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ECHO CHAMBERS AND FILTER BUBBLES OF FAKE NEWS IN SOCIAL MEDIA: MAN-MADE OR PRODUCED BY ALGORITHMS?



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Echo Chambers and Filter Bubbles of Fake News in Social Media: Man-Made or Produced by Algorithms?

Concerning fake news and deception on online media, some authors stress notions of “echo chambers” or “filter bubbles” in order to describe communities of people which believe the same (maybe false) propositions. In the popular press, the construction of such communities is made by “bad algorithms.” However, what is the truth and what are lies as well as deceptions? What is the role of the algorithms when it comes to forming filter bubbles and supporting echo chambers? And what are the roles of individuals and their information behavior (posting fake content as well as reading, commenting, liking, or sharing it) in this process? Are there human selection biases or really misleading algorithms? In this article, we are going to analyze the interrelationship of knowledge, information and truth, ranking algorithms with side effects of producing filter bubbles (with the example of Facebook’s sorting algorithm), and, finally and most important, the role of individuals in the process of making and cultivating echo chambers. Here, we empirically study the effects of fake news on the information behavior of the audience while working with two case studies, applying quantitative and qualitative content analysis of online comments and replies. We describe the reactions of audience members to deepen our understanding of the patterns of the users’ cognitive states. Do users really produce or live in echo chambers?

Keywords: Fake news, Deception, Social Media, Echo chamber, Filter bubble, Information behavior, Truth, Algorithms, Online posts, Online comments, Online replies

1. Introduction

“Whether we like it or not, deception happens every day and everywhere” [37, p. 3]. News on online press sites and on social media is no exception. Deceptive information “has had dramatic effect on our society in recent years” [57, p. 575]. Deceptions and fake news may possibly survive very well in environments of filter bubbles and echo chambers as well as in all kinds of social media, be it weblogs, microblogging services, or social networking services [55]. “Despite optimistic talk about ‘collective intelligence,’ the Web has helped create an echo chamber where misinformation thrives. Indeed, the viral spread of hoaxes, conspiracy theories, and other false or baseless information online is one of the most disturbing social trends of the early 21st century” [43, p. 60] leading even to the “emergence of a post-truth world” [36, p. 357].

However, why? For *The Guardian*, “social media filter bubbles and algorithms influence the (British, a/n) election” [27]; for the *Observer*, “the problem isn’t fake news, it’s bad algorithms” [28]; the University of Amsterdam’s *Master of Media* blog addresses filter bubbles as algorithms customizing our access to information [36]. These three examples clearly point out, what the cause for filter bubbles of fake news is: it is bad algorithms. Nevertheless, you may find divergent opinions in the popular press. The *New Statesman* claims, “Forget fake news of Facebook—the real filter bubble is you” [47]. Now, the cause of filter bubbles is the information behavior of individual people.

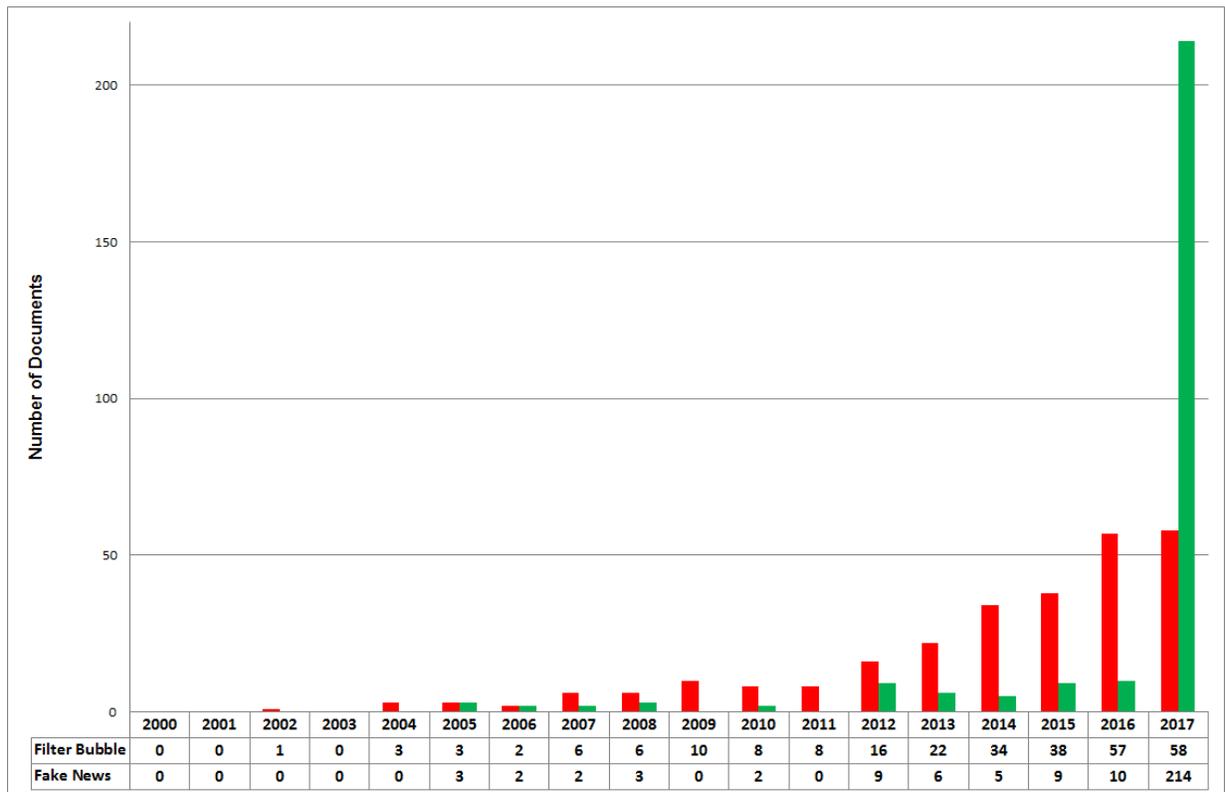


Figure 1 Articles on “Filter Bubble(s) / Echo Chamber(s)” (red) and “Fake News” (green) 2000 to 2017. *Source:* Scopus; Search arguments: (1) “filter bubble*” OR “echo chamber*” (TITLE-ABS-KEY), N = 272; (2) “fake news” (TITLE-ABS-KEY), N = 265.

These different estimations on the causes of echo chambers and filter bubbles directly lead to our central research question: Are echo chambers and filter bubbles of deceptions and fake news man-made or produced by algorithms? If echo chambers are supported by machines through the automatic construction of filter bubbles, how do such algorithms work? And if echo chambers are indeed man-made, what are the information behavior patterns of those individuals reacting on deceptions and fake news?

This paper is an interdisciplinary study including aspects of computer science, information science, and philosophy.

A brief bibliometric analysis on Scopus (Figure 1) shows that the number of scientific articles on “filter bubbles” and “echo chambers” increases slowly in the 2000s and stronger in the 2010s resulting in just under 60 articles in 2016 and 2017 each. Albeit there are some articles on “fake news” before the year 2017, there is a stark increase of papers in 2017—from 9 and 10 in 2015 and 2016 to a number of 214 in 2017. This figure exhibits the great current scientific interest on both topics “filter bubbles / echo chambers” as well as even more “fake news.” Especially historically relevant events as the UK’s Brexit vote, the 2016 presidential election in the United States, and the excessive use of the term “fake news” by Donald Trump led to discussions about the role of fake news and deception on the traditional press and social media. The related term “post-truth” was named word of the year 2016 by the Oxford Dictionaries [59].

2. Background

First of all, we should define our main concepts. *Fake news* is information including “phony news stories maliciously spread by outlets that mimic legitimate news sources” [55, p. 3977], it is misinformation (transmitting untrue propositions, nonconsidering the cognitive state of the sender) and disinformation (again, transmitting untrue propositions, but now consciously by the sender) [48]. *Deception* is a kind of disinformation, which brings an advantage to the sender.

A *user* of internet services acts as consumer (only receiving content), producer (producing and distributing content), and participator (liking or sharing content) on all kinds of online media [60]. In classical communication science we spoke of the *audience* of media; nowadays, especially on social media, audience members are called “users.”

Algorithms are sets of rules defining sequences of operations; they can be implemented as computer programs in computational machinery. In this article, the term “algorithm” is only used in the context of computer programs running on “machines.”

Filter bubbles and *echo chambers* are metaphorical expressions. An echo chamber describes “a situation where only certain ideas, information and beliefs are shared” [15, p. 1]. For Dubois and Blank [15, p. 3] a filter bubble means “algorithmic filtering which personalizes content presented on social media.” Both concepts are closely related; however, *echo chamber* is more on human information behavior and *filter bubble* more on algorithmic information filtering and results’ presentation in online services. Echo chambers are clusters of users with similar ideology or in-

terests; they occur “when people with the same interests or views interact primarily with their group. They seek and share information that both conforms to the norms of their group and tends to reinforce existing beliefs” [15, p. 3]. Users in echo chambers are on a media or content “diet” concerning a certain topic. Such a diet may result from *selective exposure of information* [35][50]. “The strongest form of the selective exposure proposition is that people prefer exposure to communications that agree with their pre-existing opinions” [46, p. 197]. A further explanation of the creation of man-made echo chambers relies on *priming*, as “priming is the activation of mental representations to influence subsequent behavior” [13, p. 139].

In contrast to traditional media with articles written by investigative journalists, especially social media documents are skipping the intermediation process. “Indeed, social media enabled a direct path from producers to consumers of contents—i.e., disintermediation—changing the ways users get informed, debate, and shape their opinions” [4, p. 1]. Prima facie, this sounds great. However, if we take a look on the other side of the coin “confusion about causation may encourage speculations, rumors, and mistrust” [4, p. 1].

News can be posted in a disclosed, anonymous, or from a bogus source. Anonymous sources are often concealed within a newsgroup or bulletin board where unaccountable expressions can be spread among a potential wide reader base. Bogus sources are defined as truly covert operations, but the sources seem authentic [2][3]. Additionally, there are the enablers. They are legit sites which inadvertently supply a platform for hoaxers [19]. These enablers are, for instance, some “Yellow Press” or clickbait articles, providing a wide spectrum of unverified news and eye-catching headlines [7]. Clickbait articles have distinctive characteristics. The headlines are exaggerated and often try to appeal to emotions. The article itself does not contain valuable content and commonly it is not true. Sensationalizing is the main principle of those articles.

Fake news is easily spread on social media. This can be partially attributed to website design and how the source presents the news. On Facebook, for instance, the fake news is shown in the same format as other links with a small icon validating which news source it originates from, making it difficult to understand if the news is credible.

Another take on fake news is the outlook on democracy. For political participation one needs to be informed correctly. This means a person cannot give their consent when they cast their vote, which makes demographic consent an illusion [18].

Other authors compare fake news to satire and parody, fabrication, manipulation, and propaganda [54]. All of these aspects are concerned with the two dimensions of the levels of facticity and deception [54].

The users’ appraisalment of a news story as fake or non-fake depends on the content of the story and—a little bit more—on the source of the transmitted information [59] as well as on the presentation format [30]. If we want to distinguish between fake (misinformation and disinformation) and non-fake (knowledge) we should know what knowledge, information, and truth are.

3. Knowledge, information, and truth

Only a proposition is able to be true or false. In epistemology, one kind of knowledge (“knowing that” in contrast to “knowing how”) is based on true propositions. Chisholm [8, p. 138] defines knowledge:

h is known by $S =Df$ h is accepted by S ; h is true; and h is nondefectively evident for S .

h is a proposition and S a subject; $=Df$ means „equals by definition.” Hence, Chisholm demands that the subject S accepts the proposition h (as true), which is in fact the case (objectively speaking) and that this is so not merely through a happy coincidence, but precisely “nondefectively evident.” Only if all three determinants (acceptance, truth, evidence) are present, knowledge can be seen as well and truly established. In the absence of one of these aspects, such a statement can still be communicated—as information—but it would be an error (when truth and evidence are absent), a supposition (if acceptance and evidence are given, but the truth value is undecided) or a lie, fake or deception (when none of the three aspects apply).

Knowledge cannot be transmitted as such; it is in need of a sender, data to be transmitted, a channel, and a receiver [53]. Information dynamically sets knowledge “into motion.” Knowledge always has a truth claim. Is this also the case for information, if information is what sets this knowledge in motion? Is there something like true or false information [53, p. 39]?

Apart from knowledge, there are further, related forms of dealing with objects. If beliefs, conjectures, or fakes are put into motion, are they not information? “Information is not responsible for truth value,” Kuhlen [32, p. 41] points out. Buckland [6, p. 50] remarks, “we are unable to say confidently of anything that it could not be information;” and Latham [33, p. 51] adds, “even untrue, incorrect or unseen information is information.” The task of checking the truth value of the knowledge, rather, must be delegated to the receiving subject S . She or he then decides whether the information retrieved represents knowledge, conjecture, or untruth. Therefore, it is terminologically very problematic to speak of “true/false *information*,” as only *propositions* are truth bearers.

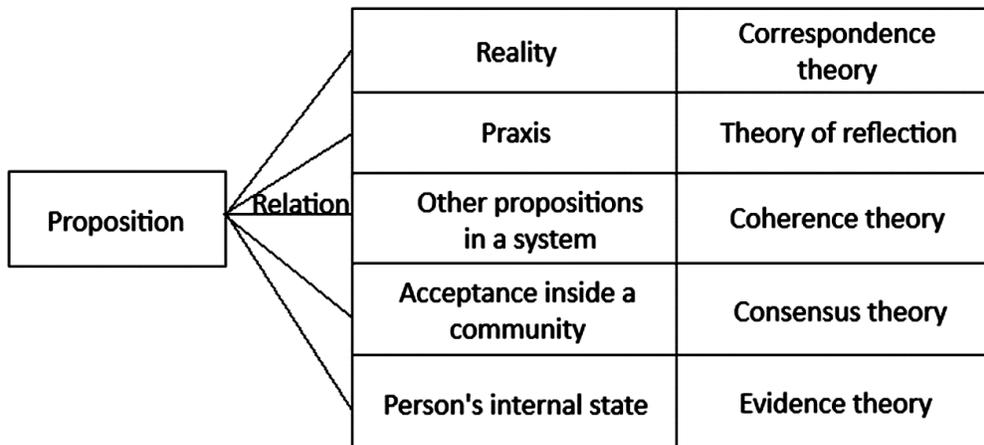


Figure 2 Truth theories.

Propositions, linguistically presented by declarative sentences, can be true or false. Here, one basic philosophical question arises. Even Pontius Pilate once famously asked “What is truth?” to which Jesus responded—with silence [59]. Truth is a relation between a proposition and a reference object. There are different truth theories working with different reference objects (Fig. 2).

A word on the *correspondence theory* of truth [10]: Although there are similar definitions of correspondence already in Aristotle’s work, the canonical form of this truth theory originates from the early 20th century. Bertrand Russell states, “(t)hus a belief is true when there is a corresponding fact and is false when there is no corresponding fact” [44, p. 129]. A person, which will make true propositions on a certain state of affairs in reality, must perceive (watch, hear, etc.) this part of reality personally, in real-time, and on site. In our context of journalism and social media, the person reporting on a state of affair makes a true proposition (“true” for his self-consciousness) when he luckily is in the right spot at the right time. In times of social media, the term “journalist” includes professional investigative journalism as well as citizen journalists reporting via channels like Facebook, Reddit, Twitter, or Periscope. For the audience of those journalists, there is no chance to verify or to falsify the correspondence between the read or heard proposition in the newspaper, the tweet, or the TV broadcast, and the part of reality, since they simply were not there. This is the reason why the correspondence theory of truth only plays a minor role, if any, in the context of fake or alternative news [38].

Accordance with the objective reality and personal awareness is the key factor of the *theory of reflection*. If the human mind contains truth is not a question of theory, but of praxis. In praxis (working, any decision procedure), humans have to proof the truth of their thinking in their practical behavior [41]. A sentence is true if its proposition works in practice. The problem with the theory of reflection is that it is impossible to consider all facts because they are always a product of selection. A problem of the media is that it sometimes takes a while to gather all facts to accurately use them in practice. By the time the facts were gathered the media momentum has passed [42].

The *coherence theory* of truth declares that one statement corresponds with another statement, or with the maximal coherent sum of opinions and accepted clauses of statements [40]. There cannot be an opposite statement within an already accepted system of statements. If the statement can be integrated, it is true, otherwise it is false. However, instead of rejecting the new statement, it is possible to change the whole system of statements to integrate the new one into the system. The statements need to be logically derivable from each other.

The definition of the *consensus theory* of truth states that truth is what is agreed upon by all people in a group. First, the speakers need to be clear in what they are saying to ensure that everyone understands what they mean, they are insinuating each other’s truthfulness and their words are accurate. A discourse needs to determine if the claim of the speaker is indeed to be accepted. Everyone needs to have the same level of influence to rule or to oppose [24]. Relying only on the consensus theory of truth is difficult and does not necessarily lead to the truth in the sense of the correspondence theory. As Albert [1, p. 238] states: “Even a consensus of an ideal community under ideal circumstances is not a substitute for truth.” We would like to illustrate

this widespread truth theory with a (rather unsavory) popular example: “Can millions of flies err?” They all believe in the “truth” that eating shit is delicious.

Brentano describes the *evidence theory* of truth, “When I have evidence, I cannot err” [5, p. 143]. A judgement is true if it expresses a simple quality of experience. Brentano adheres to the traditional view that there are two different ways for a judgement to be evident; either it is immediately, or it is evident insofar as it is inferable from evident judgements by applications of evident rules. But, evidence is a primitive notion; it cannot be defined, it is only experienceable, and thus, found in oneself.

The philosophical truth theories illustrate that truth or lies are in the eye of the beholder (evidence theory, theory of reflection), the community (consensus theory), or in the system of accepted propositions (coherence theory). As the correspondence theory of truth is not applicable in the environments of journalism and social media, we have big problems to state what exactly is true and what is not. If we do not know what *the* truth is, we also cannot know exactly what “fake news” is. It is the individual person, who decides, based on a (probably unknown) truth theory, what is considered as truth, as lies, as “true news,” and as “fake news.” By the way, attempts of automatic semantic deception detection [9] are faced with the same problems, especially when they rely on the coherence or the consensus theory of truth.

4. Relevance, pertinence, and ranking algorithms

The concept of relevance is one of the basic concepts of information science [53]. Users expect an information system to contain relevant knowledge, and many information retrieval systems, including internet search engines and social media services, arrange their results via relevance ranking algorithms. In information science, we distinguish between objective and subjective information needs. Correspondingly to these concepts, we speak of relevance (for the former) and pertinence (for the latter), respectively.

Since relevance always aims at user-independent, objective observations, we can establish a definition: A document, for instance, a website, a blog post, a post on Facebook or Reddit, or a microblog on Twitter (or, to speak more precisely, the knowledge contained therein) is *relevant* for the satisfaction of an objective (i.e. subject-independent) information need.

The research result can only be *pertinent* if the user has the ability to register and comprehend the knowledge in question according to his cognitive model. Soergel [49, p. 590] provides the following definition: “Pertinence is a relationship between an entity and a topic, question, function, or task with respect to a person (or system) with a given purpose. An entity is pertinent if it is topically relevant and if it is appropriate for the person, that is, if the person can understand the document and apply the information gained.” Pertinence ranking presupposes that the information system in question is able to identify the concrete user who works with the system; it is always subject-dependent ranking.

Facebook’s sorting of posts is a pertinence ranking algorithm; it works with the three factors af-

finity, weighting, and timeliness. According to these three aspects, a user will see posts on her or his Facebook page with the posts sorted in descending order of their retrieval status values [61]. Affinity is concerned with the user's previous interactions with the posting pages, with different interactions weighted differently. If a user frequently views another user's (say, user *A*) posts, likes them, comments on them or shares them, *A*'s future posts—depending on their weights (resulting from the numbers of likes, shares, and comments)—get a higher weight. Facebook also considers the position of the creator of the post (is this user often viewed, annotated, etc.?) and the nature of the post (text, image, or video). The timeliness states that a contribution becomes more important the newer it is. However, other factors play a role, and the algorithm is constantly being adapted. For example, an already viewed ranked list is not displayed a second time in exactly the same order (i.e., the criteria for the sorting are each slightly modified) in order to make the lists more interesting. Also, posts from people (as opposed to those from companies) are weighted higher, and the spatial proximity between the receiver and the sender of the post plays an important role. In particular, the affinity causes a user to see the one source at the top of his or her list, which he or she has often viewed in previous sessions.

The ranking on Facebook is always personalized and based on the user's common interests, her or his information behavior on the service, and her or his Facebook friends [56]. The more a user repeatedly clicks on the posts of the same people, the more the selection of posts stabilizes, which always appear at the ranking's top positions. Thus, in a short time—with high activity on Facebook—an information diet may occur that presents users only those posts on top of their pages, whose creators they prefer. So it can be assumed that such personalized content representation leads to “partial information blindness (i.e., filter bubbles)” [25, p. 330]. Nevertheless, this assumption could not be empirically confirmed [25].

It depends on the user to form a “friendship” on Facebook, and it is on the user to often select certain friends' posts for reading, liking, sharing, and commenting. Facebook's pertinence ranking algorithm indeed amplifies through filter bubbles ways into echo chambers, while the information behavior of the users plays the important primary role.

Here we arrive at a first partial result: Algorithms by themselves do not produce filter bubbles or subsequently echo chambers, they only consolidate the users' information behavior patterns. Concerning the reception of fake news, it is not possible to argue that they are solely distributed by “bad algorithms,” but by the active collaboration of the individual users. Also, Del Vicario et al., for instance, found out that “content-selective exposure is the primary driver of content diffusion and generates the formation of homogeneous clusters, i.e., ‘echo chambers’” [12, p. 554 f.]. DiFranzo and Gloria-Garcia arrive at a similar result. “The related filter-bubble effect is due to the user's network and past engagement behavior (such as clicking only on certain news stories), that is, it is not the fault of the news-feed algorithm but the choices of users themselves” [14, p. 33 f.]. There are results concerning fake news and the algorithms of Facebook: “While this criticism has focused on the ‘filter bubbles’ created by the site's [Facebook, a/n] personalisation algorithms, our research indicates that users' own actions also play a key role in how the site operates as a forum for debate” [45, p. 1]. Although algorithms are able to amplify filter bubbles, obvious-

ly, the users play the leading roles concerning construction and maintenance of echo chambers of (fake) news.



Figure 3 Triggering fake article about Hillary Clinton and her relations to the “Islamic State” on “The Political Insider.”

5. Patterns of cognitive processes of information behavior in response to deceptions and fakes: Two case studies

5.1 Methods

When we want to analyze echo chambers of fake news as well as deceptions, and believing as well as mistrusting such false propositions by individual persons, we have to study their cognitive processes in detail [23]. In our research study, we apply case study research and content analysis. As we are going to investigate which concrete cognitive information behavior patterns concerning fake news and deception exist, we start our endeavors with the help of concrete cases. Case study researchers “examine each case expecting to uncover new and unusual interactions, events, explanations, interpretations, and cause-and-effect connections” [26, p. 218 f.]. Our first case includes the first (probably fake) news and comments on it. It is the story on Hillary Clinton selling weapons to the Islamic State (Figure 3). Our second case contains reactions on Facebook after the disclosure of a deception. In the election campaign for the presidency of Austria, the candidate

(and later elected president) Alexander van der Bellen was called a cancer patient as well as demented and therefore unable to become president. Shortly afterwards, van der Bellen presented a bill of health by his doctor testifying that he is healthy (Figure 4). At this point our analysis starts. The case studies come from different continents; case no. 1 from the U.S., and case no. 2 from Austria. With these two cases, we are able to find cognitive patterns and to understand information behavior at two stages of the process of deception: on the one hand, at the time shortly after the publication of the fake post; on the other hand, at the time when the fake is disclosed. We translated all Austrian comments into English; however, for some propositions we additionally present the original version in Austrian German to show the terminological atticism.



Figure 4 Disclosure of the fake news on van der Bellen’s health on Vienna.at’s Facebook page.

To analyze the cognitive patterns of the commenting users, we apply quantitative and qualitative content analysis [31] of posts in social media. In order to create the appropriate categories for the content analysis, we applied both, inductive (or conventional) as well as deductive (or directed) measures [16][29]. By applying the conventional approach with a first and preliminary analysis of comments concerning the two cases, we defined the first codes; and we arrived at codes while studying relevant published literature. Every comment or reply was coded with only one (the best fitting) category. The coding process was conducted by two of the article’s authors, whereas all steps were conducted intellectually. In a first round, the coders worked independently; in a second round, the (few) disagreements became discussed and solved. In the end, there was an inter-coder consistency of 100 %.

Our approach is similar to research in microhistory describing posts and comments on social networking services in order to find information on historically relevant—especially local—events and developments [51][52]. Similar to our approach, Walter et al. [58] studied user comments in echo chambers concerning the topic of climate change. Gilbert et al. [22] defined agreement as manifestation of an echo chamber. They found that about 39% of all comments agree with the blog author, 11% disagree and half of all commentators react in other ways.

For case study 1, we consulted a weblog (*The Political Insider*, a right-wing oriented web site) (N = 43), Reddit’s subreddits *r/The_Donald* (a forum “for Trump supporters only”) (N = 177) and *r/worldpolitics* (a “free speech political subreddit”) (N = 246). For case study 2, we worked with a combined set of comments on Facebook published via *Der Standard* (the Facebook page of a leading Austrian daily newspaper) and *Vienna.at* (the Facebook site of Vienna’s city portal), both dated of August 31, 2016 (N = 186). We checked all comments and all replies to the comments manually. Analyzing literature and empirical material, we found different patterns of information behavior in response to fake news and deceptions and applied them as codes for our content analysis:

- Confirmation [4][20][22][46]: broad agreement with post, attempt of verification [55],
- Denial [4][20][22][46][58]: broad disagreement with post, attempt of falsification,
- Moral Outrage: questioning the posts, comments and replies from a moral point of view,
- New Rumor: creation of a new probably false proposition,
- Satire: satirical, ironic or sarcastic text,
- Off Topic: ignoring the discussion, arguing on other topics, broad generalization,
- Insult: defamation of other people or groups,
- “Meta” Comment/Reply: discussing the style of another post, offense against a commentator.

Additionally, we evaluated the topic-specific orientation (positive, negative, and neutral—similar to the values of sentiment analysis [53]) for all texts. *Positive* means an articulated or implicated agreement with the original post. If a comment, for instance, argues, “Clinton should be arrested” in response to the post “Hillary Clinton sold weapons to ISIS,” it is counted as positive. *Neutral* means that there is no relation to the concrete topic of the triggering post, e.g. “Obama is born in Kenya” as a comment on “Clinton sold weapons.” We aggregated all generations of replies (replies to a comment, replies to a reply, etc.) into the code “reply.”

5.2 Results

Concerning our case study no. 1, most comments on *The Political Insider* are confirmations of the (false) proposition; likewise, the comments’ orientation is predominantly positive (Table 1a). In both analyzed subreddits most comments (about 40 to 50 %) and even more replies (about 70 to 80 %) are off topic (Table 1b and 1c). In the subreddit *r/The_Donald* we found about 40 % agreement with the fake proposition for the comments; however, only 8 % for the replies.

About half of the comments in *r/The_Donald* expresses a neutral orientation; and the other half a

positive one; while most of the replies were neutral. Most comments and more than 80 % of the replies in *r/worldpolitics* are off topic and express no orientation concerning the given topic (i.e., the triggering post). The authors of *r/worldpolitics* are more critical than those of *r/The_Donald* as about 30 % of all comments were classified as denial (in contrast to 0 % in *r/The_Donald*).

The dominating cognitive patterns are arguments being *off topic*. The very first comment on *r/worldpolitics* was “time to put up or shut up,” which diverse authors regarded as an invitation to speculate on different political topics with loose or no relationship to the content of the post. We can find rather senseless texts as, e.g., “LOL who knew,” “Holy shit!!” or “Trump was right all along” (all from *r/The_Donald*). However, most of the off-topic comments and replies pursue a similar tendency, most notably attacking Obama and praising Trump in *r/The_Donald* or discussing the DNC (Democratic National Committee) in *r/worldpolitics*.

Sometimes, commentators are dissatisfied with the discussion and argue from a *meta position* as “I’m really not interested in engaging in a totally off-topic argument with you” (*r/worldpolitics*).

Some (however few) comments are *insults*, as, for instance, “Yet more proof that the people at the very top are, for all practical purposes, gangsters” (*r/worldpolitics*), “Obama is a piece of shit Globalist muslim” or “Aw, come on. Whadya expect from a fuckin’ Kenyan ‘born’ in Hawaii, raised in Indonesia, programmed and sponsored by the Saudi Manchurian School for Gifted Left-ists?” (both from *r/The_Donald*).

Table 1 Users’ cognitive patterns in reaction on a deception
(Case study 1: Hillary Clinton sold weapons to ISIS).

a) *The Political Insider*. Post: “Wikileaks CONFIRMS Hillary Sold Weapons to ISIS... Then Drops Another BOMBSHELL! Breaking News”

<i>Cognitive Pattern</i>	<i>Comments</i>	<i>Replies</i>
Confirmation	33.3 %	23.1 %
Denial	3.3 %	---
Moral Outrage	3.3 %	---
New Rumor	13.3 %	15.4 %
Satire	---	---
Off Topic	26.6 %	61.5 %
Insult	20.6 %	---
“Meta”	---	---
Positive Orientation	73.3 %	46.2 %
Negative Orientation	3.3 %	---
Neutral Orientation	23.3 %	53.8 %
<i>N</i>	<i>30</i>	<i>13</i>

b) *r/The_Donald*. Post: “Breaking Assange: Obama & Clinton not only supplied ISIS with a billion dollars worth of weapons annually, they paid these mercenaries salaries! Obama employed ISIS... let it sink in. Obama was the real leader of ISIS!”

<i>Cognitive Pattern</i>	<i>Comments</i>	<i>Replies</i>
Confirmation	40.8 %	7.9 %
Denial	---	4.0 %
Moral Outrage	---	---
New Rumor	5.3 %	5.0 %
Satire	1.3 %	2.0 %
Off Topic	47.4 %	78.2 %
Insult	5.3 %	3.0 %
“Meta”	---	---
Positive Orientation	48.7 %	11.9 %
Negative Orientation	---	5.0 %
Neutral Orientation	51.3 %	83.2 %
<i>N</i>	76	101

c) *r/worldpolitics*. Post: “Julian Assange: ‘1,700 emails’ proves Hillary Clinton sold weapons to ISIS in Syria.”

<i>Cognitive Pattern</i>	<i>Comments</i>	<i>Replies</i>
Confirmation	12.5 %	9.1 %
Denial	29.2 %	6.1 %
Moral Outrage	---	1.0 %
New Rumor	2.1 %	0.5 %
Satire	4.2 %	0.5 %
Off Topic	43.8 %	72.2 %
Insult	2.1 %	0.5 %
“Meta”	6.3 %	10.1 %
Positive Orientation	14.6 %	9.6 %
Negative Orientation	31.3 %	6.6 %
Neutral Orientation	54.2 %	83.8 %
<i>N</i>	48	198

Here, further cognitive patterns come into play: the construction of a *new rumor*. “The Hawaiian birth certificate (of Obama, a/n) was proven to be a forgery.” “Obama’s entire life is pure fiction, a 100% CIA creation.” “Hillary is the Mother of ISIS.” “They (Obama and Clinton, a/n) wanted this war in Syria, they wanted the refugee influx” (all from *r/The_Donald*).

Some *confirmations* (of the fakes) can be considered to be influenced by priming. For certain authors, Wikileaks is a very serious source; and they believe everything what Wikileaks publishes. “I don’t know what we’d do without Wikileaks?” or “Julian Rules. Thank you Wiki Leaks!” (both from *The Political Insider*).

In the subreddit *r/worldpolitics* (but next to nothing in *The Political Insider* and *r/The_Donald*) we found critical *denials* of the fake news as, for instance, “get suspicious when it’s only niche websites reporting stuff like this. If there were real evidence, every conservative site would make a front page” or “1700 mails about Libya proof that Hillary sold weapons to Isis in Syria? I don’t mean to comment on the allegations but I hate it when headlines are clearly bullshit.”

Table 2 Users’ cognitive patterns in reaction on the disclosure of a deception
(Case study 2: van der Bellen’s cancer).

Post: Der Standard: “Der is super beinand;” Vienna.at: “Es besteht kein Grund zur Sorge.” [“He is super healthy;” “There is no need to worry”.]

<i>Cognitive Pattern</i>	<i>Comments</i>	<i>Replies</i>
Confirmation	3.9 %	6.0 %
Denial	9.6 %	7.2 %
Moral Outrage	28.2 %	8.4 %
New Rumor	7.8 %	2.4 %
Satire	12.6 %	3.6 %
Off Topic	35.9 %	59.0 %
Insult	1.9 %	6.0 %
“Meta”	---	7.2 %
Positive Orientation	31.1 %	15.7 %
Negative Orientation	14.6 %	7.2 %
Neutral Orientation	54.3 %	77.1 %
<i>N</i>	<i>103</i>	<i>83</i>

We come to the second case study (Table 2). There is a clear result for the orientation. Most comments as well as replies are neutral, some are positive, and only a few are negative. (Please,

have in mind that “positive” here means that the user likes that the fake is disclosed.) Concerning the cognitive patterns of the commenting and replying users, we identified differences. There are much more off topic replies (59.0% in contrast to only 35.9% in comments). We could find moral outrages in 28.2% of all comments, but only in 8.4% of the replies. Satire and the creation of a (possible) new rumor happens more in comments than in replies; insults by contrast more in replies (here the users additionally have the chance to attack the commentators).

Similar to case study no. 1, here also the most frequent patterns of comments and replies are arguing *off topic* including generalizations and digressions. For instance, a user makes comparisons to a noninvolved politician. “Lately, I remember Jörg Haider again and again. His personal preferences were known to politicians and journalists, but were NOT made public.” That is a very general proposition: “Even a politician is a human being.”

The second most frequent patterns are *moral outrages*. “It is really sad that people acting in public have to justify their state of health because every effort is made to make them look bad.” Or, “It is embarrassing for Austria that you have to break the legal doctor-patient confidentiality in order to be able to resist malicious accusations.” Finally, “I think it is to feel embarrassed for somebody (zum Fremdschämen) that such measures need to be taken. ... There are limits, and to claim that someone is sick to death, only to gain a political advantage, is disgraceful (letztklassig)!”

Some users reacted with *satirical* or ironical comments, e.g., “Could I also find out information about Hofer (the other candidate for presidency, a/n)? It would be because of comparability (Wegen der Vergleichbarkeit warat’s). The author himself points out that his comment is meant satirical: “Be careful, this comment may contain traces of irony.” A user makes a joke on smoking and its consequences for health, as van der Bellen is a smoker. “Apparently, many previous findings are wrong ... Being a chain-smoker is not unhealthy ☺.” As the deception is disclosed, a user states, “Uh-oh. Now many new lies have to come up.”

Indeed, there are *new rumors* following the original, actually disclosed deception. There are constructions of new fakes concerning van der Bellen, and fakes on the opposite party. This user does not trust in the disclosure of the original fake, as doctors are called corrupt, “We all know how quickly doctors say or do something, if you kindly ask them ...” Here comes a new deception: “VdB (van der Bellen, a/n) did not get cancer—obviously a member of the illuminati.” Another user starts a rumor on Mr. Strache, a member of van der Bellens’ opposite party FPÖ, “Where is the negative cocaine finding of HC Strache?”

We found *insults* mainly in replies. “What else could one expect from the blue (FPÖ, a/n) and stupid breed? Hater gonna hate, I’d say (Was will man von der blauen und beschränkten Brut auch anderes erwarten. Hater gonna hate, würd ich mal sagen).” Some insults are addressed personally to one single commentator, “MM (name omitted), and you do not miss a leg (as Mr. Hofer has an injured leg, a/n) but a lot of brain.”

Some replies argue from a *meta level*, discussing not the topic, but the comment or the commentator, e.g. “Sadly, one has to think about such a comment to identify it as sarcasm.” Some other

replies start a discussion with a comment's author, "Does that matter play any role regarding his qualification as Federal President, Mr. XY?" Of course, there are also, however relatively few, comments and replies following the patterns of confirmation and denial. This is a typically *agreement*: "Good education, likeable person, healthy and able to climb a mountain (kommt an Berg rauf). There has never been a better presidential candidate." A rhetorically very interesting comment (however, only in Austrian German) is this *denial*: "I'm glad that he (van der Bellen, a/n) is very healthy. However, he should get his brain checked. If he thinks that 'Islamization in Europe' does not bother him, then he has an injury in his head ;) (Das freut mich, dass er pumperlgesund ist. Nur sollt er sich das Hirn untersuchen lassen. Wenn er meint 'die Islamisierung in Europa' stört ihn nicht, dann hat er fix a Della in da Jodldosn)."

5.3 Analysis

What can we learn from our two case studies? Do users indeed live inside an echo chamber? The answer depends on the concrete operationalization of "echo chamber."

If we narrowly define this concept as a community with high confirmation rates (in our case: for fake news) in combination with high degrees of positive topic-specific orientation (and further with the creation of new rumors with the same direction as the original fake), there are indeed hints for the existence of such communities. A third of the commentators of *The Political Insider* and about two fifth of the commenting audience of *r/The_Donald* seem to argue inside their echo chamber.

However, we can define "echo chamber" broader. As we know from the texts that off-topic comments and most of the neutral-orientation texts argue in the same direction as the entire community, the filter bubble may include most of these comments and replies: The content of the specific (false) proposition is entirely clear and taken for granted, so users lose the specific thread (from the triggering post); however, they do not lose the (ideological or political) direction. In the sense of this broad definition, depending on the source, up to about 90 % of comments (sum of confirmations and off topic comments) in *r/The_Donald*, about 60 % in *The Political Insider*, and about 55 % in *r/worldpolitics* exhibit hints towards the existence of echo chambers in those social media channels. Even when the fake in case study no. 2 is disclosed, still 10 % of the analyzed Austrian audience refuses to believe that it really was a false proposition. Obviously, this minority unteachable rests inside an echo chamber.

6. Conclusion

6.1 Main results

As the correspondence theory of *truth* is not applicable in mediated contexts [38], there remain truth theories which heavily depend on the community (consensus theory) and on the coherence of propositions (coherence theory), but do not point to *the* truth [59]. *Algorithms* (and their mechanisms to form filter bubbles) applied in social media themselves do not form communities alone;

however, they amplify users' information behavior. The crucial element of fake news and deceptions and their ways into social media is mainly on the individual *users*, their cognitive patterns and their surrounding echo chamber.

Reading (fake) news and eventually drafting a comment or a reply may be the result of users' selective exposure to information [20][46] leading to prefer news (including fake news) fitting their pre-existing opinions. Taking the (false) proposition as given, uncritically discussing it, while ignoring other opinions, argue further off topic (however, always in the same direction) thus can form and stabilize an echo chamber. In contrast to some empirical findings on echo chambers [17][21][39] we found clear hints for the existence of such communities. Depending on the concrete operationalization of "echo chamber," about one third to two fifth (narrow definition) and more than half of all analyzed comments and replies (broad definition) can be located inside an echo chamber.

Confirmative information behavior on fake news or deceptions goes hand in hand with the consensus and the coherence theory of truth. The (in the sense of the correspondence theory of truth basically false) proposition will be accepted "by normative social influence or by the coherence with the system of beliefs of the individual" [4, p. 2]. This behavior leads directly to a confirmation bias. Our results are predominantly in line with the theory of selective exposure of information.

However, it is not possible to explain *all* information behavior following fake news with the theory of selective exposure, but with a variety of further individual cognitive patterns. We were able to identify cognitive patterns outside of echo chambers as denial, moral outrage, and satire—all in all patterns of critical information behavior.

6.2 Limitations

This study has (as every scientific endeavor) *limitations*. In the empirical part of the study, we analyzed comments and replies on comments on social media. The publication of a comment or a reply on an online medium follows a decision-making process (should I indeed write a comment or a reply?). With our method, we are only able to gather data on individuals who have written such a text; all other remain unconsidered. We did not talk to the commenting and replying individuals. Therefore, we were not able to ask for intellectual backgrounds, motivations, and demographic details of the commentators.

We applied only two case studies. So the extent of the empirical data is rather limited. Although we collected and intellectually coded some hundreds of texts, that is like a drop in the bucket when faced with millions of posts, comments, and replies on social media.

A serious methodological problem (not only ours, but of all research relying on data from the internet) is the availability of complete data sets on, for instance, a fake news and *all* the comments and replies on the fake news as users and website administrators often delete discriminating posts, comments, or replies. We found hints for deleted comments or replies on *Facebook* as well

as on *Reddit*. In lucky cases (as in our case study no. 1 the post and the comments of the *The Political Insider*) you will find some deleted data on web archives.

We only analyzed texts on fake news in order to find cognitive reaction patterns. Research should also study in an analogous way reactions on true propositions. Are there the same cognitive patterns?

We distinguished between comments and replies and arrived at different cognitive patterns of the respective authors. Are there indeed different cognitive patterns while writing posts, formulating comments, and phrasing replies to the comments?

6.3 Outlook

What is new in this paper? As algorithms (as, for instance, Facebook’s ranking algorithm) only amplify users’ information behavior, it is on the individuals themselves to accept or to deny fake news and denials uncritically, try to verify or to falsify them, ignore them, argue off topic, write satire, or insult other users. If filter bubbles are made by algorithms and echo chambers by users, the echo chambers influence the filter bubbles; however, filter bubbles strengthen existing echo chambers as well.

There are different cognitive patterns of the individual user leading to different reactions on fake news and deceptions. Living in echo chambers (namely the uncritical accepting of the news due to own pre-existing opinions shared within a group or compared with a set of propositions) indeed is a typical, but not the only cognitive pattern.

Therefore, a “critical user” seems to be the decisive factor in identifying and preventing fake news and deceptions. Our analysis at the beginning of this paper has shown that there is no satisfying answer to what can be considered *the* truth in media. In the end—and this is in line with Chisholm’s definition of knowledge [8]—it is just a critical user who compares sources and validates the timeliness and evidence of a contribution before believing, denying, or ignoring it and then decides whether it is true or false. So, finally, it is on the individual user’s critical literacy, information literacy, digital literacy, and media literacy. However, this is another research project.

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