Media and Communication

Open Access Journal | ISSN: 2183-2439

Volume 3, Issue 1 (2015)

Editors

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COGITATIO

Media and Communication, 2015, Volume 3, Issue 1

Published by Cogitatio Press
Rua Fialho de Almeida 14, 2º Esq.,
1070-129 Lisbon
Portugal

Available online at: www.cogitatiopress.com/mediaandcommunication

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2015, Volume 3, Issue 1, Pages 1-4
Doi: 10.17645/mac.v3i1.304

Commentary

Climate Crisis and Communication: Reflections on Naomi Klein's *This Changes Everything*

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Submitted: 27 April 2015 | Accepted: 6 May 2015 | Published: 1 June 2015

Abstract
This commentary suggests that Naomi Klein's influential book *This changes everything: Capitalism vs. the climate*, implicitly points to the influence of media institutions on societal response to the crisis, yet does not analyze them explicitly. Communication scholars could help fill that gap. Conversely however, Klein's work suggests productive avenues for media researchers to explore, including a fresh take on the relationship between climate crisis, communication and capitalism as a system, and the potential for alternative media to challenge dominant cultural narratives.

Keywords
alternative media; capitalism; climate crisis and media; journalism; media reform

Issue
This commentary is part of a regular issue of Media and Communication, edited by Professor Bradley Greenberg (Michigan State University, USA) and Professor Elisabeth Klaus (University of Salzburg, Austria).

1. Introduction

The surging tide of climate crisis is sweeping media studies towards new ethical and intellectual imperatives. Most obviously, it forces us to consider how to reduce our own carbon footprint. Even if academic tourism makes only a tiny contribution to greenhouse gas emissions, and granted the undoubted value of face-to-face meetings, we could demonstrate ethical leadership by modelling new modes of collaboration, including greener and less frequent conferences, and payment of carbon offsets—not the corporate-sponsored greenwashing programs, but personal engagement and donations to civil society organizations campaigning for effective climate policy.

Climate crisis urges communication scholars to reflect upon their own conceptual tools and research agendas. Climate crisis can be incorporated into longstanding concerns in critical media studies with power, inequality, representation and ideology. Critical social science in general has introduced new concepts, such as "productivism" as a form of oppression parallel to and overlapping with racism, sexism, and capitalism.

2. Klein's Themes

Given expanding attention to climate crisis in a range of disciplines, Naomi Klein's book *This changes everything: Capitalism vs. the climate* (2014) deserves more consideration than it has received so far from critical communication scholars. Encyclopedic in scope, and based on several years of team-based research, *This changes everything: Capitalism vs. the climate* resists easy summary, but relevant themes include these: as an ontological threat to civilization, global climate change forces a rethinking and retooling of human institutions and practices. Neither geoengineering technology, benevolent billionaires, nor market forces, are probable saviours. To the contrary—free market fundamentalism and capitalist globalization have helped create the crisis, partly through free trade agreements that trump and undermine governments' willingness and ability to enact pro-climate policies. Indeed, Klein traces the crisis's origins to the coal-fuelled emergence of industrial capitalism in Britain, inextricably intertwined with colonialism, slavery and racism. Thus, attitudes to climate change are a barometer of other political values; the Right is correct that

taking it seriously requires a positive role for government, a strengthened public sector, and collective action—which is precisely why the Right prefers *not* to take climate change seriously! The dominant cultural narratives of perpetual growth and human domination of nature are also part of the problem, as is the complicity of many mainstream environmental groups with neoliberalism and the fossil fuel industry.

But there are sources of hope and renewal. Fossil-fuelled capitalism has always generated "sacrifice zones" and exploitable or expendable people, comprising a kind of global apartheid stratified along class, gender and geographic as well as racial lines. But as extreme energy extraction encroaches upon previously privileged enclaves in the global North, new alliances, resistances, and political possibilities emerge, including growing support for the determination of indigenous people to defend their lands. Other positive assets include the rapidly developing technological feasibility of renewable energy; a repertoire of workable policies, some already modelled, to rein in climate change and to pay the global North's climate debt to the South; and the reclaimed memory of past social movements (notably slavery abolitionists) that overcame overwhelming odds.

3. Media as an Underdeveloped Theme?

What about media and communication? Periodically, Klein notes omissions in corporate media reportage, such as grassroots victories against fossil fuel industries, or the impact of oil spills on the life-cycle of plants and animals. More important, media—from Hollywood blockbusters and reality TV to the daily press—collude with other ideologies and interests in shaping dominant narratives—the veneration of profit, denigration of collective action, a politically debilitating belief that humanity is selfish and greedy (p. 461), and depictions of a dystopic future with a few big corporate winners and many locked-out losers (p. 59). While the analysis throughout emphasizes the political significance of cultural narratives, however, the institutions that circulate them remain largely unexamined.

Critical communication scholars could help write that arguably "missing" chapter, focussing on the imbrication of communication policies, practices and structures with climate change and sustainability. There is already an extensive literature on journalism and climate change, particularly environmental deficits of news coverage—the unwarranted attention to climate deniers in earlier days, episodic rather than sustained attention, little focus on solutions, a narrow focus on official politics, an overriding disconnect "between the media's representations of climate change and the politics and policies needed to effect meaningful change" (Cottle, 2009).

Beyond journalism coverage, an emerging critical theme is the environmental damage from information and communication technology industries themselves. Largely under the radar screen by contrast with comparable emissions from transport industries, these include built-in obsolescence of digital gadgets, and the dumping of toxic materials in the global South, driven by the marketing and surveillance needs of business—but also by techno-fetishism in popular culture (Maxwell & Miller, 2012).

Adjacent to media studies, students of popular and political culture could explore the cultural implications of the increasingly brutal scramble for diminishing energy resources, the unevenly distributed consequences of global warming, the refusal of capital rooted in the global North to pay its climate debt. Given the tendency of cultural studies to privilege epistemology over ontology, there is a risk of overemphasizing the "discursive" construction of crisis, at the expense of exploring cultural implications of the very material processes of ecological degradation. Still, there is a need for more research on how the framing of energy politics and environmental crisis, in journalism, media and other cultural forms, influence the potential for popular political action. Moreover, parallel to political scientists researching global warming's impact on political instability, cultural researchers could consider whether climate crisis is contributing to the apparent decline of universalism, the retreat to "tribal" identities, an upsurge in nihilistic and fascistic movements, from ISIS to European and American anti-immigrant xenophobia—but also the emergence of new forms of transnational resistance and solidarity.

4. Potential Contribution to Communication Studies

While critical communication scholarship could expand Klein's book, her work conversely suggests themes that could enrich the communication field. Klein's identification of capitalism as an object of analysis in connection with climate catastrophe provides a new lens for considering the capitalism-communication nexus. To be sure, controversy surrounds the target of Klein's critique: is it capitalism as such, or particular manifestations of it? Liberal commentators have undertaken a recuperative operation, interpreting her as a critic of neoliberalism rather than a full-blooded anti-capitalist, which in their view would put her beyond the pale of legitimate debate (Foster, 2015). Her book can be read either way. Her analysis of the connection between coal, industrialism, colonialism, slavery and racism, suggests a system-level critique. Elsewhere in the book, however, the "enemy" receives more qualifiers—unfettered, contemporary, hyper-globalized, or deregulated capitalism, or market fundamentalism, or the growth ethic, or "the rules of capitalism as they are currently constructed" (p. 88)—as distinct from capitalism *per se*.

Fair enough. Hers is a work of intensely researched journalism, not of social theory as such. Arguably, the ambiguity is productive. It opens the tent to progressives of various hues, while still naming and foregrounding capitalism—not simply industrial pollution, fossil fuels, or consumerism—as a system requiring analysis and

fundamental change.

Interestingly, a similar trend is observable in the critical political economy of media. Of course, ownership, control, revenues and the subordination of media organizations to corporate imperatives, are longstanding themes in the political economy research. Implications include loss of diversity as editorial resources are rationalized within corporate empires; disinvestment in serious journalism as media are increasingly owned by conglomerates seeking short-term profits; the inability of volunteer-driven online journalism to fill the gap; and the eroding separation between marketing and news (McChesney & Nichols, 2010). As a leading media reform advocate and journalism scholar, McChesney (2013, 2014) has expanded his critique to the governing logics of capitalism, as a force that constrains the democratic potential of the Internet, the press, and indeed, the space for media reform through the state. Even further, Almiron (2010) sees a qualitative leap in the integration of news media with contemporary capitalism; as finance capital comes to dominate the industrial sphere, corporate media prioritize financial information and services at the expense of journalism, and become speculative actors themselves, desperate to increase profits and revenues (Boyd-Barrett, 2011).

A new prism is thus suggested for research: the triangular relationship between capitalism, communication and climate crisis. Most obviously, capital logic fuels hegemonic media's need to attract profitable upscale audiences, media's imbrication with the growth of the urban middle class in global capitalism's "emerging economies" like India and China, and media's sustained effort to colonize popular imagination with consumerist lifestyles. Journalism suborned by such imperatives will inevitably be muted on an issue that implicitly evokes the need for collective action beyond market constraints, consumerism and property rights. Advertising helps to create "a set of cultural conditions that makes us less inclined to deal with climate change", so that "a media and telecommunications industry fuelled by advertising and profit maximisation is, at the moment, part of the problem rather than part of the solution" (Boyce & Lewis, 2009, pp. 8-9). And yet…significant portions of audiences care about environmental issues, and occasionally the process of global warming erupts with newsworthy impact. Researchers could further explore how hegemonic media handle this potential contradiction.

Klein's critique, however, doesn't simply return us to the "radical functionalism" (Curran, 2002, pp. 137-139) of 1970s western Marxist views of media and state as irredeemably locked into the reproduction of capitalism. Nor does it nestle in the fuzzy terrain of green lifestyles or deracinated consensus-building. Her sharpest critiques target "extreme energy extraction" and the fossil fuel industries as in effect an enemy of humanity—a perspective shared with American environmental writer Bill McKibben and his 350.org, on whose board Klein serves. Her book explores the irruption of "Blockadia", community-based popular resistance to extreme energy around the world. Her incendiary call for militant agency presages the possibilities of radical transformation, and resonates richly with existing research and activism. It gives an additional motive, beyond redressing the injustices of colonialism, for supportive engagement with indigenous cultures and rights, since "…Indigenous rights—if aggressively backed by court challenges, direct action, and mass movements demanding that they be respected—may now represent the most powerful barriers protecting all of us from a future of climate chaos" (p. 380). Klein's work suggests an agenda of exploring and exposing the tentacles of the fossil fuel industries in particular, into the political, cultural and media fields. Previous research on the social determinants of news agendas suggests the potential mechanisms of power, including interlocking corporate boards, revenue flows, industry-funded think tanks, political campaign donations, sponsorship of plush journalism seminars and editorial segments, well-oiled legal teams, the regime of objectivity and other aspects of conventional journalism culture, and much else (e.g. Hackett & Zhao, 1998; Shoemaker & Reese, 1996).

5. Changing the Media Field Too

Yet Klein's implicit evocation of the media's role in shaping political imagination and cultural narratives, and her explicit celebration of hope and resistance, also suggest the importance and potential for transformation in the media field. The media field is structured in dominance, but not without contradictions, even in the era of neoliberal financialization. What are the prospects within hegemonic news organizations for better practices and frames, more conducive to forming, engaging and mobilizing resistant publics? The crusading climate journalism of the not-for-profit *Guardian,* with its international online readership, offers one inspiring model, albeit one that requires cross-subsidization from related corporations. What about emergent paradigms, whole new ways of reporting the world? Does "civic" (or "public") journalism, a movement that flourished in the US in the 1990s, or peace journalism, attracting interest in conflict-ridden societies of the global South, offer valuable techniques and experience for more effective climate journalism?

Probably they do, but the exigencies of market-driven media, the 24-hour news cycle, conventional news values and practices, and the structural ties to financial capital, are hardly conducive to climate journalism that both requires extended research and challenges the culture of consumerism. While there are some excellent blogs and websites, the growing army of precariously employed freelance journalists, scrambling for scraps from the table of media empires, cannot be expected to fill the gap. Both the content of Klein's book, and its form as itself a species of long-form journalism—one that entailed several years of collaborative research,

twinned with a forthcoming video documentary produced by her partner Avi Lewis—, indicate the importance of genres of reality-oriented narrative beyond the daily headlines of hegemonic media.

At least two paths are open. Structural reform of the political communication system, particularly to ensure the financing of public interest journalism that is independent of capital logic, and especially the extractive energy sector, is one (McChesney & Nichols, 2010). The other is to strengthen "alternative" media already operating alongside, outside and sometimes against hegemonic media, typically in the online environment (whose own class, gender and geo-cultural biases, however, should not be ignored). Alternative media have traditions that resonate with progressive and just climate politics. Some of these characteristics are vulnerable to co-optation; participatory production processes, for example, can be exploited as "user generated content" for hegemonic media. Other aspects with hardier oppositional potential include productive relationships with local communities and/or social movements; a positive orientation to social change, advocacy journalism, and popular political engagement; and counter-hegemonic or "critical" content (Atton & Hamilton, 2008; Downing, Ford, Gil, & Stein, 2001; Fuchs, 2010).

6. Conclusion

Naomi Klein has outlined an ontological crisis that requires progressive communication scholars and journalists to take sides, between extractive capitalism and societal well-being. If successful challenges to extractive capitalism require deeper democracy, as Klein argues, there is an overlapping agenda between democratic media reformers, alternative media, and the emerging global climate justice movement.

Acknowledgements

My thanks to Prof. Shane Gunster, Communication, Simon Fraser University, and this journal's editors, for comments on a draft of this article.

Conflict of Interests

The author declares no conflict of interest.

References

Almiron, N. (2010). *Journalism in Crisis: Corporate media and financialization*. Cresskill, NJ: Hampton Press.

Atton, C., & Hamilton, J. F. (2008). *Alternative journalism*. London: Sage.

Boyce, T., & Lewis, J. (2009). Climate change and the media: The scale of the challenge. In T. Boyce & J. Lewis (Eds.), *Climate change and the media* (pp. 3-16). New York: Peter Lang.

Boyd-Barrett, O. (2011). Review of N. Almiron, *Journalism in crisis*. *Journalism & Mass Communication Quarterly*, *8*(2), 449-450.

Cottle, S. (2009). Senior editor's preface: Global crises and the media. In T. Boyce & J. Lewis (Eds.), *Climate change and the media* (pp. vii-xi). New York: Peter Lang.

Curran, J. (2002). *Media and power*. London and New York: Routledge.

Downing, J. D. H., Ford, T. M., Gil, G., & Stein, L. (2001). *Radical media: Rebellious communication and social movements.* Thousand Oaks: Sage.

Foster, J. B. (2015). Crossing the river of fire: The liberal attack on Naomi Klein & This Changes Everything. *Monthly Review*, *66*(9), 1-17.

Fuchs, C. (2010). Alternative media as critical media. *European Journal of Social Theory*, *13*(2), 173-192.

Hackett, R., & Zhao, Y. (1998). *Sustaining democracy? Journalism and the politics of objectivity*. Toronto: Garamond.

Klein, N. (2014). *This changes everything: Capitalism vs. the climate*. Toronto: Knopf Canada.

Maxwell, R., & Miller, T. (2012). *Greening the media*. New York: Oxford University Press.

McChesney, R. W. (2013). *Digital disconnect: How capitalism is turning the internet against democracy.* New York: New Press.

McChesney, R. W. (2014). Sharp left turn for media reform. *Monthly Review*, *65*(9), 1-14.

McChesney, R. W., & Nichols, J. (2010). *The death and life of American journalism: The media revolution that will begin the world again*. Philadelphia: Nation Books.

Shoemaker, P., & Reese, S. (1996). *Mediating the message: Theories of influences on mass media content* (2nd ed.). White Plains, NY: Longman.

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Media and Communication (ISSN: 2183-2439)
2015, Volume 3, Issue 1, Pages 5-16
Doi: 10.17645/mac.v3i1.199

Article

Facebook Users' Engagement and Perceived Life Satisfaction

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Submitted: 17 October 2014 | In Revised Form: 29 April 2015 | Accepted: 22 May 2015 | Published: 20 July 2015

Abstract
This study extends existing research on Facebook's impact on users' life satisfaction. The results from two surveys of college students demonstrate a tension between Facebook use and users' perceived contentment with their lives. Existing literature indicates students use Facebook to enhance self-esteem, yet the results from this study connect increased Facebook use to lower self-reported levels of happiness. In particular, respondents' interactions with photos and videos increase users' dissatisfaction. This phenomenon may be due to the impact photos have on the ways users engage in social comparisons with Facebook "friends" and the self-construals they create based on these comparisons.

Keywords
Facebook; happiness; life satisfaction; self-construal; social comparison; social media

Issue
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1. Introduction

Over recent years, the number of studies examining various facets of the Internet and its impacts has continually increased. Much of that growing research focuses on social networking and information sharing. Existing scholarship about online communication ranges from descriptive examinations of use (Attrill & Jalil, 2011; Hwang, 2011; Quan-Haase & Young, 2010; Valkenburg & Peter, 2011) to specific content analysis of participant contributions (Ellison, Steinfield, & Lampe, 2011; Nosko, Wood, & Molema, 2010) and experimental tests of influence (Antheunis, Valkenburg, & Peter, 2010; Kross et al., 2013).

While much of the existing research regarding online communication looks generally at different types of content and the impact of various online functions, there is particular interest in the specific impact and influence of Facebook, a widely used social networking application (Cheung, Chiu, & Lee, 2011). Facebook has attracted several hundred million users worldwide (*Who Uses Facebook*, 2012) and young people comprise the largest percentage of participants in the Facebook world (*Engagement Analytics*, 2012). Studies focusing on Facebook as a social medium include examinations of website content (Hum et al., 2011), the types and amounts of self-disclosure users provide (Nosko et al., 2010), motivations for using Facebook (Baek, Holton, Harp, & Yaschur, 2011; Cheung et al., 2011; Nadkarni & Hofmann, 2011; Pempek, Yermolayeva, & Colvert, 2009; Quan-Haase & Young, 2010; Tosun, 2012) and the impact of personality on Facebook use (Muscanell & Guadango, 2012; Nadkarni & Hofnann, 2011; Ryan & Xenos, 2011; Sukes, Williams, & Wise, 2012). In addition, scholars have created typologies of media uses and gratifications emphasizing social networking (Bumgarner, 2007; Cheung et al., 2011; Quan-Hass & Young, 2010; Sheldon, Abad, & Hinsch, 2011; Smock, Ellison, Lampe, & Whon, 2011). Some studies show that Facebook use is driven by a variety of different functions (Pempek et al., 2009; Smock et al., 2011) and can challenge the traditional demarcation of

motivations for media use (Sheldon et al., 2011).

This study uses the theories of social comparison and self-construal to untangle the effects of Facebook use on users' reported life satisfaction. We examine the utility of these two theories in explicating the impact of mediated interpersonal communication on how individuals perceive their lives and the positive or negative judgments they make about those perceptions. Two online surveys of undergraduate students at a large university in the Northeast provide a wealth of information regarding respondents' use of the social networking medium. Consistent with expectations based on the social process of creating self-construals, the surveys investigated sex-based differences in Facebook use habits and preferences, many of which correlate with alterations in perceived levels of life satisfaction. The surveys also explored how variation in the ways respondents interact with Facebook is related to users' reported satisfaction with their own lives, a phenomenon that may be better understood through the models of upward and downward social comparison to others. The overall purpose of this study is to expand understanding of how Facebook use influences life satisfaction based on the concepts gleaned from "offline" communication theories. To better accomplish this goal, we begin with a review of relevant studies on Facebook and existing literature surrounding social comparisons and self-construal.

2. Literature Review

Previous examinations of college-aged individuals' use of Facebook have revealed consistent and similar patterns of use. College students check their established Facebook accounts on a daily basis (Nadkarni & Hofmann, 2011; Quan-Haase & Young, 2011; Vitak et al., 2011) and spend between 30–60 minutes per day on the website (Ellison, Seinfield, & Lempke, 2007; Ellison et al., 2011; Pempek et al., 2009; Quan-Haase & Young, 2010). Some studies show that individuals often "lurk" online, reading others' information without posting or responding in a reciprocal manner (Bumgarner, 2007; Pempek et al., 2009). This lurking behavior indicates that Facebook users tend to engage in various uncertainty reduction strategies to acquire information about acquaintances and friends (Antheunis et al., 2010) but do not always reciprocate with similar online disclosures. The lurking behavior gratifies some users' need for perceived maintenance of interpersonal connectivity (Cheung et al., 2011; Sheldon et al., 2011) without risking their own social identity by disclosing face-threatening personal information (Arundale, 2010; Nosko et al., 2010) or expressing potentially objectionable opinions that may disrupt affinity-seeking strategies (Hwang, 2011).

Most scholars focusing on Facebook agree that users primarily engage the networking site to maintain contact with individuals with whom they have existing offline relationships (Cheung et al., 2011; Ellison et al., 2011; Muise, Christofides, & Desmarais, 2009; Nosko et al., 2010; Pempeck et al., 2009; Sheldon et al., 2011). As Quan-Haase and Young (2010) explain, users seek social knowledge from Facebook to feel "involved in what is going on with others" or to be socially "in the know" (p. 355). The desire to be socially knowledgeable about others motivates lurking behavior online. It may also elicit participation via disclosure from those embracing the asynchronous nature of the exchange (Antheunis et al., 2010).

Several studies on the impact of Facebook have shown that participation in online social networking may have positive effects. Ellison et al. (2007) identified a positive relationship between the acquisition of Facebook "friends" and users' perceived growth in social capital, primarily due to the "crystallization" (via Facebook) of otherwise ephemeral social connections. Some scholars argue that such increased social capital favorably impacts individuals' well-being on multiple levels (Ferlander, 2007). A 2011 study by Ellison et al., demonstrates that Facebook-enabled communication practices result in connection-building strategies that can positively impact physical health. Increases in social capital are also linked to mentally healthy behaviors such as increases in self-esteem and enhanced identity formation, particularly in adolescents and young adults (Cheung et al., 2011; Valkenburg & Peter, 2011). The ability to enhance key elements of one's identity is viewed as positive because "there is a universal desire among human beings to maintain, protect and enhance their self-esteem" (Valkenburg & Peter, 2011, p. 123).

In contrast to the positive influences found in some studies, others indicate potential negative impacts of Facebook use. Sheldon et al. (2011) argue that Facebook use can heighten users' feeling of social disconnectedness by creating transient perceptions of connectedness. Chou and Edge (2012) conclude that Facebook gives users the impression that their Facebook friends have better lives than they do, thereby encouraging negative self-assessments. They report a decrease in overall life satisfaction and a lower reported level of happiness by frequent Facebook users. This finding depends largely on the closeness of the relationship between the user and his or her Facebook "friends" (Chou & Edge, 2012). In addition, Kross and his colleagues (2013) demonstrate that increased Facebook use contributes to declines in users' perceived "moment-to-moment" feelings of well-being and their satisfaction with their lives. This particular aspect of social media effect is intriguing and merits further investigation. One of the potential explanations to this phenomenon can be social comparison theories.

2.1. Social Comparisons

Social comparison theories argue that humans tend to

assess their own social standing, attributes, skills and other self-defining elements relative to others about whom they have access to information (Wheeler & Miyake, 1992). These points of access may be work-related (Fischer, Kastenmuller, Frey, & Peus, 2009), personal or romantic (Brewer & Weber, 1994; Salovey & Rodin, 1984), or mediated (Wilcox & Laird, 2000). The information acquired may be partial or complete, verbal or nonverbal, verified or invalid, and still have an impact on the social comparison (Brewer & Weber, 1994; Salovey & Rodin, 1984; Wilcox & Laird, 2000). The act of comparing the self to others can result in self-stereotyping and may encourage shifting self-perceptions to focus on group identity norms rather than individual norms and characteristics (Attrill & Jalil, 2011). Because Facebook is a medium for social exchange, an essential characteristic of its use is increased access to information about and from others (Valkenburg & Peter, 2011). Facebook, by its very purpose, encourages users to engage in social comparison with others.

The types of information sought and the directionality of the comparisons influence the power and outcome of social comparison. These two factors influence each other; the type of information that one accesses about another influences the directionality of social comparison, which, in turn, affects its valence. Lifestyle information (i.e., how one lives, activities engaged in, etc.) is primarily *sought* data requiring a certain degree of intent-driven information seeking. In offline communication, one must pursue this type of information or glean it from other disclosure (e.g., co-workers do not necessarily know about others' home lives unless an inquiry is made) (Fischer et al., 2009). Because individuals have some control over the information sought, exchanges focusing on lifestyle are often associated with downward comparisons (i.e., perceiving one's self as superior). Downward comparisons tend to result in more positive affective reactions (Wheeler & Miyake, 1992). Asset information is considered *forced* data because it is presented via the "raw materials" of personal information (i.e., abilities, social skills and appearance). These pieces of information are accessed with little or no intent and are not usually sought out. An individual has little control over the amount of asset information received during any given exchange (Sharkey & Singelis, 1995). Comparisons made under these circumstances are less deliberate and are more likely to have a negative impact (Wheeler & Miyake, 1992).

Because of the nature of social media, its influence derived from either type of information accessed is complicated. The act of logging on with the express purpose of checking Facebook content implies a large degree of intent. However, once on the site, the degree of interactive and passive information gathered actually hinges on the online behavior of the user (Smock et al., 2011). Because the tools on Facebook encourage varying levels of activity, users are likely to acquire a mix of asset and lifestyle information and a mix of sought (searching another's profile, engaging in a Facebook messenger conversation, etc.) versus forced (news feed posts, others' photos, etc.) information (Nosko et al., 2010). In addition, the way that information is disclosed on Facebook means lifestyle information is more readily available without particular inquiry than it otherwise might be in offline exchanges (Antoci, Sabatini, & Sodini, 2012). This is particularly true of posted pictures and videos that readily disclose lifestyle information (Hum et al., 2011). Thus, while the user may intentionally seek specific kinds of information, which does not mean only the sought information is received. This creates ample opportunities for a variety of upward and downward comparisons for Facebook users.

In addition to the mix of types of information received, the relationship between the respondent and the person serving as the point of comparison also influences the directionality of a social comparison (Fischer et al., 2009; Wheeler & Miyake, 1992). There is a tendency to make same-level comparison with close friends, downward comparisons with "ordinary" friends, and upward comparison with distant friends, acquaintances and strangers (Wheeler & Miyake, 1992). These findings indicate that social comparisons are rooted in familiarity with and regard for the object of comparison. The better one "knows" the other, the more neutral the comparison. The less well one knows the other, the more he or she relies on the available information for the creation of perceptions about the other. Therefore, perceived closeness of "friends" may be an important factor when using social comparison to hypothesize about Facebook effects.

While traditional social comparison findings are grounded in research outside of mediated interpersonal communication, it provides a potentially rich perspective for understanding Facebook and its influences (Hwang, 2011). Based on social comparison research, the more an individual uses Facebook, the more he or she will socially compare him- or herself to others. Because individuals are less likely to engage in upward social comparison (i.e., considering the "other" as superior) when assessing individuals with whom they have close relationships and are more likely to make upward (i.e., negative affect inducing) comparisons to distant friends and strangers (Wheeler & Miyake, 1992), the higher number of non-close Facebook "friends" an individual has, the greater the tendency to compare upwardly. In some studies, perceived friend "closeness" correlates with regular online or offline interactions (Muscanell & Guadango, 2012). Therefore, it is reasonable to hypothesize that Facebook users who visit the site often and have high numbers of non-close "friends", or friends with whom they have little personal interaction, will likely engage in more upward

comparisons than those with fewer non-close friends or those who rarely use the site. Such comparisons should adversely affect self-perceptions, degrade self-worth, and result in lower reported levels of life satisfaction. This helps explain why users with more Facebook "friends" whom they do not know personally, or with whom they have very few or inconsistent interactions, are more likely to express less contentment with their own lives (Chou & Edge, 2012).

Muise et al. (2009) support the expectations regarding possible negative responses to social comparisons via Facebook. They argue that there is "a significant association between time spent on Facebook and jealousy-related feelings and behaviors experienced on Facebook" (p. 443). The arousal of such emotions may be rooted in social-comparison jealousy that comes from a "desire for superiority on some dimension" (Salovey & Rodin, 1984, p. 780). Because improving self-esteem is considered positive, degrading self-esteem and self-worth is the logical opposite. The connection between social comparison literature and observable potential Facebook behaviors results in the following hypotheses:

H1a: Facebook users with high numbers of friends they do not have frequent contact with report less life satisfaction than other users.

H1b: Facebook users who have more frequently contacted Facebook friends report greater life satisfaction than users who have less frequently contacted Facebook friends.

H2: The more time users spend on Facebook, the lower their reported level of life satisfaction.

2.2. Self-Construal and Gender Differences

Existing scholarship also provides insight into possible expectations regarding sex and gender differences in Facebook use and its varying impacts. Social identification theories related to self-construal help to deepen our understanding of notable sex- and gender-based differences. The theory of self-construals helps us understand the differences in communication and social interactions (Tarr, Kim, & Sharkey, 2005) and explains how individuals perceive themselves in relation to the social world around them (Cross & Madson, 1997). The theory includes assessments of the contributions various communication strategies make toward an individual's self-perceptions (Tarr et al., 2005).

Similar to the cultural assertions regarding "individualism" and "collectivism" (Markus & Kitayama, 1991), self-construal generally classifies individuals' self-perceptions into two opposing yet complementary categories: "independent self-construals" and "interdependent self-construals" (Kim & Sharkey, 1995). People demonstrating independent self-construals perceive themselves as having a "bounded, unitary, stable self that is separate from the social context" (Tarr et al., 2005, p. 500). Those with interdependent self-construals have a "flexible, variable self" rooted in their relationships with others (Sharkey & Singelis, 1995, p. 920). The primary communication goals of an independent self-construal include standing out, being expressive and demonstrating his or her "unique internal characteristics or traits" (Tarr et al., 2005, p. 500). Conversely, individuals with interdependent self-construals unite perceptions of their own selfhood with those of others, focus on relationship maintenance and emphasize the "need to support others' face" (Tarr et al., 2005, p. 500). That is, interdependent self-construals are developed in relation to others and the "other" is central to the identity of the interdependent person's understanding of self.

Cross and Madson (1997) utilize the concept of self-construal to elucidate gendered communication differences among members of what is classically considered the "individual-centric" culture of the United States. Their application of self-construal theories demonstrates gender differences within the culture, particularly regarding social participation. Cross and Madson (1997) find that men tend to be more independent self-construals while women generally have more interdependent self-construals. While not categorically exclusive, the dominant tendencies indicate that women are inclined to be more relationship-oriented, more indirect in their communication and focus more on the "other" than the self (Cross & Madson, 1997) while men are more focused on self-development, self-promotion, and self-expression. In studies of individual self-representations, women more often identify themselves and their ideal self in terms of relationship to others while men represent themselves via personal attributes and individual characteristics (Cross & Madson, 1997). In terms of information processing, women tend to be more attentive to others, remember faces and demonstrate a more "other-centric" assessment of relational exchanges (Cross & Madson, 1997). These differences provide insights into possible distinctions between males' and females' use of Facebook.

Applying the self-construal concept to Facebook, Muscanell and Guadagno (2012) demonstrate a gender distinction in motivations and usage. Their study indicates that females engage in more relationship maintenance via the social networking site while males use Facebook for practical purposes. They found that women engage more in specific relationship development activities such as posting messages, sending private messages, posting pictures, and sending friend requests than men. Men more frequently seek potential dates, play games and look for event information (Muscanell & Guadango, 2012).

While the existing literature demonstrates that females and males visit Facebook at similar rates (Chou & Edge, 2012; Hum, et al., 2011; Muscanell & Guadagno,

2012; Pempek et al., 2009; Quan-Haase & Young, 2010; Sukes et al., 2012), women are more likely than their male counterparts to engage in behaviors such as reading the posts of others and looking at others' photos (Muscanell & Guedagno, 2012; Smock et al., 2011; Tosun, 2012). Males were found to be more active in self-expression activities than females (Smock et al., 2011). However, it remains to be seen if these potential dissimilarities result in a different level of reported satisfaction with their lives.

In line with the aforementioned literature, this study pursues the following research questions:

RQ1: What is the difference between male and female participants' Facebook use? Do they differ in time, frequency, number of friends, or Facebook functions used?

Combining the implications and assumptions of both social comparison and self-construal literature, the negative impact Facebook has on female users' perceived levels of happiness and life satisfaction makes sense. Because women are more inclined to seek relational information online, they tend to view more pictures and read more posts than their male counterparts. This means they are more likely to receive a bigger mix of forced and sought information. They would also be more likely to interact with information from non-close friends than their male counterparts, resulting in more upward, and therefore negative, social comparisons. Based on prior studies, it seems feasible that these types of comparisons would tend to initiate, or in some cases reinforce, negative self-construals. However, because most prior construal studies were conducted on offline interactions, it is important to explore the potential connection in an online environment. Thus, it leads to a second research question:

RQ2: How are Facebook activities related to users' life satisfaction? And do any relationships between Facebook use and life satisfaction differ across genders?

3. Methodology

This study combines the results of two online surveys investigating respondents' use of Facebook and their reported levels of happiness and life satisfaction. The surveys were administered five months apart to separate sets of undergraduate students at a large, private research-one university in the United States. The initial survey included responses from 428 students. Of those respondents, 75% were female, and 16% were international students (non-U.S. residents). Participants self-reported their race/ethnic backgrounds as 72% White, 18% Asian, 8 % Hispanic, and 2% Black. Participants in the second survey were smaller in number but similar in demographic characteristics. Of 239 respondents, 72% were female, 19% were international students, 74.8% were White, 15.7% Asian, 6.5% Hispanic, 2.6% Black and 0.4% Native American.

The initial survey consists of three parts: media use and preference (general to all media and specific to Facebook), evaluations of life, and demographics. Measures of Facebook use include number of Facebook "checks" per day and estimated length of log-ins. Questions regarding Facebook features consist of prompts regarding number of "friends" respondents have on Facebook, how many of these friends they have previously met in person, and how many Facebook friends respondents contacted regularly. It also includes questions regarding which Facebook-based activities respondents spend the time engaged in (i.e., posting on others' walls, private messaging, chatting, posting photos, playing games, etc.). Results from the initial survey led to the development of the second research question (how are Facebook activities related to users' life assessments and how does this differ across sex/gender) and the addition of questionnaire elements to the second survey.

To explore the question of the impact of Facebook activities on respondents' life satisfaction, all of the previous measures for Facebook use were repeated and expanded in the second survey. The second prompt contains similar measures with additional and more detailed questions to help explicate interesting points gleaned from the first survey. The second survey includes both closed- and opened-ended questions to gauge the motivation for Facebook use. For example, one of the open-ended questions asks, "why do you use Facebook?" The closed-ended questions examine attitudes toward Facebook's various features using Likert-scaled response choices. Such questions include a five-point scale asking respondents to indicate their level of agreement or disagreement with comments such as "Facebook is good for meeting new people" and "I prefer reading others' posts on Facebook rather than posting myself." There are also questions measuring respondents' agreement (or disagreement) with various statements about Facebook and its perceived usage. These include comments such as "People use Facebook to brag about their lives," "I get jealous when I look at other people's Facebook pictures," and "I judge others based on how many Facebook friends they have." These questions provide measures of respondents' attitudes about Facebook and Facebook users.

The second survey includes more detailed measures of life satisfaction and happiness. Respondents were asked to rate statements related to their own life satisfaction and happiness. Survey participants were asked to rate their agreement with phrases such as, "My life is fulfilling," "My life is meaningful," "I have a good life," "I am a happy person," "I am happy with my life

now," "Life is generally fair," and "Others have better lives than I do." The scale runs from 1 = "most agree" to 5 = "least agree," which was recoded in data analysis to reflect that the higher the number, the more positive the participant's assessment. A factor analysis of these measures with the Varimax rotation method resulted in the creation of a single factor that helped determine respondent's perceptions of their overall "life satisfaction."

A variety of statistical analyses were conducted in this study to extricate information from the survey responses. These include factor analyses, ANOVAs, and a canonical correlational analysis. The participants' responses were examined as a whole and the female responses were also examined separately (although there was no significant variation in findings for the purely female data set compared to the full set). The results are summarized below.

4. Findings

Initial results from both surveys support existing claims regarding the use of Facebook by college-aged participants. Respondents to both surveys reported using Facebook daily in a series of numerous short-term sessions. The average respondent logs on 5–10 times per day, with sessions estimated to last between 5 and 10 minutes. Females have a higher tendency toward daily Facebook use (r = .129, p < .01). However, the difference in overall estimated time spent on Facebook between male and female users is insignificant (r = .043, p = .376). Thus, while female users report more regular use, overall exposure to Facebook content was similar between the sexes.

The reported tally of Facebook "friends" participants report having is remarkably consistent across the two surveys for this study and with prior research. In the first survey, over 90% of respondents indicated they had 500+ Facebook friends.[1] In an upwardly adjusted measure, the second survey resulted in the mean, median and mode of number of Facebook friends converging at 650–700 friends. Approximately 20% of respondents indicated that they have more than 1000 Facebook friends. When asked the number of Facebook friends with whom respondents had regular contact, in both surveys more than 75% indicated fewer than 20. This number was consistent across male and female respondents.

As explained earlier, a factor analysis of the seven measures of respondents' perceived happiness and contentment with their lives resulted in the creation of a single "life satisfaction" factor. This factor is found to be positively correlated with the number of all Facebook friends users have (r = .136, n = 635, p < .001; r = .216, n = 230, p = .001), which contradicts with the hypothesis derived from social comparison theory. Therefore, H1a is not supported.

The number of Facebook friends surveyed participants interact with *regularly* is also found to be positively correlated with their perceived life satisfaction in both surveys (r = .066, n = 634, p = .096; r = .039, n = 230, p = .554). But both correlation coefficients fail to reach significance level. Therefore, H1b is also not supported. Given that both overall Facebook friends and friends one interacts with regularly correlate positively with users' perceived life satisfaction researchers must reconsider the application of social comparison theory into social media. This interesting result warrants further exploration of interactions with various types of Facebook and real life friends.

Using the factor analysis-derived measure of "life satisfaction" revealed a strong correlation between respondents' life satisfaction and specific activities engaged in on Facebook. Frequency of engagement in interactive activities was strongly connected to lower perceptions of contentment. In both surveys, the more respondents reported using Facebook chat (r = -.099, p = .013; r = -.199, p = .003) the less satisfied they reported being with their lives. User interactions with photos also significantly correlated with adverse perceptions of life satisfaction. Uploading photos (r = -.139, p < .001; r = -.178, p = .007), tagging photos (r = -.185, p < .001; r = -.282, p < .001) and looking at other's photos/videos (r = -.145, p < .001; r = -.225, p = .001) all have a direct relationship with users' perceived contentment with their own lives. Similar results were found based on measures of time spent using each of these tools, although Facebook chat and uploading photos fell out of statistical significance. Time spent tagging photos (r = -.123, p = .002; r = -.200, p = .002) and looking at others' photos/videos (r = -.030, p = .010; r = -.258, p < .001) were significantly correlated with negative reports of life satisfaction in both surveys.

The initial survey yielded mixed results regarding gender differences in Facebook use. Female participants tend to check out others' life presentations more frequently than their male counterparts (r = .110, p =.012), although the time women spend on this Facebook function is not significantly longer than the men's time spent at these activities (r = .039, p = .213). It is worth noting that women in the initial survey reported slightly lower levels of life satisfaction than their male counterparts–but the results are inconclusive because of low significance levels.

For the second survey, a one-way ANOVA was used to test differences in use of specific Facebook functions/activities based on the sex of the respondent. While males reported using wall posts, music and

[1] An initial flaw discovered via the exploratory study was underestimating the number of "friends" respondents would have. The scale initially stopped with a high of "500+" which proved to be far too low for any possibly meaningful discovery. The scale was adjusted upward for the second survey.

games more frequently than females, the most distinct differentiation came in engagement with photos/video. While "looking at others' photos" yielded a less than ideal .054 significance in difference ($F_{1, 228}$ = 3.758), women's tendency to upload photos is significantly higher than their male counterparts ($F_{1, 230}$ = 10.315, p = .002). Even more striking is women's tendency to "tag" photos more often than men ($F_{1, 229}$ = 16.924, p < .001).[2]

Not surprisingly, this study found that individuals who engaged with photos did so in multiple ways; several significant positive correlations were found within photo-related Facebook activities. Tagging photos is positively correlated at the p < .01 level with uploading photos, r(236) = .679; looking at others' photos, r(234) = .446; and checking others' information, r(235) = .325. Uploading photos and looking at others' photos were similarly correlated with the same activities. Individuals who engaged with photos did so in numerous ways.

The second survey also shows that engaging with photos is significantly positively correlated with a wide variety of motivations for Facebook use. "Showing off pictures," which includes behaviors such as posting one's own photos and tagging photos, is positively correlated with the following reasons for using Facebook: "meeting others' expectations," r(234) = .212, p < .01; "comparing self to other," r(233) = .353, p < .01; "keeping track of others' lives," r(234) = .318, p < .01;"seeking information about a new acquaintance," r(233) = .355, p < 01; "self-expression," r(232) = .360, p < .01; and "bragging about accomplishments," r(232) = 429, p < .01. Many of these individual concepts relate to both creating social comparisons and expressing self-construals.

Survey responses to a five-point measure of agreement with the statement "I get jealous of others' Facebook pictures" were negatively skewed (M = 3.23, SD = 1.17), indicating that the respondents do not think Facebook pictures induce jealousy in them. However, results indicate that jealousy from Facebook pictures correlates with feeling less separated from others (r(235) = .188, p < .01) and judging others based on the number of Facebook friends they have (r(234) = .357, p < .01). There is also a positive correlation between jealousy and the tendency to visit Facebook when feeling lonely (r(235) = .356, p < .01). These findings suggest that further research is needed to explicate the connection between these actions and sentiments.

[2] "Tagging" is a sharing behavior in which a person connects others to a photo by "naming" the person as associated with the photo. Individuals can "tag" their own photos or others' photos as a means of sharing.

There is an overall negative relationship between time spent on Facebook and users' assessment with their lives (r = -.154, p = .002). Therefore, hypothesis 2 is supported. This finding from the first survey led to an increased focus on the impact of specific Facebook activities on life satisfaction in the second survey. The results of the second survey demonstrate a vital difference the contribution-specific activities make to life assessments. More time allocated toward actively engaging with photos—tagging, uploading and looking at others' photos—is significantly negatively correlated with attitudes such as "Life is generally fair," "My life is meaningful," "I have a good life," and "I am a happy person." However, uploading photos and tagging photos are positively correlated with respondents' professed happiness with their current life (see Table 1). Negative relationships were also discovered with time spent engaging in other Facebook activities such as chatting, wall posts, and messaging. Time spent on wall posts is negatively correlated with attitudes of general fairness of life, r(232) = -.156, p = .018, and perceptions that "my life is meaningful," r(233) = -.172, p = .008, but is positively correlated with current happiness with life, r(233) = .132, p = .043. However, this mix of influences on time spent engaged in various activities leaves mixed results regarding RQ2 and will be explored more thoroughly in the discussion section.

In order to see the overall relationship between the 12 distinct Facebook activities and 7 Facebook users' life assessments, a canonical correlation analysis was conducted. This statistical procedure aims at extracting the maximum number of canonical variates explaining the two sets of variables. The result shows the canonical weights and canonical loadings, the latter of which indicate the correlation between the original variable and the canonical variate (see Table 2). The loadings from Facebook activities show that photo/video related activities contribute greatly to the canonical variate (loadings of "looking at other's photos/videos" and "tagging photos" are .840 and .567, respectively). It seems that these windows to others' lives via the social network do have some influence over one's life assessments and happiness level. Only one canonical variate (time spent on Facebook) achieves a statistically significant canonical root—.201 (p = .011); in other words, the time spent on Facebook's various activities can roughly explain 20% of Facebook users' life assessments. In another estimate, the overall correlation between the two sets of variables (Facebook activities and life assessments) is .449.

Table 1. Correlation matrix between Facebook use and life assessments (N = 233).

	Wall post	Facebook chat	Status	Events/groups	Messages	Music	Games	Uploading photos/videos	Tagging photos	Looking at others photos/videos	Visit fan pages	Checking out others' information
Frequency of using												
How happy are you with your life now?	.132	.033	.109	.107	.076	.046	-.028	.137	.141	.021	.064	-.056
I have a good life.	-.115	**-.211**	.004	**-.248**	**-.178**	.165	.097	-.075	**-.188**	-.145	-.050	-.032
Life is generally fair.	-.156	-.129	-.061	**-.193**	-.165	.041	-.089	-.169	**-.277**	-.098	-.051	.009
I am a happy person.	-.096	**-.181**	-.003	**-.231**	-.109	.083	-.039	**-.174**	**-.278**	**-.260**	.034	-.047
My life is meaningful.	**-.172**	-.170	-.095	**-.229**	-.077	.012	-.014	**-.173**	**-.213**	**-.251**	-.072	-.079
Others have better lives than I do.	-.026	-.010	-.026	-.019	.010	.037	.023	.001	.042	.002	-.028	.014
My life is fulfilling.	-.123	**-.177**	-.059	**-.216**	-.088	.100	.032	-.114	**-.233**	**-.183**	-.037	-.070
I take joy in being social.	**-.250**	**-.262**	-.060	**-.313**	**-.224**	.031	.030	**-.257**	**-.382**	**-.314**	.054	**-.182**
I am shy in face-to-face interactions.	-.083	-.041	-.037	-.033	-.082	**.193**	**.267**	-.068	-.121	-.103	.080	.043
I am an outgoing person.	**-.200**	**-.173**	-.102	**-.247**	-.124	.029	-.014	**-.206**	**-.315**	**=.212**	.016	-.069
Amount of time												
How happy are you with your life now?	.011	.052	.072	.110	.112	-.039	-.059	.079	.084	.168	.003	-.086
I have a good life.	-.034	-.164	.061	-.127	-.104	**.187**	.079	-.038	-.136	**-.181**	.092	.066
Life is generally fair.	-.031	-.116	-.015	-.095	-.145	.002	-.047	-.151	**-.177**	-.056	.011	-.002
I am a happy person.	.052	-.069	.056	-.111	-.108	.135	.014	-.162	**-.262**	**-.291**	.094	-.016
My life is meaningful.	.014	-.133	-.060	-.160	-.080	.079	.021	-.099	**-.174**	**-.279**	-.032	-.019
Others have better lives than I do.	.107	.083	-.067	-.001	-.020	.108	.121	.064	.020	.076	.089	.154
My life is fulfilling.	-.004	-.126	.010	-.136	-.082	.138	.066	-.058	-.120	**-.200**	.066	-.001
I take joy in being social.	-.090	-.126	.035	**-.206**	-.102	.128	.088	**-.173**	**-.301**	**-.320**	**.192**	-.061
I am shy in face-to-face interactions.	-.043	.021	.020	-.035	.051	**.194**	**.249**	-.081	-.104	-.108	**.193**	.020
I am an outgoing person.	-.100	-.065	-.053	**-.192**	-.054	.090	.049	-.160	**-.237**	**-.317**	.147	-.028

Note: *Presented in the table are Pearson coefficients, underline $p < .05$; bold $p < .01$.

Table 2. Canonical structure between the two sets of variables.

	Canonical Weight	Canonical Loading
Facebook Activity		
Wall post	-.155	-.022
Facebook chat	.099	.263
Status	-.063	-.001
Events/groups	.341	.444
Messages	.093	.218
Music	-.134	-.106
Checking out others' Info	-.051	.159
Uploading photos or/and videos	.197	.433
Tagging photos	.155	.567
Looking at other photos/videos	.731	.840
Games	.116	.039
Visit fan pages	.028	.046
Life Assessment		
I have a good life	-.041	.562
Life is generally fair	-.062	.269
I'm a happy person	.520	.807
My life is meaningful	.680	.824
Others have better lives than I do	.333	.119
My life is fulfilling	-.244	.599
I am happy with my life now	.311	.535

Note: Canonical correlation coefficient = .449; Canonical root (eigenvalue) = .201; $X^2 = 116.237$ $df = 84$ $p = .011$.

Measures of respondents' use of Facebook tools also yielded interesting results. The initial survey results indicated that "looking at others' photos" was the most frequently engaged in activity on Facebook (23%) and was how users spent the highest proportion of their Facebook time (30%). Of all respondents to the second survey, 49% indicate "looking at others' photos/videos" is an activity they "very frequently" engage in. When "frequent" and "very frequent" use responses were combined, 89% of respondents declared "looking at others' photos/videos" to be a highly used feature of the social network site. The next most frequently engaged in activities on Facebook were "messaging" (86.9% selected frequent or very frequent combined) and "wall posts" (83.5% frequent or very frequent combined). Conversely, game functions were used least frequently. Almost 70% of respondents report "never" using Facebook to play online games. The variety in the types of Facebook tools used, or not used, by respondents provides some insight into the ways these users interact with the information available via the medium and enhance our understanding of why there are such correlations between Facebook use and life satisfaction.

5. Discussion

This study examines the impact of Facebook use on college-aged individuals' life satisfaction. The discoveries across the two surveys do not support the first set of hypotheses about the relationship between the amount of Facebook friends and life satisfaction. There appears to be a need for continued exploration. The existing literature about social comparison may first appear relevant in the social media setting, but the relationships formed on social media and their impact on one's perceived life satisfaction may be based on other psychological concepts. The consistent correlation between the numbers of Facebook friends one has and his overall life satisfaction and the inconclusive finding of the impact of frequently interacted Facebook friends warrant further exploration. Perhaps a future study focusing specifically on the interactive differences based on friendship types may shed new light on this intriguing phenomenon.

Hypothesis 2 is fully supported, confirming a strong connection between the amount of time someone spends on Facebook and his or her perceived life satisfaction. This finding is consistent with existing research regarding Facebook use (Chou & Edge, 2012; Kross et al., 2013; Muise et al., 2009; Ryan & Xenos, 2011; Sukes et al., 2012). However, this study leaves the question open as to why such a negative correlation exists. Others have hypothesized that the connection may be due to a motivational disappointment (i.e., Facebook does not gratify the needs the user seeks to fulfill) (Smock et al., 2011) or that the asynchronous nature of the medium allows for the presentation of an edited or "best self" version of others' lives that no one's own life can live up to (Park, Lee, & Kim, 2012; Tosun, 2012; Wilcox & Laird, 2000). This study, although not positioned to make causal claims, hints at the ways in which users engage with Facebook content may influence the impact of the medium.

The second research question for this study asks how users' Facebook behaviors impact their life satisfaction. A clear general connection was found between the activities Facebook users engage in online and their overall life satisfaction. However, our data analysis does not provide a straightforward explanation about the social medium's impact on life satisfaction. The complex results regarding RQ2 warrant further discussion, as do the implications of this study for the listed research questions.

While previous literature suggests that increased time spent on Facebook should result in overall lower levels of happiness (Chou & Edge, 2012) this more granular approach parses out the impact of particular Facebook activities and provides potential insights into why those activities alter perceived life satisfaction based on social comparison and self-construal literature. This study reveals a pattern of respondents feeling less satisfied with their lives the more they engage in interactive activities that include a mix of "forced" information (pictures and wall posts) and "sought" information (messages and chatting), understanding that all information is, to some degree, *generally* sought when using Facebook. Existing literature on social comparisons suggests that sought information should create downward comparisons and therefore create positive reflections of self (Kim & Sharkey, 1995; Wheeler & Miyake, 1992). However, that is not the case here. Perhaps the distinction between sought and forced information is less important in this situation than another shared characteristic of these types of activities. The more telling commonality here is that these activities all encourage specific consideration of others' information. More individualized Facebook activities (those not requiring interacting with others' personal information—e.g., music, games, personal status updates) showed no statistically significant correlation with life satisfaction assessments but activities such as tagging photos requires specific examination of others' pictures—participants must consider the content of someone's photo in order to engage in this activity. Perhaps it is the interaction with others' information and not the specific category of information that stimulates social comparisons and alters self-construals, therefore, influencing overall happiness and life satisfaction.

The impact of interacting with photos on Facebook provides some support for the idea that interactive social information seeking activities have a stronger negative impact than more solitary, self-focused activities

do. Tagging photos implies an interest in relational development and maintenance because the point of tagging is creating a connection between the information and the person "tagged" and, through that, a connection to the "tagger." A person who tags must consider the content of the photo, determine the appropriate person(s) to tag based on social reasoning, and actually take the time to tag them. While not a highly technical process, it does require a high degree of intention on the part of the tagger. The interdependent construal characteristics exhibited by women (Cross & Madson, 1997) may explain why female Facebook users have a higher tendency toward engaging in tagging activities. Also, interacting so purposefully with information about others is traditionally viewed as increasing the likelihood of creating social comparisons (Wheeler & Miyake, 1992). It is not surprising, then, that female users tend to engage in these Facebook activities often and that this engagement corresponds with alterations in perceptions of one's satisfaction with her own life.

This study supports the idea that there are some gender-based differences in Facebook use and impacts. While the differences were not extensive, some were quite clear. Males and females engage in different Facebook activities and those activities impact their perceived levels of life satisfaction. Unfortunately, the disproportionate number of female respondents in each of the surveys for the present study may have masked further significant gender differences. Muscanell & Guadagno (2012) had a disproportionately high concentration of males (65%) in their study and had modestly different findings in male use patterns. For example, no respondent for either survey for this study cites "dating" as a reason or activity on Facebook, but it was a major factor in Muscanell and Guadagno's (2012) study. A separate assessment of the current data based solely on responses by females was consistent with the findings as stated here. A third iteration of the present survey should strive for a more balanced sample of males and females if more gender-based research questions are to be examined.

6. Conclusion

Facebook appears to be a rather promising medium for establishing and maintaining social connections (Chueng et al., 2011; Quan-Hass & Young, 2010). However, if Facebook users seek happiness via this social connection, they are likely to be disappointed. Extensive use of online networking, for many, actually leads to increased dissatisfaction with their lives.

The findings of this study, supported by existing literature, show that Facebook may create socio-cognitive tension for users. The strong motivation to acquire social information encourages Facebook use as a means of gratifying the need to attain social capital. The likely upward social comparisons resulting from the generally positive information available via Facebook may result in the skewed interpretations discovered by Chou and Edge (2012) and supported here.

From a theoretical perspective, this study demonstrates that while there are ties between existing interpersonal and self-perception based theories and mediated interpersonal and group networking, the theories are not necessarily directly applicable across platforms. The ideas of social comparison and self-construals logically connect with Facebook activities, but the offline findings do not directly or perfectly align with online behaviors or outcomes. This means that while the existing theories may act as guides, like other communication theories, they must be tested in the digital networking environment and adapted according to the contexts in which they are applied. Social comparison and self-construal theories may inform our understanding of online social networking, but require further exploration in mediated interpersonal settings.

Overall, this study provides interesting insights into the Facebook use patterns of college-aged population. The fact that Facebook use may engender an unanticipated, inverse impact is intriguing. Facebook users are driven to develop social connections to gratify the need to increase self-esteem by increasing social capital. However, the result of increased Facebook use, particularly interactions with photos and Facebook messaging, increases individuals' likelihood of engaging in social comparisons (including negative upward comparisons) and developing negative self-construals (particularly for females). These tendencies often serve to decrease a user's overall satisfaction with his or her life. The tension created by this dissonance between the social connectedness one seeks and the dissatisfaction one attains, however, does not seem to decrease the tendency to use the social networking system. While social comparison and self-construal research provide an initial, but only partial, explanation for this phenomenon, more research is necessary to fully understand both the causes of the dissatisfaction and users' responses to it.

Acknowledgments

The authors wish to thank all the student participants at Boston University.

Conflict of Interests

The authors declare no conflict of interests.

References

Antheunis, M. L., Valkenburg, P. M., & Peter, J. (2010). Getting acquainted through social network sites: Testing a model of online uncertainty reduction and social attraction. *Computers in Human Behavior*, *26*,

100-109. doi:10.1016/j.chb.2009.07.005

Antoci, A., Sabatini, F., & Sodini, M. (2012). See you on Facebook! A framework for analyzing the role of computer mediated interaction in the evolution of social capital. *The Journal of Socio-Economics*, *41*, 541-547. doi:10.1016/j.soec.2012.04.024

Arundale, R. B. (2010). Constituting face in conversation: Face, facework, and interactional achievement. *Journal of Pragmatics*, *42*, 2078-2105. doi:10.1016/j.pragma.2009.12.021

Attrill, A., & Jalil, R. (2011). Revealing only the superficial me: Exploring categorical self-disclosure online. *Computers in Human Behavior*, *27*, 1634-1642. doi:10.1016/j.chb.2011.02.001

Baek, K., Holton, A. Harp, D., & Yaschur, C. (2011). The links that bind: Uncovering novel motivations for linking on Facebook. *Computers in Human Behavior, 27*, 2243-2248. doi:10.1016/j.chb.2011.07.003

Brewer, M. B., & Weber, J. G. (1994). Self-evaluation effects of interpersonal versus intergroup social comparison. *Journal of Personality and Social Psychology*, *66*, 268-275.

Bumgarner, B. A. (2007). You have been poked: Exploring uses and gratifications of Facebook among emerging adults. *First Monday*, 12. Retrieved from http://firstmonday.org/article/view/2026/1897

Cheung, C. M. K., Chiu, P., & Lee, M. K. O. (2011). Online social networks: Why do students use Facebook? *Computers and Human Behavior*, *27*, 1337-1343. doi:10.1016/j.chb.2010.07.028

Chou, H. G., & Edge, N. (2012). "They are happier and having better lives than I am": The impact of Facebook on perceptions of others' lives. *Cyber Psychology, Behavior and Social Networking*, *15*, 117-121. doi:10.1089/cyber.2011.0324

Cross, S. E., & Madson, L. (1997). Models of the self: Self-construals and gender. *Psychological Bulletin*, *122*, 5-37.

Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook "friends": Exploring the relationship between college students' use of online social networks and social capital. *Journal of Computer-Mediated Communication*, *12*, 1143-1168.

Ellison, N. B., Steinfield, C., & Lampe, C. (2011). Connection strategies: Social capital implications of Facebook-enabled communication practices. *New Media Society*, *13*, 873-892. doi:10.1177/1461444810385389

Engagement Analytics, Facebook, United States. (2012). Retrieved from www.socialbakers.com/facebook-statistics/united-states

Ferlander, S. (2007). The importance of different forms of social capital for health. *Acta Sociologica*, *50*, 115-128. doi:10.1177/0001699307077654

Fischer, P., Kastenmuller, A., Frey, D., & Peus, C. (2009). Social comparison and information transmission in the work context. *Journal of Applied Social Psychology*, *39*, 42-61.

Hum, N. J., Chamberlin, P. E., Hanbright, B., Portwood, A. C., Schat, A., & Bevan, J. L. (2011). A picture is worth a thousand words: A content analysis of Facebook profile photographs. *Computers and Human Behavior*, *27*, 1828-1833. doi:10.1016/j.chb.2011.04.003

Hwang, Y. (2011). Is communication competence still good for interpersonal media? Mobile phone and instant messenger. *Computers in Human Behavior*, *27*, 924-934. doi:10.1016/j.chb.2010.11.018

Kim, M. S., & Sharkey, W.F. (1995). Independent and interdependent construals of the self: Explaining cultural patterns of interpersonal communication in multi-cultural organizational settings. *Communication Quarterly*, *43*, 20-38.

Kross, E., Verduyn, P., Demiralp, E., Park, J., Lee, D. S., Lin, N., Shablack, H., Jonides, J., & Ybarra, O. (2013). Facebook use predicts declines in subjective well-being in young adults. *PLoS ONE*, *8*(8), e69841. doi:10.1371/journal.pone.0069841.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion and motivation. *Psychological Review*, *98*, 244-253.

Muise, A., Christofides, E., & Desmarais, S. (2009). More information than you ever wanted: Does Facebook bring out the green-eyed monster of jealousy? *Cyber Psychology & Behavior*, *12*, 441-444. doi:10.1089/cpb.2008.0263

Muscanell, N. L., & Guadagno, R. E. (2012). Make new friends or keep the old: Gender and personality differences in social networking use. *Computers in Human Behavior*, *28*, 107-112. doi:10.1016/j.chb.2011.08.016

Nadkarni, A., & Hofmann, S.G., (2011). Why do people use Facebook? *Personality and Individual Differences*, *52*, 243-249. doi:10.1016/j.paid.2011.11.007

Nosko, A., Wood, E., & Molema, S. (2010). All about me: Disclosure in online social networking profiles: The case of FACEBOOK. *Computers and Human Behavior*, *26*, 406-418. doi:10.1016/j.chb.2009.11.012

Park, N., Lee, S., & Kim, J.H., (2012). Individuals' personal network characteristics and patterns of Facebook use: A social network approach. *Computers in Human Behavior*, *28*, 1700-1707. doi:10.1016/j.chb.2012.04.009

Pempek, T. A., Yermolayeva, Y. A., & Calvert, S. L. (2009). College students' social networking experiences on Facebook. *Journal of Applied Developmental Psychology*, *30*, 227-238. doi:10.1016/j.appdev.2008.12.010

Quan-Haase, A., & Young, A. L. (2010). Uses and gratifications of social media: A comparison of Facebook and instant messaging. *Bulletin of Science Technology & Society*, *30*, 350-361. doi:10.1177/0270467610380009

Ryan, T., & Xenos, S., (2011). Who uses Facebook? An

investigation into the relationship between the Big Five, shyness, narcissism, loneliness, and Facebook usage. *Computers in Human Behavior*, *27*, 1658-1664. doi:10.1016/j.chb.2011.02.004

Salovey, P., & Rodin, J. (1984). Some antecedents and consequences of social-comparison jealousy. *Journal of Personality and Social Psychology*, *47*, 780-792.

Sharkey, W. F., & Singelis, T. M. (1995). Embarrassability and self-construal: A theoretical integration. *Personality and Individual Differences*, *19*, 919-926.

Sheldon, K. M., Abad, N. & Hinsch, C. (2011). A two-process view of Facebook use and relatedness need-satisfaction: Disconnection drives use and connection rewards it. *Journal of Personality and Social Psychology*, *100*, 766-775. doi:10.1037/a0022407

Smock, A. D., Ellison, N. B., Lampe, C., & Whon, D. Y. (2011). Facebook as a toolkit: A uses and gratification approach to unbundling feature use. *Computers in Human Behavior*, *27*, 2322-2329. doi:10.1016/j.chb.2011.07.011

Sukes, J. L., Williams, B., & Wise, L. (2012). The effects of personality traits, self-esteem, loneliness, and narcissism on Facebook use among university students. *Computers in Human Behavior*, *28*, 2414-2419. doi:10.1016/j.chb.2012.07.012

Tarr, N. D., Kim, M. S., & Sharkey, W. F. (2005). The effects of self-construals and embarrassability on predicament response strategies. *International Journal of Intercultural Relations*, *29*, 497-520. doi:10.1016/j.ijintrel.2005.07.002

Tosun, L. P. (2012). Motives for Facebook use and expressing "true self" on the Internet. *Computers in Human Behavior*, *28*, 1510-1517. doi:10.1016/j.chb.2012.03.018

Valkenburg, P. M., & Peter, J. (2011). Online communication among adolescents: An intergrated model of its attractions, opportunities and risks. *Journal of Adolescent Health*, *48*, 121-127. doi:10.1016/j.jadohealth.2010.08.020

Vitak, J., Zube, P., Smock, A., Carr, C.T., Ellison, N., & Lampe, C. (2011). It's complicated: Facebook users' political participation in the 2008 election. *CyberPsychology, Behavior and Social Networking*, *14*, 107-114. doi:10.1089/cyber.2009.0226

Who Uses Facebook. (2012). Retrieved from www.arbitragemagazinf.com/topics/facebook-twitter-infographic

Wheeler, L., & Miyake, K. (1992). Social comparison in everyday life. Journal of *Personality and Social Psychology*, *62*, 760-773.

Wilcox, K., & Laird, J.D. (2000). The impact of media images of super-slender women in women's self-esteem: Identification, social comparison and self-perception. *Journal of Research in Personality*, *34*, 278-286. doi:10.1006/jrpe.1999.2281

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COGITATIO

Media and Communication (ISSN: 2183-2439)
2015, Volume 3, Issue 1, Pages 17-33
Doi: 10.17645/mac.v3i1.253

Article

The Dynamics of Issue Attention in Online Communication on Climate Change

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Submitted: 2 March 2015 | In Revised Form: 4 July 2015 | Accepted: 28 August 2015 | Published: 18 September 2015

Abstract
Issues and their sub-topics in the public agenda follow certain dynamics of attention. This has been studied for "offline" media, but barely for online communication. Furthermore, the enormous spectrum of online communication has not been taken into account. This study investigates whether specific dynamics of attention on issues and sub-topics can be found in different online public arenas. We expect to identify differences across various arenas as a result of their specific stakeholders and constellations of stakeholders, as well as different trigger events. To examine these assumptions, we shed light on the online climate change discourse in Germany by undertaking a quantitative content analysis via manual and automated coding methods of journalistic articles and their reader comments, scientific expert blogs, discussion forums and social media at the time of the release of the 5th IPCC report and COP19, both in 2013 (n = 14.582). Our results show online public *arena-specific dynamics* of issue attention and sub-topics. In journalistic media, we find more continuous issue attention, compared to a public arena where everyone can communicate. Furthermore, we find *event-specific dynamics* of issue attention and sub-topics: COP19 received intensive and continuous attention and triggered more variation in the sub-topics than the release of the IPCC report.

Keywords
climate change; dynamics of sub-topics; issue attention; online communication; online public arenas

Issue
This article is part of a regular issue of Media and Communication, edited by Professor Bradley Greenberg (Michigan State University, USA) and Professor Elisabeth Klaus (University of Salzburg, Austria).

1. Introduction

Issues in the public agenda come and go. They follow certain dynamics of attention in terms of intensity and continuity of communication. Also, the sub-topics of the issue, which basically indicate how the narratives of the issue are constructed, underlie specific dynamics over a course of time. Today, this peculiarity of public communication has to be considered against the background of digitalization and diversified media channels: Apart from the often studied traditional mass media public, the Internet provides arenas for a vast variety of communication, ranging from journalistic to Social Media communication. The Internet has changed public communication and issue attention: Social Media, for example, are supposed to have increased the intensity of attention (McGillivray, 2013). This raises the question, which dynamics of attention and sub-topics for a certain issue can be found online and what are their characteristics, patterns and influencing factors? We assume specific dynamics between the different forms of online communication.

The overall research question, which we investigate for the issue of climate change and the case of Germany, is: *Are there characteristic dynamics of issue attention and sub-topics online and do they depend on*

where and when an issue is communicated online? Do the dynamics of attention and sub-topics of an issue depend on (1) certain events, and (2) the type of online public arena where it is communicated? Do the dynamics depend on the specific stakeholders of each online public arena like journalists, experts or "ordinary citizens" or the constellation of its stakeholders, having equal possibilities to interact? Are these dynamics in Social Media indeed stronger and intensify communication in contrast to journalistic communication?

In this study, we explore the assumption of specific dynamics of attention on issues and their sub-topics in online public arenas for the first time. Furthermore, we develop a theoretical model to explain the assumed differences. It is based on previous empirical findings that explore which variables influence issue-attention cycles (Waldherr, 2012) and on the concept of online public arenas (J.-H. Schmidt, 2013). In contrast to the given literature we do not speak of "cycles", but of "dynamics" of attention on issues and sub-topics, which we understand here as changes in the frequency of communication units (like articles, posts or comments) or of certain sub-topics over time. The dynamics indicate the intensity and also the continuity of attention on issues or sub-topics over time. While the term "cycle" implies a circular process, which could be completed, the term "dynamics" is open to any kind of progress. This provides a conceptualization broadened to include any phenomena, particularly in rather short-term periods, which we have explored in our empirical study.

It is promising to investigate this question by using the scientific issue of climate change as a case. On the one hand, the Internet holds huge potential for science communication (O'Neill & Boykoff, 2011). It offers the public a wealth of information and low barriers to participate in the discourse and interact with scientists, journalists or laypeople (Bowman & Willis, 2003). This means that the dynamics of public attention on issues and sub-topics over the course of time are not only determined by scientists, journalists, politicians and profit or non-profit actors, but also by laypeople. We call these actors in the communication process "stakeholders". On the other hand, scientific topics like climate change are interesting issues to investigate due to their continuity, while keeping in mind that it is the nature of science to bring about new findings and therefore provide an ongoing dynamic of its own.

2. Dynamics of Issue Attention and Interpretation in the Public Sphere

To investigate the overall research question, different areas have to be approached: (1) research on issue-attention (cycles) and (2) research on the dynamics of sub-topics, which can be found in research on narratives and framing.

2.1. Research on Issue Attention

Probably the best known model in research on issue attention (for an overview see Brossard, Shanahan, & McComas, 2004; McComas & Shanahan, 1999; Nisbet & Huge, 2006; Shih, Wijaya, & Brossard, 2008; Waldherr, 2012) is the "issue-attention cycle" created by Downs (1972). According to him, an issue passes through different phases of attention: (1) the *pre-problem stage*, where it is only discussed by specialists, and (2) *alarmed discovery and euphoric enthusiasm*, where it makes a breakthrough into the public agenda and receives a lot of attention, often through key events (Kepplinger & Habermeier, 1995). Then, the public is increasingly able to (3) *realize the cost of significant progress*. This leads to (4) *a gradual decline of intense public interest* and other issues may enter the agenda. In the (5) *post-problem stage*, key events could trigger another attention cycle (Kolb, 2005; Petersen, 2009).

Although this ideal-typical issue-attention cycle could be found to relate to several issues (e.g. Kolb, 2005), it is not universally valid. Differences exist between issues[1] (Waldherr, 2012), countries (Brossard et al., 2004; M. Schäfer, Ivanova, & Schmidt, 2014) and also between online and traditional mass media publics: Anderson, Brossard, and Scheufele (2012) found that a scientific publication received ten times more coverage online and over a longer timespan. However, Anderson et al. (2012) did not explore the causes for these differences. In general, it was criticized that the cycle might only explain the process of issue attention, but not its causes (Nisbet & Huge, 2006; Waldherr, 2012).

Ever since Downs came about with his concept of an issue-attention cycle, further investigations, both theoretically and empirically, have been conducted. Waldherr (2012) made an important contribution to the research on issue attention by detecting four interdependent variables influencing public attention. They might explain the differences between countries, issues and the public arenas: (1) *stakeholders*, (2) *constellations of stakeholders*, (3) *events* and (4) *issues*.

(1) *Stakeholders* that are involved in the public discourse of the respective issue, such as media representatives (Mathes & Pfetsch, 1991), politicians, scientists, lobbyists, and in online public sphere(s) also increasingly laypeople, prolong public attention through launching staged events or shortening them by redirecting toward other topics (Pfetsch, 1994; Waldherr, 2012). Waldherr (2012) found that stakeholders can hinder the ideal-typical course of the "issue-attention cycle".

An issue thus receives more attention if there is a po-

[1] Downs (1972) does not claim to explain every issue career with his model. It should merely explain major social problems: (1) that most of the public does not suffer from, (2) where the suffering is made by social arrangements that benefit the majority or an influential minority and (3) that are not intrinsically interesting.

larized and conflicting (2) *constellation of stakeholders* (Kriesi, 2003). Heterogenous journalists accelerate the dynamics of issue attention and provoke shorter issue-attention cycles (Waldherr, 2012). Wolfsfeld and Sheafer (2006) assume inverted causal relations and state that much attention enables a more conflicting discourse.

The attention and news value of (3) *events* and (4) *issues* are determined by news factors like conflict, prominence, proximity and surprise (Eilders, 1997; Galtung & Ruge, 1965; Schulz, 1990; Staab, 1990). For the purpose of our study, we define *events* according to Shaw (1977, p. 20) "as discrete happenings, that are limited by space and time". They have to be distinguishable from other happenings, although this distinction is not objective (Waldherr, 2012). More concretely, events are composed of distinct actions performed by institutionalized stakeholders in the public sphere. An *issue* is a larger category, under which many related events could be subsumed (Shaw, 1977). However, they could also exist without concrete events. It depends on the context, that is, whether something is defined as an event or issue (Kepplinger, 2001): In our study, for example, the IPCC report and COP19 are defined as events, but they were also coded as sub-topics in online climate change communication.

We consider these four variables as crucial for investigating the causes of possible differences among multiple forms of online communication in the dynamics of issue attention.

2.2. Research on the Dynamics of Sub-Topics and Interpretations

Research on issue-attention (cycles) mostly neglects the dynamics in the focused sub-topics and interpretations over time, or merely makes implicit assumptions about them. Downs (1972), for instance, implies that a problem (like climate change) is framed by specialists in the pre-problem stage and is framed as difficult to solve before the decline of attention. However, research on *narratives*[2] and *framing* explicitly addresses the dynamics in the therewith-related sub-topics and interpretation of the issue (Table 1). Most of the relevant studies come from framing research. There are different and sometimes also conflicting findings on how the interpretation of an issue is supposed to change over time. However, an emphasis on dramatic and risky aspects occurring at the rise of mass media attention is often assumed. Furthermore, many studies have found a shift in frames that deal with solving the problem or focus on the scientific aspects before the decline of attention. This tendency can also be found in the only study that focused on the dynamics of sub-topics and interpretations online: Arens, Böcking, Kummer, and Rüf (2010) investigated—however without any reference to theoretical concepts like issue attention, framing or narratives—the issue-career of the climate summit in Bali as depicted by online news media, blogs and websites created by companies and organizations over the course of six months. They found the main sub-topics like "climate change mitigation measures" or the "Kyoto Protocol" to be stable over time. However, they discovered that sub-topics that focus on how to solve the problem of climate change became more important over time.

[2] Narratives have a plot with a specific sequence. The story reaches a climax, which leads to a resolution and provides insights from the story (McComas & Shanahan, 1999).

Table 1. Research overview on dynamics of sub-topics and interpretations.

Theory	Author	Object of Research	Prevailing Interpretations in Different Phases of Attention				
			Pre-problem	***Rise***	***Maintenance***	***Before decline***	***Decline***
Issue-Attention Cycle	*(Downs, 1972)*	Journalistic mass media	Framed by scientists	Problem	-	Difficult to solve	Not solved
Narratives	*(McComas & Shanahan, 1999)*	Journalistic mass media	-	Risks/danger	Discord between scientists	Difficult to solve	Solved
Framing	*(Miller, Andsager, & Riechert, 1998)*	Journalistic mass media	-	Different frames compete for prerogative	One frames wins	-	-
Framing	*(Nisbet & Huge, 2006)*	Journalistic mass media	No cycle, but waves of attention. High attention: dramatic frame, low attention: technical/scientific frame				
Framing	*(Shih et al., 2008)*	Journalistic mass media	-	Uncertainty	-	-	New evidence
Framing	*(Weaver, Lively, & Bimber, 2009)*	Journalistic mass media	-	Progress/risk	Regulation market incentives		-
Framing	*(Arens et al., 2010)*	Online communication	Stable interpretations			Strategies to solve the problem	

To explain the different findings on the dynamics of sub-topics and interpretations over time, Waldherr's (2012) four variables influencing public issue attention are also crucial. These dynamics are also influenced by: (1) *stakeholders* like journalists (Fröhlich, Scherer, & Scheufele, 2007; Schmid-Petri, 2012), politicians (Schmid-Petri, 2012) or lobbyists (Böcking, 2009), (2) *constellations of stakeholders* (Baumgartner & Jones, 1993), as a polarized constellation leads to a more dramatic framing (Nisbet & Huge, 2006), (3) *events* (Fröhlich et al., 2007; Shih et al., 2008) and (4) *issues* (Nisbet & Huge, 2006; Schmid-Petri, 2012; Shih et al., 2008).

We prefer to analyze "sub-topics" as the level below "issues", instead of "frames" or "interpretations". The term sub-topic does not contain the evaluative aspect of frames. According to Entman's (1993, p. 52) widespread definition, frames "define problems…; diagnose causes…; make moral judgments…; and suggest remedies".

To sum up both research on the dynamics of issue attention and sub-topics together with interpretations: many studies focus on the dynamics of attention without considering the dynamics of sub-topics and the interpretations of an issue. What is also striking is the focus on long timespans, such as several months or years (e.g. Brossard et al., 2004; Downs, 1972; McComas & Shanahan, 1999; Nisbet & Huge, 2006; Shih et al., 2008). The specifics of short event-based issue-attention cycles have only been investigated for events that trigger an extremely high level of attention, such as media hype or media storms (Boydstun, Hardy, & Walgrave, 2014; Wien & Elmelund-Præstekær, 2009). Furthermore, so far, most studies examine the process only in the traditional mass media. Online publics are widely unconsidered, although there are indications that they have higher and longer issue attention (Anderson et al., 2012) but little dynamics in their sub-topics, with a tendency to focus more on problem-solving strategies over time (Arens et al., 2010). This research gap is where the study at hand relates.

This study analyzes for short event-based time spans both the dynamics of attention in the sense of intensity and continuity and the dynamics of sub-topics regarding the issue of climate change in several online publics. For the development of the theoretical model, the presented four variables (stakeholders, constellation of stakeholders, events, issues) are crucial.

3. Climate Change Communication

We refer to climate change as an issue of public communication. It is an abstract issue (M. S. Schäfer & Schlichting, 2014) and its scientific findings are sometimes uncertain and conflicting (van der Sluijs, 2012). Consequently, the mass media play a crucial role in communicating this complex issue to the public (von Storch, 2009). Climate change has been a continuous issue on the public agenda for a long time (Boykoff, 2010) – nonetheless it is also dynamic as new scientific findings often arise.

Many studies have investigated the level of *mass media attention* on climate change and have shown that it has been increasing worldwide (for an overview see A. Schmidt, Ivanova, & Schäfer, 2013). M. Schäfer et al. (2014) identified certain events fostering mass media attention on climate change, such as political events, including international climate summits and the activities of international NGOs. However, the comparative study of German, Australian and Indian mass media attention showed remarkable differences between the countries: the release of the IPCC reports as well as extreme weather, for example, only triggered mass media attention in Germany. Other scientific publications did not influence media attention at all.

Also, the journalistic *mass media's sub-topics and interpretations* of climate change are well researched. One crucial finding is that, despite differences between countries, the journalistic media mostly covered the scientific consensus on anthropogenic climate change (Brüggemann & Engesser, 2014; Painter & Ashe, 2012), as stated in the IPCC report (IPCC, 2013). Particularly, the German mass media mainly represented the scientific arguments of the IPCC reports (Peters & Heinrichs, 2008). Despite country-specific topics that are related to climate change (Neverla & Schäfer, 2010), the discourse in general mainly focuses on scientific aspects, within which scientists are important stakeholders (Peters & Heinrichs, 2008). The German journalistic discourse focuses in particular on mitigation and adaptation measures (Peters & Heinrichs, 2008)—and over the course of time increasingly on citizens' individual measures (Tereick, 2014).

Less is known about online climate change communication (Jaspal, Nerlich, & Koteyko, 2013; Porter & Hellsten, 2014) and the dynamics of attention and sub-topics, although it is relevant: firstly, the Internet is considered to be a more important source of climate change information than family and friends (Synovate, 2010). Secondly, with regard to climate change, Internet usage increases knowledge (Special Eurobarometer 364, 2011; Zhao, 2009), the need for information (Zhao, 2009), and a high need for information also bolsters problem awareness and behavioral intentions (Taddicken, 2013).

Moreover, users pay significant *attention* to climate change online, as there is a huge amount of climate change related content on different platforms (O'Neill & Boykoff, 2011).

Furthermore, results regarding the *sub-topics* of climate change have already been derived from online communication. Although climate change is particularly a science topic online, a huge diversity of topics can be found (Collins, 2013; Koteyko, 2010; Koteyko, Thelwall,

& Nerlich, 2010; Ladle, Jepson, & Whittaker, 2005; Pearce, Holmberg, Hellsten, & Nerlich, 2014; Sharman, 2014)—especially on laypeople's platforms (Lörcher & Taddicken, 2015). This may be explained by the variety of platforms and stakeholders online, such as scientists, laypersons, journalists, politicians, companies and NGOs (M. Schäfer, 2012).

However, studies investigating its *dynamics* hardly exist. Only the above-mentioned study of Arens et al. (2010) on the issue-career after the climate summit in Bali on different online platforms indicates that the main frames were stable, but over the course of time more focus on how to solve the problem of climate change arose.

To sum up: climate change is receiving a great deal of continuous attention in the journalistic mass media and in online communication. The long-term dynamics of attention and sub-topics in the mass media are well studied, however little knowledge exists with regard to online discourses. Different processes can be assumed online, as there are more diverse stakeholders and sub-topics.

To systematically investigate the dynamics of attention and the sub-topics of the different forms of online climate change communication, the theoretical concept of online public arenas (J.-H. Schmidt, 2013) is applied and combined with the findings from Waldherr (2012).

4. Online Public Arenas

The public sphere is a social forum where citizens come to an understanding about common issues (Habermas, 1962/1989). It can be differentiated into *encounter public*, whereby interpersonal communication takes place between citizens in public places, *event public*, such as public lectures or town hall meetings, and the *mass media public* (Gerhards & Neidhardt, 1993).

Also, there is not one universal online public sphere, but different online public spheres. With the rise of the Internet, the concept of differentiated public spheres has been reconsidered (Klaus & Drüeke, 2012; J.-H. Schmidt, 2013) and adapted to the online environment (Gerhards & Schäfer, 2010).

J.-H. Schmidt (2013) refined the concept further and took these changing conditions into account: The constitution of a public sphere interdepends on communication technology and its modes (J.-H. Schmidt, 2013). These new modes of communication feature characteristics of both interpersonal and mass media communication. Hence, we partly find an intermingling of the different partial public arenas online as well as their coexistence on the same website. On Twitter or Facebook for example, we might find encounter public as well as event public and the mass media public.

Schmidt (2013, p. 41, own translation) defines public arenas as "specific constellations of stakeholders (communicator and audience)…, who offer information on the basis of particular rules of selection and presentation as well as a specific software architecture". The arenas, which could possibly overlap, differ, as do the partial public spheres with regard to their barriers to communication, intended audience and goals of communication. Based on Schmidt's (2013) deliberations[3] we distinguish four online public arenas: (1) *mass media arena*, (2) *expert arena*, (3) *discussion arena* (DA) and (4) *mass media induced discussion arena* (MDA) (Table 2). The mass media arena has high barriers for communication and a dispersed, anonymous audience, as seen on journalistic websites. The communicators are usually journalists. The expert arena has also high barriers for communicators and its audience is an expert community consisting of, for example, scientists or other specialized groups. It contains specialized information such as scientific journals or expert blogs. The discussion arena—which is our extension of Schmidt's concept—is characterized by low barriers to communication and an audience that has not been further specified. Since access to communication is open and equal for everybody, diverse stakeholders can be found here. Also, "ordinary citizens" can exchange their views and interaction is easy. An example of this type of arena are discussion fora. Related to the DA is the mass media induced discussion arena (MDA), which depends on the mass media arena. The MDA includes discussion arenas with initial mass mediated input, e.g. reader comments found on online news media.

[3] Schmidt (2013) differentiates between the (1) mass media, (2) expert, (3) collaborative and (4) personal arena.

Table 2. Online public arenas (based on Schmidt (2013)).

Arena	Barriers for communicators	Expertise of communicators	Intended audience	Interaction	Examples
Mass media arena	High	High	Dispersed, anonymous	Not possible	Journalistic online news platforms
Expert arena	High	High	Expert community	Not possible/possible	Professional journals, expert blogs
Discussion arena	Low	Low/high	Not specified	Possible	Discussion forums
Mass media induced discussion arena	Low	Low/high	Not specified	Possible	Online news reader comments

5. Hypotheses Regarding the Dynamics of Attention and Sub-Topics Online

We assume that for a certain issue, in this case climate change, there are specific dynamics of attention and sub-topics depending on when—on the occasion of which *event*—and where—in which *online public arena*—it is communicated online. In this study we explore two core independent variables, i.e. the type of triggering event, and the type of online public arena (which differs with regard to its stakeholders and their constellation to each other), against dependent variables such as intensity and continuity of attention on climate change and its sub-topics.

As stated above, previous findings (Waldherr, 2012) show for the "offline mass media public" that specific characteristics of *events* indeed influence the dynamics of attention and sub-topics. We will investigate online climate change communication during *events* from different systems: the scientific event "release of the IPCC report WG1", published on September 27th, 2013, preceded by final negotiations for several days; and the political event of the United Nations Climate Change Conference "COP19", which took place in Warsaw, November 11th–23th, 2013. The IPCC report is regarded as the most crucial scientific publication on anthropogenic climate change and reflects the current state of climate science (Hulme, 2009; IPCC, 2013, 2014). Though the IPCC reports are based on scientific reviews, they are also embedded in inter-governmental negotiations, but are finally presented as merely scientific reports. The annual COP, with its almost universal membership (195 parties), is the most important internationally concerted action for the mitigation and adaptation of climate change (UNFCCC, 2006, 2014). M. Schäfer et al. (2014) found that both events triggered mass media attention in Germany. It can therefore be assumed that they also triggered online attention—though possibly to a different extent.

Also *stakeholders* and the *constellation of stakeholders* were found to influence the dynamics of attention and sub-topics in the "offline mass media public" (Waldherr, 2012). As the presented online public arenas differ in these variables, we also assume the existence of arena-specific differences.

Regarding the *dynamics of attention* in terms of intensity and continuity of communication, we assume event-specific attention cycles that will not reflect the ideal-typical issue-attention cycle from Downs (1972), who describes long-term attention dynamics.

COP19 contained more of the news factor conflict, which triggered attention (Waldherr, 2012), as many different political stakeholders with conflicting aims were involved in this conference. We therefore hypothesize:

H1: The attention for COP19 is more intensive and continuous compared to the IPCC report.

More variety of opinions on climate change exists among stakeholders in the discussion arena and the mass media induced discussion arena compared to the mass media arena and the expert arena (Lörcher & Taddicken, 2015).

Due to these strong differences across the variety of opinions of the stakeholders, we formulate hypotheses on the differences between the two discussion arenas and the other two arenas, and hypotheses on the differences between mass media and expert arena.

The greater variety of opinions (Lörcher & Taddicken, 2015) may lead to more controversy in the discussion arena and the mass media induced discussion arena—this can increase attention (Kriesi, 2003; Nisbet & Huge, 2006) and it could also lead to more erratic attention for the issue.

H2: The attention for climate change in the discussion arena and the mass media induced discussion arena is more intensive, but less continuous compared to the other arenas.

We expect differences between the mass media arena and the expert arena with regard to intensity and continuity of attention. The aims of communication between the mass media arena and the expert arena differ: The former has the function to cover societally relevant information, which leads to more focus on political aspects (Lörcher & Taddicken, 2015) and furthermore less continuity for the issue climate change, because it competes with other societally relevant questions. The latter rather discusses scientific expert knowledge on climate change and the issue does not compete with other topics (Lörcher & Taddicken, 2015). We therefore hypothesize:

H3: Around COP19, attention is more intensive in the mass media arena, whereas around the release of the IPCC report, attention is more intensive in the expert arena.

H4: In general, there is more continuous attention in the expert arena for climate change as compared to the mass media arena.

We also expect event- and arena-specific differences to exist within the *dynamics of the communicated sub-topics*. Due to the focus on the discourse around specific short-term events, we do not raise hypotheses about shifts to certain sub-topics over time, which studies on long-term dynamics of frames or narratives could find out (Arens et al., 2010; Downs, 1972; McComas & Shanahan, 1999; Weaver et al., 2009).

"COP19" will probably trigger political communication while scientific sub-topics will probably prevail in the discourse around the IPCC report. Furthermore, we assume that, due to the diversity of its stakeholders and their aim to take action on the mitigation and adaptation of climate change, "COP19" is probably more compatible with other sub-topics related to economics, civil society or individual mitigation measures than the IPCC report. Therefore, we assume more dynamic of the sub-topics there—which means more variation in the relative share of the total communication of the sub-topics over time. To describe the variation in the dynamics of the sub-topics, it is not only necessary to look at the continuity of attention to the single sub-topics over time, but also the relative differences between the sub-topics there.

H5: There is more variation in the dynamics of the sub-topics during COP19 as compared to the IPCC report.

In the two discussion arenas there is a huge diversity of sub-topics compared to the other arenas (Lörcher & Taddicken, 2015), which might also foster the dynamics of the sub-topics:

H6: There is more variation in the dynamics of the sub-topics in the two discussion arenas compared to the other arenas.

We also expect differences between the mass media arena and the expert arena with regard to the dynamics of the sub-topics. Due to the function of the mass media arena to cover societally relevant information, which means that different relevant aspects of climate change (e.g. political, economic and scientific aspects) compete with each other, we hypothesize:

H7: There is more variation in the dynamics of the sub-topics in the mass media arena compared to the expert arena.

Despite the assumed arena-specific differences regarding the dynamics of attention and sub-topics, we do not expect that the dynamics in the MDA are independent from mass media coverage. Attention and sub-topics in the MDA are presumably related to the corresponding articles. Finally, the communicators in the MDA are also audiences of mass media coverage, and they process the content actively (Hall, 1973; Morley, 1992). Sub-topics could move from one public arena to the other and then be reframed or modified.

To summarize, in our empirical study we consider two independent variables against three dependent variables, as can be seen in Table 3.

Table 3. Hypotheses.

Independent variables	Dependent variables
Type of event	Intensity of attention (H1) Continuity of attention (H1) Variation in the dynamics of the sub-topics (H5)
Type of online public arena	Intensity of attention (H2, H3) Continuity of attention (H2, H4) Variation in the dynamics of the sub-topics (H6, H7)

6. Method

To answer the hypotheses, a quantitative manual and automated online content analysis was conducted in the four presented online public arenas. The inquiry period spanned from one week before until one week after the release of the 5th IPCC report WG1 (16 September until 7 October 2013) as well as the COP19 (4 until 29 November 2013).

In a conscious case selection at least two platforms with regular activity in all four arenas in Germany were selected. Crucial selection criteria were relevance in terms of the quantity of traffic and preferably, for each arena, different cases regarding the position towards climate change or the role of climate science. These samples were derived from "spiegel.de" and "Welt.de" for the mass media arena and from their reader comments for the MDA, as both outlets have a high level of media penetration (AGOF, 2014)[4]. 'spiegel.de" can be regarded as the online newspaper of record in Germany (Bönisch, 2006; MediaTenor, 2013) whereas "Welt.de" was picked because it sometimes covers climate sceptic positions, which is unusual for the German quality media's coverage. Furthermore, both outlets have an active online user community, with many reader comments submitted compared to other news websites. Two scientific expert blogs were chosen for the expert arena: both "Klimazwiebel" and "Klimalounge" are maintained by renowned climate scientists with distinct viewpoints on the role of climate science. As for the discussion arena, the "climate forum" of the meteorological homepage "wetteronline.de", the public Facebook group "Klimaschützer" and the biggest German climate sceptic platform "EIKE" were chosen. "Wetteronline.de" is one of the few German climate change discussion forums with regular communication that is not administrated by any scientific, political or civil societal organization. The Facebook-page "Klimaschützer" has a high penetration level, with its cumulated 13,329 "likes" (as of May 19th 2014). The social media campaign to fight climate change was initiated by an online provider of a

[4] "spiegel.de" with 10.73, "Welt.de" with 9.26 Mio unique users as of March 2014.

search engine for clean power (Klimaschützer, 2013). "EIKE" (the European Institute for Climate and Energy) is a registered association that is maintained by a group of politicians, engineers, scientists and journalists (EIKE, 2014). These three platforms have different aims regarding climate change communication and also different degrees of organizational structure.

The archiving was conducted by a web-crawler that was developed for the research project at hand. The crawler archived the content according to a list of climate change-related keywords. The basic population of this study was defined as all communication units (articles, posts, reader comments) in German that explicitly mention 1) the phenomenon of climate change in terms of global warming (or a synonym like greenhouse effect) or 2) carbon emissions. Excluded were communication units where climate change was merely mentioned in a list with other terms without any further reference to the phenomenon. Based on these conditions and the two events triggering climate change communication (release of the IPCC report AR5 WG1 and COP19), a search string with several key words was developed. It was controlled manually before the data collection. The keywords used by the web crawler were: climate change, global warming, climate, IPCC report, IPCC, climate summit, COP, climate policy, climate protection, greenhouse effect, greenhouse gas, carbon (dioxide) (originally in German; German synonyms of the terms were also used.) Irrelevant articles or initial posts were later eliminated by manual checks. In total, the material aggregated to 14,582 contributions (articles, posts, comments) (Table 4).

As per the first step of manual coding, a stratified random sampling was drawn if the comment frequencies exceeded 20 comments per initial post. It was subdivided according to the comment frequency succeeding an initial article or post. For 21−50 comments per initial post, every fifth comment was analyzed, while if there were more than 50 comments every tenth comment was selected. Stratified random sampling was applied to the reader comments of "spiegel.de" and "Welt.de" as well as to the "EIKE" forum. A team of 5 researchers coded manually. The coding of 2.923 communication units was done between December 2013 and June 2014 (Table 4).

In a second step, on the basis of the manual coding, an automated content analysis via machine learning was conducted to achieve full data analysis for the reader comments of "spiegel.de", "Welt.de" and "EIKE".[5] For that, RTextTools were applied according to Jurka (2013).

The codebook was developed within the project "climate change from the audience perspectives" (funded by the German Research Foundation) in 2013 to investigate the content, dynamics of attention and form of online climate change communication in different online public arenas. It was validated on the basis of the data material and it was pretested and improved in several coder trainings.

Main variables of the codebook that were analyzed for this study are the sub-topics within the communication units (H5, H6). Sub-topics had to be explicitly mentioned in the text and explicitly related to climate change: Politics and climate change, science and climate change, COP19, IPCC report (as a special subcategory for science), economy and climate change, media/culture/arts/celebrity and climate change (e.g. movies about climate change), citizen activity and climate change (e.g. activities from civil society or individual citizens) and topics without reference to climate change. For every unit, maximally 3 topics could be coded—i.e. the 3 substantial aspects that are discussed the longest or are most important for the argumentation. For every variable, the reliability values for the manual and the automated coding as well as key figures for the machine learning are documented in Table 5.

[5] In cooperation with Ana Ivanova M.A., research associate at the University of Hamburg.

Table 4. Web portal frequencies.

Arena	Web Portal	Frequency of Communication Units (e.g. article, post, comment)	Stratified Random Sampling (for manual coding)
Mass Media Arena	Spiegel.de	72	72
	Welt.de	47	47
Expert Arena	Klimazwiebel	45	45
	Klimalounge	142	142
Discussion Arena	Wetteronline	152	152
	EIKE	1.909	784
	Facebook	55	55
Mass Media Induced Discussion Arena	Comments Spiegel.de	10.678	1.242
	Comments Welt.de	1.482	384
Total		14.582	2.923

Table 5. Reliability values.

Variable	Reliability Manual Coding (Holsti)	Reliability Automated analysis with manual coding (Holsti)*	Classification Performances	F-score ** (mean of manifestation = 0 and manifestation = 1)
Politics and Climate Change	0.82	0.78	RF (Liaw & Wiener, 2002)	0.76
COP19	0.99	0.96	GLMNET (Friedman, Hastie, & Tibshirani, 2010)	0.75
Science and Climate Change	0.87	0.77	RF (Liaw & Wiener, 2002)	0.77
IPCC report	0.97	0.96	GLMNET (Friedman et al., 2010)	0.82
Economy and Climate Change	0.90	0.88	Probability	0.74
Media/Culture/Arts/Celebrity and Climate Change	0.90	0.85	MAXENT (Jurka, 2012)	0.66
Citizen Activity and Climate Change	0.98	0.86	MAXENT (Jurka, 2012)	0.57
Topics without reference to climate change	0.84	0.80	SVM (Meyer, Dimitriadou, Hornik, Weingessel, & Leisch, 2012)	0.62

Notes: * Mean of 2 reliability values: 1. Automated analysis with the majority decision of the coding from the manual coding reliability test. 2. Automated analysis with a test set of 500 manually coded units (that were excluded from the manual coding for the machine learning); **[F = 2*(precision*recall)/(precision+recall)].

To operationalize the dynamics in the intensity and continuity of attention on climate change, we calculated the frequency of communication units (articles, posts or comments) for each date; for the dynamics of attention on the sub-topics the frequency of the respective sub-topics for each date was calculated.[6]

7. Results

7.1. Dynamics of Issue Attention

7.1.1. Event-Specific Dynamics of Attention

The results show that both types of events triggered attention online. As assumed, they provoked event-specific dynamics of attention and do not reflect the ideal-typical issue-attention cycle from Downs (1972) for long time spans. *Hypothesis 1* can be confirmed: the attention for COP19 is indeed more *intensive* compared to the IPCC report (Figure 1: IPCC report, n = 6.200; and Figure 2: COP19, n = 8.382), which means that we find more communication units in this time span. The more diverse stakeholders with conflicting aims might explain this as well as the longer duration of the event. The attention during COP19 is also more *continuous*: the intensity of communication fluctuates more extremely during the release of the IPCC report. By far, we find that most communication occurred on the day where the summary of the IPCC report was presented (27th of September 2013). At first sight, these event-specific differences do not come as a surprise, since it can be argued that the release of the IPCC report was a short-term event with a short but high level of attention, whereas COP19 was a conference that extended over several days. However, both the release of the IPCC report and COP19 were events, which were preceded by public negotiations of the involved stakeholders over several days that led to a common paper. It is therefore rather surprising that the final agreement at COP19 on 23rd of November 2013 did not elicit much attention.

7.1.2. Arena-Specific Dynamics of Attention

Hypothesis 2 can also be confirmed. The attention paid to climate change in the discussion arena (DA) and above all the mass media induced discussion arena (MDA) was indeed more intensive compared to the other arenas at both events (Figure 3—Figure 4). This might be explained by the greater diversity of opinions of the stakeholders due to low communication barriers, which may trigger more controversy. Another reason might be the shorter length of the communication units in the DA and MDA—at least compared to the mass media arena. The strongest dynamics and fluctuation of attention can be found in the MDA. This means that the relative share of the total communication in the MDA varied more over time. The attention was therefore less continuous—however only for the MDA and not the DA and only for the time of the release of the IPCC report.

[6] There are also other ways to operationalize attention apart from the frequency of communication, such as the length of a contribution, its placement or ranking, as well as its scope. However, most of these indicators cannot be used for a comparative analysis of different forms of online communication like articles or comments due to different conditions.

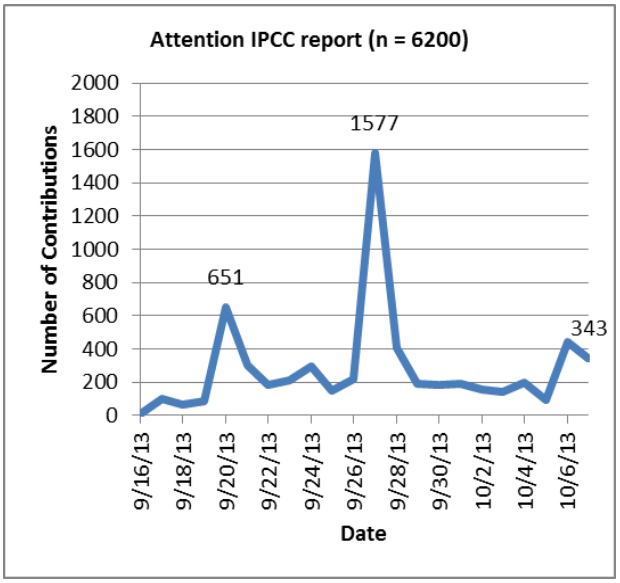

Figure 1. Dynamics of attention during the release of the IPCC report 2013.

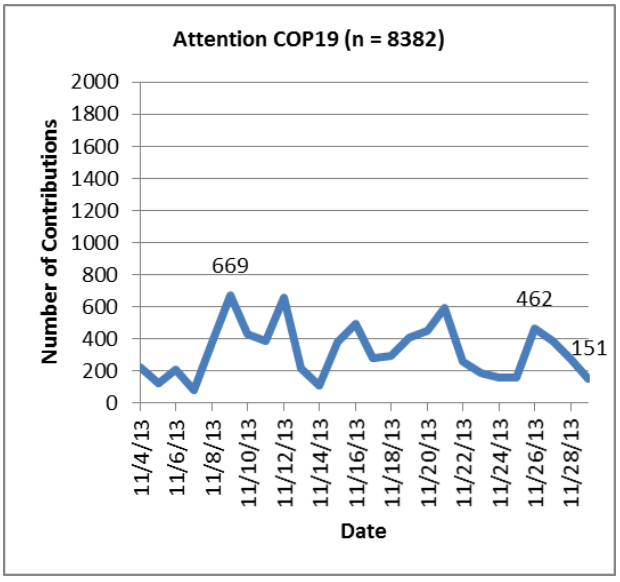

Figure 2. Dynamics of attention during COP19.

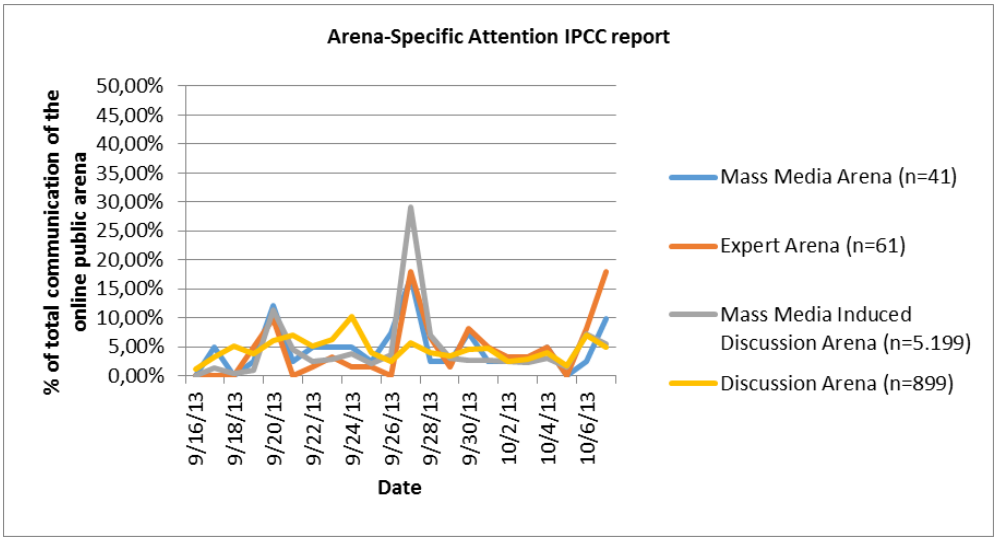

Figure 3. Dynamics of arena-specific attention during the release of the IPCC report 2013.

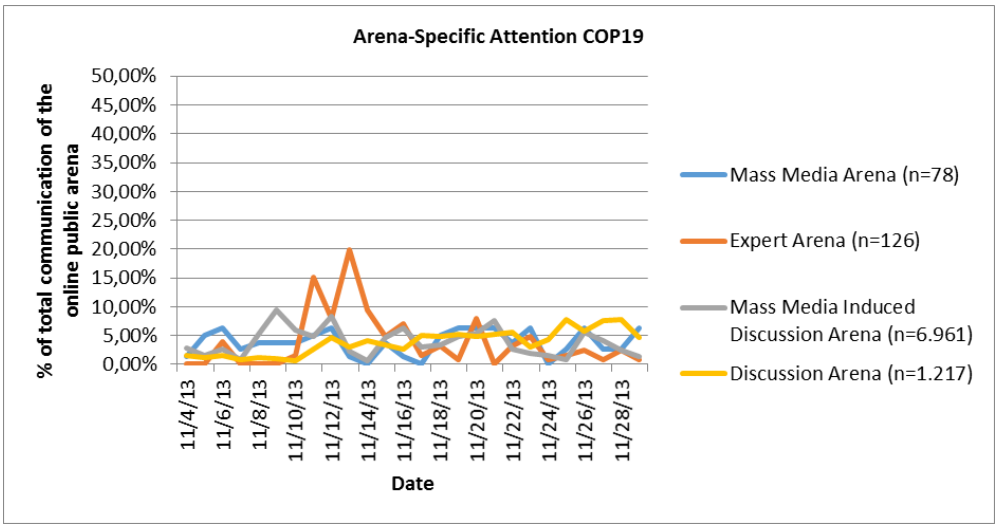

Figure 4. Dynamics of arena-specific attention during COP19.

The attention peak during the release of the summary of the IPCC report (27th of September) can be found in all public arenas except for the DA. All in all, despite the more extreme amplitude in the MDA, the attention dynamics in the mass media arena, the expert arena and the MDA are quite similar. Solely, the attention dynamic in the DA is often not related to the other public arenas.

The dynamics of attention during COP19 differ much more across the public arenas. This means that the attention paid to climate change during the IPCC report seems to have been more triggered by this event as the great peak at 27th of September demonstrates. In particular, in the expert arena we find attention peaks that cannot be explained by the climate summit proceedings. This shows that the expert arena has its own news values, as neither of the events triggered a great deal of communication about the events themselves.

Interestingly, *hypothesis 3* cannot be confirmed: Not only in the mass media arena, but also in the expert arena more intensive communication occurred during the political event COP19 compared to the IPCC report.

Also *hypothesis 4* cannot be confirmed: The attention for the issue climate change is not more continuous in the expert arena compared to the mass media arena. On the contrary: during COP19 the dynamic of attention in the expert arena shows the biggest amplitudes.

7.2. Dynamics of Sub-Topics

7.2.1. Event-Specific Dynamics of Sub-Topics

The general assumption that the scientific event of the IPCC report triggered more communication about scientific topics, whereas political aspects prevailed in the online discourse around COP19, can be confirmed. The top sub-topic during the IPCC report was science (Figure 5). There are more frequent sub-topics during COP19—firstly economy, then science and also politics and citizens (Figure 6). The higher quantity of communication about economics and climate change compared to politics during COP19 underlines the above made observation on the dynamics of attention, whereby the attention paid to climate change during COP19 does not seem to be strongly related to the event—compared to the release of the IPCC report. Beyond that, there is little communication about the events derived from the IPCC report and COP19 (Figures 5−6).

Furthermore, *hypothesis 5* can be confirmed, as there are event-specific dynamics of sub-topics. There is slightly more variation in the dynamics of sub-topics in the communication on COP19 compared to the IPCC report (Figures 5−6). This means that during COP19, over the course of time, the relative share in the total communication of the sub-topics varies more, meaning also that more sub-topics are present in the discourse. This might be explained by the variety of stakeholders from different fields at COP19 and the aim to take action on the mitigation and adaptation of climate change, which is more compatible with other sub-topics. A complementary explanation could be the finding on the dynamics of attention (7.1.2): a higher quantity of climate change communication is not triggered by COP19 itself.

In the time span of the IPCC report, the dynamics of the sub-topics in the course of time are very similar—all of the different sub-topics are communicated most at the release of the summary report.

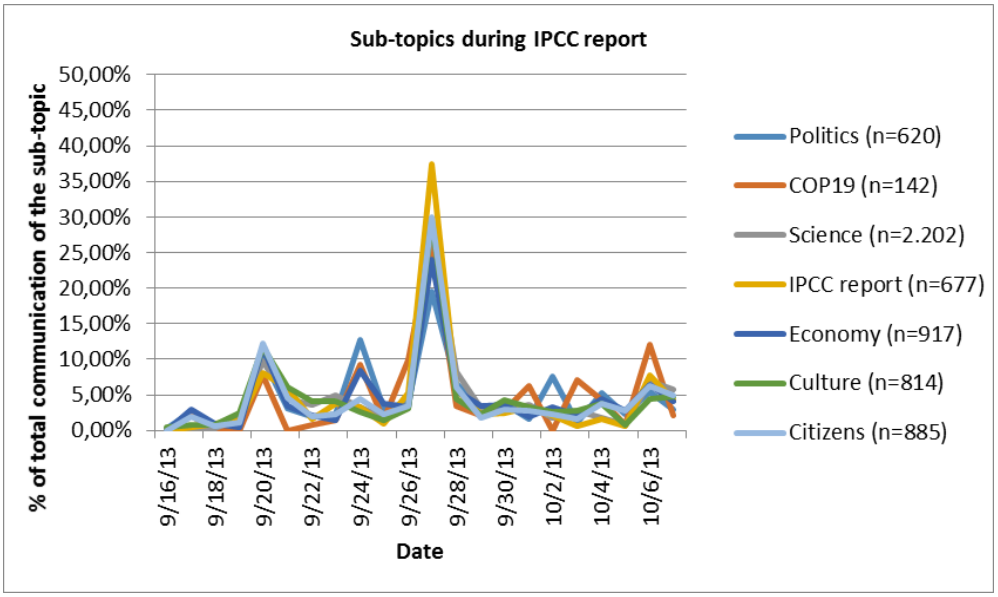

Figure 5. Dynamics of sub-topics during the release of the IPCC report 2013.

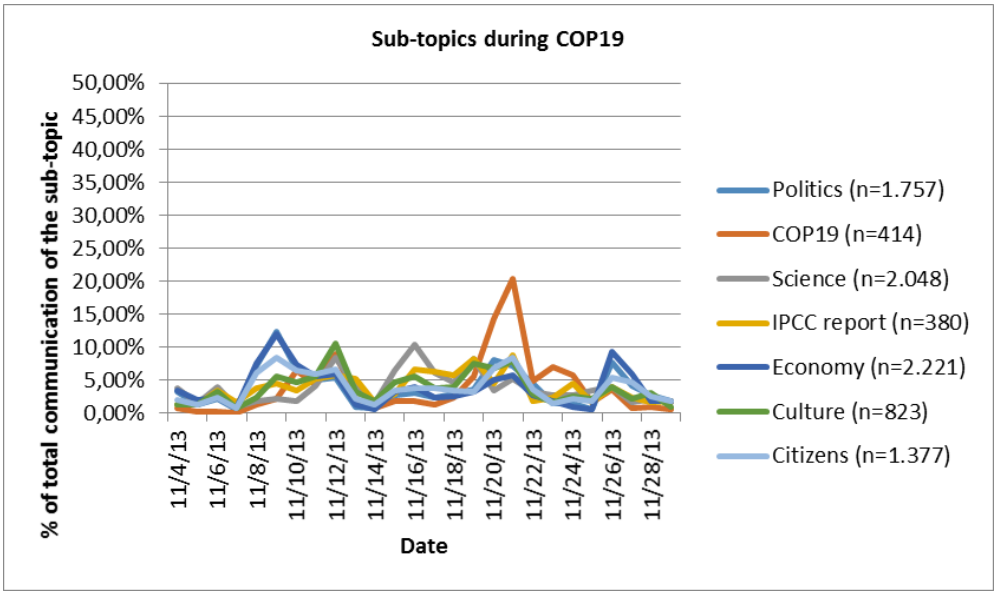

Figure 6. Dynamics of sub-topics during COP19.

Table 6. Sub-topic frequencies in different online public arenas (in %).

Sub-Topics	Arena Total N = 14.582	Mass Media Arena N = 119	Expert Arena N = 187	Discussion Arena N = 2.116	Mass Media Induced Discussion Arena N = 12.160
Politics and Climate Change	16	61	12	10	17
Science and Climate Change	29	33	62	33	28
COP19	4	34	1	2	4
IPCC Report	7	23	17	9	7
Economy and Climate Change	22	31	1	6	25
Media/Culture/Arts/Celebrity and Climate Change	11	3	13	13	11
Citizen Activity and Climate Change	16	5	5	8	17
Topic without reference to Climate Change	18	2	0	22	18

Note: Multiple response set, 3 options.

7.2.2. Arena-Specific Dynamics of Sub-Topics

The communicated sub-topics differ strongly between the online public arenas, although climate change is a science topic (Table 6): in the DA and the MDA we have a larger diversity of sub-topics compared to the other arenas, as we have a large number of communications that do not make reference to climate change. This means that communicators possibly associate sub-topics with climate change that, from our point of view, are not directly related to it. In that sense, they communicate creatively. In contrast to the other arenas, political aspects as well as the events "IPCC report" and "COP19" are especially discussed in the mass media arena and science is the main sub-topic in the expert arena.

Hypothesis 6, regarding the arena-specific dynamics of sub-topics, cannot be confirmed. This means that, despite a huge diversity of sub-topics in the two discussion arenas, no obvious differences in the dynamics of sub-topics can be found. However, this result is based on a small number of cases in the mass media arena and expert arena that do not allow for a convincing interpretation of the figures (Figure 7).

In the MDA, there is not much variation in the dynamic of the sub-topics. Especially during COP19, the relative share of each sub-topic over time is very similar. In the DA, in contrast, the dynamics of attention of certain sub-topics vary more.

Hypothesis 7 cannot be proven reliably, because the number of cases in the mass media arena and the expert arena are too small to interpret the differences in the dynamics of the sub-topics. It can, however, be stated that more sub-topics are frequently communicated in the mass media arena compared to the expert arena (Figure 7).

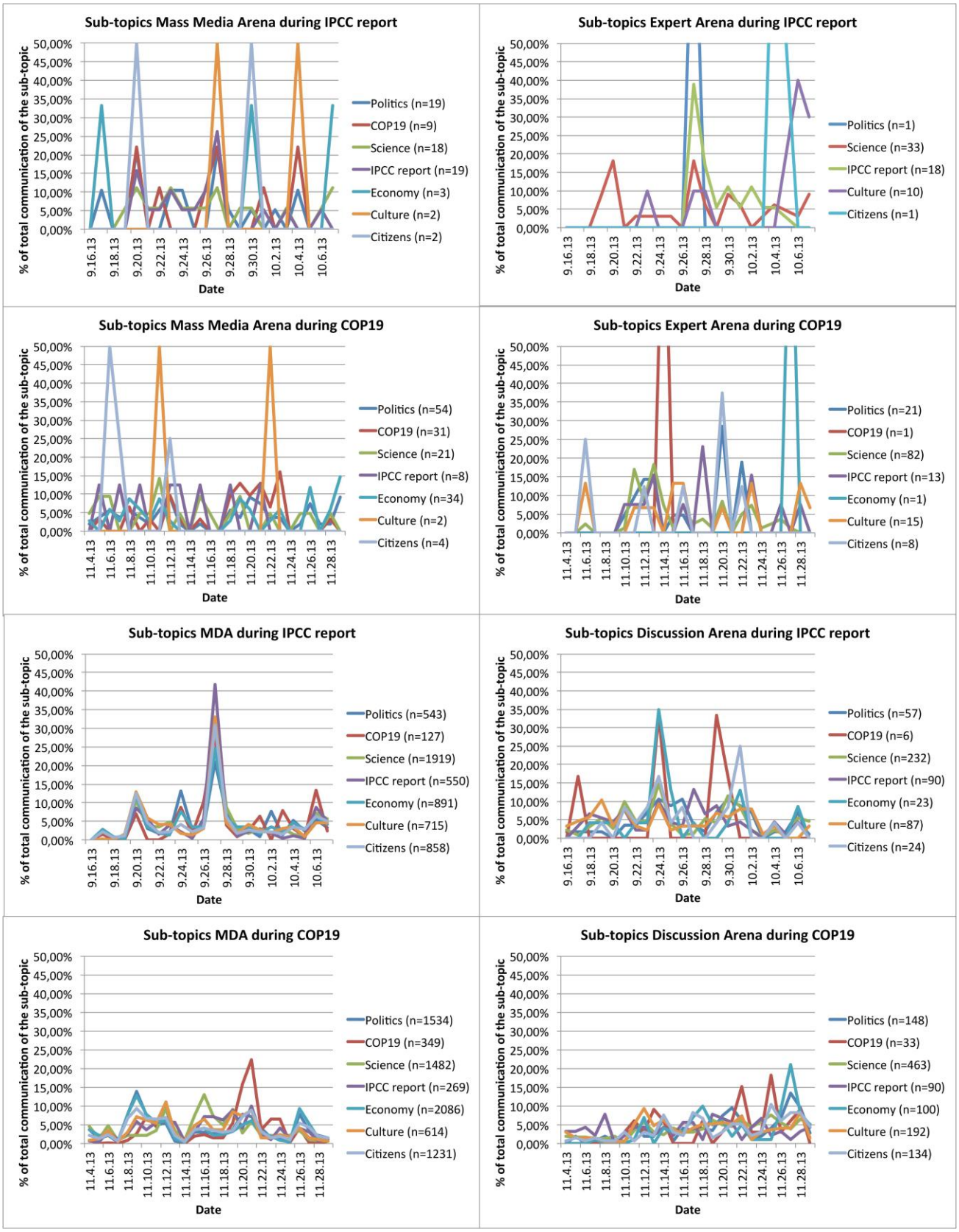

Figure 7. Overview: Dynamics of arena-specific sub-topics during the release of the IPCC report 2013 and COP19. Note: Different scales used in support of a better visualization.

8. Conclusions

The aim of this study was to investigate if climate change has specific dynamics of attention on the issue and its sub-topics depending on the triggering event and the type of online public arena, i.e. when and where it is communicated.

So far, we have known very little about the dynamics of attention on issues and sub-topics in online discourse, as most previous studies only focused on traditional, i.e. "offline" journalistic media. Furthermore, they only focused on the long-term dynamics of media attention. The few studies that analyzed online attention found indications of more and longer issue attention (Anderson et al., 2012) and little dynamics in the interpretations, with a tendency to focus more on problem-solving strategies over time (Arens et al., 2010). However, they analyzed the Internet globally and did not investigate the differences between the various online public arenas.

Our results show that the dynamics of issue attention and sub-topics online are indeed influenced by (1) *events* and by (2) the respective *online public arenas* due to their specific *(constellations of) stakeholders*. So, Waldherr's (2012) influencing factors should therefore be taken into account in further research on issue attention and even the dynamics of sub-topics.

The short-term dynamics of attention triggered by events proceed very differently. When looking at *event-specific issue attentions*, more intensive and continuous issue attention can be found related to the political event COP19, which might be explained in part by a longer duration of the event, but also by the diversity of involved stakeholders with conflicting positions. However, we find more extreme online attention peaks around the scientific event of the IPCC report release in 2013. This means that, despite the fact that both events are characterized by negotiations that lead to a final agreement, one event triggered more concentrated communication at certain times. Results on the sub-topics might explain this observation, because the communication during the release of the IPCC report is more related to the event than was found during COP19.

Furthermore, we found *arena-specific attention dynamics*. The attention towards climate change in lay communication differs from journalistic and scientific expert communication, because there is a higher intensity of attention. For the continuity of attention, we find slightly more ambiguous results. The attention in the MDA shows big amplitudes, whereas the DA does not. The expert arena, which we expected to show the most continuous attention for climate change, has the highest amplitudes of attention during COP19. Furthermore, we find the biggest amplitudes of issue attention in the expert arena. This is surprising, as we expected that scientists are the stakeholders with the steadiest interest in climate change. The result, that issue attention in the mass media arena is relatively continuous, is interesting because it is a common reproach to journalism in the public opinion that the mass media agenda changes too fast. It has to be taken into account that especially in the mass media arena, the attention to the issue of climate change is influenced by the presence of other competing issues.

Our results also showed *event-specific dynamics of sub-topics*. The dynamics of sub-topics in the communication on COP19 vary more as compared to the IPCC report. Science was the most frequent sub-topic during the release of the IPCC report, while during COP19 different sub-topics affected the discourse, especially economy and climate change. There could be two different reasons for this result: (1) the aim of COP19 was to take action in terms of the mitigation and adaptation of climate change, which is more compatible with other sub-topics and (2) much of the online communication during COP19 was not triggered by the event as compared to the IPCC report.

Our research reveals that it is crucial to differentiate between forms of online communication. Here, the concept of online public arenas proves to be sustainable in analyzing different forms of online communication with different constellations of stakeholders.

The study also makes a methodological contribution, as it proves that automated content analysis based on the machine learning of manually coded content works even for user-generated content like reader comments. This is remarkable, because user-generated content does not have a standardized structure like journalistic articles, but is often fragmentary and characterized by a style of everyday language and even deficient modes of speaking.

The major limitation of this study is its character as a case study on the issue of climate change—a long-term and global issue that is generated basically from the scientific field. Further research should therefore also investigate the influence of other issues on the dynamics of attention and of therewith-related sub-topics. The influencing factor "issue" (Waldherr, 2012) was the only one not taken into account in this study. The issues should differ in the societal fields in which they are embedded and, as such, assess whether they are related to long-term or short-term processes and/or local-related or global-related processes. We may assume that there are also "issue-specific" dynamics of attention and sub-topics—however, its underlying variables still have to be explored further.

It also has to be taken into account that our results are valid for short-term dynamics, and have yet to be proven for long time-spans.

Further research could also investigate the dynamics in the interpretation of the sub-topics. Here, it would be valuable to analyze the interpretations of the sub-topics not only via quantitative measures, but also by using qualitative methods. Likewise, it seems prom-

ising to research the dynamics of attention and subtopics not only within the online public arenas, but also between them. Are there Intermedia Agenda Setting effects or are the online public arenas fragmented from each other?

Acknowledgments

The research presented in this paper was conducted within the framework of the project "climate change from the audience perspective" under the leadership of Prof. Dr. Irene Neverla and Prof. Dr. Monika Taddicken. This project is part of the Special Priority Program 1409 "Science and the Public" which is funded by the German Research Foundation (DFG). The authors would like to thank Prof. Dr. Monika Taddicken for her help in the conceptualization and implementation of the content analysis, Ana Ivanova M.A. for the implementation of the automated content analysis, the student assistants Tjado Barsuhn, Jana Eisberg, Carolin Grüning, Kira Klinger and Sabrina Pohlmann for coding, Sandra Banjac for proofreading, and the editors and anonymous reviewers for their helpful suggestions.

References

AGOF. (2014). Angebotsranking, from http://agof.de/angebotsranking

Anderson, A. A., Brossard, D., & Scheufele, D. A. (2012). News coverage of controversial emerging technologies. *Politics and the Life Sciences, 31*(1-2), 87-96.

Arens, M., Böcking, S., Kummer, S., & Rüf, F. (2010). Das Meinungsklima zur Klimakonferenz. In M. Welker & C. Wünsch (Eds.), *Die Online-Inhaltsanalyse* (pp. 427-447). Köln: Herbert von Halem.

Baumgartner, F. R., & Jones, B. D. (1993). *Agendas and instability in American politics*. Chicago: University of Chicago Press.

Böcking, T. (2009). *Strategisches Framing*. Köln: Halem.

Bönisch, J. (2006). *Meinungsführer oder Populärmedium?* Münster: LIT Verlag.

Bowman, S., & Willis, C. (2003). We media. Retrieved from http://www.hypergene.net/wemedia/download/we_media.pdf

Boydstun, A. E., Hardy, A., & Walgrave, S. (2014). Two faces of media attention. *Political Communication, 31*(4), 509-531. doi: 10.1080/10584609.2013.875967

Boykoff, M. T. (2010). Indian media representations of climate change in a threatened journalistic ecosystem. *Climate Change, 99*(1-2), 17-25.

Brossard, D., Shanahan, J., & McComas, K. (2004). Are issue-cycles culturally constructed? *Mass Communication and Society, 7*(3), 359-377.

Brüggemann, M., & Engesser, S. (2014). Between consensus and denial. *Science Communication, 36*(4), 399-427.

Collins, L. (2013). Do online user comments provide a space for deliberative democracy. *Make Science Public*. Retrieved from https://blogs.nottingham.ac.uk/makingsciencepublic/2013/10/11/do-online-user-comments-provide-a-space-for-deliberative-democracy

Downs, A. (1972). Up and down with ecology—The "issue-attention cycle". *Public Interest, 28*(Summer), 38-50.

EIKE. (2014). EIKE. Retrieved from http://www.eike-klima-energie.eu/eike

Eilders, C. (1997). *Nachrichtenfaktoren und Rezeption*. Opladen: Westdeutscher Verlag.

Entman, R. M. (1993). Framing: Towards clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51-58.

Friedman, J., Hastie, T., & Tibshirani, R. (2010). Regularization paths for generalized linear models via coordinate descent. *Journal of Statistical Software, 33*(1), 7.

Fröhlich, R., Scherer, H., & Scheufele, B. (2007). Kriegsberichterstattung in deutschen Qualitätszeitungen. *Publizistik, 52*(1), 11-32.

Galtung, J., & Ruge, M. H. (1965). The structure of foreign news. *Journal of Peace Research*(2), 64-91.

Gerhards, J., & Neidhardt, F. (1993). Strukturen und Funktionen moderner Öffentlichkeit. In W. Langenbucher (Ed.), *Politische Kommunikation* (pp. 52-88). Wien: Braumüller.

Gerhards, J., & Schäfer, M. S. (2010). Is the Internet a better public Sphere? *New Media and Society, 12*(1), 143-160.

Habermas, J. (1962/1989). *The structural transformation of the public sphere* (trans. T. Burger and F. Lawrence). Cambridge: Massachusetts Institute of Technology Press.

Hall, S. (1973). *Encoding and decoding in the television discourse*. Birmingham: Centre for Cultural Studies, University of Birmingham.

Hulme, M. (2009). Mediated messages about climate change. In T. Boyce & J. Lewis (Eds.), *Climate change and the media* (pp. 117-128). New York: Peter Lang.

IPCC. (2013). The physical science basis. Summary for policymakers. Retrieved from http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf

IPCC. (2014). Organization. Retrieved from from http://ipcc.ch/organization/organization.shtml

Jaspal, R., Nerlich, B., & Koteyko, N. (2013). Contesting science by appealing to its norms. *Science Communication, 35*(3), 383-410.

Jurka, T. P. (2012). Maxent. *The R Journal, 4*(1), 56-59. Retrieved from http://journal.r-project.org/archive/2012-1/RJournal_2012-1_Jurka.pdf

Jurka, T. P. (2013). RTextTools. *The R Journal, 5*(1), 6-12. Retrieved from http://journal.r-project.org/archive/2013-1/collingwood-jurka-boydstun-etal.pdf

Kepplinger, H. M. (2001). Der Ereignisbegriff in der Publizistikwissenschaft. *Publizistik, 46*(2), 117-139.

Kepplinger, H. M., & Habermeier, J. (1995). The impact of key events on the presentation of reality. *European Journal of Communication, 10*(3), 371-390.

Klaus, E., & Drüeke, R. (2012). Öffentlichkeit in Bewegung? In T. Maier, M. Thiele, & C. Linke (Eds.), *Medien, Öffentlichkeit und Geschlecht in Bewegung* (pp. 51-70). Bielefeld: Transcript.

Klimaschützer. (2013). Info. Retrieved from https:// http://www.facebook.com/Klimaschuetzer/info

Kolb, S. (2005). *Mediale Thematisierung in Zyklen*. Köln: Herbert von Halem Verlag.

Koteyko, N. (2010). Mining the internet for linguistic and social data. *Discourse & Society, 21*(6), 655-674.

Koteyko, N., Thelwall, M., & Nerlich, B. (2010). From carbon markets to carbon morality. *Science Communication, 32*(1), 25-54.

Kriesi, H. (2003). Strategische politische Kommunikation. In F. Esser & B. Pfetsch (Eds.), *Politische Kommunikation im internationalen Vergleich* (pp. 208-239). Wiesbaden: Westdeutscher Verlag.

Ladle, R. J., Jepson, P., & Whittaker, R. J. (2005). Scientists and the media. *Interdisciplinary Science Reviews, 30*(3), 231-240.

Liaw, A., & Wiener, M. (2002). Classification and regression by randomForest. *R News, 2*(3), 18-22.

Lörcher, I., & Taddicken, M. (2015). Let's talk about...CO2-Fußabdruck oder Klimawissenschaft? In M. S. Schäfer, S. Kristiansen, & H. Bonfadelli (Eds.), *Wissenschaftskommunikation im Wandel* (pp. 258-286). Köln: Herbert von Halem.

Mathes, R., & Pfetsch, B. (1991). The role of the alternative press in the agenda-building process. *European Journal of Communication, 6*(1), 33-62.

McComas, K., & Shanahan, J. (1999). Telling stories about climate change. *Communication Research, 26*(1), 30-57.

McGillivray, D. (2013). Digital cultures, acceleration and mega sporting event narratives. *Leisure Studies, 33*(1), 96-109.

MediaTenor. (2013). Spiegel und Bild demonstrieren Stärke. Retrieved from http://www.mediatenor.de/ newsletters.php?id_news = 803

Meyer, D., Dimitriadou, E., Hornik, K., Weingessel, A., & Leisch, F. (2012). Misc Functions of the Department of Statistics (e1071): TU Wien. Retrieved from http://CRAN.R-project.org/package = e1071

Miller, M. M., Andsager, J. L., & Riechert, B. P. (1998). Framing the candidates in presidential primaries. *Journalism & Mass Communication Quarterly, 75*(2), 312-324.

Morley, D. (1992). *Television, audiences, and cultural studies*. London: Routledge.

Neverla, I., & Schäfer, M. S. (2010). Das Medienklima. *Mitteilungen DMG, 2010*(3), 9-12.

Nisbet, M. C., & Huge, M. (2006). Attention cycles and frames in the plant biotechnology debate. *The Harvard International Journal of Press/Politics, 11*(2), 3-40.

O'Neill, S., & Boykoff, M. (2011). The role of new media in engaging the public with climate change. In L. Whitmarsh, I. Lorenzoni, & S. O'Neill (Eds.), *Engaging the public with climate change* (pp. 236-250): Routledge.

Painter, J., & Ashe, T. (2012). Cross-national comparison of the presence of climate scepticism in the print media in six countries, 2007–10. *Environmental Research Letters, 7*(4). Retrieved from http://stacks.iop.org/1748-9326/7/i = 4/a = 044005

Pearce, W., Holmberg, K., Hellsten, I., & Nerlich, B. (2014). Climate change on twitter. *PLOS ONE, 9*(4), 1-11.

Peters, H. P., & Heinrichs, H. (2008). Legitimizing climate policy. *International Journal of Sustainability Communication, 3*, 14-36.

Petersen, K. K. (2009). Revisiting Downs' issue-attention cycle. *Journal of Strategic Security, 2*(4), 1.

Pfetsch, B. (1994). Themenkarrieren und politische Kommunikation. *Aus Politik und Zeitgeschichte, 39-40*, 11-20.

Porter, A. J., & Hellsten, I. (2014). Investigating participatory dynamics through social media using a multideterminant "frame" approach. *Journal of Computer-Mediated Communication, 19*(4), 1024-1041.

Schäfer, M. (2012). Online communication on climate change and climate politics. *Wiley Interdisciplinary Reviews: Climate Change, 3*(6), 527-543.

Schäfer, M., Ivanova, A., & Schmidt, A. (2014). What drives media attention for climate change? *International Communication Gazette, 76*(2), 152-176.

Schäfer, M. S., & Schlichting, I. (2014). Media representations of climate change. *Environmental Communication, 8*(2), 142-160. doi: 10.1080/ 17524032.2014.914050

Schmid-Petri, H. (2012). *Das Framing von Issues in Medien und Politik*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Schmidt, A., Ivanova, A., & Schäfer, M. (2013). Media attention for climate change around the world. *Global Environmental Change, 23*(5), 1233-1248.

Schmidt, J.-H. (2013). Onlinebasierte Öffentlichkeiten. In C. Fraas, S. Meier & C. Pentzold (Eds.), *Online-Diskurse* (pp. 35-56). Köln: Herbert von Halem Verlag.

Schulz, W. (1990). *Die Konstruktion von Realität in den Nachrichtenmedien*. Freiburg: Alber.

Sharman, A. (2014). Mapping the climate sceptical blogosphere. *Global Environmental Change, 26*, 159-170.

Shaw, D. L. (1977). The press agenda in a community setting. In D. L. Shaw & M. E. McCombs (Eds.), *The*

emergence of American political issues (pp. 19-31). St Paul, MN: West Publishing Co.

Shih, T.-J., Wijaya, R., & Brossard, D. (2008). Media coverage of public health epidemics. *Mass Communication and Society, 11*(2), 141-160.

Special Eurobarometer 364. (2011). Public awareness and acceptance of CO2 capture and storage. Retrieved from http://ec.europa.eu/public_opinion/archives/ebs/ebs_364_en.pdf

Staab, J. F. (1990). *Nachrichtenwert-Theorie*. Freiburg: Alber.

Synovate. (2010). *Climate change global study 2010*. Bonn: Deutsche Welle Global Media Forum.

Taddicken, M. (2013). Climate change from the user's perspective. *Journal of Media Psychology, 25*(1), 39-52.

Tereick, J. (2014). *Klimawandel im Diskurs (Doctoral Dissertation).* University of Hamburg, Hamburg.

UNFCCC. (2006). Handbook. Retrieved from http://unfccc.int/resource/docs/publications/handbook.pdf

UNFCCC. (2014). Fast facts & figures. *2014*. Retrieved from http://unfccc.int/essential_background/basic_facts_figures/items/6246.phpvan der Sluijs, J. P. (2012). Uncertainty and dissent in climate risk assessment. *Nature and culture, 7*(2), 174-195.

von Storch, H. (2009). Climate research and policy advice. *Environmental Science & Policy, 12*(7), 741-747. doi: http://dx.doi.org/10.1016/j.envsci.2009.04.008

Waldherr, A. (2012). *Die Dynamik der Medienaufmerksamkeit*. Baden-Baden: Nomos Verlagsgesellschaft.

Weaver, D. A., Lively, E., & Bimber, B. (2009). Searching for a frame. *Science Communication, 31*(2), 139-166.

Wien, C., & Elmelund-Præstekær, C. (2009). An anatomy of media hypes. *European Journal of Communication, 24*(2), 183-201. doi: 10.1177/0267323108101831

Wolfsfeld, G., & Sheafer, T. (2006). Competing actors and the construction of political news. *Political Communication, 23*(3), 333-354.

Zhao, X. (2009). Media use and global warming perceptions. *Communication Research, 36*(5), 698-723.

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Media and Communication (ISSN: 2183-2439)
2015, Volume 3, Issue 1, Pages 34-43
Doi: 10.17645/mac.v3i1.248

Article

Encoding Systems and Evolved Message Processing: Pictures Enable Action, Words Enable Thinking

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Submitted: 13 February 2015 | In Revised Form: 28 August 2015 | Accepted: 14 September 2015 | Published: 28 September 2015

Abstract
This paper, based on theories of ecological perception, embodied motivated cognition, and evolutionary psychology, proposes that pictures elicit evolved biologically imperative responses more quickly and thoroughly than do words. These biologically imperative responses are directly responsible for evolved automatic reactions away from biological threats (e.g. escaping predators, avoiding disease and noxious stimuli) and towards opportunities (e.g. consuming food, approaching mates, finding shelter) in the environment. When elicited, these responses take time to occur and may delay or interfere with other types of behavior. Thus, when environmental information is presented in pictures (which should elicit larger biological responses than words) biological responses should interfere more with higher order tasks like information processing and cognitive decision-making. To test this proposition we designed an experiment in which participants performed speeded categorizations of 60 pairs of matched pleasant and unpleasant environmental opportunities and threats. They categorized the items based on their form (is this a word or a picture?) or based on how the picture made them feel (is this pleasant or unpleasant to you?). If pictures do elicit greater biologically imperative responses than their word counterparts, participants should be able to make form decisions faster than feeling decisions, especially when presented with words rather than pictures and especially when the words and pictures have less biological relevance. This main proposition was supported. Implications for this proposition in terms of communication theory are discussed.

Keywords
embodied; embedded; dynamic systems; message processing; pictures; words

Issue
This article is part of a regular issue of Media and Communication, edited by Professor Bradley Greenberg (Michigan State University, USA) and Professor Elisabeth Klaus (University of Salzburg, Austria).

1. Introduction

Over the years, communication researchers have spent a lot of time investigating the differential effects of pictures and words on people's cognition, emotion, memory, and comprehension. Research in this area is done in an attempt to ascertain whether pictures or words are more effective for presenting various types of information in different kinds of messages. This research has demonstrated that the processing of words and pictures varies along a continuum from abstract to concrete. Here we are concerned only with the processing of concrete pictures and words; that is, pictures and words that stand for or depict real things in the world. Certainly, in the era of the internet this kind of research is more relevant to communication research

than ever. In general, we find that pictures tend to be more arousing, more memorable, more easily processed, and elicit more emotional response than words (Houts, Doak, Doak, & Loscalzo, 2006; Kensinger & Schacter, 2006; Lang, Potter, & Bolls, 1999).

Multiple explanations for these results exist, including: first, that pictures are processed in parallel while words are processed serially, or; second, that pictures are processed automatically while the processing of words is more effortful. We, based on theories of ecological perception (i.e. perception action theory), embodied motivated cognition, and evolutionary psychology, propose instead that the faster and more vigorous responses elicited by pictures compared to words arise because pictures automatically elicit more vigorous or thoroughly expressed evolved biologically imperative responses.

Dynamic human centered communication systems theory (DHCCST) (Lang, 2014) is used as the framework for explaining and testing this theoretical hypothesis for why pictures, compared to words, tend to be processed faster and elicit larger emotional responses. Unlike most communication theories framed within the dominant paradigmatic approach consisting of the linear causal model, sensation-perception theory, and information processing approaches (Lang, 2013) DHCCST is based on a new approach based on the dynamic systems non-linear causal model, perception action theory, and motivated cognition.

DHCCST conceptualizes communication as an evolved, embedded, dynamic adaptive process peculiar to animals acting in the world (Clark, 2008; Gibson, 2013; Sherry, 2011). Therefore, we analyze the differences between pictures and words by considering them from the perspective of an evolved human acting in an environment over-time. Time is essential in this analysis and provides guidance for our theorizing at several scales (Berthenthal, 2007). Time is considered at the evolutionary scale (millions of years), at the historical scale (thousands of years), the behavioral scale (days and hours), and at a cognitive/neurological scale (minutes to milliseconds).

2. From an Evolutionary Timescale

The primary assumption of DHCCST is that humans are animals and that they evolved in this particular world. As a result, we evolved in such a way as to be tuned to perceiving and acting in this world with its combination of forces and media. DHCCST's ecological approach is based on Gibson's ecological or direct perception theory. Sometimes called perception action theory, it is based on the notion that humans evolved in this particular world, which provided us with an environment where air, light, water, and gravity are the media that afford animal life and animate behavior/action. In addition to these life supporting and perception-enabling media through which we move, the world also contains substances, surfaces, detachable objects, and animals. Surfaces vary in opacity, hardness, texture, etc. Surfaces can be open (ground, walls) or closed (rooms, caves). Surfaces can contain substances. Objects are closed surfaces which can be detached and moved from one place to another. Animals are detachable objects with a closed body envelope who can change their external appearance and display animate behavior.

According to ecological perception theory, the perceptual organs are evolved machines that directly pick up information from the world. The movement (i.e. action) of animals and their perceptual organs through the world results in the direct pickup of information in the world allowing animals to move, find food, avoid danger, and procreate. The sensations of sight, hearing or smell are secondary to the actual pick up of the information. Action, not sensation, mediates perception.

DHCCST defines communication as the transfer of information from one animal to another in an environment over time. Communication is both evolved and adaptive. As evolved animals, humans have a variety of evolved communication encoding systems. DHCCST defines evolved communication encoding systems as those actions or emissions of animals that can be directly perceived by the perceptual system of another animal. For example, marking behavior (i.e. leaving behind a smell through an emission or the behavior of rubbing against something) is an evolved encoding system, and the mark is a form of communication that can be directly perceived by the olfactory system of an animal. Similarly, actions and expressions can be directly perceived by the visual system. Sounds (e.g. screams, moans, sighs, cries, growls, purrs) can be directly perceived by the auditory perceptual system. Animals communicate through a variety of evolved perceptual systems. Bees communicate the location of particularly good nectar through the waggle dance (Riley, Greggers, Smith, Reynolds, & Menzel, 2005), ants secrete scent trails to guide one another towards food (Wilson, 1962). Humans and most mammals can smell your fear (de Groot, Semin, & Smeets, 2014), hear your cries or laughter, see your facial expressions and your actions, and express tenderness and love through touch. These are our evolved communication systems.

The evolved human walking through the world in evolutionary time only encountered substances, surfaces, objects and animals. Their perceptual systems directly picked up, over time, both the invariant aspects of their environment (i.e. things that were not changing as they moved through the world) and its variants (i.e. things that were changing as they moved through the world). Invariants include the shape of a mountain, the texture and orientation of the ground, and the location of trees. As the animal moves, some invariants appear while others are occluded but they remain invariant. Other aspects of the world are vari-

ant. Leaves blow in the wind or fall. Animals appear, move, and disappear. The light changes as clouds move across the sun, or the sun rises and sets. Evolved communication information, whether it is an emission, an action, an expression, a sound, or a touch is variant and is directly perceived. Thus, information passing between animals through evolved encoding systems is directly perceived variant information in the environment and is the basis of communication. The evolved human walking through the world in evolutionary time only encountered substances, surfaces, objects, and animals. They never encountered a picture or a word as these did not yet exist.

3. From a Historical Timescale

And then someone made a drawing--in the sand, in the mud, on a cave wall, with chalk, with paint…and there was a picture. What is a picture? According to Gibson (2013) a picture is a surface that captures the invariant aspects of a place or an object at a time and freezes it. Ecological perception mediated by action includes both variant and invariant information. A picture is not an evolved encoding system. It is a man-made invention that captures the invariant aspects of a thing at a specific moment in time. In particular, it captures shape, color and form. What it doesn't capture are the variants of the object or the place. Thus, a picture of a cat has the form and the color and the shape of a cat but it doesn't have locomotion, sniffing, licking, being ruffled by the wind, or being soft when you touch it. When we see a picture of a cat, we directly perceive the invariants of the cat. But the picture of a cat affords only what is afforded by the visual invariant aspects of a cat provided in the ambient light array (i.e. information available to the visual perceptual system). As a result, the picture affords only looking at a cat, not stroking it, smelling it, or hearing it purr. But the form, shape, and color of the cat are still available for direct perception. DHCCST defines pictures as a manmade representational encoding system. Manmade representational systems are those that contain information that is directly perceivable by some perceptual system, but do not contain all of the perceptual information that would be available in the real object, substance, surface, or animal.

And then there were words. After pictures came words. Words are, in a sense, pictures. They are surfaces that provide invariant edges arranged in various orientations fixed in time. Their shape, color, and form can be directly perceived but these shapes and forms are not related to the shapes and forms of the things that they stand for. The shape of the word cat does not provide any directly perceived information about the invariants of the cat. The only directly perceivable information in a word is the shape, color, and form of the word. Thus, the meaning of the word is not directly perceivable.

4. From the Neurological and Cognitive Timescales

What happens, then, when we see a word? How do we get from directly perceiving the form of the word cat, to knowing that the word "cat" stands for cat. As complex evolved animals, humans consist of multiple nested complex systems. DHCCST pays particular attention to the cognitive/neurological system embedded in a physiological system, embedded in a motivational system, embedded in a perceptual system, embedded in a biological system. Each of these systems evolved to function in this world and constrains, interacts with, facilitates, and inhibits actions and reactions in the other systems over time. These systems are nested in the human both biologically and within time. The neurological system is in a faster band than the cognitive (Berthenthal, 2007). Complex interactions of these systems allow us to act, perceive, feel, and think in the world. DHCCST builds on Hofstadter's (Hofstadter, 2000) conceptualization of an active symbol to bridge the gap between direct perception of the form of the word "cat" and the sensation of the meaning of the word "cat". According to Hofstadter, an active symbol is something in the world which initially elicits neuronal activation associated with its form, but then immediately activates additional neuronal activity associated with its meaning and our knowledge of the thing that the symbol stands for. This activity eventually leads to the cognitive sensation of meaning. Thus, when looking at pictures we directly perceive the form of the thing that is represented and respond to it without sensation. When looking at words we directly perceive the form of the word but not the form of the thing that is symbolized. The form triggers neurological activity that both leads to an understanding of the meaning of the word and triggers the appropriate biological response. Thus, the perception of the form of a word is mediated by action, but the perception of the meaning of a word is mediated by sensation. The perception action neurological loop has been shown to be much shorter and therefore much faster than the perception action loop (Pearson, 1985). Thus, while the form of the word is directly perceived as quickly as the form of the picture, the form of the word carries no evolved invariants that will trigger a biologically imperative response while the form of the directly perceived concrete picture does. The meaning of a word arrives more slowly with completion of the perception sensation loop and triggers a biologically imperative response, should one be appropriate.

DHCCST argues that this difference between a representation (e.g. picture) of something and a symbol (e.g. word) of something is at the heart of the differential responses we see in people to concrete words and pictures. People directly perceive the meaning of a representational picture which leads directly to the evolved biologically imperative response. People do not directly perceive the meaning of a word and there-

fore their initial response to a word is neurological and then cognitive. The faster neurological component of the directly perceived picture automatically triggers the evolved biological response before the sensation of meaning but more slowly than the directly elicited response to the picture.

Having made this claim it makes sense to temper it slightly. Because communication is adaptive, it makes sense that a shouted word (Fire!) should elicit almost the same evolved response as the presence of fire. If words completely removed the ability to act swiftly, without the sensation of meaning and conscious thought, to protect ourselves from threat or seize opportunity, they would not be a particularly adaptive form of communication. Yet we know from many areas of priming research that, for practiced readers, people's physical and biological responses to words do begin before they are consciously perceived and identified. Similarly, priming research has also shown larger responses for pictures than for words (Carr, McCauley, Sperber, & Parmelee, 1982). However, once cognition catches up, we also have the ability to either facilitate or inhibit that evolved response. In this nested system approach it is likely that the repeated pairing of the meaning of the word with the invariant shape of the word results in the shape of the word developing motivational relevance, but this response is smaller than that elicit by the evolved invariants of the shape of a cat.

5. From a Behavioral Timescale

DHCCST sees human behavior as the dynamic self-organization of the human nested systems. At this timescale as the human animal acts in the evolved world it directly picks up information about the surrounding environment and its contents, perceiving what the environment affords to promote survival and task completion.

This direct perception of the information in the world is nested in our biological motivational systems which evolved to promote survival. Hence, danger, threats, food, and mates are directly perceived which leads to biological and motivational reflexes that support protective or approach behavior. Action towards and away from motivationally relevant things in the environment, that is things which afford threat or opportunity, begins with direct perception of those things and the elicitation of biological motivational responses. DHCCST conceptualizes motivational responses using Caccioppo's dual motivational system model (Cacioppo & Berntson, 1994, 1999; Cacioppo & Gardner, 1999; Cacioppo, Gardner, & Berntson, 1997).This model posits two independent motivational systems, the approach or appetitive system and the aversive or defensive system. The two systems have been shown to have different patterns of activation. Of importance here is that the aversive system has been show to activate more quickly and more vigorously than the appetitive system. This characteristic of the aversive motivational activation function is called the negativity bias. Initial activation in the direct perceptual, biological (e.g. motor), and motivational systems has been shown to be faster than neurological and cognitive responses to the environment and its contents. For example, Whelan, Hiebert and Pearson (1995) showed that changes in gait (biological) in response to direct perception of variations in the ground occurred before the information could have travelled from the foot to the brain and back again, given the speed of nerve propagation, as would have to happen if the gait change resulted from sensation based perception. Similarly, motivation based alteration in probe stimuli can be seen as early as 8 msec post probe onset. The motivational response can modulate the auditory nerve response at 8 msec post probe onset suggesting that the motivational system is faster than one of the fastest parts of the neurological system (Davis, 1997). Cognitive facilitation or inhibition of these automatic/reflexive actions comes somewhat later. This means that motivationally relevant information in the environment directly elicits biologically imperative responses. Its mere presence begins a response that may or may not be stoppable. If the response is very swift (e.g. a startle response (protective) or an orienting response (approach) they can't be stopped. If it's a slower acting response (e.g. moving forward or back, hiding, etc.) its continuation may be slowed by cognitive inhibition or sped up by cognitive facilitation.

6. Media as Part of the World

DHCCST argues that when an animal encounters motivationally relevant contents in the world they respond in an evolved biologically imperative manner. But what happens when motivationally relevant representations (e.g. pictures) and symbols (e.g. words) are encountered in the environment? Decades of communication research have supported the conclusion that responses to mediated information are very similar, at least at the neurological time scale, to responses to similar information in the world (Reeves & Nass, 1996). It has been found, in previous studies examining the processing of words and pictures, that pleasant and unpleasant words and pictures automatically activate the motivational systems (Lang, 2009; Lang & Yegiyan, 2009; Lee & Lang, 2009) with pleasant words and pictures eliciting appetitive activation and unpleasant words and pictures eliciting aversive activation (P. J. Lang, Greenwald, Bradley, & Hamm, 1993). Thus, both pictures and words elicit motivational activation but, due to the negativity bias, unpleasant pictures and words elicit more activation than pleasant pictures and words.

However, as discussed previously, we are arguing that when perceiving pictures, the biologically evolved

response, either aversive or appetitive, will begin immediately because the form of the motivationally relevant thing can be directly picked up from a picture. However, as time continues and there are no variants to accompany the invariants in the picture, the response may unfold in a less vigorous manner since there are no indications that the picture contains further motivationally relevant information (e.g. animate behavior). On the other hand, when a motivationally relevant word is encountered, there is no direct pickup of the form of the object, only the form of the word. Instead, the neurological response occurs identifying the shape of the word, which then triggers the biological response of identifying threat or opportunity and eventually the cognitive identification of the thing. For this reason, DHCCST argues that symbols (i.e. words) result in a slower, less vigorous, and more modifiable biologically imperative response and then enable its inhibition or facilitation.

These biologically imperative motivational responses happen automatically and quickly in order to support behavior towards opportunity and away from threat. Therefore, they can interfere with other ongoing behaviors. Research demonstrates that automatically elicited motivational responses interfere with and slow learned and ongoing behaviors (Boysen, Berntson, Hannan, & Cacioppo, 1996) and that the larger the biological imperative, the greater the interference with the task.

7. Processing Pictures and Words

What does this mean for the processing of pictures and words? The theory described above offers four basic propositions from which to predict human processing of words and pictures. First, pictures elicit bigger and faster biologically imperative responses than do words. Second, unpleasant things elicit larger biologically imperative responses than do pleasant things. Third, biologically imperative responses happen automatically, take time to occur, and affect not only the timing but also the trajectories of other behavior. They may speed certain types of related behavior (e.g. approaching, avoiding), but may interfere with and slow other behavior (e.g. accessing stored information, making decisions). Fourth, biologically imperative responses can be actively inhibited over time and that inhibition will be more successful during the delayed responses triggered by neuronal activation than during the direct activation of the response by pictures.

To test these propositions we have designed an experiment in which people view, on a computer screen, 60 pairs of matched motivationally relevant concrete pictures and words (e.g. the word apple, a picture of an apple). Half of the picture/word pairs are motivationally relevant and pleasant (e.g. food, sex, babies) and half are motivationally relevant and unpleasant (e.g. blood, death, weapons, snakes). Participants view and categorize the 120 pictures two times. Once, participants categorize as fast as they can, whether the thing on screen is a picture (representation) or a word (symbol) (called form categorization). The other time, they categorize whether the thing on screen is pleasant or unpleasant (called emotional categorization).

Applying the propositions, we expect slower categorization when biological imperatives are larger. Therefore, in general, (H1) pictures and (H2) negative things should have larger biologically imperative responses and be categorized more slowly than words and positive things.

The next prediction (H3) is that emotional categorization will be slower than form (word/picture) categorization. This is because neither the meaning nor the emotional valence of the word or picture is necessary to categorize whether it is a picture or a word. Therefore, the human system will self-organize, during this task, in such a way as to perform the task most successfully and efficiently. This means that people will automatically (and perhaps even intentionally) inhibit their motivational systems in order to decrease the interference of the biologically imperative response with the encoding system categorization task. This should reduce the size of the response and increase the speed of categorization. However, during the emotional categorization task, it is the activation of the motivational systems in response to the directly perceived stimulus that leads to the sensation of pleasantness or unpleasantness. In order to do this task efficiently participants' need the information provided by the biologically imperative response. Therefore, they will not inhibit the motivational systems (to the same degree), resulting in larger responses and slower categorization.

In addition, it is possible that there may be some interactions. For example, the difference in categorization speed between unpleasant pictures and unpleasant words will likely be larger than the difference between positive pictures and positive words. Research question 1 asks if there are any interactions.

8. Method

8.1. Experimental Design

A 2 (Task: Emotional categorization, Form categorization) × 2 (Encoding System: representation/picture, symbol/word) × 2 (Valence: Pleasant, Unpleasant) × 15 (pictures) fully within-subjects factorial design was used.

8.2. Independent Variables

Stimulus. The stimulus consisted of 60 words and 60 pictures which were representations of the words. The 60 words were concrete words selected from the Affective Norms for English Words (ANEW) system (Brad-

ley & Lang, 1999). The ANEW system contains over 1000 words that are normed for valence and arousal. Thirty of the 60 words chosen were rated as pleasant and 30 were rated as unpleasant. The 60 pictures were selected from Google Images to represent the words. The images were selected controlling for background and size. The focal object (which represented the word) was large and centrally foregrounded and backgrounds were simple and emotionally neutral.

Categorization Task. Participants completed two timed categorizations of the stimulus set. The form categorization task required participants to view the words and pictures in random order and indicate whether each was a word or a picture by pressing one of two indicated keys on the keyboard as quickly as possible. The emotional categorization task used the same procedure but participants were asked to categorize whether the word or picture was emotionally pleasant or unpleasant. Participants were instructed to use fingers on different hands. They used either the R-Shift (positive) versus L-Shift (negative) for the emotion categorization or R-Ctrl (picture) vs. L-Ctrl buttons (word), which are on opposite sides of the keyboard to complete the categorizations. The more natural position for using these keys was two hands, and this was the demonstrated positioning. The keys representing a category were the same for all participants. This should not be a problem as Woods, Wyma, Yund, Herron & Reed (2015) demonstrated that simple categorizations were not affected by handedness except in cases of lateral presentation. In this study there was no lateralization of stimuli. Pictures and words were always presented in the center of the screen.

8.3. Dependent Variables

Response Latency. Items were evaluated one at a time. Individuals were instructed to keep their fingers on the response keys and answer as quickly as possible without sacrificing accuracy. The time of evaluation for each image or word was collected in milliseconds from the time the item appeared to the time the participant pressed a response key. The accuracy of the categorization of each word and picture in both tasks (word/picture or pleasant/unpleasant) was monitored. Proportion correct was computed. Accuracy was slightly higher for the form task (97%) than the emotional valence task (89%).

8.4. Data Analysis

Measures were taken to deal with outliers in these latency data. For each categorization, reaction time outliers over and under 2.49 standard deviations from the mean were replaced with the value of that limit (Cousineau, & Chartier, 2010). In order to do this, Z-scores were calculated. Of the total 11,520 reaction time responses in both tasks, only 383 (3%) were replaced (187 in the emotional task and 196 in the form task). After replacing the outliers, the Z-scores were then calculated back into milliseconds for analysis. These data were then analyzed as raw data submitted to a 2 (Categorization Task: Emotional, Form) × 2 (Encoding System: Word, Picture) × 2 (Valence: Pleasant, Unpleasant) × 15 (Repetitions) repeated-measures ANOVA.

8.5. Participants

Participants (N = 48) were undergraduates in a telecommunications class and received extra credit in the course for their participation. 60% were females with a median age of 18.

8.6. Procedure

Participants completed the protocol individually. Upon arrival informed consent was obtained after all participants' questions were answered satisfactorily. Then, participants were seated at a laptop station equipped with MediaLab and DirectRT software (Jarvis, 2010), which were responsible for delivering the stimuli and collecting responses. Participants first engaged in an unrelated picture evaluation task. Next, participants completed the emotional and form categorization tasks in random order. Upon completion of these tasks, the participants completed a series of personality scales. Then, participants were thanked, debriefed and dismissed.

9. Results

Hypothesis one predicted that people would categorize pictures as pictures more slowly than they would categorize words as words. The main effect of encoding system was significant, $F(1,47)=17.64.$, $p<.00$, $\eta^2= .27$. The average categorization speed for pictures was slower ($M=706.10$, $SE=14.243$) than that found for words ($M=668.40$, $SE=11.40$) across both categorization tasks.

Hypothesis two predicted that classifying feelings would be slower than classifying form. The main effect of task was significant, ($F(1,48)=279.82$, $p<.00$, $\eta^2= .86$. On average people categorized how they felt much more slowly ($M=869.40$, $SE=20.47$) than form ($M=505.10$, $SE=10.57$).

Hypothesis three predicted that unpleasant pictures and words would be categorized more slowly than pleasant pictures and words. The main effect of valence only approached significance, $F(1,48)=2.62$, $p<.11$, $\eta^2= .05$, though it was in the correct direction. On average people categorized negative words and pictures more slowly ($M=695.99$, $SE=15.29$) than positive pictures and words ($M=678.51$, $SE=10.82$).

Research question one asked about the possibility of interactions. There were no significant interactions, though the task X valence interaction approached sig-

nificance, $F(1,47) = 1.84$, $p < .18$, $\eta^2 = .04$. During form categorization (when the motivational systems are inhibited) there is virtually no difference in the speed of categorizing words (M=503.31, SE=10.00) and pictures (M=506.90, SE=11.46). During valence categorization, however, pictures are categorized more slowly (M=885.09, SE=26.89) than words (M=853.71, SE=*18*.07), $t(47)=2.97$, $p<.01$.

10. Discussion

This paper uses DHCCST to reconceptualize communication from an evolved, embedded, embodied, dynamic perspective. The difference between pictures and words is considered to be a difference in perception. Pictures are thought to enable direct perception (or perception mediated by action) while words are thought to allow direct perception only of the shape of the word. Subsequent neurological and cognitive activity is required before the meaning of a word is understood (sensation mediated perception). For this reason it is argued that pictures elicit faster and more intense biologically imperative responses (associated with approach and avoidance), which interfere with ongoing tasks. Thus, pictures, through direct perception, elicit action, especially that action which is in service of biologically imperative behaviors (consuming food, finding mates, avoiding danger). Words on the other hand, elicit a delayed biological response which can then be inhibited or facilitated once it is activated. For this reason, words allow us to think about motivationally relevant material in a more cognitive and less motivational fashion.

Using this perspective it was predicted that 1) people would categorize pictures as pictures more slowly than they would categorize words as words; 2) that they would perform form categorization faster than emotional categorization, and; 3) that they would categorize negative words and pictures more slowly than positive words and pictures. Hypothesis 1 and 2 were supported. Hypothesis 3 was partially supported by the nearly significant task X valence interaction which showed no difference between pleasant and unpleasant pictures and words during form categorization but a significantly slower categorization of unpleasant compared to pleasant pictures and words during emotional categorization.

The primary importance of these findings may be that they provide initial support for the approach being advocated by DHCCST but there are also some implications for communication research. A great deal of communication research has focused on the use of pictures compared to text or television compared to print. In general pictures are found to be remembered somewhat better than text (Finnegan & Vishwanath, 1996), to elicit somewhat more attention (Houts et al., 2006), and to improve memory for text, especially when the topic of the picture or the news is concrete (David, 1998). In addition, it has been suggested that picture processing requires fewer cognitive resources compared to the processing of words (Lang et al., 1999). And while the evidence is somewhat mixed it has been suggested that pictures increase comprehension, attention, and memory even more for people with lower levels of literacy (Finnegan & Vishwanath, 1996; Houts et al., 2006).

The results of this study support the contention that concrete pictures, because they are directly perceived, activate very fast acting biological and motivational systems, which then slave the initial response of slower acting, higher order systems. This direct perception is not related to literacy or education or previous knowledge, but only to our nature as evolved humans. As a result, pictures, and in particular those that are threats or opportunities (i.e. motivationally relevant), will be perceived, attended to, and understood by these lower acting processes faster and at a lower level than the same information presented in words. This could be the underlying mechanism for the higher order cognitive effects described above.

It is also worth pointing out that the results of this study do not correspond to the predictions of more cognitive, information processing based approaches to the processing of words and pictures and standard interpretations of simple reaction time as it relates to processing, resource allocation, and attention. For example, the LC4MP argues that motivationally relevant compared to non-motivationally relevant media content both elicits a greater allocation of cognitive resources and requires their use. As a result, as motivational relevance increases motivationally relevant material is thought to be harder to process and to lead more quickly to cognitive overload. This prediction has been supported using secondary task reaction times and recognition as a combined indicator of available resource (i.e. resources allocated–resources required) both for audio (verbal/word) and visual (picture) information. To the extent that pictures and words are processed differently, the LC4MP argues that pictures may improve memory because they require fewer resources to process than words and therefore encounter cognitive overload less quickly compared to verbal and text stimuli. But these arguments of automatic processing and fewer resources for pictures do not translate into a prediction that pictures will categorized as pictures more slowly than words would be categorized as words. Rather the more likely prediction would be that motivationally relevant information (whether a picture or a word) should be categorized more quickly than non-motivationally relevant information and that effect would be larger for negative motivationally relevant information due to the negativity bias. But the results of this study are the opposite of that prediction. Instead negative motivationally relevant images are categorized as images more slowly than any of the other categories.

The results of this study are in line with communication research that theorizes that negative information (and in these studies primarily pictorial or audio/visual negative information) is compelling (Grabe & Kamhawi, 2006; Newhagen & Reeves, 1992; Shoemaker, 1996). This research is based on the idea that we evolved to keep track of threats in the environment and therefore that we automatically attend to negative information. Again, the suggestion here is that motivationally relevant pictures are indeed directly perceived and that the elicited biological imperative (which evolved to protect the animal) precedes and interferes with other tasks and processes. In other words, motivationally relevant pictures, in particular those of primary motivators such as sex, food, and danger, should interfere more with other tasks, thereby compelling the processing of the motivationally relevant material.

Finally, these results provide encouraging support for the DHCCST perspective. Future research in this area should be done to attempt to track the underlying processes theorized to result in the behavioral results found in this paper. For example, one idea would be to include neutral pictures and words as a comparison. DHCCST would predict that neutral words and pictures depicting objects would not differ in the time it takes to categorize form and valence (as pleasant, unpleasant, or neutral) because they would not elicit biologically imperative responses to delay and interfere with the task.

Building on direct perception research, future research could compare word/picture pairs of objects with those of pleasant and unpleasant animals. Given that animals are more consequential than objects (because they can engage in animate behavior) one might expect them to elicit larger biological responses than objects Building on theories of motivational relevance, future studies might also compare word/picture pairs that differ in their levels of motivational relevance. Some pairs might represent primary reinforcers (food, sex, blood, attacking animals) and others things that are merely pleasant and unpleasant (flowers, garbage, etc.) Here the prediction would be that the primary reinforcer word/picture pairs would have a larger biological imperative than the merely pleasant and unpleasant word/picture pairs. Building on the suggestion made earlier, that the shape of a word may become motivationally relevant over repeated pairings, might be tested by examining categorization speed differences in pairs of highly arousing and calm words of different frequency of occurrence in the English language. Finally, future research might use neurological and physiological indicators of motivational activation to ascertain if indeed emotional pictures lead to faster neurological and motivational responses compared to words and if motivational activation is lower during form compared to picture categorization. This would provide additional support for the notion that timed response data can be used as an indicator of the level of inhibition of the motivational systems.

Conflict of Interests

The authors declare no conflict of interests.

References

Bertenthal, B.I. (2007). Dynamical systems: It's about time! In S. Boker (Ed.), *Data analytic techniques for dynamical systems*. Hillsdale, NJ: Erlbaum.

Boysen, S. T., Berntson, G. G., Hannan, M. B., & Cacioppo, J. T. (1996). Quantity-based interference and symbolic representations in chimpanzees (Pan troglodytes). *Journal of Experimental Psychology: Animal Behavior Processes*, *22*(1), 76-86.

Bradley, M. M., & Lang, P. J. (1999). *Affective norms for English words (ANEW)*. Gainesville, FL: The NIMH Center for the Study of Emotion and Attention, University of Florida.

Cacioppo, J. T., & Bernston, G. G. (1994). Relationship between attitudes and evaluative space: A critical review, with emphasis on the separability of pleasant and unpleasant substrates. *Psychological Bulletin, 115*(3), 401-423.

Cacioppo, J. T., & Berntson, G. G. (1999). The affect system: Architecture and operating characteristics. *Current Directions in Psychological Science, 8*(5), 133-137.

Cacioppo, J. T., & Gardner, W. L. (1999). Emotion. *Annual Reviews: Psychology, 50*, 191-214.

Cacioppo, J. T., Gardner, W. L., & Berntson, G. G. (1997). Beyond bipolar conceptualizations and measures: The case of attitudes and evaluative space. *Personality and Social Psychology Review, 1*, 3-25.

Carr, T. H., McCauley, C., Sperber, R. D., & Parmelee, C. M. (1982). Words, pictures, and priming: on semantic activation, conscious identification, and the automaticity of information processing. *Journal of Experimental Psychology: Human Perception and Performance*, *8*(6), 757.

Clark, A. (2008). *Supersizing the mind: Embodiment, action, and cognitive extension*. New York: Oxford University Press.

Cousineau, D., & Chartier, S. (2010). Outliers detection and treatment: A review. *International Journal of Psychological Research*, *3*(1), 58-67.

David, P. (1998). News concreteness and visual-verbal association: Do news pictures narrow the recall gap between concrete and abstract news? *Human Communication Research, 25*(2), 180-201.

Davis, M. (1997). The neurophysiological basis of acoustic startle modulation: Research on fear motivation and sensory gating. In *Attention and orienting: Sensory and motivational processes* (pp. 69-96). New York: Psychology Press.

de Groot, J. H. B., Semin, G. R., & Smeets, M. A. M. (2014). I can see, hear, and smell your fear: Comparing olfactory and audiovisual media in fear communication. *Journal of Experimental Psychology: General*, *143*(2), 825-834. doi:http://dx.doi.org/10.1037/a0033731

Finnegan, J. R., & Viswanath, K. (1996). The knowledge gap hypothesis: Twenty five years later. In *Communication yearbook* (pp. 117-135). Thousand Oaks, CA: Sage.

Gibson, J. J. (2013). *The ecological approach to visual perception*. New York: Psychology Press.

Grabe, M. E., & Kamhawi, R. (2006). Hard wired for negative news? Gender differences in processing broadcast news. *Communication Research, 33*(5), 346-369.

Hofstadter, D. R. (2000). *Godel, Escher, Bach*: New York: Penguin.

Houts, P. S., Doak, C. C., Doak, L. G., & Loscalzo, M. J. (2006). The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. *Patient Education and Counseling*, *61*(2), 173-190.

Jarvis, B. G. (2010). *MediaLab research software*. New York: Empirisoft.

Kensinger, E. A., & Schacter, D. L. (2006). Processing emotional pictures and words: Effects of valence and arousal. *Cognitive, Affective, & Behavioral Neuroscience*, *6*(2), 110-126.

Lang, A. (2013). Discipline in crisis? The shifting paradigm of mass communication research. *Communication Theory*, *23*, 10-24. doi:10.1111/comt.12000

Lang, A. (2014). Dynamic human-centered communication systems theory. *Information Society, 30*(1), 60-70.

Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology*, *30*(3), 261-273. doi:10.1111/j.1469-8986.1993.tb03352

Lang, A. (2009). The limited capacity model of motivated mediated message processing. In R. Nabi & M. B. Oliver (Eds.), *The Sage handbook of mass media effects* (pp. 193-204). Thousand Oaks, CA: Sage.

Lang, A., Potter, R. F., & Bolls, P. D. (1999). Something for nothing: Is visual encoding automatic? *Media Psychology*, *1*(2), 145-163.

Lang, A., & Yegiyan (2009). Motivated message processing: How media elicit motivation which influences how media are processed. In J. McCroskey, K. Floyd, & M. Beatty (Eds.), *Biological dimensions of communication* (pp. 135-159). New York: Hampton Press.

Lee, S., & Lang, A. (2009). Discrete emotion and motivation: Relative activation in appetitive and aversive motivational system as a function of anger, sadness, fear, and joy during televised information campaigns. *Media Psychology*, *12*, 148-170.

Newhagen, J. E., & Reeves, B. (1992). The evening's bad news: Effects of compelling negative television news images on memory. *Journal of Communication*, *42*(2), 25-41.

Pearson, K. G. (1985). Are there central pattern generators for walking and flight in insects? In *Feedback and motor control in invertebrates and vertebrates* (pp. 307-315). New York: Springer.

Reeves, B., & Nass, C. (1996). The media equation: How people treat computers, television? New media like real people? Places. *Computers and Mathematics with Applications*, *5*(33), 128.

Riley, J., Greggers, U., Smith, A., Reynolds, D., & Menzel, R. (2005). The flight paths of honeybees recruited by the waggle dance. *Nature*, *435*(7039), 205-207.

Sherry, J. (2011). *Communication science in the 21st century*. East Lansing: Michigan State University.

Shoemaker, P. J. (1996). Hardwired for news: Using biological and cultural evolution to explain the surveillance function. *Journal of Communication*, *46*(3), 32-47.

Whelan, P. J., Hiebert, G. W., & Pearson, K. G. (1995). Plasticity of the extensor group I pathway controlling the stance to swing transition in the cat. *Journal of Neurophysiology*, *74*(6), 2782-2787.

Wilson, E. O. (1962). Chemical communication among workers of the fire ant Solenopsis Saevissima: The Organization of Mass-Foraging. *Animal Behaviour, 10*(1), 134-147.

Woods, D. L., Wyma, J. M., Yund, E. W., Herron, T. J., & Reed, B. (2015). Factors influencing the latency of simple reaction time. *Frontiers in Human Neuroscience*, *9*.

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Media and Communication (ISSN: 2183-2439)

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