The Role of Social Media in Political Campaigns: A Sentiment and Engagement Analysis of Political News Feeds and Facebook Comments in Three Political Events in Hong Kong

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Introduction

People usually discuss socio-political issues based on their news exposure and ongoing events at that time. Social interactions are often affected by the dissemination of news, which convey not only information about the facts, but also the journalist or a media organization's judgment and evaluation about a certain person or issue, or the intended emotional effect the news reporter wishes to have on the audience during news exposure. Sentiment reflected by media text and public opinion expression is becoming an important dynamic in today's changing society and media environment. This paper contextualises journalism in an emotionally charged networked environment and examine its relationship with public sentiment, by studying how emotion is produced and consumed via news exposure on social media. In the social media domain, the emotional profile is sometimes more influential than the factual elements of contents. Yet knowledge about the relationship between the news feed emotional profile and readers' comments (opinion expression) remains limited. Thus, the key issue at the heart of our inquiry is: How "affective" news operates to establish and maintain connections with the public engagement?

Computer automation methods reveal a great deal of potential in studying this new media environment. One application is to outline and validate a new automated measurement instrument for sentiment analysis in political texts. The linguistic patterns of news posts as well as the comments to them on social media, can help us obtain better understanding about the news exposure and public opinion expression online. Thus, this study tries to analyse a large amount

of news feeds from news media's social media outlet (i.e. Facebook). The instrument used was based on a dictionary-based approach, which consists of a simple word count of the frequency of keywords in a text from a predefined dictionary. We analyse the linguistic patterns of those news feeds and corresponding comments, in order to identify sentimental elements embedded in news reporting and commenting that are related to particular political campaigns. The linguistic patterns reflecting the emotion and logical thinking on the campaign related topics will be compared cross media outlets and campaign periods. Meanwhile, relationships between the news and comments' linguistic patterns and Facebook engagement will be also examined.

Literature Review

Social Media's Emotional Effect in Political Campaigns

One of the common characteristics of political campaigns in the recent decade, ranging from large scale protest to different levels of elections, is the heavy usage of digital media for communication and coordination. Social networking sites (SNS) like Facebook facilitate self-expression and promote social connections. The norms of emotion disclosure may affect valenced responses on SNS, and the diffusion of emotions in the SNS environment is faster and broader than that through traditional communication channels (Brady, Wills, Jost, Tucker, & van Bavel, 2017). Growing scholarly attention has been paid to the outstanding role social media play in various of political campaigns. For example, some studies investigate how social media being used by political campaign runners in order to mobilise the public participation (e.g. Cogburn, 2011) or how social media being used by participants to facilitate kinds of decentralized connective actions (e.g. Zhang & Lee, 2018). However, there is not so much research effort look into how news feeds provided by media organizations spread over social media platforms and their emotional effect in political campaigns.

Today's journalism practices tend to craft powerful and engaging news stories. Searching for something emotional, startling or shocking to capture the audience's attention is what journalists have learned to take into account when they report political, social or human interest stories. Previous study indicated that political campaign periods strongly influence the amount, style and actors of the (political) news (van Aelst & Swert, 2009). Different news media handle the same news story in different ways. Sober and serious newspapers and television news programs more often used the responsibility and conflict frames in the presentation of news,

whereas sensationalist outlets more often used the human interest frame (Semetko & Valkenburg, 2006).

Against this background, a classic media effect question remains significant when studying the roles journalism practices and social media play in political campaigns. That is, the emotional effect of news. There is little research about whether news frames can influence what citizens *feel* about politics' (Gross & Brewer, 2007), not to mention that in the social media domain. Research on the cognitive and attitudinal effects of the news posit that information presented by the media not only set the public agenda (salience or the perceived importance of social affairs), but also dictate to the public how to think about certain matters (e.g., de Vreese, Boomgaarden, & Semetko, 2011; Scheufele & Tewksbury, 2007). Previous experimental study revealed that the news frame stressed in the news report could exert significant cognitive, attitudinal, and emotional effects; and the emotional impact aroused by the news frame was conditioned by the incidental presence of information (Igartua, Moral-Toranzo, & Fernández, 2011). In this study, we intend to focus on the emotional effect of news feeds on readers' commentary expression via social media.

As Gross and Brewer recognize, the research significance grounds on two reasons: First, emotions play a fundamental role in political processes, for example, by affecting the appraisal of candidates in an electoral confrontation (e.g., Conover & Feldman, 1986), and; Second, news frames, by affecting accessibility to certain considerations of a topic, also influence the type of emotional response that a person can have when reading a news story, since emotions depend on cognitive appraisals of facts or situations (Frijda, 1986). Recent findings revealed that media content such as populist ads will strengthened intergroup anxiety and negative stereotypes for voters with lower educational degrees and lead to more negative explicit attitudes (Matthes & Schmuck, 2017).

Sentiment Analysis in Political Communication

An increasing number of studies in political communication focus on the emotional tone of news content, political speeches, or advertisements. This growing interest in measuring sentiment coincides with a dramatic increase in the volume of digitized information (Young & Soroka, 2012). Social media content often conveys information about the author's emotional state, his or her judgment or evaluation of a certain person or issue, or the intended emotional

effect the sender wishes to have on the receiver during communication (Bollen, Pepe, & Mao, 2011), which is generally termed as "sentiment". Written text is inherently linked to emotion, and classic journalism studies indicate that news production is affected by ideological, cultural, institutional, and professional biases. Many of these studies focus on classifying the journalists' emotional state. However, little is known about the makeup of emotions during news reading on social media. Do reporters and audiences share the same feelings? If not, is the relationship between the news posts and emotions of the audience incidental, or are there recurring patterns? Previous studies have shown that affective information could be transferred through computer-mediated communication (Harris & Paradice, 2007). It's likely that similar emotional effects would be found when news feeds spread via social media platform.

The connection between language and communication has been well established. Across academic disciplines, a number of analytical tools have been applied to political, social, and cultural discourses. There is more than one approach to assessing the emotion of written text. Examining linguistic patterns is an alternative to the traditional approach of interpreting a text's symbolic meanings and considering the text within a certain context. In this study, we aimed to explore this linguistic method as it relates to news reading on social media.

Emotions are the glue of human societies and their influence on human behavior is significant. It is one of the areas attracted computational researchers focus on (Bajaj, Pattabiraman, & Mesbah, 2014; Barua, Thomas, & Hassan, 2014). Based on the assumption that political discourse can provide an accurate measurement of individual personality differences, a theoretical and methodological approach that measures personality through language in order to quantify linguistic differences has been developed. These programmes "assume that the words people use convey psychological information over and above their literal meaning and independent of their semantic context" (Pennebaker, Mehl, & Niederhoffer, 2003). Thus, the theoretical assumption in this study is that language can be categorised and quantified to make inferences about individuals' personalities, attitudes, or standpoints on a given issue. One advantage of this strategy in media studies is that a large number of written samples can be collected and analysed more quickly than with other methods, such as traditional discourse analysis or content analysis by human coding (Song & Zhang, 2017).

Research Background and Research Questions

Research Background: Umbrella Movement and the Following Elections

   This study chooses the Umbrella Movement (UM) in Hong Kong and two political elections after the large-scale social movement as the main research background for empirical investigation. UM was a 79-day civil disobedience campaign in Hong Kong that occurred between September and December 2014. The movement was widely called as "Umbrella Movement" (UM here after) by foreign media and local activists, for the recognition of the umbrella as a symbol of defiance and resistance against the police force. The large scale protest demanded the institutionalisation of a "filterless" election for the Chief Executive of the Hong Kong Special Administrative Region government.

   There are two major reasons that make UM a good case for sentiment and engagement analysis of political news posts on social media: First, the movement itself was very decentralised – the demands and perspectives of the protesters could not be unified from the beginning and even changed over time. The public opinion towards the movement also varied in the whole society. Second, although the protests ended without any political concessions from the government in December 2014, in the following years, the movement remains an icon, with polarised symbolic meanings among different stakeholders, especially during the following two district- and city- level elections. Observers still believed that UM has significant implications for the future of Hong Kong democracy. Ideological divisions of the society became more polarised; tension and conflicts increased between political camps (pro-establishment vs pro-democratic) and generations (Lee & Chan, 2018).

Research Questions

   Based on the above literature review and discussion, media discourse changed in reaction to the shifting socio-political contours throughout UM as well as the post-movement elections. By identifying the linguistic patterns of news coverage and public comments through quantifiable text analysis, this study seeks to delineate the public discourse surrounding large-scale political campaigns. Particularly, the following research questions are asked:

 RQ1: How the news feeds from Hong Kong news media convey their different tones and
    emotions in portraying the political campaign of UM?

RQ2: How Facebook user comments convey their varying expression of opinion on different news outlets' social media platforms?

RQ3: Whether and how the tones and emotions of news feeds transmit to the readers' commentary expression?

RQ4: What are the correlations between found linguistic pattern and Facebook engagement in the three political campaigns?

Methods

Data Collection

This study chooses Facebook as the outlet for investigation. The reason why choosing Facebook is because the SNS is currently the most dominant social media platform in Hong Kong, with more than 4.4 million local users, comprising more than 60% of the population (Go-Globe, 2015). Most pertinent to this study is the fact that many Hong Kong citizens, especially supporters of the UM, used Facebook to obtain information and communicated with others (Ma, Lau, & Hui, 2014).

We used R to retrieve news posts that were published on the Facebook by four local news media, namely *Apply Daily*, *Ming Pao*, *Passion Times*, and *Speak Out HK*. The first two outlets are traditional newspapers that provide both print and online versions of news services, while the other two are purely online news media (some called alternative media) that target the online readership market niche. The selected news media represent a diversity of ideological standpoints on the political spectrum in Hong Kong, from radical anti-establishment (*Passion Times*) and typical pro-democratic (*Apply Daily*), to the central and professional (*Ming Pao*), and to pro-establishment (*Speak Out HK*). In terms of audience orientation, the four news media also vary, ranging from mas orientated (*Apply Daily* and *Speak Out HK*), middle-class and well-educated group orientated (*Ming Pao*), and younger generation targeting (*Passion Times*).

A total of 12,758 news posts met the criteria and were retrieved directly from the news media Facebook pages. Accordingly, a total of 1,967,882 comments of those news posts were also retrieved. Since the main focus of the current study is to look at the role of social media in political campaigns. The selection criteria of the news posts are based on a set of keywords concerning the Umbrella Movement in Hong Kong. This study used a series of keywords to search for news posts. The keywords were terms that people used to refer to the movement,

including "*zimling*" (meaning: occupy), "*zimzung*" (meaning: occupy central), "*zim ling gam zung*" (meaning: occupy Admiralty), "*zim ling hang dung*" (meaning: occupy movement), "*jyu-saan*" or "*saan*" (meaning: umbrella), "*ze-daa*" (literally means using the umbrella to fight), "*bou pou syun*" (meaning: fight for universal suffrage), "*jyu saan gaak ming*" (meaning: umbrella revolution), "*wong si daai*" (meaning: yellow riband – a symbol of the democratic movement), and "*ngaan sik gaak ming*" (meaning: colour revolution).

The sampling timeframe covers three political campaigns: 1) 28 Sept to 15 Dec 2014 (the Umbrella Movement); 2) 16 Dec to 22 Nov 2015 (the District Council election); and 3) 10 Apr to 31 Dec 2016 (the Legislative Council Election). Any news posts on the four Facebook pages that included one or more of the above keywords would be identified as part of the sample set, and the comments left on these news posts on Facebook were also retrieved (as long as they fell within the timeframe).

The collected news posts, as well as the comments to them, would provide a general picture about how news media portrayed the large-scale political campaigns and the response to the incidents by a significant portion of the public.

Variables for Data Analysis

Opinion mining is the computational study of opinions, sentiments and subjectivity of text. Much of the relevant research has considered sentiment polarity at granularity levels ranging from sentences to documents (Cao & Zukerman, 2012). Two basic approaches can be classified in opinion mining, namely, machine learning approach and lexicon-based approach. Each of these approaches has benefits and potential risks. Machine learning approaches are often efficient in contexts where training data are available for supervised learning. Nevertheless they are less useful in contexts without training data nor clear categorization or labelling in output. In social sciences field sentiment benchmarks are either entirely nonexistent or difficult to obtain. To attain training data, researchers often have to rely on human-coding of a substantial number of texts.

On the other hand, lexicon based approach relies on a predefined dictionary of positive and negative words. This method involves classifying written samples by matching word stems with entries in the software's internal dictionary, and then placing the properly identified words into their respective categories. Word counts or other measures of frequency are used to score the

opinions in the data. As such, the cost for automated analysis of texts is extremely low. However, their application are often context-dependent, as their validity depend on whether the dictionary reflects the sentiment in the text to which is applied. Constructing context-sensitive dictionaries for each analysis is necessary. In this study, we adopted the latter computational approach to conduct analyses of the news feeds and comments.

TextMind was used to identify emotional, pronouns, and exclamation marks lexicons. It is a Chinese-language text analysis program based on Linguistic Inquiry and Word Count (LIWC, Pennebaker, Booth, & Francis, 2007). TextMind uses the LIWC2007 English lexicon and the traditional Chinese C-LIWC lexicon. It also integrates the word segmentation and part-of-speech tagging modules of both the Natural Language Processing Information Retrieval (NLPIR) and the Language Technology Platform (LTP). The percentages of words in each of these target categories were computed, namely, affect in general, positive and negative tones, anxiety, anger, and sadness. TextMind quantifies emotion using the percentage of identified words from the total number of words per post (see Song & Zhang, 2017). The generated word count scores indicate the frequencies of words and punctuation marks (i.e. number of occurrences divided by the total number of words in the text).

Other variables generated for data analysis include: Facebook engagement intensity (i.e. numbers of likes, comments, and shares), length of news feeds and comments, word per sentence of each news feed and comment.

Results

Descriptives

To answer RQ1 and RQ2, descriptive analyses were conducted to illustrate how the organizational feeds from the four Hong Kong news media convey their different emotional tones in portraying UM in the three political campaigns; and how Facebook user comments convey their varying expression of opinion on different news outlets' social media platforms. As Table 1.1 to 1.5 show, the tones and emotions reflected by linguistic patterns vary among the four news media. Moreover, these differences evolved during the three periods of time, i.e. the movement and the two following elections.

The pro-democratic and mass orientated news media *Apple Daily*'s emotions remains steady when mention UM, while the tones were relatively stronger during the movement period

than that in the two following elections. At the comment level, the emotions were generally stronger during the movement while declined in the latter elections after the movement's failure.

The professional and middle class orientated newspaper *Ming Pao* performed a relatively stronger tone, particularly in positive wording, during the movement; it indicates the hope of middle class upon the potential political change during the large scale social movement. However, such affect could be hardly found after the UM failed. The newspaper tried to retain professional and less emotional in the afterward elections.

The alternative news media with radical pro-democratic position *Passion Times* was the most emotional news media among the four. It adopted an increasingly emotional tone in the post-movement periods, especially during the district council election periods. Those linguistic patterns reflected the pro-democratics' frustration, disappointment, and even anger about the lack of political development.

The analysis revealed that the newly emerged pro-establishment news site, *Speak Out HK*, expressed the most intensely negative emotion towards the "chaos" created by the movement, including anxiety, anger, and sadness. The word count scores of *Speak Out HK* were highest among the four news media. Such linguistic patterns were consistent with the site's anti-movement position.

Table 1.1 Positive wording comparison across three periods

	Apple Daily		Ming Pao		Passion Times		Speak Out HK	
	News	Comment	News	Comment	News	Comment	News	Comment
UM	1.07%	3.69%	2.18%	2.46%	0.92%	2.89%	1.84%	3.31%
District	1.09%	2.40%	1.33%	2.14%	1.71%	2.11%	1.60%	2.24%
LegCo	1.24%	1.98%	1.59%	1.88%	1.73%	1.99%	2.50%	2.85%

Table 1.2 Negative wording comparison across three periods

	Apple Daily		Ming Pao		Passion Times		Speak Out HK	
	News	Comment	News	Comment	News	Comment	News	Comment
UM	.26%	.62%	.32%	.54%	.24%	.52%	.39%	.62%
District	.40%	.42%	.32%	.46%	.46%	.47%	.36%	.42%
LegCo	.27%	.54%	.23%	.44%	.40%	.41%	.13%	.54%

Table 1.3 Anxiety emotion score comparison across three periods

	Apple Daily		Ming Pao		Passion Times		Speak Out HK	
	News	Comment	News	Comment	News	Comment	News	Comment
UM	.13%	.18%	.17%	.16%	.11%	.12%	.30%	.14%
District	.11%	.12%	.13%	.13%	.15%	.13%	.13%	.10%
LegCo	.18%	.10%	.11%	.13%	.09%	.11%	.00%	.14%

Table 1.4 Anger emotion score comparison across three periods

	Apple Daily		Ming Pao		Passion Times		Speak Out HK	
	News	Comment	News	Comment	News	Comment	News	Comment
UM	.33%	.72%	.44%	.52%	.32%	.47%	.60%	.66%
District	.32%	.53%	.37%	.62%	.51%	.49%	.58%	.84%
LegCo	.45%	.50%	.42%	.62%	.42%	.48%	.20%	.74%

Table 1.5 Sadness emotion score comparison across three periods

	Apple Daily		Ming Pao		Passion Times		Speak Out HK	
	News	Comment	News	Comment	News	Comment	News	Comment
UM	.11%	.20%	.15%	.16%	.09%	.15%	.26%	.21%
District	.15%	.15%	.15%	.16%	.21%	.19%	.17%	.17%
LegCo	.25%	.12%	.11%	.13%	.21%	.13%	.00%	.22%

Comparing the mean scores of news feeds across the three political campaigns, several trends have been found: The professional and middle-class targeting newspaper, *Ming Pao*, was the most positive about the potential of political change during the movement, reflecting the middle class' hope for progressive improvement in political reform. Such a positive tone towards UM declined after the movement failed. In contrast, during the post-movement elections, the radical anti-establishment news web (*Passion Times*) and the typical pro-democratic newspaper (*Apply Daily*) on one wing of the political spectrum tended to adopt stronger tones and increased emotions in the post-movement periods, reflecting the fact that the political camp kept using UM as an icon for their political persuasion. These linguistic patterns embodied the two news media's frustration, disappointment, and even anger about the lack of political development.

The total amount of comments reflected a tendency of Facebook engagement to UM related news feeds. That is, the social media news posts remain a popular space for expressing one's own political attitude. The linguistic patterns (i.e. tones or emotions) embodied the readership profiles of four different news media.

Emotion transmission

In answering RQ3, whether and how the tones and emotions of news feeds can transmit to readers, regression models were conducted to examine the associations between two sets of linguistic patterns.

Results show that the tones and emotions of news feeds were all positive correlated with that in comments. Comparatively, negative tone ($\beta = .24$, $p < .001$) and sadness ($\beta = .29$, p

< .001) were more easier to be transmitted than positive wording (β = .16, p < .001), anxiety (β = .18, p < .001) and anger (β = .14, p < .001).

The exploratory findings also reveal that, instead of transmitting the same emotion from news feeds to readers' opinion expression, the emotion embedded may affect another type of emotion in audience comments. Interestingly, negative wording was negatively related with sadness (β = -.10, p < .001).

It was confirmed that the linguistic and emotional transmission patterns could be different across news media and sensitive to the campaign context. The models used Apple Daily as the reference group for comparison. Generally, the tone, either positive or negative, was easier to be transmitted through news feeds of *Apple Daily*. For the emotion of anxiety, *Apple Daily* and *Ming Pao*'s patterns were similar; *Passion Times* transmitted strongest anxious emotion to the readers, while *Speak Out HK* transmitted less anxious emotion to readers. For the emotion of anger, *Apple Daily* and *Speak Out HK*'s correlating patterns were similar; both *Ming Pao* and *Passion Times* transmitted less anger to the readers' comments. For the emotion of sadness, *Apple Daily* and *Speak Out HK*'s correlating patterns were similar; *Ming Pao's* correlating pattern was a bit stronger and *Passion Times' tones and emotions transmitted* strong sorrowful emotion.

Table 2. Regression of news feed linguistic characters on comments

IVs – News Feed	DV – Comment Tone or Emotion				
	Positive	Negative	Anxiety	Anger	Sadness
Word count	-.06***	-.06***	-.06***	-.04***	.05***
Word per sentence	.03**	.01	.15***	.01	-.01
Positive	.16***	-.01	-.04**	-.02*	-.08***
Negative	-.02	.24***	.04**	.05***	-.10***
Anxiety	-.04***	-.00	.18***	.02*	.05***
Anger	-.04**	-.02	.03**	.14***	.02**
Sadness	-.08***	-.10***	.06***	-.03*	.29***
Past	-.01	.05***	-.01	.02*	-.04***
Now	.03*	.01	-.03***	.00	-.06***
Future	.05***	.02*	.00	.00	-.03***
Ming Pao (yes = 1)	-.34***	-.13***	.01	-.11***	.05***
Speak Out HK (yes = 1)	-.08***	-.03***	-.04***	.00	.01*
Passion Times (yes = 1)	-.45***	-.44***	.20***	-.29***	.55***
Period	.10***	.00	-.10***	.00	-.19***
R^2	.20***	.34***	.16***	.12***	.65***

News emotion and social media engagement

In answering RQ4, correlation tests were firstly performed to examined the relationship between general affect of news feeds and their Facebook engagement figures, namely, number of likes, comments, and shares. It was confirmed that the affect of news feeds were positively correlated with numbers of like (r = .08, p < .001), comment (r = .13, p< .001), and share (r = .12, p < .001). It was confirmed that among three types of Facebook engagement, news feeds' emotional effect was most influential to commenting.

Table 3 Regression of News Feeds Characters on Facebook Engagement

News Post	Facebook Engagement		
	Like	**Comment**	**Share**
Word count	.10***	-.07***	-.07***
Word per sentence	.38***	-.00	-.00
Positive	.15***	.15***	.12***
Negative	.11***	.13***	.20***
Anxiety	-.08**	-.10***	-.08***
Anger	.02	.02	.03
Sadness	-.12***	-.18***	-.19***
Past	.17***	.22***	.21***
Now	.05**	.09***	.07***
Future	-.04**	-.04**	-.03*
R^2	.25***	.21***	.25***

Note. Entries are standard coefficients. *** p < .001, ** p < .01, * p < .05.

Table 3 presents the regression results on Facebook engagements by the linguistic pattern of news feeds. Several findings have been found: First, longer news feeds got more likes (β = .10, p < .001) but shorter news feeds got more comment (β = -.07, p < .001) and share (β = -.07, p < .001). Second, both positive and negative news affect Facebook engagements. News feeds readers tend to interact with news stories with clear stands. Third, the emotion of anxiety and sadness were both a factor that reduce reader engagements. That is, less anxious and sad news reporting, more intensive engagement readers are likely to perform. However, angry news feeds won't be very engaged by readers. Forth, because the four news media paid different attention to the time when mentioning UM in their news feeds. It was found that news

mentioning the past, including background information, previous events, etc., were more engaging to the readers; whenever future was mentioned in a news feed, the engagement rate likely declined.

Discussion

In a world of evolving digital media and online audiences, the dynamics of issue agendas are becoming more complex. Both traditional and social media news outlets have online presences, and they are more accessible to multi-level and time-series analysis. Therefore, systematic research on both news reporting and public opinion expression become increasingly important but challenging. In this study, we retrieve both news feeds and their Facebook comments about the Umbrella Movement and used computational method to conduct automated linguistic analyses across campaigns and news media. The preliminary results are basically consistent with a few basic theoretical assumptions discussed in previous literature and provide new insights about news spread and public opinion expression via social media during political campaigns.

The linguistic choices of news reporting are affected by news media's (or journalists') political, ideological, and market orientations. By comparing the word count scores of the four news media, we found that the reporting style of news media change along the time in response to the social atmosphere and development of social events. Traditional newspapers was not necessarily more conservative or moderate than their emerging online competitors (i.e. online news websites). During particular circumstance (i.e. a large-scale social movement like the UM), traditional print media expressed emotions, and engaged by the readers on social media.

The findings also support the argument that news exposure divided by like-minded audience, so as emotional expression (Song & Wu, 2018); and may contribute to a better understanding of the mechanisms explaining the so-called framing effect of news feed distribution on social media in particular context of political campaigns. Political news feeds transmit emotions and affect audience's opinion expression during political campaigns. Correlations between the tones and emotions in news feeds and that of Facebook comments have been found. Although further investigation is needed to validate the causality, the findings still provide insights about how emotions being transmits from news feeds to readers. This exploratory study also contributes to strategy of promoting the public's personal and emotional

engagement with their daily news exposure. Shorter news feed with stronger tone or anxious or sad wordings are more engaging in the social media environment.

Nonetheless, some limitations we found during the study: First, the validity is contingent on whether the dictionary reflects the sentiment in the text to which is applied. Thus, we still need to use a hand-coded sub-sample to compute the accuracy. Second, dictionary-based programmes can be notoriously noisy, especially for the application in Chinese context. Robust testing might be needed to verify the results.

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