civility, so that variable is not particularly useful in differentiating comments. On the other hand, results for hostility were significant. Findings indicate that comments posted to the r/EverythingScience Subreddit (the Subreddit with less stringent rules) are significantly more hostile than comments posted to r/Science. Furthermore, comments in response to sensitive posts are more hostile than comments on non-sensitive posts. These findings align with previous research stating that less group oversight and more sensitive topics lead to greater instances of hostile behavior. The comment type of the first comment in a conversation was also a significant predictor of hostility. Specifically, a conversation that began with an Emotional Interrogation comment includes significantly more hostility than a conversation beginning with a Polite Participation or On Topic Information comment. This suggests that early comments may set the tone for the rest of the conversation. Comment type significantly predicted hostile interaction above and beyond group rules and topic sensitivity, but results for civility were not significant. Therefore, Hypothesis 2 was partially supported.

Incivility Spirals. Incivility spirals refer to escalating patterns of behavior that begin with a mildly impolite act followed by a series of increasingly aggressive behaviors which culminate in an act out of proportion with the original event (Cortina et. al., 2017). In their paper on incivility spirals in the workplace, Andersson and Pearson (1999) give the example of Party A engaging in uncivil behavior toward Party B, such as forgetting to say please or thank you. Party B interprets this behavior as incivility, which creates the desire to reciprocate. Party A perceives the uncivil act performed by Party B and goes through the same response sequence that Party B experienced after the original act. This sequence of events is due to individuals' desire to

retaliate for uncivil treatment (Penney & Spector, 2005). The escalation of the event is the result of nonproportional revenge because, when people reciprocate uncivil behavior, their behavior is typically more uncivil than the original act (Felson & Steadman, 1983; Helm, et. al., 1972; Youngs, 1986). Past research on incivility spirals has focused primarily on their formation face-to-face and in the workplace. This project extended this framework to explore whether incivility spirals occur online and what factors encourage or discourage them.

The factors of interest were which Subreddit a conversation occurred on, discussion topic sensitivity, the hostility of the first comment in the conversation, and the hostility of the parent comment. A hierarchical regression was conducted to identify the presence of incivility spirals and explore which factors encourage them. Results indicate the presence of incivility spirals, with a comment's hostility significantly correlated with the hostility of following comments. Incivility spirals are more likely to occur on r/EverythingScience and when a sensitive topic is being discussed, however the most significant predictor in the model was the hostility of the parent comment. This aligns with research on face-to-face incivility spirals in the workplace, where an individual is more likely to behave uncivilly if someone else has just engaged in uncivil behavior.

Deliberation. Deliberation is a communicative process during which people analyze a topic and weigh the pros and cons of each argument (Black, Burkhalter, Gastil, & Stromer-Galley, 2013). Engagement in deliberation is beneficial both for individuals and for society as a whole. Engaging in deliberation allows individuals to reflect on their opinions, which results in the development of well-reasoned ideas (Cappella, Price, & Nir, 2002). Deliberation is beneficial to society because it leads to better ideas and decision making (Cappella, Price, & Nir, 2002; Habermas, 1989/1962).

Deliberation is also important because it leads to learning (Sagoff, 1998). Deliberation is an effective method for disseminating information because it forces deliberators to confront their differences (Barabas, 2004; Chappell, McGregor, & Vermilyea, 2012). Effective deliberation can help individuals to see all aspects of an issue, allowing them to weigh the pros and cons of each choice. In this way, the process of deliberation allows participants to better understand the issue being discussed by learning from the knowledge and experience of others (Daniels & Walker, 1996). For individuals who have no previous knowledge of the topic being discussed, deliberation gives them the opportunity to construct an opinion through dialogue (Sagoff, 1998).

Some scholars claim that the Internet contributes to productive deliberation by providing a platform on which groups of people can share their ideas, learn from their peers, and build knowledge collectively (Brundidge, 2010; Coffey & Woolworth, 2004; Rafaeli & Kent, 2015). However, the existence of a space where productive discourse *can* occur does not mean that it necessarily *will* occur, and online discussions often do not meet the expectations of deliberation (Stroud et. al., 2014). Therefore, this study explored what factors encourage productive deliberation online.

The factors of interest were topic sensitivity, which Subreddit the conversation occurred on, and the type of comment that begins the conversation. Deliberation was an ordinal variable, with 0 representing no deliberation, .5 indicating moderate deliberation, and 1 representing extreme deliberation. For both sensitive and non-sensitive topics, conversations on r/EverythingScience are more likely to represent low levels of deliberation and least likely to be highly deliberative. Alternatively, conversations on r/Science are typically highly deliberative. Topic sensitivity only played a role in moderate deliberation. Specifically, when posts are sensitive in nature, conversations are more likely to be moderate on r/EverythingScience. To summarize, Reddit users hoping to engage in highly productive deliberation about science should join the r/Science Subreddit and can discuss both sensitive and non-sensitive topics. Individuals looking for moderately deliberative discussions should participate in conversations about sensitive topics on r/EverythingScience. Finally, Reddit users who prefer to engage in generally impolite, non-deliberative conversations should join r/EverythingScience and can discuss both sensitive and non-sensitive topics.

The type of comment that begins a conversation also has a significant impact on whether deliberation occurs. Results revealed that Emotional Interrogation comments are significantly more likely to lead to non-deliberative conversations and significantly less likely to lead to extremely deliberation conversations. Polite Participation tends to discourage non-deliberative and extremely deliberative conversations, but encourage moderate deliberation. Finally, On Topic Information comments are significantly more likely to encourage extremely deliberative conversations and less likely to encourage moderate deliberation. To summarize, the best comment type for encouraging deliberation is On Topic Information and the type least likely to encourage deliberation is Emotional Interrogation. These findings support the idea that the first comment in a conversation sets the tone for following interaction.

Differences in Uses and Gratifications between Subreddits

Another factor that may influence a user's behavior online is their motivation for using the platform. This study applied a Uses and Gratifications framework to examine differences in user behavior between Subreddits, explore how that behavior impacts the formation of incivility spirals, and identify any new gratifications that have emerged as a result of social media or Reddit use.

Significant differences were found in uses between the two Subreddits, which suggests differing gratifications. First, there were significantly more question marks in comments on r/EverythingScience while comments on r/Science were more likely to be informative. This indicates that individuals may use r/EverythingScience to seek out information and r/Science to provide information. This is further supported by differences in comment type between Subreddits which found that there are significantly more On Topic Information comments on r/Science. Comments on r/Science were also significantly higher on the On Topic variable and conversations were more likely to be highly deliberative. This suggests that a gratification of r/Science use is to have productive discussions about scientific topics. On the other hand, r/EverythingScience comments included more Disagreement, Hostility, Vulgarity, and Negative Emotion. It could be that many of that Subreddit's users are trolls and get enjoyment from provoking the more serious users. On the other hand, users may want to engage in productive discussion but, because of the less stringent rules, incivility spirals are permitted to form when disagreement occurs. Because a key part of trolling is monopolizing conversations with hostile comments and controlling the topic and style of discourse, I plan to conduct a follow-up analysis exploring whether the Hostile, Vulgar, and off topic comments are posted by the same users who are very active on the page. I am also going to examine conversations to determine whether there are patterns in comment characteristics. For example, if only one conversation participant is being Hostile and Vulgar while everyone else remains calm and civil, it suggests trolling behavior.

Uses and Gratifications Theory has proven to be resilient to changing and emerging media technologies throughout the years and is useful in studying how people engage with new media (Moore & Chuang, 2017). Ruggiero (2000) suggests that, although gratifications sought through traditional media are still valid, new gratifications emerge with new media. I suggest that trolling, or intentionally angering others for one's own amusement, may be a new gratification

that is emerging because of new media. Entertainment has long been considered a gratification of media, but trolling requires more action by the user than reading comic books or watching TV. The entertainment gained through trolling also differs from our original understanding of that gratification because it requires the unwilling participation of at least one other person. Not only that, but in order for the entertainment need to be gratified through trolling, other user must be made to feel uncomfortable, confused, or angry.

Theoretical Contributions

In addition to identifying a new gratification that has emerged from new media, this project makes several important theoretical contributions. First, this is the first study to my knowledge that created a detailed typology of online messages. Past research has categorized messages based on a single variable such as informativeness or hostility, but this is the first to create a typology based on a series of variables. Scholars have indicated a need for a better understanding of the content of online comments, suggesting that this knowledge has the potential to reveal patterns in uncivil discussions, which will allow site owners and moderators to identify and minimize antisocial behavior (Cheng, Danescu-Niculescu-Mizil, & Leskovec, 2015). This more nuanced typology will also help researchers better understand what factors influence the types of messages users post and what effects the different message types can have. Furthermore, this study found that the typologies developed have predictive power above and beyond the variables commonly used in past research. Many studies have used moderators (i.e. Hmielowski, Hutchens, & Cicchirillo, 2014; Hinduja & Patchin, 2006), group rules (i.e. Andersson & Pearson, 1999; Phillips, 2016), and discussion topic (i.e. Braun & Gillespie, 2011; Diakopoulos & Naaman, 2011) to predict the quantity and quality of user interaction. This study found that message typology can predict interaction above and beyond those variables, and that adding it to the model improves predictive power. From a practical perspective, site moderators and administrators can use this information to improve the quality and quantity of user interaction. For example, moderators could post On Topic Information comments on posts shared by community members to increase both the quantity and quality of interaction.

A related contribution of this study is evidence that the first comment in a conversation has a significant impact on the interaction that follows. Results indicated that comments in a conversation tend to be the same type of comment as the first comment posted. So, conversations

beginning with an On Topic Information comment include significantly more On Topic Information comments throughout the entire interaction compared to conversations that begin with a Polite Participation or Emotional Interrogation comment. Conversations beginning with On Topic Information comments are also significantly more likely to represent extreme deliberation. Conversely, conversations beginning with an Emotional Interrogation comment will generally be filled with those types of comments. Due to the nature of Emotional Interrogation comments, interactions beginning in this manner include more Positive and Negative Emotion and Vulgarity, and do not represent productive deliberation. Similarly, conversations that begin with a comment high in hostility include more hostility overall than interactions that begin more civilly.

One benefit of the Internet is that it provides the opportunity for individuals to connect with a wide range of other people and learn vicariously from their experiences. The Internet also makes it possible to interact with diverse groups and form heterogenous networks that can serve as a valuable source of vicarious learning (Brundidge, 2010). This type of knowledge construction has the benefit of allowing individuals to play the role of both learner and teacher (Rafaeli & Kent, 2015). This decentralized knowledge production leads to a better understanding of ideas because exposure to alternative positions encourages people to reflect on what they already know (Sunstein, 2006). Although face-to-face communication also allows for exposure to alternative positions, it requires significantly more time, effort, and resources to bring large groups together for in-person discussions. On the other hand, individuals only need access to an Internet connection and computer or smart phone to be able to interact with large groups online. The Internet overcomes many of the obstacles that make face-to-face discussion with large, diverse groups difficult to organize. With social media, individuals who many never have the opportunity to engage in face-to-face discussions with diverse groups are able to easily interact with people from all over the world. For example, Brundidge (2010) argues that the Internet has the power to weaken social boundaries and bridge geographical divides, bringing people together. Because deliberation is an effective method for maximizing productive collaboration and knowledge sharing online, it is important to know what factors encourage it. This study demonstrates that how a conversation begins can predict the overall quality of the following interaction and whether deliberation occurs above and beyond group rules and discussion topic.

Another significant contribution is the identification of incivility spirals in a new environment. Past research has focused primarily on incivility spirals that occur face-to-face and in the workplace (Andersson & Pearson, 1999; Felson, 1982; Gallus et.al., 2014). In these instances, incivility spirals often occur over a period of days or weeks and among people who know each other and likely have a history that is encouraging the spiral. On the other hand, this project demonstrated that incivility spirals can form rapidly in a virtual environment and when all discussion participants are anonymous. On Reddit, it is unlikely that users know each other or have a history of interaction that would encourage an incivility spiral to form. This finding demonstrates that incivility spirals can form rapidly based only on a few anonymous comments. By applying the incivility spiral framework to a new context, this study demonstrates its generalizability. This project paves the way for a theory that has previously focused primarily on face-to-face incivility in the workplace to be applied to a variety of contexts.

Not only did this project confirm the existence of incivility spirals on social media, it also identified factors that encourage them. Some of these variables are similar to previous research on workplace incivility spirals, but some are unique to the online environment. For example, research on incivility spirals in the workplace found that group norms can encourage or discourage their formation (Anderrson & Pearson, 1999; Carter, 1998; Gallus, et. al., 2014). Results of this study confirm that the same is true for incivility spirals online. To my knowledge, no researcher has studied whether the topic being discussed can influence the formation of incivility spirals. This study found that discussing sensitive topics is more likely to lead to an incivility spiral than discussion about non-sensitive topics. Finally, this study contributed to incivility spiral research by demonstrating that spirals can occur between large groups of people even when no one participates in the conversation more than once. Past research has focused primarily on the formation of an incivility spiral between two actors who continue to switch between roles of perpetrator and victim. Some studies have examined the development of secondary spirals inspired by observing the first (Foulk, Woolum, & Erez, 2016; Masuch, 1985), but this is the first study to show that incivility spirals can be encouraged simply by reading hostile comments posted by anonymous strangers. In other words, when an incivility spiral forms during a conversation where no one comments more than once, that spiral is encouraged by something other than revenge for past indiscretions.

A final significant contribution of this study was developing a better understanding of user behavior on Reddit. Although Reddit is the fourth most visited website in the United States, it is still relatively understudied (Record et. al., 2018). Exceptions include a study which explored why people participate on Reddit (Moore & Chuang, 2017). Results of this study indicated that people use Reddit primarily for socializing/community building, status-seeking, and entertainment. However, a major limitation of these findings was the data collection process. Participants were recruited via the Subreddit r/SampleSize to complete a survey about their Reddit use, so only Reddit users who follow that Subreddit were included in the sample. r/SampleSize is a Subreddit where people can post surveys for both academic and casual research, so the only members are likely individuals who need to gather data or enjoy completing surveys. Therefore, these findings cannot be generalized to the entire Reddit population because each Subreddit has its own culture and group of users, likely with varying motivations for using the site (Moore & Chuang, 2017). Other exceptions are a study that explored Reddit users' health information seeking behavior on the platform (Record, Silberman, Santiago & Ham, 2018) and a project that examined the Reddit use of individuals trying to quit cannabis use (Sowles, Krauss, Gebremedhn & Cavazos-Rehg, 2017). Despite these exceptions, scholars have indicated a need for additional studies on Reddit. Specifically, Moore and Chuang (2017) called for future work to build on the Uses and Gratifications of Reddit by a more nuanced exploration of users' commenting behaviors on specific content. Furthermore, Record and colleagues (2018) suggested that future work should apply Reddit to an existing communication model that lacks social media examples. This study addressed both of these calls by exploring Uses and Gratifications through commenting behavior on scientific content and applying the incivility spiral framework to a social media platform for the first time.

Now that the major theoretical contributions of this study have been discussed, I will summarize some practical implications based on the project's results.

Practical Implications

There are three primary groups that could benefit from the results of this study: site developers, site moderators, and social media users. This study found that strict group rules do improve the quality of user interaction online. However, unlike Reddit, many social media platforms do not have a place where rules are written out and easily accessible. Site developers

should consider adding a space to pages where group moderators or administrators can list the group rules. Explicitly listing behavior guidelines will increase the civility and productivity of user interaction. This tactic could also be used on news sites and other pages that allow commenting. For site moderators, this finding indicates that they should make rules stricter and more specific if they want to improve the quality and quantity of interaction on their page. This study also found that discussing sensitive topics leads to more hostility in conversations. Because moderators have a finite amount of time to supervise commenting, they should devote more effort to policing comment sections on sensitive posts. Identifying and removing hostile comments on those posts will help avoid the formation of incivility spirals and improve the quality and productivity of interaction.

Reddit users can use the results of this study to make informed decisions about what Subreddits to join and what conversations to participate in. Users should make sure that Subreddit rules align were their sought gratifications for using the platform. Specifically, if a user wants to engage in civil and informative deliberation, they should join Subreddits with more stringent and specific rules. Users who are looking for casual conversation or even a place to engage in trolling should join Subreddits that are less strict and tolerate that type of behavior. Additionally, if users want to avoid engaging in conversations that become hostile, they should not comment on posts that are particularly sensitive in nature as they are more likely to encourage incivility spirals.

Limitations

Although this study makes important theoretical and practical contributions, there are some limitations that must be addressed. First is this issue of Reddit users' demographics. Reddit users are primarily young, white men. Specifically, 64% of users are 18-24 years old, 70% are white, and 69% are male (Djordjevic, 2020; Sattelberg, 2020). Only 8% of users are younger than 18 and 7% are over the age of 50 (Djordjevic, 2020). It is possible that people of varying ages, genders, and ethnicities may behave differently online. It may also be that people behave differently on other social media platforms and when discussing non-scientific topics. Because the comment typology was developed using only two scientific Subreddits, it is impossible to tell whether it will apply to conversations on other Subreddits or on other social media sites. The use of a single social media platform also meant that platform-oriented Uses and Gratifications could

not be explored. Platform-oriented Uses and Gratifications focus on the features of the platform and the affordances they offer (Rathnayake & Winter, 2018). For example, the blog ambiance gratification demonstrates that individuals enjoy the general atmosphere of a blog (Kaye, 2010). Because Uses and Gratifications for discussing scientific information was only tested on Reddit, it is impossible to differentiate between process gratifications and platform gratifications.

Related to this is the issue of whether certain Subreddit rules attract specific users or users adjust their behavior based on the rules. This study found that people on r/Science behave more civilly and less emotionally than people on r/EverythingScience, but that may be a symptom of the type of user they are and not because of the strictness of the rules. Because individual user characteristics were not included in analysis, it is impossible to tell whether people with certain personality traits are drawn to specific Subreddits. For example, people high in Need for Cognition may prefer to participate on r/Science because of its more stringent rules in terms of posting and commenting. Another variable that was not taken into consideration was the actual topic of the discussion. Rather, posts were coded as either sensitive or non-sensitive and the list of "hot button" topics was created based on studies exploring different online platforms. It may be that a more nuanced coding scheme for discussion topic would lead to different results. It is also possible that, because different social media platforms attract varying types of users, different topics elicit strong emotions from Reddit users than those identified in previous studies on other platforms.

Another limitation is that only comments to a depth of three were analyzed. Although there was evidence of incivility spirals in the current study, results may differ when the entire conversation is analyzed. Furthermore, the results for civility spirals were not significant. It may be that civility spirals do form, but at a greater depth in the conversation. Finally, although uses could be directly observed through commenting behavior, gratifications were perceived by the researcher and not self-reported or confirmed with users. Future research is required to determine whether the perceived gratifications are accurate. However, this method is not unique to this study. Katz, Blumler, and Gurevitch (1973) indicate that some studies examine Uses and Gratifications by observing behavior and attempting to reconstruct the needs that are being met.

Plans for Future Research

       In addition to future research that addresses the Uses and Gratifications limitation, I have plans for future analyses and data collection that will address some of the other limitations. First, I plan to analyze the complete dataset using all replies rather than stopping at a depth of three. In this dataset, replies go up to a depth of 19 so incorporating them will significantly increase the size of the dataset. Including all comments will also be helpful in studying incivility spirals. Because only comments up to level three were included in this project, there may be patterns in commenting behavior that were not identified. For example, results indicate that the hostility in comments increased as depth increased, but only until the depth of three. Including all comments will determine whether this pattern continues indefinitely, or if someone intervenes to stop the incivility spiral. Analyzing the full dataset will also allow me to test how comment depth impacts how on topic a comment is. I hypothesize that as comment depth increases, comments become less on topic. For example, comments at a depth of ten or greater may be completely unrelated to the original post.

       To partially address the issue of whether Subreddit rules impact user behavior or whether certain users are drawn to different Subreddits, I plan to identify users who are active on both r/Science and r/EverythingScience to determine whether their behavior differs. If there is no significant difference in their comments between Subreddits regarding civility, hostility, vulgarity, or comment type, it will indicate that group rules may not impact behavior significantly. However, if the same user is significantly more hostile and vulgar on r/EverythingScience, it will suggest that group rules and norms do have an impact. I also want to explore how user characteristics such as comment karma, post karma, and their length of time as a Reddit user interact with contextual factors to influence the types of messages they post. Comment karma refers to the total number of upvotes a user has received on all their comments across all Subreddits combined, while post karma refers to all their upvotes on posts. It would be interesting to explore whether users who tend to post a certain type of comment, or a comment with certain characteristics, have higher comment karma. I would also like to explore the differences in commenting behavior between users who are new to Reddit and veteran users. Because of Reddit's policing system through upvoting and downvoting, it is possible that veteran users post higher quality comments because they have had time to learn which comments are acceptable and appreciated.

This study represents the first time that the incivility spiral framework was applied in an online context. Because this study only examined Reddit, there are many factors that may impact incivility spirals that were not accounted for. For example, past research has demonstrated that anonymity increases hostility in online contexts. Perhaps incivility spirals are less likely to occur in situations where users are not anonymous. Incivility spirals may also be encouraged because there is no limit to commenting depth. Therefore, I would like to apply this framework to a social media site like Facebook where users' identities are known and commenting depth is restricted.

I also plan to test my comment typology on different Subreddits and social media platforms. Because this typology was developed using two science-focused pages on a single platform, its generalizability is limited. I would like to do a follow-up study on two different Subreddits, one that is inherently sensitive in nature like r/politics and one that is not, like r/aww (a Subreddit devoted to cute pictures and videos of animals) to determine whether the typology still applies. It would also be interesting to determine the overall differences in commenting behavior between those two Subreddits. Finally, I would like to test my typology on at least one other popular social media platform to see whether the platform influences the type of messages posted.

Conclusion

Based on Uses and Gratifications Theory and an Incivility Spiral framework, this study examined commenting behavior and characteristics on the social media site Reddit. Results have practical implications for website developers, moderators, and social media users. This study makes significant theoretical contributions to Uses and Gratifications Theory, Incivility Spirals, and social media research. A comment typology was created which can be used to predict the quality and quantity of user interaction and differentiate between Subreddits. This typology can be used in future research to improve our understanding of online discourse.

APPENDIX A. SUBREDDITS' DESCRIPTIONS AND RULES

r/EverythingScience
Community Description: r/EverythingScience is the sister subreddit to r/Science. With a broader rule set than r/Science, it is the place for high quality scientific content that doesn't necessarily reference a peer-reviewed paper from the last 6 months.
Community Rules:
1) Be civil
   a. Do not be abusive or offensive to any users regardless of differences in opinion. Memes and joke comments are not allowed.
2) Maintain scientific integrity
   a. We do not expect peer review, but we do expect a level of scientific rigor in comments and submissions; pseudoscientific comments or submissions that run counter to accepted scientific consensus are not allowed. Anecdotal comments are allowed so long as they maintain scientific integrity. Political posts are allowed so long as they primarily relate to scientific policy.
3) Up to date content
   a. Submissions must have been published in the past 6 months. Submissions covering older stories or studies must be less than 6 months old and contain new developments.
4) No link dumping
   a. Content must follow spam and self-promotion guidelines. No more than 10% of your activity should relate to material you are affiliated with. Do not post more than 3 submissions per day to allow a diversity of topics. Additionally, we do not allow crossposting. Instead, just link directly to the article/content you wish to submit.
5) No reposts
   a. Submissions must not be reposts of popular submissions
6) No misleading, inaccurate, or clickbait titles
   a. Submissions have accurate and clear titles that inform the reader. Minor editing of titles is fine if it makes the title and findings clearer
7) No rehosted content
   a. Submissions must not rehost copied or stolen content. Link to the original source where possible.
8) No spam
   a. This includes, but is not limited to: surveys, questions, downloads e.g. pdfs.
9) No promotional material
   a. This includes, but is not limited to: general webpages, crowdfunding, sales pages, lecture courses
10) No audiovisual material
   a. We do not allow audio-visual material (e.g. videos, podcasts)

r/Science
Community Description: "This community is a place to share and discuss new scientific research. Read about the latest advances in astronomy, biology, medicine, physics, social science, and more. Find and submit new publications and popular science coverage of current research.
Community Rules:
1) Must be peer-reviewed research
    a. Submissions must directly link to recently published peer-reviewed research or media summary. Review articles are prohibited unless they contain new results.
2) No summaries of summaries, rehosts, reviews, or reposts
    a. Articles that obtain their information second-hand from other articles are not acceptable for submission. Websites that re-host press releases are prohibited. All peer reviewed articles must contain new research, data analysis, or meta-analysis. Review articles are prohibited unless they contain new results. Reposting of existing, popular submissions is prohibited.
3) No editorialized, sensationalized, or biased titles
    a. The title and content of submissions should not be editorialized, sensationalized, or biased. All titles must adhere to our headline rules.
        i. Headlines may not:
            1. **Ask a question.** (anything with a "?") Linked articles which have a question title should be re-written to describe the content of the paper in keeping with our existing rules against editorializing and sensationalizing.
            2. **Make claims of resolving a long-standing issue/cure/mystery.**
            3. **Use an exclamation point.**
            4. **Make general statements about large groups.** (e.g. "men don't trust women," "doctors hate him"). The headline should indicate the group the finding applies to.
            5. **Have a list mentioned.** (e.g. top 10 things you must read)
            6. **Make reference to the thoughts or feelings of the reader.** (e.g. "You'll never expect this")
            7. **Contain the work "[Video]" or related terms.**
            8. **Obfuscate details to encourage click-through.** (ex. One Personality Characteristics Predicts Domestic Nudity)
            9. **Be in all caps.**
        ii. Headlines must:
            1. **Contain at least 1 finding or result of research.** Headlines that focus only on the speculative conclusion or author/press commentary of the research will be removed.
            2. **If relevant for interpreting results, indicate the model system used in the research.** (Ex. If it's a study on a human cancer but the study was only conducted on mice that info should be included in the headline.)
4) Research must be <6 months old
    a. All submission must have been published within the past six months. This time requirement refers to the publication date of the research, not the article or web

page. Ambiguous publication dates are determined by the first available date, which is typically the "Published Online" or "Pre-Print" date.

5) No off-topic comments
   a. Comments must be on topic and not a meme or joke. Comments should constructively contribute to the discussion or be an attempt to learn more.
6) No jokes or memes
   a. Comments must be on topic and not a meme or joke. Comments should constructively contribute to the discussion or be an attempt to learn more.
7) No abusive or offensive comments
   a. Abusive or offensive comments will be subject to removal and repeat or malicious offenders will be banned. Bots and novelty accounts are prohibited and will be banned immediately.
8) No anecdotal comments
   a. Comments that only rely on a user's non-professional anecdotal evidence to confirm or refute a study will be removed. (e.g. "I do that but that result doesn't happen to me"). Comments should be limited in personal details and scientific in nature. Including references to peer-reviewed research to support your claims is highly encouraged.
9) Not scientific or dismissive of established work
   a. Comments that dispute well-established concepts (e.g. gravity, vaccination, anthropogenic climate change, etc.) must be supported with appropriate peer-reviewed evidence. Links to personal blogs or "skeptic" websites are not valid forms of evidence. Comments that are overtly fringe and/or unsubstantiated will be removed.
10) No medical advice
   a. Offering or seeking medical advice is strictly prohibited and offending comments will be removed. Discussions regarding the advantages and/or disadvantages of certain treatments, diets, or supplements are allowed as long as relevant and reputable evidence is provided.

APPENDIX B. CODEBOOK

Clarity (1=yes; 0=no)
- The comment is coherent and intelligible
- Based on the comment, you can understand the author's intent and/or opinion.
- Short answers that indicate agreement (exactly), disagreement (no way), laughter (lol; hahahha), etc. should be coded as clear.
- Comments in which users tag other subreddits should be coded as clear (r/WatchdogJournalism; r/nottheonion)
- You may need to examine the comment in the context of the conversation to determine whether it is clear.
- A comment that includes typos or grammatical errors can still be coded as "clear" if you can figure out what the person intended to write.
- If a comment is marked as unclear, it should receive a 0 for all other single-comment variables
- Examples:
    - **Yes**: "Speaking as someone who nearly died when I was an infant from a disease that has vaccines (pertussis aka whooping cough), vaccinate your damn kids and yourself so other kids and even adults don't get sick."
    - **No**: "They'll look at the incomplete and unknown as evidence they don't."

Argument Ad Hominem (1=yes; 0=no)
- The comment insults *a specific person involved in the conversation*
- The comment attacks the person rather than their argument
- Not just general rudeness (go away, why are you still talking), but direct personal attacks or insults
- Implied insults such as being overly condescending should NOT be coded as ad hominem
- Comments telling someone they suck, are part of the problem, etc. are ad hominem
- The insult is aimed at a particular Reddit user, not a group of people (i.e. Republicans; all Redditors) or a third party not involved in the conversation (i.e. President Trump, Greta Thunberg)
- Examples:
    - **Yes**: "Oh wow, it must of been the vaccines that made you this stupid. You're stupid."
    - **Yes**: "You're full of shit. Take your tinfoil hat and get out of here."
    - **No**: "It's Tennessee – They rely on God & Prayer."
    - **No**: "Goddamned Millennials killing everything!"

Informative (yes=1; 0=no)
- The comment provides information above and beyond what is found in the article
- The information does NOT need to be accompanied by a source, but it cannot simply be an opinion
- The information provided does NOT need to be directly related to the topic of the article or conversation

- Including a link to a specific Reddit thread should be coded as informative, but tagging an entire Subreddit should NOT
- It doesn't matter if the entire comment isn't informative. If it includes *any* additional information, it should be coded "1"
- The information does not need to be useful or relevant. For example, a comment stating that Greta Thunberg's mother is an opera singer is informative.
- Any comment that includes a link to a source should be coded as informative
- All comments that are answers to a question should be coded as informative
- Informative comments must provide additional information to that covered in the article. Simply paraphrasing the article is not informative.
- Comments that only include questions should NOT be coded as informative
- A comment that includes information that is considered "common knowledge" should NOT be coded as informative
- Sharing personal experiences, including implied personal experience, should be considered informative
- Making points that may not have been considered in the study or previous conversation or were not included in the article should be coded as informative
- Examples: (Comments in response to an article about flu vaccines)
  - **Yes**: "Interesting bit of info here. We've already shipped 70 percent of this year's flu vaccine supply as of today. Edit: some people seem to be confused. This is for the 2019/2020 formula. We started to ship a month ago cdc released it 2 months ago. So 70 percent in a month is actually pretty good. The rest trickles out until next season."
  - **Yes**: "Southern Plains here, they're already asking us to get flu shots. My workplace won't do it until November though, so most people I'm around won't bother until then."
  - **No**: "I always thought it odd that it's a seasonal/annual thing. Is there a reason for this?"
  - **No**: "How would they have gotten the variated flu before it has reached the states? I thought assuming that they caught a flu that was still going around was a safer assumption than they all caught the new flu in another country and brought it back."

Removed Comment = 2; **Deleted Comment** = 3
- Skip over these as if they do not exist
- Code the rest of the conversation like normal

Deliberation (Code this item at the conversation level; 1=very deliberative; .5=moderately deliberative; 0=not deliberative)
- A very deliberative conversation is one where participants ask/answer questions, share opinions/information, and consider the opinions/information shared by others. Some individuals in these conversations comment more than once, so that the exchange resembles an engaged discussion. Individuals engaged in very deliberative conversations will often learn something new.
  - A conversation is deliberative (coded as 1) if anyone comments more than once, at least one comment in the conversation is coded as "informative," and no

comments include argument ad hominem or a greater proportion of hostility than civility.

- Moderately deliberative conversations are civil and include an exchange of opinions/information, but lack the reciprocity and productivity of very deliberative conversations. Moderately deliberative conversations may more closely resemble small talk or joking than productive discussion. Specifically, a moderately deliberative conversation is differentiated from very deliberative conversations because 1) No individuals comment more than once and/or 2) No comment is coded as "informative"
  - Conversations should be coded as .5 if they do NOT include argument ad hominem or more hostility than civility AND if no one comments more than once or no comment is coded as informative
- Deliberation does not occur in conversations in which comments are uncivil or insulting. Even if individuals comment more than once and/or learn something new, if the conversation includes argument ad hominem or hostile comments, it is not deliberation.
  - Conversations should be coded as 0 if any comments include ad hominem or there is a greater proportion of hostility than civility.
- All comments in the same conversation should receive the same code for this variable

A comment at 0 depth that has no replies should be coded 9

APPENDIX C. LIWC 2015 SAMPLE OF PRELOADED DICTIONARIES

LIWC 2015 Positive Emotion Dictionary

Accept	Healthy	Respect
Benefit	Important	Safe
Best	Kind	Thankful
Considerate	Legitimate	Useful
Dear	Merit*	Valued
Enjoy	Nice	Wise
Fabulous	Optimistic	Yay*
Good	Proud	

LIWC 2015 Negative Emotion Dictionary

Abuse*	Gloom	Pain
Anger*	Harm	Rage*
Bastard*	Immoral*	Savage*
Cruel	Jealously	Selfish*
Dangerous	Kill*	Threat*
Enemy*	Liar*	Unsafe
Evil	Maniac*	Violent
Fail*	Nervous	War
Fear	Obnoxious*	Yell

LIWC 2015 Swear Dictionary (Vulgar)

Asshole*	Fuckboy*	Twat*
Bitch*	Hell	Whore*
Cunt*	Mfs	Wtf
Damn*	Shit*	

LIWC 2015 Interrogate Dictionary (Questions)

How	Where	Why
Wat	Where'd	Wut
When	Which	
Whence	Whoever	

APPENDIX D. SAMPLE FROM CUSTOM DICTIONARIES

Custom Civility Dictionary

Agreeable	informative*	Reevaluat*
answer*	joy*	Share
believe	knowledg*	Solve
calm	learn	Thoughtful*
decent	Memorabl*	Understand
explain	Nice	Value
favor	Optimal*	Warm
good	Peaceful	Wellbeing
hug	Realize	Yay*

Custom Hostility Dictionary

Aggressive	Intimidat*	Stupid
Bitter	Irrational*	Tantrum*
Contempt*	Jerk	Tense
Demean*	Lame	Unsuccessful*
Effin	Mad	Upset
Fake	Mock	Violence
Gross	Obnoxious*	Weak
Harass*	Pathetic	Weapon*
Humiliat*	Rude	Yelling
Ignorant	Steal*	

APPENDIX E. ON TOPIC DICTIONARIES

r/EverythingScience

CDC whistleblower says he was told not to use phrase "climate change" after Trump elected

Administration	Dismantl*	Optics
Administrative	Deny	Patrick
Agency	Denied	Phrase
Agencies	Deniers	Political*
Al	Denies	Politics
Allegations	Donald	President
Breysse	Dr	Program*
Cancel	Employee*	Reassign*
Canceled	Expert*	Research
Cancelled	Extreme	Refute*
Cancels	Falsif*	Republican*
CBS	Fire	Review*
CDC	Fired	Revoke*
Change	Fires	Science
Chinese	George	Scientist*
Climate	Gore	Strassmann
Complain*	Government	Troubl*
Complaint*	Health	Trump*
Conference	Hoax	Weather
Create*	House	Whistleblower*
Credential*	Inauguration	White
Disease*	Luber	

Climate scientists say Greta Thunberg's efforts are building real momentum: "She is getting people to listen, which we have failed to do," one climatologist said.

Action	Challeng*	Emotional
Active	Climate	Energy
Activist*	Climatologist*	Environment
Address	CO2	Environmental
Addressed	Control	Extreme
Addressing	Controlled	Gas
Addresses	Controlling	Glacial
Administration	Controls	Glacier
Administrations	Degree	Global
Atmosphere	Degrees	Greta
Awareness	Dioxide	Green
Benson	Donner	Greenhouse
Budget	Effect	Heat
Carbon	Effects	High
Celsius	Emission	House
Change	Emissions	Hultman
Changes	Emotion	Human

Humans	Panels	Speech
Huq	Planet	Stanford
Ice	Policy	Statement
Iceberg*	Progress	Strike
Impact	Project	Strikes
Impassion	Record	Summit
Impassioned	Reduce	Summits
Intergovernmental	Reduces	Support
International	Reducing	Teen
IPCC	Report	Teenage
Irreversible	Reported	Teenager
Leader*	Reports	Teenagers
Level	Research	Threat
Levels	Researcher*	Threats
Life	Rise	Threaten
Limit	Rising	Threatening
Limited	Rises	Threshold
Limiting	Rose	Thunberg
Limits	Risk	Trend
Live	Risks	UN
Lives	Saleemul	United
Mehling	Sally	Urgency
Melting	Science	Urgent
Michael	Scientist*	Warmed
Mobilize*	Sea*	Warming
Movement	Simon	Warned
Nathan	Situation	Warning
Nations	Speak	White
Obama	Speaking	World
Panel	Speaks	Young

I'm a scientist. Under Trump I lost my job for refusing to hide climate crisis facts. I was a climate scientist in a climate-denying

Action	Blocking	Constraint*
Actions	Blocks	Coastal
Administration*	Career	Complain
Agenda	Careers	Complaint*
Agendas	Cause	Congress
Alter*	Caused	Continu*
Application	Causes	Crises
Apply	Causing	Crisis
Budget	Change	Centuries
Budgets	Changed	Century
Bureaucracy	Changes	Danger*
Bush	Changing	Declin*
Block	Clements	Delay
Blocked	Climate	Delayed

Delaying	Integrity	Retaliate
Delays	Job	Retaliates
Delete	Jobs	Retaliation*
Deleted	Joel	Retribution*
Deletes	Led	Rod
Deleting	Lead	Schoonover
Deletions*	Leader*	Sea
Demote	Leading	Seas*
Demotion	Letter	Science
Demotions	Letters	Scientific
Denial	Level	Scientist
Denied	Levels	Scientists
Deniers	Media	Senior
Denies	National	Silenc*
Deny	NPS	Storm
Email	Official	Storms
Emailed	Officials	Supervisor*
Emails	Park	Support*
Employee	Parks	Suppress
Employees	Planet*	Surge
Estimate	Politic*	Suppressed
Estimated	Project	Taxpayer*
Estimating	Projects	Terminate*
Estimates	Protect*	Termination
Fact	Public	Testimony
Facts	Publication*	Threat
Factual	Publics	Threatened
Federal	Publish	Threatens
Fired	Record	Trump
Fired	Records	Violation*
Firing	Reference	Volunteer
Fires	Referenced	Volunteered
Fund	References	Volunteering
Funded	Referencing	Volunteers
Funding	Release	Warns
Funds	Released	Warn
Govern*	Releasing	Warned
Human	Renew*	Warning
Humans	Report	Whistleblower*
Impact	Reported	
Impacts	Reporting	Work
Implication*	Reports	Worked
Infrastructure*	Resign	Working
Inquire	Resigned	Works
Inquiries	Resigning	Write
Inquiry	Resigns	Writes

Written	Wrote	

Judge rules that Trump can't ignore 'inconvenient facts' about climate change.

Acknowled*	Explains	Pipelines
Administration*	Explanation*	Plan
Agency	Fact	Planned
Agencies	Facts	Planning
Agenda	Factual*	Plans
Approv*	Federal	Policies
Argu*	Find*	Policy
Assert*	Fossil	President
Barack	Found	Prior
Base	Fuel	Project
Based	Global	Provid*
Bases	Ignore	Reason*
Basing	Ignored	Recommend*
Block	Ignoring	Reject
Blocked	Ignores	Rejected
Blocking	Impact*	Rejecting
Blocks	Inconvenient	Rejects
Brian	Issue*	Requir*
Change	Judge	Reversal
Changed	Keystone	Reverse
Changing	Law	Reversed
Changes	Laws	Reversing
Climate	Legal	Reverses
Conclusion*	Lie	Rule
Construction	Lied	Ruled
Contrary	Lies	Rules
Course	Lying	Ruling
Crisis	Morris	State
Decision*	Obama	Stated
Department*	Oil	Statement*
Determination*	Omission*	States
Discard*	Omit*	Stating
Disregard*	Pass	Support*
Document*	Passed	Trump
Donald	Passing	Warming
Explain	Passes	XL
Explained	Past	
Explaining	Pipeline	

Michele Bachmann: Climate Change Is a Fraud Because 'God Says We Will Never Be Flooded'

Abraham	Challeng*	Covenant*
Bachman*	Change	Deception*
Bible	Climate	Deceive
Biblical	Congress	Deceived
Catastrophe	Congresswoman	Deceives

Deceiving	Lacks	Salvation
Destroy	Markel*	Sermon
Destroyed	Michele	Sin
Destroying	Michelle	Sinner
Destroys	Minnesota	Sinning
Flood	Nations	Sins
Flooded	Noah	Sky
Flooding	Pastor	Threat
Floods	Pastors	Threaten*
Fraud*	Perish*	Threats
God	Political	Times
Human	Politics	Truth
Humanity	Preach	Understand
Humans	Preached	Understanding
Issue*	Preaches	United
Jan	Preaching	View
Judgment*	Program	Views
Knowledg*	Programs	Water
Lack	Pulpit*	Word
Lacked	Radio	World
Lacking	Rainbow	

Nestlé plan to take 1.1m gallons of water a day from natural springs sparks outcry - to sell back to the public as bottled water. "A big threat to this diversity is habitat degradation, which will happen with reduced flows."

Agency	Buying	Critic*
Agent	Buys	Critically
Agents	California	Customer*
Approval	Campaign*	Day
Approved	Capacities	Decid*
Approves	Capacity	Decision*
Approving	Claim	Declin*
Aquifer*	Claimed	Decreas*
Arrowhead	Claiming	Degradation
Bank	Claims	Denied
Banks	Company	Denies
Bernardino	Companies	Deny
Beverage	Consume	Denying
Bottle	Consumed	Deplete
Bottled	Consumer*	Depleted
Bottles	Consumes	Depletes
Bought	Consuming	Depleting
Brand	Cost	Depletion
Brands	Costs	District
Business*	Creek	Districts
Buy	Creeks	Diversity

Draw	Interests	Producing
Draws	Investigat*	Production
Eco	Jipson	Project
Ecological*	Level*	Projects
Engineer*	Life	Promise*
Environment*	Local	Protect*
Evaluat*	Locals	Pure
Expire	Malwitz	Quality
Expired	Management	Recover
Expires	Manufactur*	Recovered
Expiring	Merrillee	Recovering
Extract	million*	Recovers
Extracted	native	Recovery
Extracting	official*	Reduc*
Extraction	Opponent*	Regulat*
Extracts	Oppos*	Renew
Facilities	Overdraw*	Renewable
Facility	Overdrew	Renewal
Factories	Overpump*	Renewed
Factory	Own	Renewing
Fe	Owned	Renews
Fight	Permission*	Report*
Fighting	Plan	Responsible
Fights	Planned	Responsibility
Florida	Planning	Resource*
Flow	Plans	Restor*
Flowed	Public	Result
Flowing	Publics	Resulted
Flows	Natural	Resulting
Food	Nestle	Results
Fought	Partner*	Review*
Freshwater	Pearl	Ring
Fragile	Pearls	River
Gaber	Permission*	Rivers
Gallon*	Permit*	Robust
George	Petition*	Santa
Ginnie	Plan	Sell
Habitat*	Planned	Selling
Harm*	Planning	Sells
Haven	Plans	Seven
Havens	Plant	Sold
Health	Plants	Source
Impact*	Population*	Sourced
Increas*	Produce	Sources
Inhabit*	Produced	Sourcing
Interest	Produces	Species

Spring	Sustainable	Upgrades
Springs	Sustained	Upgrading
Standard*	Sustaining	Vegetation
Stefani	Sustains	Vitality
Strateg*	Suwannee	Volume
String	System*	Water
Studied		Wetland*
Studies	Threat*	Withdraw
Study	Took	Withdrawal
Studying	Turtle	Withdrawing
Substantial*	Turtles	Withdraws
Support*	Upgrade	Withdrew
Sustain	Upgraded	Zephyrhills

'So they knew': Ocasio-Cortez questions Exxon scientist on climate crisis denial – Hoffert testified that in 1982, Exxon scientists predicted how carbon dioxide levels would rise and heat the planet as humans burned more fossil fuels

Accurate*	Denied	Ocasio
Alexandria	Denied	Oil
Atmosphere	Deny	Planet
Averag*	Denying	Predict*
Burn	Dioxide	Project*
Burned	Doubt*	Question*
Burning	Earth	Represent*
Burns	Engineer*	Research*
Carbon	Evidence	Rise
Celsius	Exxon	Rises
Change	Exxonmobil	Rising
Concentration	Fossil	Rose
Congress*	Fuel*	Science
Consult*	Future	Scientific
Cortez	Heat	Scientist*
Climate	Hoffert	Temperature*
Crises	House	Testified
Crisis	Human*	Testifies
Cycle*	Increas*	Testify
Degree	Level	Testifying
Degrees	Levels	Testimony
Democrat*	Martin	Year
Denial	Model*	Years

The Bee Is Declared the Most Important Living Being On The Planet

Agrarian	Animal	Bacterium
Agriculture	Animals	Bee
Agrotoxins	Announcement*	Bees
Albert	Apiculture	Behavior*
Alternative*	Bacteria	Behaviour*

Beneficial	Emits	natural
Benefit	Emitted	nature
Benefits	Emitting	Nest
Benefitted	Experiment*	Nests
Benefitting	Extinct*	Noise
Biologist*	Fauna	Noises
Call	Favre	Noisy
Called	Fed	Observ*
Calling	Feed	Pathogen*
Calls	Feeding	Perform*
Carrier	Feeds	Pesticide*
Carriers	Flower*	Planet
Catastrophe*	Food	Plant*
Change	Foods	Poison*
Chile	Fumigation	Pollinate
Colombia	Fungus	Pollination
Conclud*	Fungi	Pollinator*
Conclusion*	Geographical	Presence
Conservation	Grisales	Produc*
Countries	Health	Prohibit*
Country	Healthy	Promot*
Crises	Hive	Protect*
Crisis	Hives	Provid*
Crop	Honey	Provision*
Crops	Human*	Reason*
Danger*	Importance	Region
Debate	Important	Regions
Debated	Insect*	Repopulat*
Debates	Institute	Reproduc*
Debating	Lack	Research*
Deforestation	Lacked	Risk
Determine	Lacking	Risked
Determined	Lacks	Risking
Determines	Life	Risks
Determining	Live	Safe
Die	Lived	Safer
Died	Lives	Save
Dies	Living	Science
Dying	London	Scientific
Direction*	Lose	Scientist*
Disappear*	Loses	Skin
Disorient*	Losing	Soil
Earth	Lost	solution*
Earthwatch	Luciano	strategic
Einstein	Mobile	Strategies
Emit	monitor*	Strategy

Studies	Urgency	Virus
Study	Urgent	Viruses
Switzerland	Valuable	Vital
Technology	Value	Wave
Telephony	Valued	Waves
Toxic	Values	Welfare
Toxin*	Valuing	World

The man who advised the GOP to drop "global warming" for the less scary-sounding "climate change" now calls for climate action. "I'm here before you to say that I was wrong in 2001. Just stop using something that I wrote 18 years ago, because it's not accurate today."

Accurate	consequence*	Ends
Action	Conservative*	Enhanc*
Activist*	Consultant*	Evidence
Administration	Convince*	Fire
Advice	Countries	firefighter*
Advise	Country	fires
Advised	Create	flame
Advises	Created	flames
Advising	Creates	florida
Air	Creating	focus
America*	Crises	foreign
Angeles	Crisis	forest
Audience	Economic	frame
Barrier*	Emergency	framed
Bipartisan	Energy	frames
Battle*	Environment*	framing
Border*	Estate	Frank
Brian	Evacuation	Fuel
Brother*	Extreme	Fuels
Bush	Death	Fund*
California	December	Future*
Career	Defend	George
Careers	Defended	Global
Catastrophe	Defending	GOP
Catastrophic	Defends	Grew
Certain*	Defense	Group
Change	Democrat*	Groups
Clean	Depend*	Grow
Cleaner	destroy*	Growing
Climate	economic	Grows
combat*	economy	Growth
committee*	Elect*	Hawaii
Communicate*	End	Healthier
communication*	Ended	Healthy
conflict*	Ending	Hearing

Home
Homes*
Hurricane*
Ice
Icecap*
Improve*
Inaccurate
Innovate*
Innovative
Invest*
Job
Jobs
Koch
Lack
Leader*
Learn
Learned
Learning
Learns
Legislation
Level*
Life
Live
Lives
Living
Lose
Losing
Luntz
Memo
Master
Melt
Melted
Melting
Melts
Messag*
Mind
Nation
National
Nations
Nonpartisan
Opportunities
Opportunity
Partisan
Party
Peace
Personal

Personalize
Personalize
Personalizes
Personalizing
Persuade*
Policies
Policy
Political
Politics
Pollster
Pollsters
President*
Press
Prevent*
Principle*
Problem*
Program*
Protect*
Priorit*
Quo
Rebrand*
Regret*
Release*
Reliable
Represent*
Republican*
Rising
Safe
Safer
Save
Saved
Saves
Saving
Schatz
Science
Scientific
Scientist*
Sea
Seas
Security
Senate
Senator*
Service*
Skireball
Solution*
Solve

Solved
Solves
Solving
Southern
Status
Strateg*
Suggest*
Support*
Survey*
Sustain
Sustainability
Tax
Taxes
Technology
Testimony
Threat*
Together
Tornado*
Trump
Value*
Vote
Voted
Voters
Votes
Voting
Use
Used
Uses
Using
Wall
Warming
Warn
Warned
Warning
Warns
Water
Weather
Wild
Wildfire*
Word
Wording
Words
Work
Worked
Working
Works

World   Yale

USDA Indefinitely Suspends Honeybee Tracking Survey as States Get Approval to Use Bee-
Killing Pesticide: "Yet another example of the Trump administration systematically undermining
federal research on food safety, farm productivity, and the public interest writ large."

Abuse	Corporation*	Instituted
Abused	Critic	Institutes
Abuses	Critics	Instituting
Abusing	Dangerous	Interest
Administration*	Data	Joyce
Agriculture	Decid*	Kill
Analyz*	Decision*	Killed
Approval	Declin*	Killer
Approve*	Department*	Killing
Approving	Director*	Kills
Assess*	Diversity	Lawsuit*
Attorney	Donald	Loophole*
Ban	Earth	Lori
Banned	Economist	Lose
Banning	Ecowatch	Loses
Bans	Effect	Losing
Bee	Effects	Loss
Beekeeper*	Emergencies	Lost
Bees	Emergency	Maryland
Biological	Entomologist*	Monitor*
Biology	Environment*	Pesticide*
Boehm	EPA	Policies
Brianna	Exemption	Policy
Budget*	Extinct*	Pollinate
Burd	Factor*	Pollinated
Candidate*	Farm*	Pollinates
Chemical*	Federal	Pollinating
Closer	Food	Pollinator*
CNN	Friends	Population*
Collaps*	Fungicide	President
Collect*	Health*	Prioritize
Colonies	Hive	Prioritized
Colony	Hives	Prioritizes
Compare	Honey	Priorities
Compared	House	Prioritizing
Compares	Human	Priority
Comparing	Humans	Profit*
Congress	Impact*	Program*
Conservation	Insect	Productive
Conserv*	Insecticide	Productivity
Continuous*	Institute	Public

Publics	Sulfoxaflor	Trump
Rebecca	Survey*	Undermine*
Refus*	Suspend*	Undermining
Report*	Suspension	Union
Research*	Systematically	US
Responsibl*	Thermometer*	USDA
Rodenticide	Toxic	Valu*
Safety	Track	Vance
Science	Tracked	vanEngelsdorp
Scientific	Tracking	Vaughan
Scientist*	Tracks	Wellbeing
Societ*	Transform	White
Species	Trend*	Xerces

r/Science

Having kids makes you happier, but only when they move out, according to a new study, which suggests that parents are happier than non-parents later in life, when their children move out and become sources of social enjoyment rather than stress (n=55,000).

Age	Empty	Kid
Ages	Enjoy	Kids
Analys*	Enjoyed	Late
Analyze	Enjoying	Later
Analyzed	Enjoyment	Left
Analyzes	Enjoys	Leave
Analyzing	Enrich	Leaves
Aspect*	Enriched	Leaving
Becker	Enriches	Life
Care	Enriching	Live
Cared	Europe	Lived
Caregiver*	European	Lives
Cares	Finance	Living
Caring	Finances	Maximis*
Child	Financial	Maximiz*
Childcare	Generous	Money
Childfree	Germany	Move
Children	Grew	Moved
Christoph	Grow	Moves
Contact*	Growing	Moving
Countries	Grows	Negative
Country	Happy	Nest
Data	Happier	Nicholas
Depressed	Happiest	Norway
Depresses	Happiness	Old
Depressing	Heidelberg	Older
Depression	Holiday	Outweigh*
Emotion*	Home	Paid

Pay	Satisfies	Subsidies
Paying	Satisfy	Subsidize
Pays	Satisfying	Subsidized
Parent	Sick	Subsidizes
Parental	Sleep	Subsidizing
Parenthood	Sleeping	Support
Parenting	Sleeps	Supported
Parents	Slept	Supporting
Peer	Social	Supports
Peers	Socialize	Survey
Portugal	Source	Surveyed
Potential	Sources	Surveying
Provide	States	Surveys
Provided	Stress	Sweden
Provides	Stressed	Time
Providing	Stressed	Unhappy
Research*	Stressing	United
Role	Studied	US
Roles	Studies	Utah
Satisfaction	Study	Wellbeing
Satisfied	Studying	Wolfinger

Industrial methane emissions are 100 times higher than reported, and have been vastly underestimated, finds a new study using a Google Street View car equipped with a high-precision methane sensor. They also were substantially higher than the EPA estimate for all industrial processes in the US.

Agencies	Climate	Emitted
Agency	Colorado	Emitting
Air	Combust*	Environment*
Albertson	Contribut*	EPA
Ammonia	Cornell	Estimat*
Analyses	Data	Evaluat*
Analysis	Defense	Evidence
Analyz*	Detect	Extract*
Annual*	Detected	Facilities
Assess*	Detecting	Facility
Atkinson	Detection	Factories
Atmosphere	Detects	Factory
Car	Dioxide	Fertiliz*
Carbon	Discover*	Find
Chain	Downwind	Finding*
Chains	EDF	Fletcher
Change	Elementa	Fossil
Chemical	Emission*	Found
Clean	Emit	Fuel
Cleanliness	Emits	Fugitive

Fund	Percentage	Self
Funded	Pipeline*	Self-report*
Funding	Plant	Sense
Funds	Plants	Sensed
Future	Policies	Senses
Gap	Policy	Sensing
Gas	Policymaker*	Sensor*
Gigagram*	Pollute	Shale
Google	Polluted	Source
Global	Pollutes	Sources
Greenhouse	Polluting	States
Industrial	Pollution	Street
Industry	Power	Studied
Infer	Precise	Studies
Inference*	Precision	Study
Inferred	Process*	Studying
Inferring	Produc*	Supplied
Infers	Program*	Supplies
John	Protect*	Supply
Joseph	Public	Supplying
Leak*	Publics	Sustain*
Lose	Rate	Technologies
Loss	Rates	Technology
Lost	React*	Underestimat*
Measur*	Reduc*	United
Methane	Report*	Urea
Mitigat*	Research*	Vehicle*
Mobile	Resource	View
Molecular	Resources	Warming
Molecule*	Road	Xiaochi
Municipal*	Roads	Year
Natural	Roadway*	Years
Opportunistic	Rudek	Zhou
Percent	Scientist*	

In Seattle, Washington, delaying the start time of two high schools by nearly an hour lengthened students' daily sleep by more than half an hour, and was associated with reduced sleepiness and increased academic performance.

Absence*	Attendance*	Biological*
Absent	Awake	Circadian
Absentee*	Bedtime*	Cycle
Academic*	Beneficial	Cycles
Activities	Benefit	Data
Activity	Benefits	Decreas*
Advantage*	Benefitted	Delay*
Asleep	Benefitting	Deprive

Deprived	Learns	Sleepy
Deprives	Measur*	Socioeconomic
Depriving	Morning*	
Device	Natural	Sophomore*
Devices	Naturally	Start
Disadvantage*	Night	Started
Dunster	Nights	Starting
Earlier	Nighttime	Starts
Early	Pediatric*	Student
Economic*	Perform*	Students
Evidence	Policies	Studied
Franklin	Policy	Studies
Gap	Public	Study
Gaps	Punctual*	Studying
Gideon	Quantitative	Teen
Grade	Reduc*	Teenager
Grades*	Result	Teenagers
High	Resulted	Teens
Horacio	Resulting	Time
Iglesia	Results	Times
Increas*	Roosevelt	Wake
Late	School	Wakes
Later	Seattle	Washington
Learn	Sleep	Woke
Learned	Sleepiness	Wrist
Learning	Sleeping	Wrists

MMR vaccine does not cause autism, another study confirms

Activist*	Choose*	Global
Afraid	Chose	Health
Alter*	Compensat*	Hospital*
Anders	Control*	Hviid
Andrew	Denmark	Increas*
Anti-vaccine	Diagnos*	Journal
Antivaccine	Disease	Journals
Anti-vax	Disorder*	Kid
Antivax	Evidence	Kids
Antivaxer*	Factor	Lancet
Antivaxxer*	Factored	License
Autism	Factoring	Link
Autistic	Factors	Linked
Birth	Fear	Linking
Brazil	Feared	Links
Child	Fearing	Measles
Children	Fears	Media
Choice*	France	Medical

Medicine	Reproduc*	Study
Misrepresent*	Research*	Studying
MMR	Result*	Threat*
Mumps	Retract*	Trigger*
Myth	Risk	UNICEF
Offit	Risked	US
Outbreak*	Risking	Vaccinate
Paid	Risks	Vaccinated
Parent*	Rubella	Vaccinates
Paul	Science	Vaccinating
Pay	Scientific	Vaccination
Paying	Scientist*	Vaccine
Pays	Sibling*	Vaccines
Philadelphia	Social	Wakefield
Philippines	Spectrum	World
Preterm	Studied	
Prevent*	Studies	

Scientists believe that the function of zebras' stripes are to deter insects, so a team of researchers painted black and white stripes on cows. They found that it reduced the number of biting flies landing on the cows by more than 50%.

Animal*	Flicked	Livestock
Behavior*	Flicking	Loss
Bit	Flicks	Losses
Bite	Flies	Material*
Bites	Fly	Motion
Biting	Function*	Observ*
Bitten	Graze	Paint
Black	Grazing	Painted
Breed	Health*	Painting
Breeds	Humane	Paints
Bug	Industries	Pesticide*
Bugs	Industry	Reduce
Cattle	Injure	Reduced
cheap*	Injured	Reduces
chemical*	Injures	Reducing
color*	Injuries	Repel*
Cow	Injury	Research*
Cows	Insect*	Scientist*
Detect*	Japan*	Skin
Deter*	Land	Sleep
Eat	Landed	Solution*
Economic	Landing	Spray
Economy	Lands	Sprayed
Environment*	Leg	Spraying
Flick	Legs	Sprays

Stamp	Stripes	Twitched
Stamped	Studied	Twitches
Stamping	Studies	Twitching
Stamps	Study	Unpaint*
Stress	Studying	White
Stressed	System*	Year
Stresses	Tail	Yearly
Stressing	Tails	Zebra
Stripe	Toxic	Zebras
Striped	Twitch	

Self-driving cars will "cruise" to avoid paying to park, suggests a new study based on game theory, which found that even when you factor in electricity, depreciation, wear and tear, and maintenance, cruising costs about 50 cents an hour, which is still cheaper than parking even in a small town.

Adam	costed	Killing
Airport	costing	Kills
Airports	costly	Law
Autonomous	costs	Laws
Available	crawl*	Legal*
Availability	Cruise	Locate
Avoid	Cruised	Located
Avoided	Cruises	Locates
Avoiding	Cruising	Locating
Avoids	Downtown*	Location
Car	Drive	London
Cars	Driven	Mile
Center	Drives	Mileage
Centers	Driver	Miles
Charge*	Drivers	Millard
Cheap	Driving	Money
Cheaper	Drove	Motor
Cheaply	Enforc*	Motors
Cities	Fee	motorist*
City	Fees	Paid
Commute	Francisco	Park
Commuted	Free	Parked
Commutes	Gridlock*	Parking
commuter*	Hour	Parks
commuting	Hours	Passenger*
congest	Illegal*	Pay
congested	Impact*	Paying
congesting	Implement*	Pays
congestion	Incentiv*	Pick
congests	Kill	Picked
cost	Killed	Picking

Picks	Public	Solved
Plan	Rate	Solves
Planned	Rates	Solving
Planning	Reduc*	Speed*
Plans	Regulat*	Stockholm
Policies	Remote	Street
Policy	Remotely	Streets
Pollute	Research*	Time
Polluted	Restrict*	Timed
Pollutes	Road	Times
Polluting	Roads	Timing
Pollution	Self	Traffic
Price	Self-driving	Transit
Priced	Singapore	Transport*
Priced	Slow*	Travel*
Pricing	Solution*	Vehicle*
Problem*	Solve	Widespread

The first picture of a black hole opens a new era of astrophysics. The supermassive beast lies in a galaxy called M87 more than 50 million light-years away

Accretion	Edge*	Light
Astrophysics	EHT	Lights
Astrophysicist*	Einstein	Lit
Billion	Escap*	M87
Black	Estimat*	Markoff
Boundar*	Extreme	Mass
Bright	Feryal	Massive
Clifford	First	Material
Cloud	France	Materials
Clouds	Gas	Measur*
Condition	Gases	Mechanics
Conditions	Galaxies	Mile
Constellation*	Galaxy	Miles
Controvers*	General	Milky
Cordova	Gravitation*	Monster
Detect	Gravity	Natarajan
Detected	Harvard	Network*
Detecting	Heft	Outer
Detection	Hole	Outerspace
Detects	Holes	Ozel
Diameter	Horizon	Photograph*
Disk	Horizons	Physics
Disks	Image	Physicist*
Distance	Images	Picture*
Doeleman	Journal*	Predict*
Earth	Kilometers	Priyamvada

Quantum	Size	Telescope*
Relativity	Sky	Test
Result	Smithsonian	Tested
Results	Solar	Testing
Ring	Space	Tests
Rings	Spacetime	Time
Sagittarius	Star	Theories
Saw	Stars	Theory
Science	Studied	Universe
Scientific	Studies	Virgo
Scientist*	Study*	Weigh
See	Sun	Weighed
Seeing	Suns	Weighing
Seen	Supermassive	Weighs
Sees	Technique*	Weight
Sera	Technological	Year
shadow*	Technologies	Years
Sheperd	Technology	

The United States, on a per capita basis, spends much more on health care than other developed countries; the chief reason is not greater health care utilization, but higher prices, according to a new study from Johns Hopkins.

Access*	Doctor	Insurer*
Administration*	Doctors	Hussey
America*	Domestic	Japan
Anderson	Drug	Johns
Annual*	Drugs	Low
Average	Economic	Lower
Bloomberg	Economist*	Lowest
Canada	Economy	Mean
Capita	Expense*	Median
Care	Expensive	Medical
Control*	Gap	Medicin*
Corporation*	Gaps	Medical
Cost	GDP	MRI
Costed	Gerard	Nurse
Costing	Gross	Nurses
Costs	Health	OECD
Countries	High	Outspend*
Country	Higher	Outspent
CT	Highest	Peter
Data	Hopkins	Petrosyan
Dean	Hospital*	Pharma
Developed	Increas*	Pharmaceutical*
Difference*	Inflat*	Pharmacist*
Different	Insurance	Physician*

Policies	Rates	Spent
Policy	Reinhardt	States
Population*	Research*	Studied
Price	Resource*	Studies
Prices	Salaries	Study
Princeton	Salary	Studying
Private	Service*	Switzerland
Produce*	Spend	United
Product*	Spender*	US
Public	Spending	Uwe
Rate	Spends	Varduhi

Tree stumps that should be dead can be kept alive by nearby trees, discovers new study, which found a tree stump that should have died is being kept alive by neighbouring trees through an interconnected root system, which may change our view from trees as individuals to forests as 'superorganisms'.

Adult	Grew	Near
Alive	Grow	Nearby
Auckland	Growing	neighbor*
Australia	Grows	neighbour*
Beneficial	Health*	network*
Benefit*	Help	night
Carbon	Helped	nights
Circulat*	Helping	nighttime*
Evaporat*	Helps	nutrient*
Day	High	nutrition
Days	Host	organism*
Dead	Hosts	overcast
Dieback	individual*	rain
Died	Interconnect*	rained
Dies	Kauri	raining
Disease*	Leaf	rains
Dying	Leafless	rainy
Ecosystem*	Leaves	relationship*
Evaporat*	Leuzinger	resist*
Evening*	Live	resource*
Exchang*	Lived	risk
Flow	Lives	risked
Flowed	Living	risking
Flowing	Low	risks
Flows	Melbourne	root
Foliage	Moore	roots
Forest*	Move	Sebastian
Fungi	Moved	Species
Fungus	Moves	Spread*
Funnel*	Movement*	Stable
Greg	Moving	Stability

Stump	System*	Wood
Stumps	Together	Woods
Superorganism*	Tree	Zealand
Support*	Trees	
Surviv*	Water*	

Woman with 'mutant' gene who feels no pain and heals without scarring discovered by scientists. She reported numerous burns and cuts without pain, often smelling her burning flesh before noticing any injury, as published in the British Journal of Anesthesia, and could open door to new treatments.

Abnormal*	Healing	Scarring
Anesthesia	Heals	Scars
Anesthesia	Help*	Scientist*
Anxiety	Hip	Scotch
Arthritic	Hospital*	Scottish
Arthritis	Injuries	Scotland
Burn	Injury	Super
Burned	Kingdom	Superhuman
Burning	Medical	Surgeon
Burns	Medicine	Surgeries
Burnt	Memories	Surgery
Cameron	Memory	System
Cannabis	Mood	Systems
Central	Moods	Test
Chronic	Mutant	Tested
Comfort*	Mutate	Testing
Cut	Mutated	Tests
Cuts	Mutates	Tolerance
Cutting	Mutating	Tolerant
Different	Mutation*	Tolerate
Discomfort	Nervous	Tolerated
Disorder*	Normal*	Tolerates
Doctor*	Pain*	Tolerating
Endocannabinoid	Power	Treatment*
Faah	Powers	Woman
Gene	Problem*	UK
Genes	Recover*	United
Genetic*	Research*	Wound*
Heal	Scar	
Healed	Scarred	

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