Fake online reviews: a literature review, synthesis and directions for future research

Abstract: Fake online reviews in e-commerce have substantially affected online consumers and legal merchants and subsequently destroyed overall social welfare and market efficiency. Despite the effort of researchers to examine fake online reviews, some important questions remain unanswered. Moreover, existing studies only have partial understanding of fake online reviews. For example, the majority of these studies merely focus on fake online reviews posted by merchants and disregard individual consumers and review platforms that may also post fake online reviews. The current study reviews the existing literature on fake online reviews and proposes an antecedent–consequence–intervention (ACI) conceptual framework. The ACI framework is used to develop an initial research agenda for fake online reviews with 13 open-ended questions and 15 propositions. This study contributes to the overall understanding of the existing research in this area and highlights the related challenges and promising research directions. Lastly, we provide the theoretical and practical implications of the current research. This study draws attention to fake online reviews in various aspects and assists practitioners in understanding the antecedents and consequences of fake online reviews.

Keywords: electronic commerce; fake review; online review; literature review; antecedents and consequences

1. Introduction

Prior studies have proposed figures to describe the proportion of fake online reviews in e-commerce from different domains, such as restaurant reviews on Yelp, hotel reviews on TripAdvisor, and book reviews on Amazon. This proportion ranges from 16% (Luca et al. 2016), 20% (Schuckert et al. 2016), 25% (Roberts 2013; Munzel 2016), to 33.3% (Salehi-Esfahani et al. 2018). As early as 2012, approximately 10.3% of online products were subjected to review manipulation (Hu et al. 2012). Furthermore, fake online review prevalence continues to escalate at present (Hunt 2015).

Some famous cases also demonstrate the seriousness of fake online reviews in e-commerce. For instance, in 2012, the Advertising Standards Authority in the UK found TripAdvisor to be

involved in fake reviews as approximately 50 million online reviews in the site cannot be verified as trusted (Travelmail Reporter 2012). In 2013, Samsung was ordered to pay a $340,000 fine by the Taiwan Federal Trade Commission for posting negative fake reviews to its competitor, HTC (Bates 2013). In 2015, Amazon sued 1,114 unidentified people for posting deceptive reviews (Gani 2015). In 2018, Mafengwo.com, a famous tourism platform in China, was involved in data fraud, such as duplicating online reviews from competitors, and the platform subsequently admitted the fake review issue (Zhao 2018).

All sectors of society spend many efforts in detecting and punishing fake online reviews to restrict their prevalence. Governments continually perfect legal systems and make great efforts in supervising online sellers and platforms. In 2013, the Attorney General of the State of New York spearheaded "Operation Clean Turf," which is a year-long undercover investigation that aims to identify and expose firms that create fake online reviews (Schneiderman 2013). In 2018, China enacted the first E-commerce Law and stipulated that merchants cannot conduct false or misleading commercial promotions to defraud or mislead consumers with fictional transactions, fabricating online reviews, or any other means (CIRS 2018). Furthermore, many practitioners and scholars have continuously developed algorithms to detect fake online reviews and assert that their algorithms have achieved a high percentage of accuracy (Cardoso et al. 2018; Dewang et al. 2018). Yelp, one of the industry leaders in review platforms, has also developed its own algorithms to detect fake online reviews and filter them off (Luca et al. 2016).

However, the effect of reducing fake reviews is unclear when only external efforts are taken. Developing computerized algorithms to identify fake reviews only place high emphasis on treating the symptom from a methodological perspective, rather than thoroughly understanding the root causes of fake online reviews. Many fake reviews still exist online regardless of algorithms with high detection rates because smart promulgators frequently post novel fake reviews endowed with new features that evade filter detection.

The phenomenon of fake online reviews has increased in complexity. Driven by various ulterior motives, relevant interested parties, such as vendors, retailers, and platforms, may fall into the trap of manipulating online reviews (Hu et al. 2011; Gössling et al. 2018; Lee et al. 2018). Online sellers may tend to release positive fake reviews of their own products or negative fake reviews of competitors' products for financial gains (Wang et al. 2018). Platforms may be inclined to acquiesce to these manipulations and actively add fake reviews to increase traffic and consumer engagement (Lee et al. 2018). Individuals may post fake online reviews for various reasons, such as seeking opportunities (Salehi-Esfahani et al. 2018). However, most studies only consider that fake online reviews are posted by online sellers with the aim of maximizing their profits.

The understanding about fake online reviews is limited, and their antecedents and

consequences need to be comprehensively explored. Despite existing studies, a number of important questions about fake online reviews are still unanswered. To directly and deeply comprehend this phenomenon, open-ended questions about fake online reviews are presented and the related literature published in academic journals are reviewed and analyzed.

The value of this study lies in its comprehensive review of the articles in the subject area. It exploits the antecedents and features studied by prior researchers and the influencing mechanisms, detection algorithms, and other control measures. On the basis of these findings, this study generates a roadmap and reference for both academics and researchers; and provide directions for future research studies in fake online reviews.

2. Research design

To understand fake online reviews, we search and analyze journal articles related to fake online reviews retrieved in the Science Citation Index (SCI) and Social Science Citation Index (SSCI), which cover majority of high-quality academic journals (Ngai et al. 2002; Ngai et al. 2015).

As some similar terms of "fake review" are used in related journal articles, we search the related literature using descriptors "fake review," "deceptive review," "bogus review," "spam review," "spam opinion," "review manipulation," and "online review." The search process originally produced 822 journal articles written in English as of February 2019. The full text of each article is strictly and independently verified by co-authors to ensure that all selected articles are actually related to fake online reviews. To minimize any possibility of personal bias affecting the selection of articles retrieved, each paper is classified in accordance with the proposed conceptual framework. The classification process follows the three steps: classifying articles selected by one co-author, verifying the classification with another co-author and double checking with another independent co-author, and approving the categories assigned to the article if the classification results are consistent or hold a discussion among researchers to reach a consensus. As a result, 75 journal articles are identified as relevant for the next analysis.

The 75 selected journal articles, which are distributed across 59 journals, are first analyzed by publication information. Most of these journals are in the fields of computer science and information systems, including "*IEEE Transactions on Information Forensics and Security*," "*IEEE Transactions on Knowledge and Data Engineering*," "*Information Systems Research*," and "*Journal of Management Information Systems*." "*Expert Systems with Applications*" and "*Decision Support Systems*" contain 12% (nine of 75) of the total number of articles. Moreover, other leading journals in the fields of economics and management, marketing, and tourism pay attention to fake online reviews, such as the "*American Economic Review*," "*Management Science*," "*Production and Operations Management*," "*Journal of Marketing Research*," "*Marketing Science*," and "*Tourism Management*."

The distribution of the 75 selected journal articles by publication year is shown in Figure 1. In 2006, an article published in "*Management Science*" (Dellarocas, 2006) proactively began to pay attention to opinions manipulation. Since 2013, the related publications have significantly increased. Moreover, in the last two years, many related papers have been published.
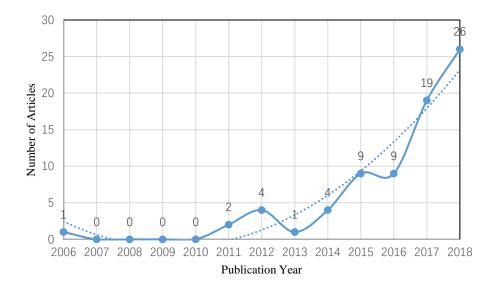

Figure 1 Distribution of articles by publication year

The next step is to thoroughly analyze the selected articles. The analysis is conducted in accordance with the proposed conceptual framework and research issues. By answering the open-ended questions, we offer propositions to help us understand fake online reviews. After summarizing the findings and limitations of these studies, we discuss the challenges and future research directions of the current study.

3. Conceptual Framework and Research Issues

We articulate an antecedent–consequence–intervention (ACI) conceptual framework. Accordingly, we use this framework to develop an initial research agenda for fake online reviews comprising 13 open-ended questions spanning antecedents, features, consequences, and interventions.

3.1 ACI Conceptual Framework

In recent decades, some studies have advanced an input–process–outcome (IPO) framework or implemented an adapted version of an IPO framework to study the antecedents and consequences of team effectiveness (McGrath 1964), transactive memory systems (Ren et al.

2011), online brand community participation (Madupu et al. 2010), organizational citizenship behavior (Chahal et al. 2010), and firms' process innovation capability (Frishammar et al. 2012). In the IPO framework, the inputs and outcomes describe the antecedents and consequences of the studied objects, while various antecedents are combined to derive the process of the studied objects (Mathieu et al. 2000; Mathieu et al. 2008).

An antecedent is the starting point of the development process of fake online reviews. Thus, we need to understand the antecedents, including the definition of fake online reviews, reasons for their emergence, and motivations for posting such reviews. In particular, we aim to examine the "what, why, who, when, where, and how" of posting fake online reviews.

The emergence of fake online reviews has prompted many studies to start examining the features of such reviews. Evidently, accurately realizing the features of fake online reviews will enable us to substantially identify and avoid their hazards. We specifically aim to realize the features, spreading features, and distributions of fake online reviews.

The influencing mechanisms of fake online reviews are crucial. First, the emergence of fake online reviews undoubtedly affects the development of online product reviews. Second, we should clearly realize how fake online reviews affect stakeholders. Third, the effects of fake online reviews on the overall market and society is also important.

Similar as team effectiveness and transactive memory systems, the antecedents and consequences of fake online reviews should be realized. Unlike these studied objects, fake online reviews can be damaging, thereby underscoring the urgency of exploring intervention measures for fake online reviews. The direct intervening measure should be detection methods. However, merely proposing detection methods is insufficient to effectively reduce fake online reviews. We also need to explore how stakeholders can respond to these types of online reviews.

Therefore, we extend the IPO framework to propose the ACI conceptual framework (see Figure 2). Accordingly, understanding the ACI framework contents can help us understand fake online reviews. From the existing literature review, we determine that further research is necessary to understand a few aspects of fake online reviews. Hence, we offer 15 propositions for future studies (see Figure 2).
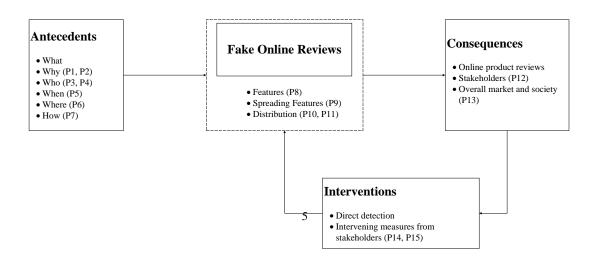

5

Figure 2 The ACI conceptual framework for understanding fake online reviews

3.2 Open-Ended Research Questions

We use the ACI framework to develop an initial research agenda for fake online reviews comprising 13 open-ended research questions spanning antecedents, features, consequences, and interventions of fake online reviews. These proposed research questions are presented in the Table 1.

Table 1 Open-ended research questions

Domain	Open-ended Research Questions
Antecedents	RQ1.1: What are fake online reviews?
	RQ1.2: Why do interested parties post fake online reviews?
	RQ1.3: Who (which types of parties) have higher motivations to post fake online reviews?
	RQ1.4: When (under what conditions) and where are interested parties more prone to post fake online reviews?
	RQ1.5: How do the interested parties post fake online reviews?
Features	RQ2.1: What are the features of fake online reviews?
	RQ2.2: What are the spreading features of fake online reviews?
	RQ2.3: How are fake online reviews distributed?
Consequences	RQ3.1: How do fake online reviews affect the development of online product reviews?
	RQ3.2: What are the influencing mechanisms of fake online reviews on the stakeholders, such as consumers, online sellers, and platforms?
	RQ3.3: How do fake online reviews affect the overall market or society?
Interventions	RQ4.1: How about the existing methods in detecting fake online reviews?
	RQ4.2: What can stakeholders, such as consumers, online sellers, and platforms, do to effectively respond to fake online reviews?

4. Analyses and Propositions

This section follows the ACI conceptual framework. We conduct detailed analyses for the identified articles to answer these open-ended research questions raised in the previous chapter

from four aspects: antecedents, features, consequences, and interventions (Table 2).

Table 2. Classification of studies in terms of the open-ended research questions

Research Questions	Studies	N
Antecedents		
RQ1.1 What	Hu et al.(2011b); Hu et al.(2012); Anderson and Simester (2014); Hunt (2015); Choi et al.(2017); Wang et al.(2018b).	6
RQ1.2 Why	Dellarocas (2006); Anderson and Magruder (2012); Anderson and Simester (2014); Filieri et al. (2015); Heydari et al.(2015); Choi et al.(2017); Gössling et al. (2018); Lee et al. (2018); Petrescu et al.(2018); Wang et al. (2018a).	10
RQ1.3 Who	Hu et al.(2011a); Hu et al.(2011b); Anderson and Simester (2014); Mayzlin et al.(2014); Luca and Zervas (2016); Choi et al.(2017); Cardoso et al.(2018); Li et al.(2018); Zhuang et al.(2018).	9
RQ1.4 When & Where	Hu et al.(2011a); Luca and Zervas (2016)	2
RQ1.5 How	Mayzlin et al.(2014); Li et al.(2018)	2
Features		
RQ2.1 Difference	Huang et al.(2012);Anderson and Simester (2014); Ong et al. (2014);Banerjee and Chua (2017a); Banerjee and Chua (2017b); Kleinberg et al.(2018); Petrescu et al.(2018).	7
RQ2.2 Spreading	Ahmad and Sun (2018).	1
RQ2.3 Distribute	Dellarocas (2006); Hu et al. (2011b); Mathews Hunt (2015); Lappas et al.(2016); Luca and Zervas (2016); Munzel (2016); Schuckert et al.(2016); Salehi-Esfahani and Ozturk (2018);	8
Consequences		
RQ3.1 On "online review"	Zhao et al.(2013); Wan and Nakayama (2014); Luca and Zervas (2016); Song et al.(2017); Zhang et al.(2017); Petrescu et al.(2018).	6
RQ3.2 On "stakeholders"	Dellarocas (2006); Hu et al. (2012); Zhao et al. (2013); Anderson and Simester (2014); Filieri et al.(2015); Mathews Hunt (2015); Lappas et al.(2016); Munzel (2016); Pranata and Susilo (2016); Liu et al.(2017); Song et al.(2017); Zhang et al.(2017); Ahmad and Sun (2018); DeAndrea et al. (2018); Feng et al. (2018); Zhuang et al.(2018); Petrescu et al. (2018).	17
Q3.3 On "market/society"	Mathews Hunt (2015); Song et al.(2017); Zhang et al.(2017).	3
Interventions		
RQ4.1 Detection methods	Hu et al. (2012); Wang et al. (2012); Fusilier et al. (2015); Hammad and El-Halees (2015); Heydari et al. (2015); Rahman et al. (2015); Ren et al. (2015); Zhu et al. (2015); Heydari et al. (2016); Savage et al. (2015);Sun et al. (2016); Wang et al. (2016); Zhang et al. (2016a); Zhang et al. (2016b); Cagnina and Rosso (2017); Catal and Guldan (2017); Hool et al. (2017);Hernández-Castañeda and Calvo (2017); Liao et al. (2017); Li et al. (2017); Ren and Ji (2017); Rout et al. (2017a); Rout et al. (2017b); Shehnepoor et al. (2017); Viviani and Pasi (2017); Xu and Zhang (2017); Akram et al. (2018); Dong et al. (2018); Hazim et al. (2018); Kleinberg et al. (2018); Kumar et al. (2018); Li et al. (2018); Liu and Pang (2018); Rajamohana	41

	and Umamaheswari (2018); Wang et al. (2018a); Wang et al. (2018c); Yuan et al. (2018a); Yuan et al. (2018b); Zhang et al. (2018b); Zhang et al. (2018a); Zhang et al. (2018c).	
RQ4.2 Respond strategies	Hunt (2015); Lappas et al. (2016); Zhang et al.(2017); Ivanova and Scholz (2017); Song et al. (2017).	5

4.1 Antecedents of Fake Online Reviews

4.1.1 What: Definition of fake online reviews (Q1.1)

Most studies in the extant literature just analyzed one type of fake online review and did not comprehensively consider various aspects of such reviews. This research gap can be reflected from the existing definitions of fake online reviews.

Hu et al. (2011b) defined review fraud as an act occurring when online vendors, publishers, or authors write "consumer" reviews by posing as real customers. Hu et al. (2012) defined review manipulation as an act when vendors, publishers, writers, or any third-party monitor online reviews and post non-authentic online reviews on behalf of customers to boost their product sales. This definition tends to consider that only online sellers can post fake online reviews and ignores the typical phenomenon that real consumers also perhaps post fake online reviews. Subsequently, Hunt (2015) suggested that fake reviews are false, misleading, and deceptive communications in a digital environment, which do not "reflect the genuinely held opinion of the author." Although this definition is more advanced than the prior definitions, it does not consider that some incentivized online reviews reflect the genuinely held opinion of the author. In addition, it continues to mislead consumers who cannot receive the incentive. We then try to develop a definition of fake online reviews to consider various types on the basis of these existing definitions.

Most existing definitions suggest that fake online reviews are merchants' dominant behavior. Merchants, such as vendors, publishers, and retailers, look for people to post fake online reviews and offer compensation in return (Choi et al. 2017). Nonetheless, fake online reviews are firms' strategic (Wang et al. 2018) and individual behaviors. While individual consumers perhaps receive incentives from merchants to affect product ratings, some consumers who may have no financial incentive also do so (Anderson et al. 2014).

Through summarizing these literatures, therefore, we define fake online reviews as false, bogus, and deceptive reviews, which are inconsistent with actual evaluations of products or services themselves. The main feature by which we judge fake online reviews is whether they mislead others. Fake online reviews can be posted by various kinds of people, including individual consumers, online merchants, and review platforms.

4.1.2 Why: Reasons causing fake online reviews (Q1.2)

We intend to find the reasons behind the release of fake reviews by relevant interested parties. The essential reason should be pecuniary motivation. The effect of online product reviews on merchants' profits is significant. Studies have confirmed that online product reviews directly affect consumers' purchase decisions (Heydari et al. 2015; Kostyra et al. 2016; Choi et al. 2017; Watson et al. 2018) and product reputations (Filieri et al. 2015; Petrescu et al. 2018), and affects the sales volumes and profits of merchants (Chevalier et al. 2006; Dellarocas 2006; Cai et al. 2009). For instance, some studies found that a 1% increase in hotel review ratings may increase sales per room by approximately 2.6% in Paris and London (Öğüt et al. 2012; Gössling et al. 2018). An extra half-star rating causes restaurants to sell out 19 percentage points more frequently (Anderson et al. 2012). While positive online product reviews yield considerable financial gains, negative online product reviews cause monetary loss (Wang et al. 2018).

Competition is another reason causing the emergence of fake online reviews. Lee et al. (2018) suggested that competition can lead to the manipulation of movie reviews. Online product reviews can cause fierce competition and promote the formation of consumer decision-making cultures (Gössling et al. 2018). For instance, the results from 20 semi-structured interviews with accommodation managers reveal that managers fell into the prisoner's dilemma in manipulating online product reviews (Gössling et al. 2018). Anderson et al. (2014) pointed out three reasons of individual consumers in posting fake online reviews: upset customers, self-appointed brand managers, and social status. Therefore, we understand that merchants who manipulate online product reviews are mainly driven by profits and competition, and that individual consumers post fake online reviews because of the below three reasons: upset customers, self-appointed brand managers, and social status.

Our summary of the existing literature enables us to qualitatively realize why merchants and individual consumers post fake online reviews. However, a single study that focuses on individual consumers is insufficient. Thus, we encourage that additional studies be conducted to reveal the reasons why individual consumers post fake online reviews. Evidently, we still have limited understanding of the reasons why review platforms, such as Mafengwo.com, post fake online reviews. In contrast to ordinary businesses, in which profits are mainly dictated by prices, demands, and costs of their products (Levin et al. 2008; Berger et al. 2013), such platforms as Yelp, Amazon, TripAdvisor, and eBay, provide a space for merchants to sell their goods and allow people to write public reviews. Their profits primarily come from two sources, namely, commission revenues from the merchants selling products and advertising revenues from the advertisements in the platform (Mayzlin et al. 2014). Thus, we consider that platforms post fake online reviews because review manipulation increases commission and advertising revenues. Although fake online reviews destroy the reputation of platforms, the additional

profits provided by fake online reviews should be higher than the potential loss of the affected reputation. Therefore, Proposition 1 (P1) is presented as follows:

P1: Fake online reviews attract traffic and consumer engagements in the platform and increase commission and advertising revenues for the platform. At present, the additional profits provided by fake online reviews are higher than the potential loss of the affected reputation.

Another gap in the literature is that the existing studies merely qualitatively analyze the reasons and fail to quantify the motivations. Hence, quantifying the motivations of stakeholders to post fake online reviews can facilitate the realization of the underlying reasons. To quantify the motivations, we can focus on the effects of fake online reviews on the evolutional development of such reviews and the number of consumers. Therefore, Proposition 2 (P2) is presented as follows:

P2: Fake online reviews affect the evolutional development of online reviews and consumers' purchase behaviors. The motivations of posting fake online reviews can be quantified by comparing the dynamic differences of these indicators with and without fake online reviews.

4.1.3 Who: Promulgators of fake online reviews (Q1.3)

The behavior subject is also a key point of research. From firms' perspective, those with small owners and small management companies (Mayzlin et al. 2014), weak brands (Zhuang et al. 2018), low ratings (Li et al. 2018), and inferior quality (Hu et al. 2011) have high motivation to post fake online reviews. Most studies consider that fake online reviews are mainly posted by firms associated with inferiors. However, the famous case wherein Samsung posted negative fake reviews on HTC (Cardoso et al. 2018) emphasizes that firms with strong brands, high ratings, superior quality, and competitive advantages have a high probability of posting fake online reviews when faced with fierce competition (Hu et al. 2011; Luca et al. 2016). From consumer's perspective, powerless individuals are more prone to write fake reviews than powerful individuals (Choi et al. 2017).

The existing literature help us understand the promulgators of fake online reviews. Merchants with weak brands, low ratings, inferior quality, or fierce competition have high motivations to post fake online reviews, while individuals receiving incentives have a high probability to post fake online reviews. Other superior merchants, individuals without financial incentives, and online review platforms may also post fake online reviews.

The existing studies mainly focus on promulgators with high probabilities to post fake online reviews but disregard other low-probability promulgators. In the future, we should explore which types of review platforms post fake online reviews and the underlying

psychological mechanism that cause individual consumers to post such online reviews.

Individuals without financial incentives may also post fake online reviews (Anderson et al. 2014). However, the underlying mechanism remains unclear. Opportunism may be an effective explanation for stating that individuals post fake online review without financial incentive. Opportunistic consumers may attempt to gain monetary service recovery or pursue other objectives by posting negative fake reviews (Salehi-Esfahani et al. 2018). Thus, we present Proposition 3 (P3) for future research.

Mafengwo.com was reportedly involved in data fraud for duplicating online reviews of competitors; this platform subsequently admitted the fake review issue (Zhao 2018). Evidently, review platforms also post fake online reviews. However, no studies have yet to focus on review platforms or the promulgators of fake online reviews. In P1, we propose that review platforms may post fake online reviews when the additional profits provided by fake online reviews is higher than the potential loss of the affected reputation. When the profits of review platforms mainly rely on the commission revenues, these review platforms obtain additional profits from fake online reviews. Therefore, Proposition 3 (P3) is presented as follows:

P3: Fake online reviews are also posted by opportunistic consumers and review platforms with profits that mainly come from commission revenues.

Another research gap is that the existing literature exclusively focused on the promulgators but disregarded the surrounding environment. When these promulgators are located in a specific environment, they may have high motivations to post fake online reviews. For example, we can further explore how the consumer structure affects the motivations of merchants for posting fake online reviews. Similar with weak brands and low ratings, a small proportion of loyal consumers may cause merchants to post fake online reviews. Therefore, Proposition 4 (P4) is presented as follows:

P4: Fake online reviews are generally posted by merchants with only a few loyal consumers and low initial assessments from consumers.

4.1.4 When and where: Time and place for posting fake online reviews (Q1.4)

The studies that answer Q1.4 are limited compared with the previously discussed aspects. The extant studies have indicated that parties are less likely to manipulate reviews with the passage of time (Hu et al. 2011). Positive fake reviews are considerably prevalent when a business reputation is weak, whereas negative fake reviews are likely to occur when a business has an independent competitor (Luca et al. 2016).Therefore, promulgators of fake online reviews are likely to manipulate reviews when the time period is early, their business reputation is weak, or

they have an independent competitor.

When and where relevant interested parties are considerably prone to post fake online reviews should be further realized. For example, when the relevant interested parties receive negative fake reviews from their opponents, firms often have high motivation to post fake online reviews. When the interested parties can obtain additional profits, they have high motivations to post fake online reviews. When the number of existing unscrupulous promulgators is small, the promulgators of fake online reviews often obtain additional profits. Therefore, Proposition 5 (P5) is provided as follows:

P5: The promulgators of fake online reviews are likely to manipulate reviews when the number of existing unscrupulous promulgators is small or when they receive negative fake reviews from their opponents.

Many review platforms are available and these platforms have different characteristics. The number of fake online reviews varies among review platforms. However, our understanding remains limited on why the number of fake online reviews varies among review platforms. Although some review platforms have strict policies for punishing fake online reviews, other platforms lack such measures. Therefore, Proposition 6 (P6) is presented as follows:

P6: Unscrupulous promulgators tend to issue fake reviews in platforms with low sensitivity to fake reviews and with inappropriate punishment intensity.

4.1.5 How: Ways for posting fake online reviews (Q1.5)

Firms typically post positive fake reviews of themselves or negative fake reviews of their competitors to promote or diminish products or services, respectively. Firms adopt various measures to achieve this goal, such as manipulation of the relationship with users (Li et al. 2018). To date, only exterior behaviors on how the fraudulent firms post fake online reviews have been generally realized.

Fraudulent individuals may also post fake online reviews even without receiving monetary incentives from merchants. With the aim of gaining monetary service recovery or pursuing other objectives, opportunistic individuals may have a few active communication exchanges with merchants. Fraudulent merchants may ask their employers or agents and outsource a company to directly post fake online reviews and use incentives to induce consumers to indirectly post fake online reviews.

In terms of posting fake online reviews, review platforms may adopt a variety of strategies for different merchants. Platforms may duplicate the fake online reviews from other platforms

to attract consumers. When the merchants in the platforms can obtain additional profits and provide substantial commission revenues, the platforms may acquiesce to their review manipulation. Therefore, Proposition 7 (P7) is presented as follows:

P7: Opportunistic individuals may have a few active communication exchanges with merchants. Fraudulent merchants may directly post fake online reviews and use incentives to induce consumers to indirectly post fake online reviews. Platforms may duplicate the fake online reviews from other platforms or acquiesce to some merchants' review manipulation.

4.2 Features of Fake Online Reviews

4.2.1 Features of fake online reviews (Q2.1)

Fake and authentic online reviews have different features. We can distinguish authentic and fake online reviews in terms of four constructs (comprehensibility, specificity, exaggeration, and negligence) (Banerjee et al. 2017a; Banerjee et al. 2017b), seven characteristics (structure and format, attributes of content, information orientation, number of words, lexical richness, personal pronouns, and paralinguistic features) (Huang et al. 2012), and three aspects (informativeness, subjectivity, and readability) (Ong et al. 2014). Compared with normal reviews, manipulated reviews are not concerned with product prices and qualities (Petrescu et al. 2018). Truthful reviews are more detailed and contain more contextual references (Kleinberg et al. 2018) and expressive descriptions (Anderson et al. 2014).

Mining the features of fake online reviews and developing the detection algorithms for fake online reviews are closely linked (Akram et al. 2018). Although we obtained a high degree of information in this field, studies on the features and detection methods should be incessantly developed.

The existing literature has provided us with a general understanding of the textual features of fake online reviews, although we remain to have limited grasp of the image features of fake online reviews. The development of technology has prompted promulgators to post textual evaluations and provide product pictures or videos. Given that fraudulent promulgators often rapidly post fake online reviews, they frequently disregard uploading the image information or merely duplicate same images. Therefore, Proposition 8 (P8) is provided as follows:

P8: Fake online reviews provide minimal or low-quality image information. Images in the normal online product reviews are more diverse and denser than those in fake online reviews.

4.2.2 Spreading features of fake online reviews (Q2.2)

To maximize the influence of fake online reviews, fraudulent promulgators tried to manipulate

the spread of fake online reviews by adopting measures, such as manipulating the sorting rule of online product reviews and giving "likes" or "helpfulness rating" to fake online reviews. Given the existences of these behaviors affecting the spread of fake online reviews, selected helpful online reviews may consist many fake online reviews (Ahmad et al. 2018).

Our understanding on the spread of fake online review is still limited. Although we know fraudulent promulgators manipulate the spread of fake online reviews, the specific strategies are unknown, and the understanding about the effects of manipulating the spread is limited.

Fake news and online reviews are fake online information. Existing studies have revealed that fake news has three times more shares than verified stories because of elaborate features, which purposely meet factors causing rapid transmission (Sommariva et al. 2018). Thus, we are apprehensive that the spread of fake online reviews can be modeled as the spread of a viral contagion. Some influencing factors may cause the extensive spread of fake online reviews, including different technologies, the related business model, demographic factors, news consumption habits, and features of e-commerce. Key opinion leaders (KOL) are important in the social media transmission of fake news (Shin et al. 2018). We consider that fake online reviews can gain visibility through influential KOLs. Therefore, Proposition 9 (P9) is presented as follows:

P9: Fake online reviews spread more extensively than normal online product reviews. KOLs are important in the spread of fake online reviews. The factors influencing the spread fake online reviews include technologies and the features of consumers, merchants, and e-commerce.

4.2.3 Distribution of fake online reviews (Q2.3)

Among all online reviews, the fake ones occupy a substantial percentage (Luca et al. 2016; Munzel 2016; Schuckert et al. 2016; Salehi-Esfahani et al. 2018) in e-commerce and their proportion continues to increase (Hunt 2015). Thus, realizing the distribution of fake online reviews is extremely beneficial. The gap between the total and specific ratings can facilitate the determination of suspicious reviews (Munzel 2016; Schuckert et al. 2016). Compared with normal online reviews, fake online reviews have more polarized distribution (Luca et al. 2016). Existing studies have revealed that positive fake reviews are more common than negative fake reviews (Lappas et al. 2016).

Although the general distribution of fake online reviews has been explored, we have yet to be provided with any explanation for such a distribution. The perspective of analyzing the relationship between the motivation values and specific percentages of fake online reviews will enable us to understand the distribution of fake online reviews. Therefore, Proposition 10 (P10) is provided as follows:

P10: The motivation values of merchants posting fake reviews increase when the total percentage of fake reviews decreases or the difference of percentage between fake positive reviews and fake negative reviews increases.

We can further analyze the spatiotemporal distribution of fake online reviews. In different periods or regions, the promulgators of fake online reviews possibly adopt different strategies to post fake online reviews. Thus, the distribution of fake online reviews should be further explored by combining temporal and spatial characteristics. Therefore, Proposition 11 (P11) is presented as follows:

P11: The development stages of online reviews and a country's culture affect the intensities of fake online reviews, thereby leading to the spatiotemporal distribution of these fake online reviews.

4.3 Consequences of Fake Online Reviews

The effects of fake online reviews on the development of online product reviews, stakeholders, and the overall market and society have engendered serious concern. We depict the influencing mechanisms of fake online reviews to answer Q3.1–Q3.3 (see Figure 3).
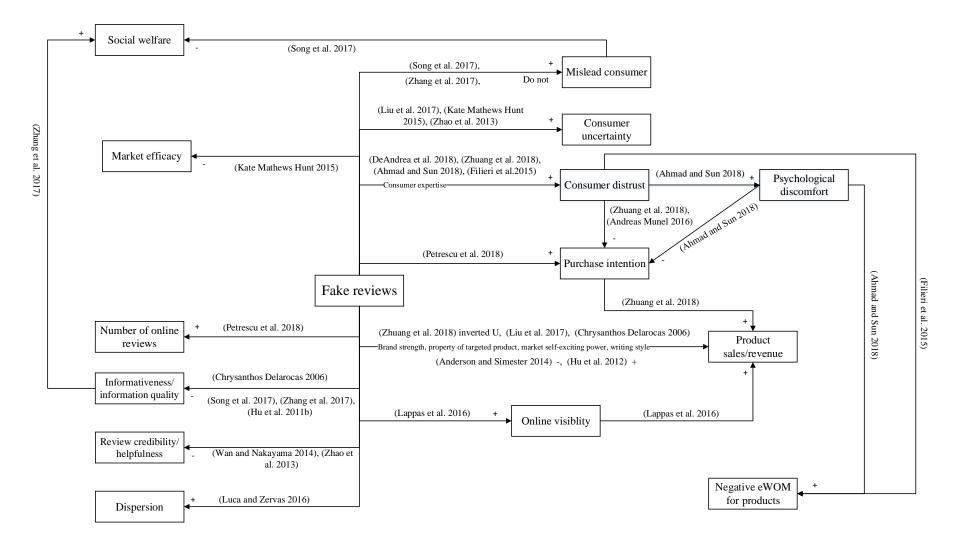
+ Social welfare - (Song et al. 2017)

(Song et al. 2017), + Mislead consumer
(Zhang et al. 2017), Do not

(Liu et al. 2017), (Kate Mathews Hunt
2015), (Zhao et al. 2013) + Consumer
uncertainty

Market efficacy - (Kate Mathews Hunt 2015)

(DeAndrea et al. 2018), (Zhuang et al. 2018),
(Ahmad and Sun 2018), (Filieri et al.2015)
Consumer expertise + Consumer distrust (Ahmad and Sun 2018) + Psychological
discomfort

(Zhuang et al. 2018),
(Andreas Munel 2016) - (Ahmad and Sun 2018)

(Petrescu et al. 2018) + Purchase intention -

Fake reviews

(Zhuang et al. 2018)

Number of online
reviews + (Petrescu et al. 2018)

(Zhuang et al. 2018) inverted U, (Liu et al. 2017), (Chrysanthos Delarocas 2006)
Brand strength, property of targeted product, market self-exciting power, writing style + Product
sales/revenue
(Anderson and Simester 2014) -, (Hu et al. 2012) +

Informativeness/
information quality - (Chrysanthos Delarocas 2006)
(Song et al. 2017), (Zhang et al. 2017),
(Hu et al. 2011b)

(Lappas et al. 2016) + Online visiblity (Lappas et al. 2016)

Review credibility/
helpfulness - (Wan and Nakayama 2014), (Zhao et
al. 2013)

Dispersion + (Luca and Zervas 2016)

Negative eWOM
for products +

(Zhang et al. 2017)

(Ahmad and Sun 2018)

(Filieri et al. 2015)

Figure 3. Influencing mechanisms of fake online reviews

4.3.1 Effects of fake online reviews on the development of online product reviews (Q3.1)

The existence of fake online reviews constantly increases the number of online product reviews (Petrescu et al. 2018). The propensity for leaving fake online reviews is either positive or negative, so such reviews are unlikely to be mediocre (Luca et al. 2016). Accordingly, as a distorted form of online product reviews, fake online reviews aggravate the dispersion of online product ratings (Luca et al. 2016).

If a specific company's manipulation strategy is an increasing (decreasing) function of true quality, then it will increase (decrease) information quality (Dellarocas 2006). Given that the company's manipulation strategy is usually a decreasing function of the product's quality (Hu et al. 2011), fake online reviews decrease informativeness, distort information quality (Zhang et al. 2017), and impede the effective utilization of online product reviews (Song et al. 2017). Furthermore, fake online reviews damage the credibility of reviews (Zhao et al. 2013) and affect review helpfulness (Wan et al. 2014).

Therefore, we summarize that fake online reviews increase the number of online reviews, and aggravate the dispersion of online ratings. Moreover, fake online reviews usually decrease information quality and damage review credibility, thus negatively affecting review helpfulness. The influence mechanism of fake online reviews on the development of online product reviews can also help understand the distribution of fake online reviews.

4.3.2 Effects of fake online reviews on stakeholders (Q3.2)

Fake online reviews significantly affect stakeholders, such as consumers, merchants, and platforms. In terms of the effect on consumers, fake online reviews increase uncertainty (Zhao et al. 2013; Hunt 2015; Liu et al. 2017) and mislead consumers (Song et al. 2017). However, some people hold the opinion that fake online reviews cannot mislead consumers (Zhang et al. 2017). Furthermore, fake online reviews give rise to consumer distrust toward online product reviews (Filieri et al. 2015; DeAndrea et al. 2018; Zhuang et al. 2018), leading to the psychological discomfort of consumers (Pranata et al. 2016; Ahmad et al. 2018). While fake online reviews directly increase consumers' purchase intentions (Petrescu et al. 2018), increased distrust and psychological discomfort weaken consumers' purchase intentions (Munzel 2016; Ahmad et al. 2018; Zhuang et al. 2018) and create negative word-of-mouth for products (Filieri et al. 2015; Ahmad et al. 2018).

Consumers' purchase intentions directly affect product sales/revenues (Zhuang et al. 2018). Thus, fake online reviews also affect product sales/revenues. However, extant studies have not researched a consensus as regards the effects of fake online reviews on product sales/revenues (Dellarocas 2006; Liu et al. 2017). Different studies hold different opinions on the effects of fake online reviews on product sales/revenues, including a positive relationship (Hu et al., 2012;

Lappas et al., 2016), a negative relationship (Anderson et al. 2014), and an invented U-shaped relationship (Zhuang et al. 2018). The effect of fake online reviews on product sales/revenues is moderated by certain factors, including brand strength (Zhuang et al. 2018), property of the targeted product, market self-exciting power (Liu et al. 2017), writing style (Hu et al. 2012), and online visibility (Lappas et al. 2016). Fake online reviews can also increase merchants' profits through attracting consumers in participating merchants' virtual brand community (Feng et al. 2018).

Therefore, we summarize that fake online reviews increase product uncertainty and give rise to consumer distrust toward online product reviews, leading to the psychological discomfort of consumers. Fake online reviews directly affect consumers' purchase intentions, and thus significantly affect product sales/revenues. However, we have not researched a consensus as regards the effects of fake online reviews on product sales/revenues. The effect of fake online reviews on product sales/revenues is moderated by certain factors, including brand strength, property of the targeted product, market self-exciting power, writing style and online visibility.

The Mafengwo.com case has revealed that review platforms have high motivation to post fake online reviews (Zhao 2018). Given that review platforms post fake online reviews, we believe that these reviews have significant effects on such platforms. However, we are unable to find any studies that explore the effects of fake online reviews on review platforms. Accordingly, studying the effects of fake online reviews will enable us to expand the research boundary to review platforms in the future.

Fake online reviews give bad impressions to consumers, thereby damaging the reputation of review platforms. Consumers would not like to use review platforms with many fake online reviews. However, some review platforms continue to acquiesce to fake online reviews or actively post fake online reviews. The reason is that fake online reviews may occasionally bring profits to review platforms. Therefore, Proposition 12 (P12) is provided as follows:

P12: Fake online reviews damage the reputations of platforms and reduce the total number of consumers in these platforms. If fake online reviews in various platforms increase merchants' profits, then these platforms can obtain additional profits from fraudulent merchants. The final effects of fake online reviews on a variety of platforms are moderated by consumers' attitudes toward fake online reviews.

4.3.3 Effects of fake online reviews on the overall market or society (Q3.3)

Fake online reviews affect the development of online product reviews and various stakeholders, thereby resulting in a final effect on the overall market or society. In particular, fake online reviews undermine market efficacy (Hunt 2015) and have a negative effect on social welfare

(Song et al. 2017; Zhang et al. 2017). Therefore, fake online reviews undermine market efficacy and social welfare.

Undoubtedly, fake news and online reviews are presented as detrimental to various aspects of our lives. However, the emergence of fake news requires the media and journalists to reassert their dominance and reaffirm the professional paradigm of news (Wasserman 2017). The past news order can no longer adapt to the requirements of contemporary society. Fake news is symptomatic of the collapse of the old news order and chaos of contemporary public communication (Waisbord 2018). Moreover, fake news attests to the new chapter of news and journalism by redefining the "truth" and creating the "empathic media," thereby suggesting the use of personally and emotionally targeted news produced by algo-journalism (Bakir et al. 2018). Moreover, fake news, bloggers, and columnists, comprise the fifth estate to watch over mainstream journalism institution and relocate it to within its professional boundaries (Berkowitz et al. 2016; Wasserman 2017).

Similarly, we consider that fake online reviews may provide an opportunity for e-commerce because the emergence of such reviews requires e-commerce to considerably focus on the healthy e-commerce environment and development of online product reviews. In the early stage, the emergence of fake online reviews may drive the development of e-commerce because fake online reviews considerably increase e-commerce traffic and attract users. Therefore, Proposition 13 (P13) is provided as follows:

P13: Fake online reviews provide an opportunity for the development of e-commerce and are beneficial in some specific environments.

4.4 Interventions of Fake Online Reviews

4.4.1 Summary of detection methods for fake online reviews (Q4.1)

The majority of related studies focus on the detection of fake online reviews. These detection methods aim at three targets: review spam, spammer, and spammer group (Zhang et al. 2018). A spammer is a person who writes fake reviews, whereas a spammer group is organized by several spammers to collaboratively take full control of sentiment of a product or service (Dewang et al. 2018; Wang et al. 2018). We classify related studies in terms of the three detection targets in Table 3.

Table 3. Related studies about detection of fake online reviews

Targets	Authors and Date of Articles	Number	Percentage (%)
Review Spam	Hu et al. (2012), Fusilier et al. (2015), Hammad and El-Halees (2015), Heydari et al. (2015), Rahman et al. (2015), Ren et al. (2015), Zhu et al. (2015), Heydari et al. (2016), Sun et al. (2016), Zhang et al. (2016a), Zhang et al. (2016b), Cagnina and Rosso (2017), Catal and Guldan (2017), Hernández-Castañeda and Calvo (2017), Li et al. (2017), Ren and Ji (2017), Rout et al. (2017a), Rout et al. (2017b), Shehnepoor et al. (2017), Viviani and Pasi (2017), Akram et al. (2018); Dong et al. (2018), Hazim et al. (2018), Kleinberg et al. (2018), Kumar et al. (2018), Rajamohana and Umamaheswari (2018), Yuan et al. (2018a), Yuan et al. (2018b), Zhang et al. (2018b).	29	70.73
Spammer	Wang et al. (2012), Savage et al. (2015), Hool et al. (2017), Liao et al. (2017), Liu and Pang (2018)	5	12.20
Spammer Group	Wang et al. (2016), Xu and Zhang (2017), Li et al. (2018), Wang et al. (2018a), Wang et al. (2018c), Zhang et al. (2018a), Zhang et al. (2018b)	7	17.07
	Total	41	100

As shown in Table 3, most of the extant studies (70%) have proposed several feature selection methods and detection algorithms for distinguishing authentic and fake online reviews (Hu et al. 2012; Hammad et al. 2015; Hernández Fusilier et al. 2015; Heydari et al. 2015; Rahman et al. 2015; Ren et al. 2015; Zhu et al. 2015; Heydari et al. 2016; Sun et al. 2016; Zhang et al. 2016; Zhang et al. 2016; Cagnina et al. 2017; Catal et al. 2017; Hernández-Castañeda et al. 2017; Li et al. 2017; Ren et al. 2017; Rout et al. 2017; Rout et al. 2017; Shehnepoor et al. 2017; Viviani et al. 2017; Akram et al. 2018; Dong et al. 2018; Hazim et al. 2018; Kleinberg et al. 2018; Kumar et al. 2018; Rajamohana et al. 2018; Yuan et al. 2018; Yuan et al. 2018; Zhang et al. 2018).

In recent years, scholars have begun to pay attention on detecting spammer groups (Wang et al. 2016; Xu et al. 2017; Li et al. 2018; Wang et al. 2018; Wang et al. 2018; Zhang et al. 2018; Zhang et al. 2018). In additional to the 41 articles in Table 2, another two reviewed articles focus on detecting fake online reviews and summarizing these detection methods (Cardoso et al. 2018; Dewang et al. 2018).

The detection methods usually aim at three targets: review spam, spammer, and spammer group. Even though these methods have high accurate rates in detecting fake online reviews, their effects on reducing fake online reviews are not significant.

4.4.2 Response strategies of stakeholders of fake online reviews (Q4.2)

Aside from directly detecting fake online reviews, all sectors of society expend efforts to intervene in fake online reviews. Governments continually improve laws and make great efforts in supervising online sellers and platforms (Schneiderman 2013; Hunt 2015; CIRS 2018).

However, the effect of these efforts on reducing fake reviews is unclear when only external efforts are taken. Compared with consumers, merchants, and review platforms, governments have an irrelevant role with regard to fake online reviews. We need to focus on exploring the response strategies of stakeholders of fake online reviews, such as consumers, merchants, and review platforms.

To some extent, the effects of fake online reviews are decided by how a platform operates. With the aim of significantly reducing the effects of fake online reviews, review platforms can invest more to detect fake online reviews (Zhang et al. 2017). Moreover, review platforms can develop novel methods to display online reviews and reduce the visibility of fake online reviews (Ivanova et al. 2017; Song et al. 2017). They can also develop novel methods for the aggregation of online ratings to restrain the spread of fake online reviews and reduce the harmful effects of rating manipulation (Ivanova et al. 2017; Song et al. 2017).

To confront fake online reviews, attacked merchants can develop their own abilities and enhance new features (Lappas et al. 2016). Furthermore, consumers need to strengthen their awareness about responding to fake online reviews (Hunt 2015).

In summary, various stakeholders should proactively develop their abilities and respond to fake online reviews. Consumers should strengthen their awareness and improve their abilities to respond to fake online reviews. Normal merchants should enhance new features and improve abilities to escape the attack of fake online reviews. Review platforms should also invest substantially to detect fake online reviews and develop novel methods to aggregate online reviews.

In the future, we can continuously enhance consumers' ability to identify fake online reviews and suggest timely and effective response of consumers to fake online reviews. If consumers do not rely on existing online products when posting online reviews, then fake online reviews have minimal effects on the evolutional development of online reviews. Legal merchants should also develop strategies to respond to the fake online reviews of rivals. The active confrontation of merchants with fake online reviews should be encouraged and suitable response strategies for those individuals should be developed. Moreover, the intervention measures of review platforms are extremely important because the policies of these review platforms substantially affect the behaviors of consumers and merchants. Therefore, Proposition 14 (P14) is presented as follows:

P14: To reduce fake reviews, we suggest that consumers rely minimally on the perceived value and effect of existing online reviews. Merchants should promote their competitiveness by winning over loyal consumers, promoting consumers' initial assessment of their values, and improving their actual star ratings. We further suggest that platforms adopt such strict regulatory policies as imposing serious punitive measures and designing exhibition rule for presenting

online reviews.

An effective aggregation method can reduce the online visibility of fake online reviews. Thus, the effects of fake online reviews are reduced and the motivation for posting is weakened. Although the current exhibition rules for presenting online reviews can guarantee that they provide abundant, authoritative, and latest product information, they have been criticized for their weakness in considering the characteristics of fake reviews. An effective exhibition rule should be explored for presenting online reviews to reduce the effects of fake online reviews. Therefore, Proposition 15 (P15) is provided as follows:

P15: Effective exhibition rules are substantially superior to traditional detection algorithms because such rules can reduce the effects of fake online reviews with low cost and considerable efficiency. Accordingly, excluding extreme online reviews could be simple but beneficial exhibition rule of online reviews.

5. A Framework for Further Investigating Fake Online Reviews

Through the detailed analyses, we have a better understanding of fake online reviews. The literature review also reveals some limitations of these existing studies, which need to be further explored. With our review serving as a foundation, we present a framework in which scholars can further investigate fake online reviews.

5.1 Data Sources

Fake online review is a typical practical research topic, so data sources are very important for studying it. The data sources used in the 75 selected articles are summarized in Table 4. In terms of the data acquisition method, we divide the data sources into four categories: public datasets, private collected datasets, private crawled datasets, and experiments (surveys/interviews) datasets.

Table 4. Data sources used by the 75 selected studies

Categories	Datasets	Studies
Public datasets	TripAdvisor (hotel) review datasets from Ott et al. (2011, 2013)	Fusilier et al. (2015); Zhang et al. (2016b); Cagnina and Rosso (2017); Catal and Guldan (2017); Hernandez-Castaneda and Calvo (2017); Rout et al. (2017a); Rout et al. (2017b); Ajamohana and Umamaheswari (2018); Ardoso et al. (2018); Kleinberg et al. (2018); Yuan et al. (2018a); Zhang et al. (2018c).
	TripAdvisor and Yelp (hotel, restaurant and doctor) review datasets from Li & Ott et al. (2014)	Cagnina and Rosso (2017); Li et al. (2017); Ren and Ji (2017); Zhang et al. (2018c).
	Yelp datasets from Rayana and Akoglu (2015)	Kumar et al. (2018); Wang et al. (2018a); Wang et al. (2018c); Yuan et al. (2018b).
	Yelp datasets from Mukherjee et al.(2013)	Cardoso et al. (2018); Hazim et al. (2018).
	SNAP Stanford repository	Akram et al. (2018).
Private collected datasets	Amazon review datasets from Mcauley et al.(2015)	Liao et al. (2017).
	Apparel review datasets from a private company	Anderson and Simester (2014).
	Book review datasets from a U.S. company	Zhao et al. (2013).
	Review datasets from review site management	Andreas Munzel (2016).
Private crawled datasets	Amazon (products such as book, CDs, DAD, video, and MP3 players) review datasets	Hu et al. (2011a); Hu et al. (2011b); Hu et al. (2012); Anderson and Simester (2014); Ong et al. (2014); Wan and Nakayama (2014); Savage et al. (2015); Sun et al. (2016); Wang et al. (2016); Hernandez-Castaneda and Calvo (2017); Rout et al. (2017a); Shehnepoor et al. (2017); Xu and Zhang (2017); Petrescu et al. (2018); Wang et al. (2018a); Wang et al. (2018c); Zhang et al. (2018a); Zhang et al. (2018b).
	TripAdvisor, Expedia, Agoda, Booking (hotel) review datasets	Mayzlin et al. (2014); Hammad and El-Halees (2015); Ren et al. (2015); Lappas et al. (2016); Schuckert et al. (2016); Banerjee and Chua (2017a); Banerjee and Chua (2017b); Song et al. (2017); Zhuang et al. (2018).
	Yelp (restaurant, hotel and reservation) review datasets	Anderson and Magruder (2012); Rahman et al. (2015); Luca and Zervas (2016); Zhang et al. (2016a); Shehnepoor et al. (2017); Viviani and Pasi (2017); Xu and Zhang (2017); Dong et al. (2018).
	Other review datasets	Apple APP Store: Zhu et al. (2015); Barnes & Noble: Hu et al. (2011b); CNET Download.com: Liu et al. (2017); Dianping: Li et al. (2018); Google: Rahman et al. (2015), Hazim et al. (2018); Reseller-ratings.com: Wang et al. (2012); STR: Zhuang et al. (2018); Xiaomi community: Feng et al. (2018).
Experiments (surveys/ interviews) datasets	Participants write fake online reviews	Huang et al. (2012); Ong et al. (2014); Banerjee and Chua (2017a); Banerjee and Chua (2017b).
	Experiments	Choi et al.(2017); DeAndrea et al. (2018); Wang et al.(2018b).
	Interviews	Huang et al. (2012); Gössling et al.(2018).
	Survey questionnaires	Raffaele Filieri (2015); Andreas Munzel (2016); Hernandez-Castaneda and Calvo (2017); Ahmad and Sun (2018).

As shown in Table 4, public datasets are limited. Three gold standard datasets accepted by most scholars are created by Ott et al. (Ott et al. 2011; Ott et al. 2013) and Li et al. (Li et al. 2014). The first two datasets are collected from deceptive positive/negative and truthful hotel reviews on TripAdvisor in Chicago, whereas the last is dataset collected from three different domains, i.e. hotels, restaurants, and doctors, on TripAdvisor and Yelp. Among the 75 selected studies, 16 articles (21.33%) used the three datasets from Ott et al. (2011, 2013) and Li et al. (2014). In the three public review datasets, the creators employ Amazon Mechanical Turk to judge fake online reviews. Six articles (8%) used public Yelp datasets. Yelp, a famous review platform, developed its own algorithm to filter fake online reviews and then publicized their review datasets. Another widely used fake review dataset is Stanford Network Analysis Platform (SNAP) which is a public dataset repository. Currently, public fake review datasets are still limited, but the demand is huge. These public review datasets cannot completely meet the requirements of scholars. In the future, we need to build and update more review datasets from different domains and groups.

Given the lack of public fake review datasets, most scholars have collected their required review datasets from specific companies or crawled review datasets from popular e-commerce sites, such as Amazon.com, TripAdvisor.com, and Yelp.com. Although privately collecting or crawling review datasets is an efficient method for scholars to acquire required review datasets, the processes are time consuming and have restraints. Thus, we suggest that more review platforms should publicize their review datasets after deleting users' private characteristics.

In addition, conducting experiments (surveys/interviews) is a good strategy to study personal behaviors. When we cannot distinguish authentic and fake online reviews, we can ask participants to write fake online reviews in our experiments. The fake online reviews written by our invited participants can help realize the characteristics of fake online reviews. Moreover, these reviews can explore the effects of fake online reviews on personal behaviors in e-commerce in future experiments.

5.2 Research Methods

Table 5 summarizes the research methods utilized in the 75 selected journal articles. The table demonstrates that majority of the journal articles (87.67%) adopted quantitative methods to examine fake online reviews. Only 8.22% used qualitative methods and 4.11% employed qualitative and quantitative methods.

Given that most of the studies focus on detecting fake online reviews, the proportion of articles using quantitative content, sentiment analysis, and machine learning is high at 53.33%. 14 articles (18.67%) employed empirical methods to analyze fake online reviews after obtaining the required review datasets. Although conducting experiments is a good way to understand fake online reviews from a personal perspective, the proportion of studies using experiments is

only 8.00%.

Table 5. Analyses about research methods

Method	Number	Percentage (%)
Qualitative		
Descriptive	2	2.67
Conceptual	2	2.67
Narrative/Case study	2	2.67
subtotal	6	8.00
Quantitative		
Empirical method (regression/factors/ANOVA/DID)	14	18.67
Experiment	6	8.00
Mathematical models	6	8.00
Quantitative content/sentiment analysis/machine learning	40	53.33
Subtotal	66	88.00
Hybrid	3	4.00
Total	75	100.00

5.3 Future Research Directions

After a detailed analysis of the related studies on fake online reviews, we find that some open-ended research questions should continuously be explored. We provide several propositions in Section 4 to improve the related future research. The current section concluded these propositions and suggest promising research directions.

5.3.1 Motivations for posting fake online reviews

Fake online reviews are posted by various types of people, including individual consumers and online merchants, and review platforms. However, the understanding on the reasons why individual consumers and review platforms post fake online reviews remains limited. In the future, we can study the review manipulation of review platforms (P1) by obtaining some empirical data sets and building analytical models.

Quantifying the motivations of stakeholders posting fake online reviews can facilitate the understanding of the underlying reasons. To quantify the motivations, we can focus on the effects of fake online reviews on the evolution of online reviews and the number of consumers. An interesting technique to quantify the motivations of posting fake online reviews (P2) is by adopting various methods, such as building mathematical or analytical models and conducting empirical analyses.

By analyzing and comparing the motivational differences in multiple scenarios, we can realize the "when and where" of interested parties who are prone to post fake online reviews. Moreover, focusing on opportunistic consumers and the source proportion of platforms' profits (P3) could facilitate the comprehensive identification of the interested parties. Hence,

conducting experiments is effective for studying opportunistic consumers.

Apart from studying the promulgators, we also need to explore their surrounding environment. For P4, combining the analytical models and empirical analyses can obtain additional findings to understand the effects of consumer structure.

By realizing the preferred time and place of the promulgators of fake online reviews, we can improve the avoidance of the negative effects of fake online reviews and contribute to the detection of these types of reviews. P5 and P6 are proposed to enable us to understand the "when' and "where," respectively. We can study these two propositions by performing statistical analyses of the number of fake online reviews in different environments and building analytical models.

Moreover, we need to further explore how fraudulent individuals, merchants, and review platforms post fake online reviews. Evidently, understanding how fraudulent promulgators post fake online reviews (P7) is important to enable us to respond to fake online reviews. Conducting experiments is a good method to analyze individual behaviors. To understand the behaviors of merchants and platforms, we need to build models or conduct empirical analyses.

5.3.2 (Spreading) Features of fake online reviews

To date, we have limited understanding of the features of fake online reviews despite the importance of such features. Future research could further explore the image features of fake online reviews (P8). If the required data sets cannot be acquired from public data sets, then we need to crawl the data sets. Various computation technologies, such as the Natural Language Processing and Image Mining, could be applied.

The spreading process of fake online reviews and its influencing factors (P9) should be explored. Mathematical models and simulations may be useful for depicting the spread process of fake online reviews. Moreover, the structural equation models and empirical analyses can facilitate the understanding of the factors that affect the spreading process. Experiments and empirical analyses may obtain additional findings on KOL.

5.3.3 Distributions of fake online reviews

Understanding the distribution of fake online reviews is important for control. From existing studies, we could realize the preliminary distributions of fake online reviews. Currently, we realized that merchants prefer to post positive fake online rather than negative fake reviews, but have not provided explanations. P10 is proposed to understand the underlying reasons causing the distribution of fake online reviews. Simulations could help analyze the relationship between the motivation values and the specific percentages of fake online reviews

In the future, we should further analyze the spatiotemporal distribution of fake online reviews. P11 was proposed to enable us to understand the spatiotemporal distribution of fake

online reviews. The structure equation model may help collect data to analyze the spatiotemporal distribution of the motivations. Collecting empirical data is also useful for exploring P9.

5.3.4 Effects of fake online reviews on review platforms

Existing studies have comprehensively explored the effects of fake online reviews on the development of online product reviews and stakeholders, such as individual consumers and online merchants. Some studies have analyzed the effects of fake online reviews on the overall market or society. The Mafengwo.com case has revealed that review platforms have high motivation to post fake online reviews (Zhao 2018). However, understanding the effects of fake online reviews on review platforms (P12) remains limited.

Given the difficulty of acquiring the data sets on review platforms, we may explore P12 by building mathematical and analytical models. The game-theoretical model is suitable for studying the review platforms because the behaviors of platforms are the results of the game among consumers, merchants, and platforms.

5.3.5 Benefits of fake online reviews

The existing literature has focused on the detrimental effects of fake online reviews but completely disregarded their benefits. Hence, we should continue to evaluate the benefits of fake online reviews in an objective manner. The analytical model can be used to evaluate P13 because it can describe the features and effects of fake online reviews to evaluate their benefits.

5.3.6 Accurate detections of fake online reviews

Although nearly all studies developing novel algorithms/methods to detect fake online reviews assert that their algorithms have achieved a high percentage of accuracy, the prevalence of fake online reviews continues to increase. Thus, the continuous development of methods or algorithms for detecting fake online reviews should be prioritized.

In continuously developing detection algorithms, we need to mine many more features of fake online reviews. Only after realizing the features of online product reviews can we accurately distinguish between authentic and fake.

5.3.7 Intervening measures for fake online reviews

If online consumers are not misled by fake online reviews and promulgators have less motivation to post fake online reviews, then the number of fake online reviews can be spontaneously reduced. Thus, we should continuously improve detection algorithms and explore how stakeholders can effectively respond to fake online reviews. Developing computerized algorithms to identify fake reviews only treats the symptom, not the underlying

problem. Finding suitable intervening measures for fake online reviews has become a fundamental problem.

To evaluate the effects of the intervening measures, we should observe the results of the intervening measures of fake online reviews. We cannot collect the data sets to explore the intervening measures. Hence, the experiments and simulations can be beneficial to study P14.

5.3.8 Aggregations of online product reviews

One of the effective intervening measures for fake online reviews is to design aggregation methods of online product reviews. Due to the importance of designing exhibition rule for presenting online reviews, it is solely analyzed here.

An effective aggregation method can reduce the online visibility of fake online reviews. Thus, the effects of fake online reviews are reduced and the motivation for posting is weakened. If we want to design a useful aggregation method for online product reviews to reduce fake online reviews, then we should first realize the spread characteristics of fake online reviews. Currently, the spread process is still not clearly understood. Thus, we need to understand more about the spread features of fake online reviews and design effective aggregation methods of online product reviews with the aim of reducing fake online reviews.

To explore an effective aggregation method of online product reviews (P15), we can build mathematical models and design algorithms. Simulations can also be used to verify these aggregation methods.

6. Conclusions and Discussions

6.1 Conclusions

A critical component of any new research venture is the timely establishment of a reference collection of the relevant literature and the forward-looking analyses of the existing literature. The research area of fake online reviews is no exception. Although some studies have explored various aspects of fake online reviews, they do not have comprehensive understanding of the subject. For example, the majority of the existing studies only focus on fake online reviews posted by merchants but disregard reviews from individual consumers and review platforms who also post fake online reviews. Thus, a literature review should be conducted to enhance public understanding of fake online reviews and improve future research.

To understand fake online reviews, we propose the ACI conceptual framework and use the ACI framework to develop an initial research agenda for fake online reviews. The ACI framework comprises 13 open-ended questions spanning antecedents, features, consequences, and interventions of fake online reviews.

The present study uses such descriptors as "fake review," "deceptive review," "bogus

review," "spam review," "spam opinion," "review manipulation," and "online review" to search relevant journal articles published as of February, 2019 on the SCI and SSCI databases. Thereafter, by meticulously reading 822 original journal articles, 75 journal relevant articles are identified and further analyzed to provide 13 open-ended questions and 15 propositions. By exploring the research questions, we gain an improved understanding of fake online reviews and realize the current research status of fake online reviews.

Our intention is to inform academicians and practitioners of this area regarding the current research situations, implications, and limitations of existing studies and prospective research directions in this area. Although our literature review cannot be considered exhaustive, we are convinced that this review can be a beneficial resource for anyone interested in fake online reviews. Moreover, our literature review can stimulate further interest in the field. Apart from contributing to the overall understanding of the existing research and the corresponding limitations, the current study analyzes the data sources and research methods in this area and highlights promising research directions.

6.2 Theoretical and Practical Implications

6.2.1 Theoretical implications

From a theoretical perspective, this study makes three contributions. First, this study extends the classic IPO framework to propose the ACI conceptual framework for developing an initial research agenda for fake online reviews. The ACI framework can be used to explore harmful objectives, such as fake online reviews.

Second, by summarizing the literature and observing the cases, we define fake online reviews. Existing studies provide an incomplete understanding of fake online reviews. For example, the majority of studies merely focus on fake online reviews posted by merchants and disregard individual consumers and review platforms that may also post fake online reviews. We start our literature review by defining fake online reviews.

Third, we analyze the antecedents and consequences of fake online reviews and explore effective ways to respond to fake online reviews. Moreover, aiming at the limitations of current literature, this study makes 15 propositions for conducting future research to provide an enhanced understanding of fake online reviews. The propositions in this research suggest eight promising future research directions.

6.2.2 Practical implications

This study has short- and long-term practical implications. In particular, studying the motivations of posting fake online reviews and the related features can facilitate a considerably effective detection of fake online reviews. Moreover, the welfare of various stakeholders, such

as consumers, merchants, and platforms, is substantially affected by fake online reviews. This study could enable us to understand the effects. After determining the limitations of the current literature, this study offers 15 propositions to improve the comprehension of fake online reviews.

In the long term, understanding and effectively responding to fake online reviews can guarantee the healthy development of e-commerce and improve the welfare of various stakeholders.

References

Ahmad, W., and Sun, J., "Modeling consumer distrust of online hotel reviews" *International Journal of Hospitality Management* (71), 2018, pp 77-90.

Akram, A.U., Khan, H.U., Iqbal, S., Iqbal, T., Munir, E.U., and Shafi, D.M., "Finding rotten eggs: a review spam detection model using diverse feature sets" *KSII Transactions on Internet and Information Systems* (12:10), 2018, pp 5120-5142.

Anderson, E.T., and Simester, D.I., "Reviews without a purchase: low ratings, loyal customers, and deception" *Journal of Marketing Research* (51:3), 2014, pp 249-269.

Anderson, M., and Magruder, J., "Learning from the crowd: regression discontinuity estimates of the effects of an online review database" *The Economic Journal* (122:563), 2012, pp 957-989.

Bakir, V., and McStay, A., "Fake news and the economy of emotions: problems, causes, solutions" *Digital Journalism* (6:2), 2018, pp 154-175.

Banerjee, S., and Chua, A.Y.K., "Theorizing the textual differences between authentic and fictitious reviews validation across positive, negative and moderate polarities" *Internet Research* (27:2), 2017a, pp 321-337.

Banerjee, S., and Chua, A.Y.K., "Authentic versus fictitious online reviews: a textual analysis across luxury, budget, and mid-range hotels" *Journal of Information Science* (43:1), 2017b, pp 122-134.

Bates, D., "Samsung ordered to pay $340,000 after it paid people to write negative online reviews about htc phones," URL: https://www.dailymail.co.uk/sciencetech/article-2476630/Samsung-ordered-pay-340-000-paid-people-write-negative-online-reviews-HTC-phones.html, 2013.

Berger, J., and Iyengar, R., "Communication channels and word of mouth: how the medium shapes the message" *Journal of Consumer Research* (40:3), 2013, pp 567-579.

Berkowitz, D., and Schwartz, D.A., "Miley, cnn andthe onion：when fake news becomes realer than real" *Journalism Practice* (10:1), 2016, pp 1-17.

Cagnina, L.C., and Rosso, P., "Detecting deceptive opinions: intra and cross-domain

classification using an efficient representation" *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems* (25:Suppl. 2), 2017, pp 151-174.

Cai, H., Chen, Y., and Fang, H., "Observational learning: evidence from a randomized natural field experiment" *American Economic Review* (99:3), 2009, pp 864-882.

Cardoso, E.F., Silva, R.M., and Almeida, T.A., "Towards automatic filtering of fake reviews" *Neurocomputing* (309), 2018, pp 106-116.

Catal, C., and Guldan, S., "Product review management software based on multiple classifiers" *IET Software* (11:3), 2017, pp 89-92.

Chahal, H., and Mehta, S., "Antecedents and consequences of organisational citizenship behaviour (ocb): a conceptual framework in reference to health care sector" *Journal of Services Research* (10:2), 2010, pp 25-44.

Chevalier, J.A., and Mayzlin, D., "The effect of word of mouth on sales: online book reviews" *Journal of Marketing Research* (43:3), 2006, pp 345-354.

Choi, S., Mattila, A.S., Van Hoof, H.B., and Quadri-Felitti, D., "The role of power and incentives in inducing fake reviews in the tourism industry" *Journal of Travel Research* (56:8), 2017, pp 975-987.

CIRS, "China's first e-commerce law published" URL: http://www.cirs-reach.com/news-and-articles/Chinas-First-E-Commerce-Law-Published.html, 2018.

DeAndrea, D.C., Van Der Heide, B., Vendemia, M.A., and Vang, M.H., "How people evaluate online reviews" *Communication Research* (45:5), 2018, pp 719-736.

Dellarocas, C., "Strategic manipulation of internet opinion forums: implications for consumers and firms" *Management Science* (52:10), 2006, pp 1577-1593.

Dewang, R.K., and Singh, A.K., "State-of-art approaches for review spammer detection: a survey" *Journal of Intelligent Information Systems* (50:2), 2018, pp 231-264.

Dong, L., Ji, S., Zhang, C., Zhang, Q., Chiu, D.W., Qiu, L., and Li, D., "An unsupervised topic-sentiment joint probabilistic model for detecting deceptive reviews" *Expert Systems with Applications* (114), 2018, pp 210-223.

Feng, N., Su, Z., Li, D., Zheng, C., and Li, M., "Effects of review spam in a firm-initiated virtual brand community: evidence from smartphone customers" *Information & Management* (55:8), 2018, pp 1061-1070.

Filieri, R., Alguezaui, S., and McLeay, F., "Why do travelers trust tripadvisor? Antecedents of trust towards consumer-generated media and its influence on recommendation adoption and word of mouth" *Tourism Management* (51), 2015, pp 174-185.

Frishammar, J., Kurkkio, M., Abrahamsson, L., and Lichtenthaler, U., "Antecedents and consequences of firms' process innovation capability: a literature review and a conceptual framework" *IEEE Transactions on Engineering Management* (59:4), 2012, pp 519-529.

Gani, A., "Amazon sues 1,000 'fake reviewers'" URL: https://www.theguardian.com/technology/2015/oct/18/amazon-sues-1000-fake-reviewers, 2015.

Gössling, S., Hall, C.M., and Andersson, A., "The manager's dilemma: a conceptualization of online review manipulation strategies" *Current Issues in Tourism* (21:5), 2018, pp 484-503.

Hammad, A.A., and El-Halees, A., "An approach for detecting spam in arabic opinion reviews," *The International Arab Journal of Information Technology* (12:1), 2015, pp 9-16.

Hazim, M., Anuar, N.B., Ab Razak, M.F., and Abdullah, N.A., "Detecting opinion spams through supervised boosting approach" *PLOS ONE* (13:6), 2018, p e198884.

Hernández Fusilier, D., Montes-y-Gómez, M., Rosso, P., and Guzmán Cabrera, R., "Detecting positive and negative deceptive opinions using pu-learning," *Information Processing & Management* (51:4), 2015, pp 433-443.

Hernández-Castañeda, Á., and Calvo, H., "Deceptive text detection using continuous semantic space models" *Intelligent Data Analysis* (21:3), 2017, pp 679-695.

Heydari, A., Tavakoli, M., and Salim, N., "Detection of fake opinions using time series," *Expert Systems with Applications* (58), 2016, pp 83-92.

Heydari, A., Tavakoli, M.A., Salim, N., and Heydari, Z., "Detection of review spam: a survey" *Expert Systems with Applications* (42:7), 2015, pp 3634-3642.

Hu, N., Bose, I., Gao, Y., and Liu, L., "Manipulation in digital word-of-mouth: a reality check for book reviews" *Decision Support Systems* (50:3), 2011, pp 627-635.

Hu, N., Bose, I., Koh, N.S., and Liu, L., "Manipulation of online reviews: an analysis of ratings, readability, and sentiments" *Decision Support Systems* (52:3), 2012, pp 674-684.

Hu, N., Liu, L., and Sambamurthy, V., "Fraud detection in online consumer reviews" *Decision Support Systems* (50:3), 2011, pp 614-626.

Huang, Y.K., Yang, W.I., Lin, T.M.Y., and Shih, T.Y., "Judgment criteria for the authenticity of internet book reviews" *Library & Information Science Research* (34:2), 2012, pp 150-156.

Hunt, K.M., "Gaming the system: fake online reviews v. Consumer law," *Computer Law & Security Review* (31:1), 2015, pp 3-25.

Ivanova, O., and Scholz, M., "How can online marketplaces reduce rating manipulation? A new approach on dynamic aggregation of online ratings" *Decision Support Systems* (104), 2017, pp 64-78.

Kleinberg, B., Mozes, M., Arntz, A., and Verschuere, B., "Using named entities for computer-automated verbal deception detection" *Journal of Forensic Sciences* (63:3), 2018, pp 714-723.

Kostyra, D.S., Reiner, J., Natter, M., and Klapper, D., "Decomposing the effects of online

customer reviews on brand, price, and product attributes" *International Journal of Research in Marketing* (33:1), 2016, pp 11-26.

Kumar, N., Venugopal, D., Qiu, L., and Kumar, S., "Detecting review manipulation on online platforms with hierarchical supervised learning" *Journal of Management Information Systems* (35:1), 2018, pp 350-380.

Lappas, T., Sabnis, G., and Valkanas, G., "The impact of fake reviews on online visibility: a vulnerability assessment of the hotel industry" *Information Systems Research* (27:4), 2016, pp 940-961.

Lee, S., Qiu, L., and Whinston, A., "Sentiment manipulation in online platforms: an analysis of movie tweets" *Production and Operations Management* (27:3), 2018, pp 393-416.

Levin, Y., McGill, J., and Nediak, M., "Risk in revenue management and dynamic pricing" *Operations Research* (56:2), 2008, pp 326-343.

Li, J., Ott, M., Cardie, C., and Hovy, E., "Towards a general rule for identifying deceptive opinion spam" Proceedings of the 52nd Annual Meeting of the Association for Computational Linguistics, 2014.

Li, L., Qin, B., Ren, W., and Liu, T., "Document representation and feature combination for deceptive spam review detection" *Neurocomputing* (254), 2017, pp 33-41.

Li, N., Du, S., Zheng, H., Xue, M., and Zhu, H., "Fake reviews tell no tales? Dissecting click farming in content-generated social networks" *China Communications* (15:4), 2018, pp 98-109.

Liu, Y., Zhou, W., and Chen, H., "Efficiently promoting product online outcome: an iterative rating attack utilizing product and market property," *IEEE Transactions on Information Forensics and Security* (12:6), 2017, pp 1444-1457.

Luca, M., and Zervas, G., "Fake it till you make it: reputation, competition, and yelp review fraud" *Management Science* (62:12), 2016, pp 3412-3427.

Madupu, V., and Cooley, D.O., "Antecedents and consequences of online brand community participation: a conceptual framework" *Journal of Internet Commerce* (9:2), 2010, pp 127-147.

Mathieu, J., Maynard, M.T., Rapp, T., and Gilson, L., "Team effectiveness 1997-2007: a review of recent advancements and a glimpse into the future" *Journal of Management* (34:3), 2008, pp 410-476.

Mathieu, J.E., Heffner, T.S., Goodwin, G.F., Salas, E., and Cannon-Bowers, J.A., "The influence of shared mental models on team process and performance" *Journal of Applied Psychology,* (85:2), 2000, pp 273-283.

Mayzlin, D., Dover, Y., and Chevalier, J., "Promotional reviews: an empirical investigation of online review manipulation" *American Economic Review* (104:8), 2014, pp 2421-2455.

McGrath, J.E.,*Social psychology: a brief introduction* Holt, Rinehart and Winston, New York,

1964.

Munzel, A., "Assisting consumers in detecting fake reviews: the role of identity information disclosure and consensus" *Journal of Retailing and Consumer Services* (32), 2016, pp 96-108.

Ngai, E.W.T., Moon, K.K., Lam, S.S., Chin, E.S.K., and Tao, S.S.C., "Social media models, technologies, and applications an academic review and case study" *Industrial Management & Data Systems* (115:5), 2015, pp 769-802.

Ngai, E.W.T., and Wat, F.K.T., "A literature review and classification of electronic commerce research" *Information & Management* (39:5), 2002, pp 415-429.

Öğüt, H., and Taş, B.K.O., "The influence of internet customer reviews on the online sales and prices in hotel industry" *Service Industries Journal* (32:2), 2012, pp 197-214.

Ong, T., Mannino, M., and Gregg, D., "Linguistic characteristics of shill reviews" *Electronic Commerce Research and Applications* (13:2), 2014, pp 69-78.

Ott, M., Cardie, C., and Hancock, J.T., "Negative deceptive opinion spam," in: *Proceedings of the 2013 conference of the north american chapter of the association for computational linguistics*, Atlanta, Georgia, USA, 2013.

Ott, M., Choi, Y., Cardie, C., and Hancock, J.T., "Finding deceptive opinion spam by any stretch of the imagination" in: *Proceedings of the 49th annual meeting of the association for computational linguistics*, 2011.

Petrescu, M., O Leary, K., Goldring, D., and Ben Mrad, S., "Incentivized reviews: promising the moon for a few stars" *Journal of Retailing and Consumer Services* (41), 2018, pp 288-295.

Pranata, I., and Susilo, W., "Are the most popular users always trustworthy? The case of yelp," *Electronic Commerce Research and Applications* (20), 2016, pp 30-41.

Rahman, M., Carbunar, B., Ballesteros, J., and Chau, D.H.P., "To catch a fake: curbing deceptive yelp ratings and venues" *Statistical Analysis and Data Mining: The ASA Data Science Journal* (8:3), 2015, pp 147-161.

Rajamohana, S.P., and Umamaheswari, K., "Hybrid approach of improved binary particle swarm optimization and shuffled frog leaping for feature selection" *Computers & Electrical Engineering* (67), 2018, pp 497-508.

Ren, Y., Ji, D., Yin, L., and Zhang, H., "Finding deceptive opinion spam by correcting the mislabeled instances" *Chinese Journal of Electronics* (24:1), 2015, pp 52-57.

Ren, Y., and Argote, L., "Transactive memory systems 1985–2010: an integrative framework of key dimensions, antecedents, and consequences" *Academy of Management Annals* (5:1), 2011, pp 189-229.

Ren, Y., and Ji, D., "Neural networks for deceptive opinion spam detection: an empirical study"

Information Sciences (385-386), 2017, pp 213-224.

Roberts, D., "Yelp's fake review problem" URL: http://fortune.com/2013/09/26/yelps-fake-review-problem/, 2013.

Rout, J.K., Dalmia, A., Choo, K.R., Bakshi, S., and Jena, S.K., "Revisiting semi-supervised learning for online deceptive review detection" *IEEE Access* (5), 2017, pp 1319-1327.

Rout, J.K., Singh, S., Jena, S.K., and Bakshi, S., "Deceptive review detection using labeled and unlabeled data" *Multimedia Tools and Applications* (76:3), 2017, pp 3187-3211.

Salehi-Esfahani, S., and Ozturk, A.B., "Negative reviews: formation, spread, and halt of opportunistic behavior" *International Journal of Hospitality Management* (74), 2018, pp 138-146.

Schneiderman, E., "A.g. Schneiderman announces agreement with 19 companies to stop writing fake online reviews and pay more than $350,000 in fines" URL: https://ag.ny.gov/press-release/ag-schneiderman-announces-agreement-19-companies-stop-writing-fake-online-reviews-and, 2013.

Schuckert, M., Liu, X., and Law, R., "Insights into suspicious online ratings: direct evidence from trip advisor" *Asia Pacific Journal of Tourism Research* (21:3), 2016, pp 259-272.

Shehnepoor, S., Salehi, M., Farahbakhsh, R., and Crespi, N., "Netspam: a network-based spam detection framework for reviews in online social media" *IEEE Transactions on Information Forensics and Security* (12:7), 2017, pp 1585-1595.

Shin, J., Jian, L., Driscoll, K., and Bar, F.O., "The diffusion of misinformation on social media: temporal pattern, message, and source" *Computers in Human Behavior* (83), 2018, pp 278-287.

Sommariva, S., Vamos, C., Mantzarlis, A., Dào, L.U., and Martinez Tyson, D., "Spreading the (fake) news: exploring health messages on social media and the implications for health professionals using a case study" *American Journal of Health Education* (49:4), 2018, pp 246-255.

Song, W., Park, S., and Ryu, D., "Information quality of online reviews in the presence of potentially fake reviews" *The Korean Economic Review* (33:1), 2017, pp 5-34.

Sun, C., Du, Q., and Tian, G., "Exploiting product related review features for fake review detection" *Mathematical Problems in Engineering*, 2016, pp 1-7.

Travelmail Reporter, "Tripadvisor told to stop claiming reviews are 'trusted and honest'," URL: https://www.dailymail.co.uk/travel/article-2094766/TripAdvisor-told-stop-claiming-reviews-trusted-honest-Advertising-Standards-Authority.html, 2012.

Viviani, M., and Pasi, G., "Quantifier guided aggregation for the veracity assessment of online reviews" *International Journal of Intelligent Systems* (32:5), 2017, pp 481-501.

Waisbord, S., "Truth is what happens to news: on journalism, fake news, and post-truth" *Journalism Studies*, 2018.

Wan, Y., and Nakayama, M., "The reliability of online review helpness" *Journal of Electronic Commerce Research* (15:3), 2014, pp 179-189.

Wang, C., Li, Y., Luo, X., Ma, Q., Fu, W., and Fu, H., "The effects of money on fake rating behavior in e-commerce: electrophysiological time course evidence from consumers" *Frontiers in Neuroscience* (12), 2018, pp 1-9.

Wang, Z., Gu, S., Zhao, X., and Xu, X., "Graph-based review spammer group detection" *Knowledge and Information Systems* (55:3), 2018, pp 571-597.

Wang, Z., Gu, S., and Xu, X., "Gslda: lda-based group spamming detection in product reviews" *Applied Intelligence* (48:9), 2018, pp 3094-3107.

Wang, Z., Hou, T., Song, D., Li, Z., and Kong, T., "Detecting review spammer groups via bipartite graph projection" *The Computer Journal* (59:6), 2016, pp 861-874.

Wasserman, H., "Fake news from africa: panics, politics and paradigms" *Journalism*), 2017.

Watson, J., Ghosh, A.P., and Trusov, M., "Swayed by the numbers: the consequences of displaying product review attributes" *Journal of Marketing* (82:6), 2018, pp 109-131.

Xu, C., and Zhang, J., "Collusive opinion fraud detection in online reviews: a probabilistic modeling approach" *ACM Transactions on the Web* (11:4), 2017, pp 1-28.

Yuan, L., Li, D., Wei, S., and Wang, M., "Research of deceptive review detection based on target product identification and metapath feature weight calculation" *Complexity* (2018), 2018, pp 1-12.

Yuan, S., Wu, X., and Xiang, Y., "Task-specific word identification from short texts using a convolutional neural network" *Intelligent Data Analysis* (22:3), 2018, pp 533-550.

Zhang, D.S., Zhou, L.N., Kehoe, J.L., and Kilic, I.Y., "What online reviewer behaviors really matter? Effects of verbal and nonverbal behaviors on detection of fake online reviews" *Journal of Management Information Systems* (33:2), 2016, pp 456-481.

Zhang, L., He, G., Cao, J., Zhu, H., and Xu, B., "Spotting review spammer groups: a cosine pattern and network based method" *Concurrency and Computation: Practice and Experience* (30:20), 2018, p e4686.

Zhang, L., Wu, Z., and Cao, J., "Detecting spammer groups from product reviews: a partially supervised learning model" *IEEE Access* (6), 2018, pp 2559-2568.

Zhang, T., Li, G., Cheng, T.C.E., and Lai, K.K., "Welfare economics of review information: implications for the online selling platform owner" *International Journal of Production Economics* (184), 2017, pp 69-79.

Zhang, W., Bu, C., Yoshida, T., and Zhang, S., "Cofea: a novel approach to spam review identification based on entropy and co-training" *Entropy* (18:12), 2016, pp 1-11.

Zhang, W., Du, Y., Yoshida, T., and Wang, Q., "Dri-rcnn: an approach to deceptive review identification using recurrent convolutional neural network" *Information Processing & Management* (54:4), 2018, pp 576-592.

Zhao, R., "Mafengwo accused of faking 85% of all user-generated content," URL: https://technode.com/2018/10/22/mafengwo-fake-comments-blog-comment/, 2018.

Zhao, Y., Yang, S., Narayan, V., and Zhao, Y., "Modeling consumer learning from online product reviews" *Marketing Science* (32:1), 2013, pp 153-169.

Zhu, H., Xiong, H., Ge, Y., and Chen, E., "Discovery of ranking fraud for mobile apps" *IEEE Transactions on Knowledge and Data Engineering* (27:1), 2015, pp 74-87.

Zhuang, M., Cui, G., and Peng, L., "Manufactured opinions: the effect of manipulating online product reviews" *Journal of Business Research* (87), 2018, pp 24-35.