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Helpfulness of product reviews as a function of discrete positive and negative emotions

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ABSTRACT

The product review plays an important role in customer's purchase decision making process on the e-commerce websites. Emotions can significantly influence the way that reviews are processed. The importance of discrete emotions embedded in online reviews and their impact on review helpfulness is not explored intensively in prior studies. This study builds a helpfulness predictive model using deep neural network and investigates the influences of emotions that contribute to review helpfulness. We present an approach that extract novel discrete positive and negative emotion features from textual content of product reviews using NRC emotion Lexicon. In addition, the type of product, reviewer, visibility, readability, linguistics and sentiment related characteristics are also used for comparison and helpfulness prediction. The experimental results on two real-life datasets demonstrate that positive emotion features are the best predictors when individual category of feature is considered. However, negative emotion features and visibility features have comparable performance. Furthermore, the hybrid set of features with positive emotion features produce the best predictive performance for helpfulness of online reviews. The empirical evaluation finds that Trust, Joy and Anticipation (positive emotions); Anxiety and Sadness (negative emotions) are most influential emotion dimensions and have greater impact on perceived helpfulness. The findings of this study highlight the importance of emotions in online reviews and have significant implications for consumer and e-commerce retailers.

1. Introduction

In e-commerce, Web 2.0 provides platforms for the internet users to share their knowledge, expertise and experiences on forums, review portals, blogs and other social media websites (Bertola & Patti, 2016). These platforms facilitate the users to express their personal feelings, opinions, experiences and attitudes not only for political and economic problems but also for products and services (Samha, Li, & Zhang, 2014). Product reviews are essential part of both traditional and electronic commerce. According to a survey, Google scholar found that there are 15,600 hits for "product reviews" and 13,200 hits for "online reviews" respectively (Anderson & Magruder, 2012). Consumers mostly preferred reading product reviews to gather information before purchase decisions (Zhang & Piramuthu, 2016). Therefore, an intensified level of attention is to be given by the manufacturers/retailers to online product reviews because they can be an opportunity or thread for businesses (Li & Hitt, 2010; Anderson & Magruder, 2012; Yan, Wang, & Chau, 2015). The volume of product reviews on review websites is instantly increasing that result in information overload problem (Liu, Huang, An, & Yu, 2008). However, users' opinions and emotions about particular topics or services in terms of reviews aid the customers in future purchase decisions (Xu, Xia, Wong, & Li, 2008; Samha et al., 2014).

Several studies described that sales of products are affected by product reviews and related factors of particular product categories under some conditions (Duan, Gu and Whinston, 2008; Forman, Ghose, & Wiesenfeld, 2008). Recent studies highlighted that reviewer and review characteristics such as information quantity, semantic factors, reviewer location and identity opened new dimensions in the line of research (Cao, Duan, & Gan, 2011; Ganu, Kakodkar & Marian, 2013). However Mudambi and Schuff (2010) described that future research will focus on new dimensions of reviewers' status such as designation of "top reviewer" of Amazon.

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com. Reviews may be classified on the basis of linguistic characteristics. A comparative opinion expresses the relationship of similarities or differences between entities where as regular opinion expresses a general opinion (Jindal & Liu, 2006a, b; Liu, 2012). The suggestive opinion is based on the directives of somebody for actions in a polite way. This reveals that various sort of opinions carry various type of aspects and behaviors that are useful in desirable decision making process (Jindal & Liu, 2006a, b; Qazi, Raj, Tahir, Cambria, & Syed, 2014).

Helpful reviews facilitate consumers in terms of significant feedback and experiences of other consumers about the product (Cao et al., 2011; Li, Huang, Tan, & Wei, 2013). Other benefits are 1) Reviews can be effectively summarized by filtering low-quality reviews. 2) Websites that do not use voting feature could benefit from an automated helpfulness prediction system. 3) Review ranking system can be improved with better understanding of the review helpfulness factors. This implies that e-commerce websites such as Amazon and Yelp.com, containing more helpful reviews definitely maximize consumers' satisfaction by providing significant information (Kohli, Devaraj, and Mahmood, 2004; Baek, Ahn, and Choi, 2012). Review helpfulness is an important feature among other features associated with online products. It is computed as ratio of the number of helpful votes to the total number of votes obtained by a review. This ratio is referred as the helpfulness ratio. It is a fact that reviews are not always being consistently helpful because sentiments expressed in the reviews can have varied effect on helpfulness (Forman et al., 2008). The variations in helpfulness of reviews also exist across product types i.e. experience and search goods (Pan & Zhang, 2011). The quality of the experience products is difficult to verify before use while search products can be judged on the basis of product specifications before purchase (Mudambi & Schuff, 2010; Willemsen, Neijens, Bronner, & De Ridder, 2011). Therefore consumers looking for experience products specifically rely on others' usage experience.

2. Motivation and research contributions

To draw useful information about the effect of various predictors on review helpfulness, an efficient ML algorithm is required. Deep learning is a class of ML algorithms that uses multi-layer neural networks as architecture. Contrary to traditional-based algorithms, deep neural network provides architecture that is capable to counter new problems relatively easily. Deep neural network provides training stability, generalization, and scalability with big data. Since it performs quite well in a number of diverse domains, therefore it is quickly becoming the algorithm of choice for the highest predictive accuracy.

With the exponential growth of reviews on websites, reviews are not always being consistently helpful e.g. sentiments expressed in the reviews can have varied effect on helpfulness and its importance has already been acknowledged in the previous studies (Chua & Banerjee, 2016; Crowley & Hoyer, 1994). New opportunities and challenges have arisen and there is a need to measure the emotions of the large collections of product reviews. The traditional studies utilized self reports and survey based approaches to measure the emotions of small number of candidates; however e-commerce websites today have masses of customer data to gain valuable insights. Related studies have already addressed sentiment classification (Blitzer, Dredze, & Pereira, 2007), review helpfulness prediction (Ghose & Ipeirotis, 2011) and impact of sentiment on review helpfulness (Chua & Banerjee, 2016). However, our research addressed the following research questions;

- How much discrete positive and negative emotions embedded in review content affect the review helpfulness ratings?
- Which emotions type (negative or positive) strongly drive the helpfulness (quality) of online reviews?
- Does the perceived helpfulness change, when product type (experience or search goods) is considered?
- Which emotion dimensions are more influential for helpfulness among positive and negative emotions?

The aim of this research is to examine the interconnection between emotional content of product reviews and their helpfulness ratio. We are the first that introduced four discrete positive and four discrete negative emotions. The influences of positive emotions and negative emotions embedded in reviews on perceived helpfulness are investigated and a binary classification model is built for helpfulness prediction based on deep neural network. Two real life review datasets are utilized to demonstrate the utility of proposed emotion features and six different models are trained to evaluate their contribution towards helpfulness prediction. Theoretically, the results of the current research has contributed to relevant literature by providing further understanding of sentimental features of review and their influence on review helpfulness. More specifically, the study takes a step further to uncover the importance of each type of positive and negative emotions that sheds light on the empirical relationship between these variables and review helpfulness. Additionally, the findings of the study extends the results found in existing literature (i.e. Yin, Bond, & Zhang, 2014; Ullah, Zeb, & Kim, 2015). Major contributions of the proposed study includes

1. We are the first to investigate the influences of discrete positive and negative emotions embedded in product reviews on review helpfulness prediction.
2. This article devises a method for extracting discrete positive and negative emotions features from review content and builds a review helpfulness prediction model based on deep neural network.
3. This research facilitates e-commerce managers and retailers in minimizing the cognitive processing costs for better organization of their product reviews.
4. It has been observed that proposed emotion features have vital role in predicting review helpfulness in contrast to existing state of the art baseline techniques. Results reveal that Trust, Joy, Angry and Sadness are most influential predictors for review helpfulness.

The remainder of the paper is structured as follows. Section 3 presents the related work which is followed by Section 4, which describes problem formulation, proposed novel features, data collection and analysis method. Subsequently, detailed results analysis is presented in Section 5, followed by the discussion (Section 6). Section 7 explains the implications of this research and Section 8 presents conclusion and directions for future research work.

3. Related work

3.1. Review helpfulness and measurement

Review helpfulness is formulated as the observed/perceived value of a given entity to make aware about the purchase decisions (Mudambi & Schuff, 2010). It is very difficult for consumer to identify helpful reviews among large volume of product reviews posted on websites. Amazon has pioneered the idea of helpful votes (Wan, 2015). What makes a helpful review has gained growing interest in online review platforms and researchers had discovered that various product, reviewer and review features have more