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Do you like me when the sun is shining? The influence of weather and point-in-time on the stakeholder-Dialogue in Facebook

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Abstract

Purpose – The purpose of this paper is to investigate the influence of external factors on the Facebook dialogue. As both weather and point in time substantially. As both weather and point in time substantially influence people's lives, it can be assumed that both factors may also affect communication on Facebook. To the best of the authors' knowledge, this is the first study focusing on the impact of the external factors "weather" and "point in time" on a public utility's Facebook communication.

Design/methodology/approach – The potential influence is explored through the case study of an Austrian public utility. The study focuses on 321 postings, published via the company's official Facebook account between August 2016 and February 2018.

Findings – The empirical results confirm the influence of "weather" and "point in time" indicators on the stakeholder dialogue. The findings highlight how the relevant items affect the posting behavior of a utility, as well as stakeholders' reactions, comments and shares.

Originality/value – By introducing both external factors to the social media literature, this paper broadens the understanding of Facebook communications beyond the sender and receiver of digital information. In this way, the research contributes to a more holistic view of Facebook dialogue. It provides practical advice on how social media managers of public utilities may use weather forecasts and "point in time" considerations to more strategically foster stakeholder dialogue in social media.

Keywords Social networks, Facebook, Case study, Weather, Public utilities, Social media analysis, Stakeholder dialogue, Time of the day

Paper type Research paper

1. Introduction

European utility companies are confronted with sectoral changes, including the ongoing energy transition, technical progress and increasing competition

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(Dechange and Friedrich, 2013; Witt, 2013; Martin *et al.*, 2018). To meet these challenges, the dialogue with a wide variety of stakeholders is becoming more and more important (Martin, 2017a). As a social network, Facebook offers a virtual communication platform for such stakeholder dialogue (Manetti *et al.*, 2017; Lovari and Parisi, 2015; Hurlbert, 2014; Cho *et al.*, 2014).

Some studies have investigated communication on Facebook between public utilities and their stakeholders. For example, a multi-year panel study has analyzed the manager's perspective on the Facebook dialogue (Martin and Grüb, 2016; Martin, 2016; 2016b). Another study interviewed users on the Facebook pages of public utilities about their expectations in terms of a dialogue on Facebook (Martin *et al.*, 2018). Both strands of research provide detailed insights into the communication on the Facebook pages of public utilities. Nevertheless, these studies focus on aspects of communication, including the content of the conversation, which can be directly influenced by the utility or their stakeholders. Additional influences of external factors on the Facebook dialogue have not been taken into account so far. However, as external factors might also impact the conversation on Facebook, a closer investigation of these factors seems necessary to broaden our understanding of social media communication beyond the actual sender and receiver of digital information (compare with e.g. studies of Martin, 2016 and Martin *et al.*, 2018). As the virtual dialogue might be actively used by the utilities to meet the challenges in the European energy sector, a more holistic view of the Facebook communication becomes crucial. Such broadened scope needs to include the potential impact of external factors on the communication in Facebook.

"Weather is one of the most pervasive background environmental variables in human life" (Rind, 1996, p. 137). It might be such an external factor influencing the Facebook dialogue. Weather significantly affects human behavior (Keles *et al.*, 2018; Moon *et al.*, 2018a, 2018b) and the individual's mood (Murray *et al.*, 2010; Spasova, 2011) and well-being (Canova and Nicolini, 2019; Von Mackensen *et al.*, 2005), even including the self-reported levels of happiness (Rehdanz and Maddison, 2005). Nevertheless, weather has so far been largely neglected in the marketing literature (Murray *et al.*, 2010; Moon *et al.*, 2018b). "[M]arketing scholars have not examined weather marketing as intensively as its practical importance suggests" (Moon *et al.*, 2018b, p. 380).

In addition to weather, the days (Horanont *et al.*, 2013; Larsen and Kasimatis, 1990), weeks (Larsen and Kasimatis, 1990) or even months (Parsons, 2001; Radas and Shugan, 1998) of individuals are often pre-scheduled. Therefore, the point in time at which communication occurs may also affect individuals' behavior (Canova and Nicolini, 2019; Curini *et al.*, 2015; Guo *et al.*, 2007) and should be considered as a potential external factor as well.

To the best of our knowledge, no research has examined the potential impact of both external factors toward the communication of public utilities in Facebook. As both weather and point in time substantially influence people's lives, it can be assumed that both factors may also affect the communication on Facebook. Therefore, this explorative study focuses on the following research question:

RQ1. To what extent do the external factors weather and point in time impact Facebook communication between a public utility and its stakeholders?

By questioning the potential impact of both external factors, this paper adds a new perspective to the current literature on social media. In this way, the study aims to provide

new social media insights to scholars and practitioners in the energy sector. Social media managers shall benefit from practical advice on how public utilities may use weather forecasts and "point in time" considerations to more strategically foster the stakeholder dialogue in social media and achieve better contact to and feedback from relevant stakeholders. Scholars shall be provided with additional insights about external factors that might help to better explain the communication in social media and need to be taken into consideration in future research.

2. Theoretical framework

2.1 Stakeholder theory: stakeholder dialogue of public utilities on Facebook

According to stakeholder theory, the activities of public utilities might be substantially influenced by their various stakeholder groups (Donaldson and Preston, 1995; O'Riordan and Fairbrass, 2008; Freeman, 1984). For this reason, it seems important for companies to increasingly focus on active stakeholder management (Payne and Calton, 2004; Freeman, 1984). Particularly, a dialogue offers the opportunity to identify stakeholders' expectations, wishes and points of criticism (Manetti *et al.*, 2017; Driessen *et al.*, 2013). In addition, the dialogue enables public utilities to explain their own objectives and behavior (Pedersen *et al.*, 2013). By allowing for a "pushing" of information from the utility toward its stakeholders and a "pulling" of information from stakeholders to the utility (Martin, 2017a; Cuppen, 2012), Facebook provides a virtual platform for such dialogue (Lovari and Parisi, 2015; Hurlbert, 2014; Cho *et al.*, 2014; Driessen *et al.*, 2013).

As recent studies show, public utilities increasingly communicate with their stakeholders on Facebook (Martin, 2016, 2017b). The majority of companies uses their social network accounts to address citizens, current or potential private customers, current employees and the public and media. They provide a variety of information, for example about their products and services, career and job openings, renewable energy, electric mobility, energy saving tips, their sponsorship or social engagement (Martin, 2017a). Users may react to (like, love, wow, haha, sad and angry), comment on or share postings (Kim and Yang, 2017; Liu *et al.*, 2017). Although reactions only need one click, comments and shares are more time consuming and therefore require a higher degree of commitment (Kim and Yang, 2017). For this reason, users more frequently react to a post than comment or share it (Bonsón *et al.*, 2015). The response to the released postings also depends on users' expectations of such a dialogue on Facebook. In this respect, users expect the public utility to post a variety of information regularly. In addition, users want to provide feedback and thereby actively participate in the stakeholder dialogue (Martin *et al.*, 2018).

The literature refers to differences regarding the use of Facebook between women and men. Gender may affect the motives for spending time on Facebook (Horzum, 2016; Sheldon, 2008), the chosen topics of interest (Brandtzaeg, 2017), the way individuals express themselves (Oleszkiewicz *et al.*, 2017; Luarn *et al.*, 2015) and the intensity of Facebook use (Przepiorka *et al.*, 2016; Shepherd, 2016). These gender-specific differences can also be identified in Facebook communication with a public utility. For example, women are more interested in information on social aspects, such as sponsorship and social responsibility, whereas men are more interested in company-related information, such as generating stations or investment projects (Martin *et al.*, 2018). The above-described gender differences raise the question of whether the potential impact of "weather" and "point in time" on Facebook conversations is equally applicable to women and men.

2.2 Influence of weather and point in time as external factors

2.2.1 Weather as external factor. Weather is an essential external factor that substantially affects human life (Rind, 1996) and behavior (Murray *et al.*, 2010). For example, weather may

influence the choice of individuals' daily activities (Horanont *et al.*, 2013; Gailliot, 2014), their chosen means of transportation (Guo *et al.*, 2007) and their shopping behavior (Keles *et al.*, 2018; Bertrand *et al.*, 2015). Even individuals' helpfulness (Cunningham, 1979; Rind, 1996), self-control (Gailliot, 2014) and aggression (Gailliot, 2014) may be affected by weather. In addition, the literature shows a correlation between weather and state of health, including emotional status and mood (Denissen *et al.*, 2008; Spasova, 2011; Murray *et al.*, 2010), well-being (Von Mackensen *et al.*, 2005), level of chronic pain (Shutty *et al.*, 1992), tiredness (Denissen *et al.*, 2008) and the ability to perform cognitive tasks (Gailliot, 2014).

Significantly, weather can also influence how people communicate with each other. Extreme humidity or low temperatures increase the likelihood of people having longer telephone calls. In contrast, high temperatures, high barometric air pressure and high wind velocity reduce the number of people being called (Phithakkitnukoon *et al.*, 2012). Regarding Twitter conversations, the proportion of happy tweets is influenced by temperature and rain (Curini *et al.*, 2015). Additionally, sunshine impacts the health- or relationship-related telephone calls to counseling services (Hribersek *et al.*, 1987). The above-mentioned influences of specific weather conditions on human behavior and health are detailed in Table 1. Following the systematic approach outlined by Rind (1996), this study differentiates between overt (e.g. activities) and covert behavior (e.g. mood).

2.2.2 Point in time as external factor. Besides weather, the life of individuals is often pre-scheduled daily (Horanont *et al.*, 2013; Larsen and Kasimatis, 1990), weekly (Larsen and Kasimatis, 1990) or even monthly sequences (Parsons, 2001; Radas and Shugan, 1998). For example, days are frequently determined by work–life routines, such as spending time at work followed by leisure time (Horanont *et al.*, 2013). Similarly, the week serves as a crucial point of orientation that guides and structures upcoming events in the near future (Larsen and Kasimatis, 1990).

Additionally, specific days of the week may carry pre-determined meanings for the individual but also for social groups:

> The expression "blue Monday" reflects a commonly held belief in our culture that Monday is the worst day of the week, representing the low point for affective states [. . .]. Monday is viewed as unpleasant because most people anticipate four more (presumably unpleasant) workdays ahead (Stone *et al.*, 1985, p. 129).

Therefore, individuals are more likely to prefer Fridays and Saturdays since the following days provide leisure time for recreational activities (Stone *et al.*, 1985). In this context, the literature emphasizes that the emotional status and mood of individuals is affected by both the time of the day (Egloff *et al.*, 1995) and the day of the week (Larsen and Kasimatis, 1990; Reis *et al.*, 2000; Kennedy-Moore *et al.*, 1992).

Moreover, the time of the day may influence people's activities, such as places visited or the duration of a visit (Horanont *et al.*, 2013), whereas shopping behavior seems to be correlated to the day of the week (Parsons, 2001; Kahn and Schmittlein, 1989), season (Radas and Shugan, 1998) or holidays (Parsons, 2001). Additionally, internet usage seems to be influenced by the day of the week. For instance, Canova and Nicolini (2019, p. 38) observed "that more consumers engage in online price search during weekdays, and on Mondays in particular [. . .]. [They] find more pronounced price search activity using mobile devices in the weekends, while desktops are preferred at the beginning of the week." Likewise, communication on Twitter is influenced by the day of the week, month and season. On average, the proportion of happy tweets is higher on Saturdays and (surprisingly) Tuesdays than on other days of the week. The highest proportion of happy tweets is reached in July, whereas the smallest proportion of happy tweets is sent in February. Additionally, specific

Table 1.
Influence of weather on human behavior and health

Human behavior and health	Weather as external factor: Temperature	Precipitation	Humidity	Barometric-Pressure
Overt behavior				
Phone conversation	Phithakkitnukoon *et al.* (2012)		Phithakkitnukoon *et al.* (2012)	Phithakkitnukoon *et al.* (2012)
Telephone counseling				
Twitter communication	Curini *et al.* (2015)	Curini *et al.* (2015)		
Activity (e.g., places/duration of visit)	Horanont *et al.* (2013); Gailliot (2014)			
Transit ridership	Guo *et al.* (2007)	Guo *et al.* (2007)		
Shopping behavior	Keles *et al.* (2018); Bertrand *et al.* (2015); Parsons (2001); Moffett (1996)	Parsons (2001); Murray *et al.* (2010)	Murray *et al.* (2010)	Murray *et al.* (2010)
Stock returns				
Recruitment				
Helpfulness	Cunningham (1979)		Cunningham (1979)	
Covert behavior				
Health				
Emotional status/mood	Gailliot (2014); Denissen *et al.* (2008)			Denissen *et al.* (2008)
Well-being	Von Mackensen *et al.* (2005)	Von Mackensen *et al.* (2005)	Von Mackensen *et al.* (2005)	
Tiredness				
Performing cognitive tasks/ productivity	Gailliot (2014)			
Chronic pain	Shutty *et al.* (1992)	Shutty *et al.* (1992)	Shutty *et al.* (1992)	
Self-control/aggression	Gailliot (2014)			
Product valuation	Zwebner *et al.* (2013)			

Source: Own compilation

(*continued*)

Table 1.

Human behavior and health	Weather as external factor: Wind velocity direction	Sunshine/cloudiness	Thunderstorms	Abrupt weather changes
Overt behavior				
Phone conversation	Phithakkitnukoon *et al.* (2012)			Phithakkitnukoon *et al.* (2012)
Telephone counseling		Hribersek *et al.* (1987)		
Twitter communication				
Activity (e.g., places/duration of visit)	Horanont *et al.* (2013)			
Transit ridership	Guo *et al.* (2007)			
Shopping behavior		Murray *et al.* (2010)		
Stock returns		Hirshleifer and Shumway (2003)		
Recruitment		Simonsohn (2007)		
Helpfulness	Cunningham (1979)	Cunningham (1979); Rind (1996)		
Covert behavior				
Health				
Emotional status/mood	Denissen *et al.* (2008)	Murray *et al.* (2010)		Denissen *et al.* (2008); Spasova (2011)
Well-being			Von Mackensen *et al.* (2005)	
Tiredness		Denissen *et al.* (2008)		
Performing cognitive tasks/ productivity				
Chronic pain				Shutty *et al.* (1992)
Self-control/aggression				
Product valuation				

holidays, such as Christmas day, increase the proportional number of happy tweets (Curini *et al.*, 2015). The above-described influences of the external factor point in time on human behavior and health are detailed in Table 2.

2.2.3 External factors in the virtual stakeholder dialogue of public utilities. The previous chapters describe the substantial impact of the external factors weather and point in time on human behavior and health. For example, both factors influence the emotional statute and mood of individuals (Gailliot, 2014; Reis *et al.*, 2000), their daily activities (Horanont *et al.*, 2013), the chosen means of transportation (Guo *et al.*, 2007), shopping behavior (Parsons, 2001; Keles *et al.*, 2018) and internet usage (Canova and Nicolini, 2019). More specifically, various studies describe how weather and time affect online (Curini *et al.*, 2015) and offline communication (Phithakkitnukoon *et al.*, 2012; Hribersek *et al.*, 1987). Therefore, it can be assumed that these factors may also influence online communication with public utilities on Facebook.

Thus, the behavior of the utilities' social media team and the various groups of stakeholders who engage in dialogue on Facebook can be affected. More specifically, weather and point in time might influence the content, visualization and length of postings and the users' respective reactions, comments and shares. The literature emphasizes significant differences in the Facebook communication between men and women (Oleszkiewicz *et al.*, 2017; Brandtzaeg, 2017). Consequently, the variable of gender needs to be considered in investigating the influence of external factors on dialogue on Facebook. Figure 1 visualizes the potential integration of these external factors in communication on Facebook.

3. Research design and methods

This research follows a mixed-method design (Morse and Niehaus, 2009). We used a case study approach (Yin, 2009) within which data was analyzed with quantitative methods. The case study design was deemed suitable insofar as it allows "investigat[ing] a contemporary phenomenon in depth and within its real-life context" (Yin, 2009, p. 18).

For the case study, a public utility's Facebook page was analyzed to explore the potential influence of external factors on the virtual stakeholder dialogue on Facebook. The chosen case study design avoids varied company specifications (e.g. company size, ownership structure, geographical location and monetary and time resources spent on the Facebook page) that might additionally influence the utility's posting behavior and the stakeholders' responses (see Martin, 2017b). Communication on the company's Facebook page is analyzed with quantitative techniques (i.e. regression analysis), which are described in more detail in the course of this chapter.

The case study utility is a predominantly publicly held company and located in Lower Austria. In 2018, the utility had almost 7,000 employees and generated around 90% of its sales with electricity, gas and heat. This study comprises 321 postings published on the company's official Facebook account between August 2016 and February 2018. The analysis encompasses the postings' contents (categorized into company-related or not company-related postings), the postings' visualization (presence or absence of an image), the postings' length (number of words) and stakeholders' reactions (measured as number of reactions), comments (yes/no) and shares (yes/no).

The operationalization of external factors is derived from the literature and is detailed in Table 3. The weather data was collected from the websites www.timeanddate.de/wetter and www.wetteronline.at for the location of the company's headquarters. This approach was based on the assumption that the majority of the company's key stakeholders, such as

Table 2.
Influence of timing on human behavior and health

	Point in time as external factor				
Human behavior and health	Time of the day	Day of the week	Month	Season	Holiday month/public holidays
Overt behavior					
Twitter communication		Curini *et al.* (2015)	Curini *et al.* (2015)		Curini *et al.* (2015)
Internet usage		Canova and Nicolini (2019)			
Internet device		Canova and Nicolini (2019)			
Activity (e.g., places/duration of visit)	Horanont *et al.* (2013)				
Transit ridership	Guo *et al.* (2007)	Guo *et al.* (2007)		Guo *et al.* (2007)	Guo *et al.* (2007)
Shopping behavior		Parsons (2001); Kahn and Schmittlein (1989)		Radas and Shugan (1998)	Parsons (2001)
Stock returns				Kamstra *et al.* (2003)	
Covert behavior					
Health					
Emotional status/mood	Egloff *et al.* (1995)	Larsen and Kasimatis (1990); Reis *et al.* (2000); Kennedy-Moore *et al.* (1992); Stone *et al.* (1985); McFarlane, Martin and Williams (1988); Egloff *et al.* (1995)		Denissen *et al.* (2008)	

Source: Own compilation

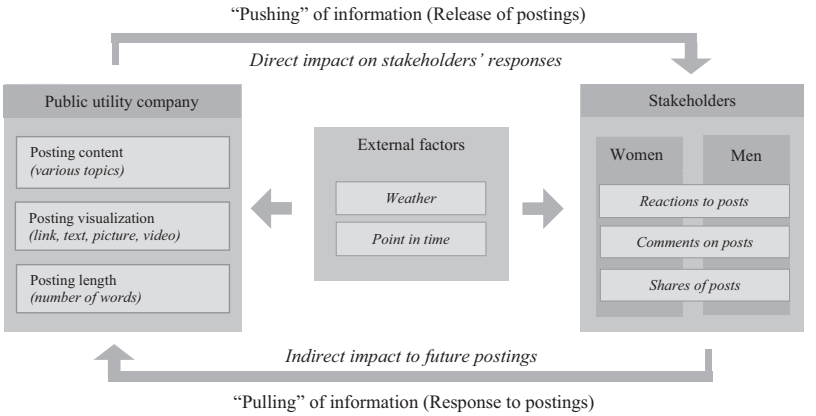

Figure 1.
Influence of the external factors "weather" and "point in time" on the virtual dialogue

Source: Own compilation

German-speaking customers or employees, are located in the region around the company's headquarters and are therefore are affected by the same or similar weather conditions.

To test our assumption regarding the influence of weather and point in time on Facebook communication, we performed regression analyses since regression "is the statistical foundation for causal analysis" (Birnbaum, 1981, p. 3). However, regression analysis does not verify that a specific incidence (variable) causes another. Such determinations can be made only on the basis of plausible assumptions about the direction of influence between the variables (Birnbaum, 1981). In our case, such assumptions are derived from the literature reviewed in Section 2.2, which guided our approach.

Hence, three conditions – which must hold to claim that one event causes another (Kenny, 1979) – are met:

(1) asymmetric relationship (e.g., weather and time cause behavior – not the other way around);

(2) cause and effect is measured by variables that allow the relationship between the two to be demonstrated; and

(3) nonspuriousness, since no third variable exists that causes both (e.g., weather and behavior).

More precisely, we performed two different multivariate analyses: linear regression for models with continuous dependent variables and logistic regressions for dichotomous dependent variables. The first allows interpreting the strength of the effect of the predictors on the dependent variable, whereas the latter allows predicting the probability of the change of the dependent variable (odds) when there is a unit change in the respective predictor.

4. Empirical findings

4.1 Descriptive results

Table 4 shows the descriptive statistics for the external factors (point in time and weather), the company's own postings and the triggered responses of the stakeholders

A large proportion of the postings were made in leisure time (44 %) and holiday seasons (38%). Only a small proportion of postings was done on public holidays (4 %). Temperature,

Table 3. Operationalization of the external factors

Dimension	Item	Authors who investigated the influence of the Item	Item indicators in this study
Weather	Temperature	Phithakkitnukoon *et al.* (2012); Horanont *et al.* (2013); Guo *et al.* (2007); Keles *et al.* (2018); Bertrand *et al.* (2015); Parsons (2001); Gailliot (2014); Cunningham (1979); Shutty *et al.* (1992); Von Mackensen *et al.* (2005); Curini *et al.* (2015); Denissen *et al.* (2008); Zwebner *et al.* (2013); Moffett (1996)	Temperature in Degrees Celsius at the time of posting[a]
	Precipitation (rain or snow)	Guo *et al.* (2007); Parsons (2001); Murray *et al.* (2010); Shutty *et al.* (1992); Von Mackensen *et al.* (2005); Curini *et al.* (2015)	Precipitation in mm on the day of posting[b]
	Humidity	Phithakkitnukoon *et al.* (2012); Murray *et al.* (2010); Cunningham (1979); Shutty *et al.* (1992); Von Mackensen *et al.* (2005)	Humidity in % at the time of posting[a]
	Barometric pressure	Phithakkitnukoon *et al.* (2012); Murray *et al.* (2010); Denissen *et al.* (2008)	Barometric pressure in mbar at the time of posting[a]
	Wind velocity/direction	Horanont *et al.* (2013); Guo *et al.* (2007); Cunningham (1979); Denissen *et al.* (2008); Phithakkitnukoon *et al.* (2012)	Wind velocity in km/h at the time of posting[a]
	Sunshine/cloudiness	Hirshleifer and Shumway (2003); Murray *et al.* (2010); Cunningham (1979); Denissen *et al.* (2008); Simonsohn (2007); Rind (1996); Hribersek *et al.* (1987)	Sunshine or partly sunshine at the time of posting: no (0) vs yes (1)[a/c]
	Thunderstorms	Von Mackensen *et al.* (2005)	Not used in this study[d]
	Abrupt weather changes	Phithakkitnukoon *et al.* (2012); Shutty *et al.* (1992); Denissen *et al.* (2008); Spasova (2011)	Not used in this study[d]
Point in time	Time of the day	Horanont *et al.* (2013); Guo *et al.* (2007); Egloff *et al.* (1995)	Leisure time (5–10 p.m.): no (0) vs yes (1)
	Day of the week	Reis *et al.* (2000); Curini *et al.* (2015); Egloff *et al.* (1995); Larsen and Kasimatis (1990); Canova and Nicolini (2019); Kennedy-Moore *et al.* (1992); McFarlane *et al.* (1988);	Weekday: Monday till Sunday

(*continued*)

Table 3.

Dimension	Item	Authors who investigated the influence of the Item	Item indicators in this study
		Stone *et al.* (1985); Parsons (2001); Kahn and Schmittlein (1989); Guo *et al.* (2007)	
	Month	Curini *et al.* (2015)	Not used in this study[d]
	Season	Guo *et al.* (2007); Radas and Shugan (1998); Kamstra *et al.* (2003); Denissen *et al.* (2008)	Not used in this study[d]
	Holiday month/public holidays (e.g. Mother's Day, Christmas, Easter)	Guo *et al.* (2007); Parsons (2001); Curini *et al.* (2015)	Holiday Month (February, July, August, December): no (0) vs yes (1) Public holidays in Lower Austria: no (0) vs yes (1)

Notes: [a]Weather data of the website: www.timeanddate.de/wetter. *The* weather information is predominantly provided on a half-hourly basis. This may result in a slight time difference between the time of a given posting and the time of a given weather measurement. [b]Weather data of the website: www.wetteronline.at. [c]We applied the weather descriptions as used on the website www.timeanddate.de/wetter (e.g., sunny, partly sunny, passing clouds, cloudy). [d]Due to the insignificant consideration in the literature, the dimensions "Thunderstorms" and "Month" were not used for further investigation. Moreover, a profound consideration of the dimension "Abrupt weather changes" would have doubled the number of weather variables applied from 6 to 12. Therefore, the authors suggest separately considering "Abrupt weather changes" in future studies. We did not focus on "season" as a separate dimension, as seasonal effects are indirectly measured by weather variables, such as temperature or precipitation

Source: Own compilation

Table 4. Descriptive statistics of external factors, company postings and stakeholder's responses

Dimension		Item	n	Min.	Max	Mean/Percentage	SD
External factors							
Point in time	Time of the day	Leisure time (5–10 p.m.): no (0) vs yes (1)	321	0	1	44%	0.497
	Day of the week	Monday till Sunday	321	–	–	Monday 17%; Tuesday16%; Wednesday13%; Thursday18%¨; Friday16%; Saturday11%; Sunday10%	–
	Holiday month	(February, July, August, December): no (0) vs yes (1)	321	0	1	38%	0.486
	Public holidays	No (0) vs yes (1)	321	0	1	4%	0.190
Weather	Temperature	Degrees Celsius[a]	321	−12	34	10.56	9.871
	Precipitation	mm[b]	320	0	91	6.09	10.029
	Humidity	Percent[a]	321	21	100	69.93	18.331
	Barometric pressure	mbar[a]	321	994	1037	1017.29	7.756
	Wind velocity	km/h[a]	321	2	48	17.28	9.907
	Weather condition	Sunshine or partly sunshine: no (0) vs yes (1)[a]	321	0	1	31%	0.463
Company posting	Content	Company related: no (0) vs yes (1)[c]	320	0	1	35%	0.479
	Visualization	Picture: no (0) vs yes (1)	321	0	1	75%	0.433
	Length	Number of words	321	0	91	24.43	16.476
Stakeholder's response	Reaction	Number of reactions per post	321	0	1379	46.07	110.649
	Comment	Comments to the posting: no (0) vs yes (1)	321	0	1	41%	0.492
	Shares	Shares of the posting: no (0) vs yes (1)	320	0	1	38%	0.485

Notes: *n*, number of postings; Mean, arithmetic average; SD, standard deviation. [a]At the time of posting. [b]On the day of posting. [c]Company-related postings that focus on, e.g., product and service information; job offers or investment projects of the company; not company-related postings with general information about, e.g., the current energy transition, electric mobility, energy saving tips, events, things to do in the city or contests
Source: Own compilation

humidity and barometric pressure, as well as wind, are subjected to substantial variation from minus 12 to 34°C, 21 to 100%, 994 to 1037 Mbar and 2 to 48 km/h. Nearly, one-third of the days were (partly) sunny (31 %). On average, one posting contained 25 words. In total, 35% of the postings focused on company-related information, and 75% included an image. In total, one posting yielded 46 reactions on average. In total, 41% of the postings triggered a comment, whereas 38% were shared.

4.2 Results of multivariate analysis

As stated above, we tested the impact of weather and point in time on the Facebook communication of a public utility, considering postings' content, visualization and number of words. As the first step, we focused on the impact of both external factors on the stakeholders' responses, whereas taking the potential influence of the posting design into account (Models A–C). As the second step, we analyzed the effect of the external factors on the company's postings (Models D–F).

The first multivariate analyses (Table 5) examine how the external factors and the company's posting behavior influence the stakeholders' responses. Three models are applied, namely, focusing on the number of reactions (Model A), the probability of comments (Model B) and the probability of shares (Model C).

Model A indicates that with increasing precipitation or humidity, the number of reactions to a posting rises significantly ($p \leq 0.05$) or nearly significantly ($p \leq 0.1$). This effect is independent of gender. In contrast, rising temperature results in a significantly higher number of reactions by women only. Additionally, company-related content increases the reaction of men (almost significantly), whereas a higher number of words triggers a significantly higher number of reactions by women.

Model B indicates that, in general, stakeholders tend to comment on a post on Tuesdays or Sundays rather than on Mondays. More precisely, comments are written about two and a half times more often by women on Tuesdays (significant) and by men on Sundays (nearly significant). The commenting behavior of the Facebook users in this study is also affected by weather conditions. Higher humidity significantly increases the probability of comments by women, whereas higher barometric pressure (almost significantly) decreases it. Moreover, a higher number of words significantly raises the probability of comments.

With respect to the individual values of weather items (temperature, precipitation, humidity, barometric pressure and wind velocity), it must be taken into account that the effects shown for commenting refer to a value change of 1 scale point of the independent item. If the value change is more than 1 scale point, the effect will be stronger. The same effect can be found for the relation between posting length and the probability of comments. For example, while an increase from 20% humidity to 21% humidity increases the probability of comments by women by around 3%, an increase from 20% humidity to 40% humidity almost doubles the probability of a comment. Therefore, it is important to note that the effect of the weather must be seen in relative measures.

Model C shows that women share postings more than three times more often on Tuesdays than on Mondays (significantly). The probability of shares decreases with a higher temperature (significantly) or higher barometric pressure (almost significantly). The effect of barometric pressure applies mainly to women. In contrast, higher precipitation significantly increases the probability of shares. Additionally, company-related content of a posting also (almost significantly) raises the probability of shares. In this context, women react more than men (three times compared to posting with no company-related content). A higher number of words raises the probability of sharing by women (almost significantly). Similar to the above-described effects on comments, the higher the difference between the

Table 5. Linear and logistic regressions testing the dependency of the stakeholders' response behavior

		Stakeholder response (dependent variable)								
		No. of reactions to post *Model A: Linear Regression*			Probability of comments *Model B: Log. Regression*			Probability of shares *Model C: Log. Regression*		
Dimension	Predictor (Independent variable)	Total ß (stand.)	Men ß (stand.)	Women ß (stand.)	Total Exp. (ß)	Men Exp. (ß)	Women Exp. (ß)	Total Exp. (ß)	Men Exp. (ß)	Women Exp. (ß)
External factors										
Point in time	Time of the day: Leisure time	0.014	0.027	−0.010	1.145	1.394	1.303	0.936	1.524	1.196
	Day of the week					*REFERENCE: Monday*				
	Tuesday	0.083	0.077	0.081	*2.564**	1.584	*2.593**	1.824	1.936	3.030*
	Wednesday	−0.041	−0.044	−0.031	1.014	0.515	0.552	1.011	0.910	0.980
	Thursday	−0.028	−0.035	−0.013	0.832	0.725	0.819	0.629	0.729	1.112
	Friday	0.013	0.002	0.029	1.325	1.219	0.987	0.658	0.770	0.425
	Saturday	−0.036	−0.041	−0.025	0.722	0.610	0.625	0.634	0.956	0.468
	Sunday	−0.007	−0.022	0.017	*2.328*[a]	*2.314*[a]	1.171	1.255	1.087	1.271
	Holiday month	−0.041	−0.049	−0.024	0.909	1.024	1.712	0.891	1.181	0.833
	Public holidays	0.019	−0.003	0.045	1.177	0.764	0.982	0.723	1.117	1.562
Weather	Temperature [b]	0.104	0.054	*0.167**	0.995	1.761	1.744	*0.955 **[f]*	0.979	0.988
	Precipitation [c]	*0.165***	*0.169***	*0.136**	1.014	0.995	1.000	1.002	*1.034**[f]	*1.032**[a/f]
	Humidity [b]	*0.157*[a]	*0.141*[a]	*0.161*[a]	1.004	1.021	*1.032 **[f]*	1.002	1.011	1.014
	Barometric Pressure [b]	−0.055	−0.065	−0.032	*0.970*[a/f]	0.994	1.013	*0.969*[a/f]	0.984	*0.960*[a/f]
	Wind Velocity[b]	0.081	0.087	0.058	0.993	0.985	0.970	1.017	1.007	0.998
	Sunshine [b]	−0.027	−0.031	−0.018	0.916	0.984	0.979	0.749	0.685	0.855
Company posting	Company-relevant content [d]	*0.105*[a]	*0.112*[a]	0.081	0.910	1.092	1.008	*2.245***	*1.836*[a]	*3.124***
	Presence of image	0.052	0.072	0.012	1.258	1.313	0.809	1.120	1.182	1.325
	Number of words	*0.102*[a]	0.058	0.162**	*1.024***	*1.029**[f]	*1.037***[f]	1.012	1.003	*1.018*[a/f]
Model	r^2	0.099	0.100	0.087	0.138	0.140	0.193	0.175	0.138	0.224

Notes: Significance[e]: italic letter = [a]0.1, *0.05, **0.01, ***0.001; Logistic Regression Nagelkerke r^2. [b]At the time of posting. [c]On the day of posting. [d]Company-related postings that focus on, e.g., product and service information; job offers or investment projects of the company; not company-related postings with general information about, e.g., the current energy transition, electric mobility, energy saving tips, events, things to do in the city or contests. [e]Due to the explorative character of this study and the limited sample of 321 postings, an expanded approach of four significance levels is applied ($p < 0.001$; $p < 0.01$; $p < 0.05$; $p < 0.1$). [f]Probability of comments or shares when changing the item indicators by one unit. For example, an increase from 5 to 6 °C or a decrease from 11 to 10 words in a posting

Source: Own compilation

compared indicators, the stronger the stated influence. For example, an increase from 5°C to 6°C reduces the probability of shares by approximately 4.5%, whereas a higher temperature difference such as 20°C reduces the probability of shares by 60%. Thus, it is important to note that the influence of weather and the posting length on the probability of shares must also be considered in relative measures.

The point in time and the weather also seem to affect the utility's posting behavior. The findings of the second multivariate analyses describe these influences in more detail (Table 6).

Model D shows that the number of words per posting is significantly lower on Sundays (compared to Mondays). Furthermore, the number of words decreases with increasing temperature (almost significantly) and barometric pressure (significantly). Model E indicates that the probability of postings containing images is more than halved on Thursdays (compared to Mondays). Moreover, the probability of postings containing images significantly decreases with increasing temperature, barometric pressure or wind velocity. Model F shows that the probability of postings containing company-related information is more than twice as high on Wednesdays (almost significantly) compared to Mondays and public holidays (significantly). In contrast, the probability of postings containing company-related information is significantly lower during a holiday month. Additionally, increasing precipitation and barometric pressure raise the probability of company-related postings. As stated above, the impact of the studied weather indicators on the posting behavior of the company must be considered in relative measures.

5. Discussion

Our paper applies the stakeholder theory to the Facebook communication of public utilities. It analyses to which extent the external factors weather and point in time affect the virtual dialogue between a public utility and its stakeholders.

The results show that with increasing precipitation or humidity, the number of reactions to a posting rise. This matches the findings reported by previous work: "A first, immediate, reason is that when the weather conditions are poor, outdoor activities decrease in favor of other non-outdoor activities [. . .]. We might expect that under bad weather the opportunity cost of time is lower and consumers are more likely to engage in activities that are easy to implement irrespective from the weather conditions" (Canova and Nicolini, 2019, p. 33).

It can be argued that individuals in Austria use Facebook predominantly on their mobile devices (Statista, 2018). Hence, communication on Facebook is not necessarily a desktop-computer-related indoor activity. People can and do check their Facebook profiles outside, independent of weather conditions.

Nevertheless, the literature emphasizes the strong influence of weather on covert behavior, including emotional status or mood (Gailliot, 2014; Denissen *et al.*, 2008) and well-being (Von Mackensen *et al.*, 2005). Such an impact on covert behavior might also indirectly affect communication behavior. A study by Phithakkitnukoon *et al.* (2012) seems to support this idea inasmuch as it describes the relationship between extreme humidity or low temperatures and the increased likelihood of mobile phone users making longer calls. In line with Phithakkitnukoon *et al.* (2012), poor weather conditions might also lead to an increased virtual dialogue on the Facebook page of a public utility.

However, in our case study, higher temperatures result in higher numbers of reactions by women. Therefore, the results of this study seem to contradict the general conclusion that poor weather conditions influence the communication on Facebook positively. It might also be the case that increased temperature, at a certain level, is not perceived as pleasant, supporting the influence of uncomfortable weather conditions. Moreover, the effect of

Dimension	Predictor (Independent variable)	Company posting (dependent variable) No. of words *Model D: Linear Regression* ß (stand.)	Use of picture *Model E: Log. Regression* Exp. (ß)	Company-relevant content *Model F: Log. Regression* Exp. (ß)
Exogenous factors				
Point in time	Time of the day: Leisure time	−0.080	0.672	1.530
	Day of the week		*REFERENCE: Monday*	
	Tuesday	−0.008	1.492	1.036
	Wednesday	−0.082	0.846	*2.257*[a]
	Thursday	−0.118	*0.424*[a]	1.446
	Friday	−0.032	0.924	0.778
	Saturday	0.077	1.605	0.514
	Sunday	*−0.139**	0.464	0.442
	Holiday month	0.064	1.051	*0.210***
	Public holidays	−0.078	0.363	*2.108***
Weather	Temperature [b]	*−0.205**	*0.961*[a/e]	1.181
	Precipitation [c]	0.029	0.996	*1.100* ***[a/e]
	Humidity [b]	0.001	0.988	0.990
	Barometric Pressure [b]	*−0.123**	*0.956***[a/e]	*1.025***[a/e]
	Wind velocity [b]	0.007	*0.959*****[a/e]	1.007
	sunshine [b]	−0.044	0.811	1.019
Model	r^2	0.109	0.127	0.154

Notes: Significance[d]: italic letter = [a]0.1, *0.05, **0.01, ***0.001; Logistic Regression Nagelkerke r^2. [b]At the time of posting. [c]On the day of posting. [d]Due to the explorative character of this study and the limited sample of 321 postings, an expanded approach of four significance levels is applied ($p < 0.001$; $p < 0.01$; $p < 0.05$; $p < 0.1$). [e]Probability of an image or company-relevant content in a posting when changing the item indicators by one unit. For example, an increase from 5°C to 6°C

Source: Own compilation

Table 6. Linear and logistic regressions testing the dependency of the companies' posting behavior

precipitation or humidity on the "number of reactions" is stronger than the influence of the "number of words" or "company-specific content" on the "number of reactions." This comparison furthermore seems to highlight the relevance of the external factor "weather" on the behavior of Facebook users. In addition to "single click" reactions, the impact of weather on comments and shares, which are a more time-consuming forms of communication, has to be considered.

Regarding the social media team of the utility, the number of words per posting decreases with rising temperature and barometric pressure. In addition, the probability of postings containing images also declines with increasing temperature, barometric pressure or wind velocity. Furthermore, higher precipitation and barometric pressure increase the probably of company-related content in postings. Therefore, the communication of the utility's social media managers is affected by weather as well.

In addition to weather, the point in time influences stakeholders' communication with the utility on Facebook. A high percentage of the company's postings are made during leisure time (5–10 p.m.). This can be explained by the fact that, in Austria, afternoon and evening are the times of day with the highest percentage of active social network users (Statista, 2019). The results described above also confirm the impact of the day of the week on

Facebook communication between the public utility and its stakeholders. Nevertheless, we cannot verify a "blue Monday" effect (Stone *et al.*, 1985; Canova and Nicolini, 2019) to the extent that Mondays especially increase the communication of Facebook users or reduce the engagement of the social media team.

On or during public holidays, the probability for the utility to publish company-related information is more than twice as high than otherwise. This might be explained by members of the social media team being on holiday. The reduced personnel resources might lead to a more frequent release of "standardized" company content, which might be less time-consuming to prepare. As shown by the analyses, the posting of such company-related content increases the reactions of men and raises the probability of shares – especially by women.

Bauer *et al.* (2012) emphasize that access to information is the main reason to become a fan of a Facebook page. Therefore, Facebook users might explicitly visit the utility's Facebook page to find information about the company, its products and services. This argument might explain why users are more likely to share company-related information than content without reference to the company. In our study, the probability of sharing company-related content is significantly higher for women than for men. In this context, the current literature states gender-specific differences regarding the topic of interest on Facebook (Brandtzaeg, 2017) and the ways Facebook users express themselves (Brandtzaeg, 2017; Luarn *et al.*, 2015; Oleszkiewicz *et al.*, 2017). Martin *et al.* (2018, pp. 418–419) describe how "gender influences a Facebook conversation [with the public utility]. More specifically, women and men seem to be attracted by different kinds of information. Whereas female users are more interested in information about social aspects (e.g. sponsorship, social engagement and special events), male users seem to prefer company-related information (e.g. generating station) [. . .]." Therefore, we cannot argue that women share company-specific content more often because they are more interested in this kind of information than men. Still, it might be concluded that men are more likely to express themselves through a "reaction," whereas women prefer to "share" the company-related content.

Literature refers to the increasing importance of social media and suggests that public utilities need to actively engage in a dialogue with their stakeholders on Facebook (Martin, 2017a). Various studies point out that public utilities seem to follow this advice by using Facebook as a communication channel (Martin, 2017a, b; Martin and Grüb, 2016) and that such virtual exchange of information is even expected by the majority of their stakeholders (Martin *et al.*, 2018). Nevertheless, research in this field strongly focuses on the direct interaction between the utilities and their stakeholders (Manetti *et al.*, 2017; Kim and Yang, 2017; Martin *et al.*, 2018). On basis of an Austrian case, our study empirically confirms that a sole focus on the sender and receiver of Facebook content might not be sufficient to understand the course of a virtual conversation. External factors, such as "weather" and "point in time" additionally, impact the Facebook dialogue. By empirically verifying the influence of both external factors, this study contributes to a more holistic understanding of Facebook communication in the energy sector. The explorative findings of the study suggest practical advice on how social media managers may use weather forecasts and point in time to influence online communication. To foster a livelier virtual debate on Facebook, social media managers could for example post topics with a strategically high relevance on a rainy Tuesday or Sunday. Information with a lower strategic relevance should instead be shared on a sunny Monday. In this way, our explorative insights propose that social media managers should publish and communicate more wisely and strategically as the impact for stakeholder dialogue is more effective, if information is published under the "right" conditions (weather and point in time). Hence, managers might use weather

forecasts and timely planned posts to actively steer organizational communication on Facebook.

In addition, the study raises awareness of the fact that the Facebook conversation of women and men seems to be differently affected by the observed external factors. Moreover, not only stakeholders but also the employees of the company seem to be subject to the effects of both external factors.

6. Research implications

To the best of our knowledge, this is the first study focusing on the impact of the external factors "weather" and "point in time" on the communication between a public utility and its stakeholders on Facebook. However, by analyzing the case of a single public utility, the study at hand only has explorative character. To investigate the transferability of our results, the Facebook pages of other public utility companies must be examined as well. Researchers need to be aware that the influence of "weather" on individuals' behavior seems to be complex and difficult to measure or predict. "The effect of heat, for example, may be negated by a nice breeze on a cloudy day" (Gailliot, 2014, p. 166). In addition, "[p]erceptions of good and bad weather also differ. People within the same region, state or city, or even within the same household, may react differently to the same weather" (Cawthorn, 1998, p. 20). Thus, weather sensitivity is specific to the individual, and the resulting behavior may accordingly vary between people (Von Mackensen *et al.*, 2005; Moon *et al.*, 2018a; Denissen *et al.*, 2008).

Similarly, the "point in time" influences individuals differently (Larsen and Kasimatis, 1990). For example, "extraverts were found to have day-to-day moods that were less strongly linked to the 7-day cycle than the daily moods of introverts" (Larsen and Kasimatis, 1990, p. 170). Consequently, it seems likely that the impact of the two external factors on the communication behavior on Facebook differs between individuals, depending on their "weather" and "point in time" sensitivity. This aspect needs to be taken into consideration in future studies.

Additionally, numerous studies confirm differences between men and women regarding the use of Facebook (Frison and Steven, 2016; Horzum, 2016; Luarn *et al.*, 2015; Sheldon, 2008). In this study, we can empirically confirm only a few gender-specific differences. Nevertheless, such gender-aspects should be taken into account in further studies as well.

Koroleva and Kane (2017, p. 570) showed in their study "that on Facebook, information is the glue that connects users to one another and influences the development of their relationships." Communication and information on social media are not only important for organizations, they are also essential for society as a whole, as they connect individuals to each other. It is the interplay between individuals and between individuals and organizations that makes societies work. Hence, understanding the mechanisms of social media communication and the factors that influence such communication (e.g. weather or point in time) is important to understand contemporary society.

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