Investigating the impact of social support embedded in online consultation on physicians' online reputation: The moderating role of media capabilities

Wei Wang
University of Melbourne
wanww2@student.unimelb.edu.au

Libo Liu
University of Melbourne
libo.liu@unimelb.edu.au

Abstract

The importance of physicians' online reputation (POR) has been recognized in the healthcare consultation process. However, few studies provide physicians with practical advice that help them improve their online reputation. Drawing on the taxonomy of social support and media synchronicity theory, this study proposes a theoretical model to study the relationship between physicians' computer-mediated social support (CMSS) and POR, and the moderating effect of media capabilities on above relationships. This study collects online consultation records from a leading Chinese online consultation platform and employs the long short-term memory (LSTM) model to extract measurements of two types of CMSS. Our finding suggests that physicians' action-facilitating support and nurturant support have significant positive impacts on POR. Furthermore, physicians' communication frequency and communication depth strengthen the relationship between physicians' action-facilitating support and POR. Readability strengthens the relationship between social support and POR. This study provides implications on how physicians can improve their online reputation.

1. Introduction

COVID-19 is a major challenge facing all countries in the world today. Isolation and quarantine have become a public health measure, despite the unexpected inconvenience of accessing necessary medical services [1]. In response, Online Health Consultation (OHC) platforms are rapidly gaining popularity among healthcare consumers and providers [1]. OHC provides benefits to both services' providers and services consumers. On one hand, OHC can serve as a source of physicians' social returns and economic returns. It enables a more effective online reputation mechanism which plays an important role in the patient's decision-making process [2-6]. On the other hand, OHC facilitates patients accessing medical information and computer-mediated social support through physician-patient online interactions [7]. CMSS helps patients cope with their illness in a convenient way and has been linked to improved patient health outcomes [8-11].

In the context of OHC, the importance of POR has been examined in previous studies due to its significant impact on 1) physicians' economic return [7], 2) patients' choice [4, 6, 12, 13], 3) perceived health service quality [14] and 4) sharing outpatients' experience [15, 16]. However, few studies are devoted to investigating the antecedents that influence POR. This study focuses on investigating the factors/antecedents of POR in OHC. As previous research indicated the role of CMSS in patients' information seeking [17, 18] and knowledge sharing behaviors [19], this study will explore the antecedents of POR from the perspective of CMSS.

Information delivers in physician-patient communication of offline and online health consultation may vary due to the communication media is different [20, 21]. Previous research indicated that different media exert different influences on communication performance [22-25]. Therefore, we will further examine the moderating effect of media capabilities on the relationships between CMSS and POR. To summarize, this study will answer the following two research questions:

1. *How do different categories of CMSS influence POR?*
2. *How do different media capabilities of OHC moderate the relationship between physicians' different types of CMSS and POR?*

To answer these research questions, we propose a research model that depicts the impact of two types of CMSS on POR as well as the moderating effect of media capabilities. We validate the research model by developing measurements based on consultation records from 2358 physicians collected from a leading Chinese OHC platform. Our results suggest that physicians' action-facilitating support and nurturant support have significant positive impacts on POR. Furthermore, physicians' communication frequency and communication depth positively moderate the relationship between physicians' action-facilitating

support and POR. Whereas, both media capabilities do not strengthen the positive effect of nurturant support on POR. Readability positively moderates the relationship between both two types of CMSS and POR.

This study contributes to POR research from two aspects. First, our study extends the literature on CMSS in OHC by examining the relationship between CMSS and POR. The implications of this study can help physicians accumulate their online reputation and thus contribute to the sustainable provision of OHC services. Second, we further test the roles of different media capabilities on the relationship between CMSS and POR, which not only enrich the studies on the mechanism of POR through social interaction but also provide practical guidance for physicians' communication strategies.

This paper is organized as follows: the next section is the theoretical background. In section 3, we review the literature relevant to online reputation mechanisms and social support. In section 4, we develop the theoretical model and associated hypotheses. In section 5 and 6, we describe the research methodology and the result of data analyses. Section 7 discusses the findings, implications, and limitations.

2. Theoretical background

2.1. Media synchronicity theory

The physician-patient communication is delivered through different media with similar content [23, 26, 27]. The media synchronicity theory argues that different media capabilities can moderate communication performance [22]. Prior studies have shown that media capabilities can moderate the impact of physician-patient communication on service quality [27, 28] and patient satisfaction [24, 29]. The communication performance will be improved when the requirements of communication are matched with media capabilities [22]. Higher synchronous media are more effective for communication tasks that aim to converge meaning. For conveying information, media with lower-level synchronicity media is more suitable.

As shown in Table 1, this study compares the different media capabilities in both offline and online contexts. First, offline health consultation requires more prompt information transmission and less information processing, while OHC can provide a larger and more diverse set of information which requires more time for patients and physicians to comprehend the information [22]. Existing studies have proved that offline communication can provide instant feedback through body language and facial expressions [27, 28]. Second, the actual level of synchronicity of OHC is still influenced by the time it takes to encode and decode the

message, although instant message in OHC allows quick information transmission [22]. This study explores the moderating effect of different media capabilities of the OHC channel in terms of different levels of information processing, transmission, and required synchronicity.

Table 1. Online & Offline health consultation

Communication	OHC	Offline	Media factors
Information processing	Medium	low	Readability
Information transmission	Slow-medium	Fast	Communication depth
Synchronicity Required	Low-Medium	High	Communication frequency

3. Literature review

3.1. Online reputation mechanism

Online reputation mechanisms can not only reduce the risk caused by information asymmetry for OHC but also help build trust between patients and physicians [30]. The prior literature mainly focuses on the demand-side of physician reputation [4, 6, 7, 12-16]. On the supply side, the impact of physician-patient communication through OHC on POR has not been well explored. As shown in Table 2, online reputation in different contexts can be established through 1) social interaction [6, 7, 13, 31-35], 2) online feedback [6, 7, 13, 36-38], 3) past contribution [6, 7, 13], and 4) quality of the answer [39]. In our study, physicians can build their online reputation through online physician-patient communication since online consultation records can be viewed by all patients. Therefore, we adopt social interaction as the online reputation mechanism to explore the impact of CMSS embedded in physician-patient communication on POR.

3.2. Social support

Coping resources can improve individuals' ability to manage stressful events, and OHC serves as a useful tool for helping patients to cope with their illness by providing CMSS. Social support is regarded as a coping resource since it can reduce the impact of exposure to stressful events [13, 14, 16, 40]. It can also interact with two coping strategies: problem-focused coping and emotion-focused coping. Problem-focused coping is more likely to be adopted when the situation is manageable and specific effort will be employed to solve or mitigate the problem. Whereas emotion-focused coping is more prevalent when the situation spirals out of control and requires individuals to manage

their emotional responses to the stressors [41]. According to these two coping strategies, CMSS can be grouped into action-facilitating support and nurturant support [40]. Action-facilitating support consists of informational support and tangible aid, while emotional support, network support and esteem support belong to nurturant support.

Unlike offline social support, CMSS is hard to render tangible aid since online users are generally scattered geographically and can hardly meet to "provide goods or services needed in the stressful situation" [40, 42, 43]. Esteem support might be more suitable to be considered as a subcategory of emotional support [42]. Network support is rare among physician-patient communication [42]. Therefore, informational support and emotional support are the main CMSS under the action-facilitating support and nurturant support category respectively.

Social Support Behavior Code defines 23 subcategories of social support [40]. "Listening" and "physical affection", which are two subcategories of emotional support, were removed in some studies since both are less likely to be rendered in asynchronous communication [43-46]. In addition, some studies used "share personal experience" as a new subcategory of informational support since it's common for a physician to share other patients' experiences when physicians explain possible complications in the future and offering reassurance [44, 47-49]. Although two subcategories, "compliment" and "relief of blame" were removed in prior studies [42], there are still some articles that found these two subcategories were prevalent [45]. Therefore, we include the relationship, confidentiality, sympathy, empathy, encouragement, prayer, relief of blame, compliments, and validation as subcategories of nurturant support, advice, referral, situation appraisal, teaching and sharing experience as subcategories of action-facilitating support.

Table 2. The online reputation mechanism

Citation	Antecedents	Context
[31-33]	Social interaction	Social networks
[34, 35]	Social interaction (management responses)	Firm's responses
[36-38]	Online feedback mechanisms	E-market, eBay
[39]	a) Online popularity b) Quality of past contributions	Q&A site Quora
[6, 7, 13]	a) Past contribution b) Social interaction c) Online feedback	Online health community

4. Research model and hypotheses development

This study takes two steps to explore the impacts of physician-patient communication on POR in OHC by drawing on the media synchronicity theory. First, we explore the impact of the two categories of CMSS on POR. The research model theorizes that action-facilitating support and nurturant support can be antecedents for POR since CMSS can help patients develop strategies for coping with health problems [37].

Second, this study investigates the moderating effect of media capabilities (communication depth, communication frequency and readability) in OHC. Media capabilities moderate the communication performance by influencing information processing and transmission [22]. The capabilities of different media will affect patient's perception of CMSS. We propose the research model of this study as Figure 1.
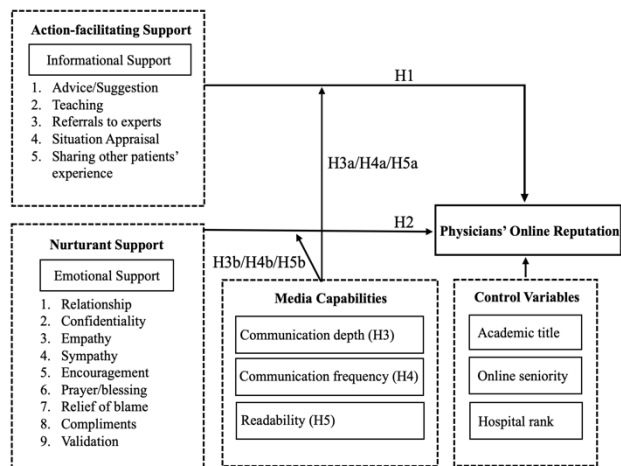

Figure 1. Research model

4.1. Action-facilitating support and nurturant support

Patients usually seek information from physicians to cope with health problems and to assist them in managing their health in daily life [23]. Physicians are expected to provide needful information to patients regarding their diagnosis results and treatment plans [50]. Existing studies have declared that patients perceive the medical information exchanged as indicative of physicians' professional competence [50]. Physicians' action-facilitating support can meet patients' problem-oriented needs [20]. Patients who believe they are capable of coping with their current health conditions are more likely to engage in prosocial behaviors and are less hesitant to make sacrifices when required [51]. For example, patients may undertake

voluntary actions in favor of physicians, such as giving public thank letters, online votes, and virtual gifts to physicians, which can serve as a kind of visualized reputation [52]. On the contrary, when patients are not fully informed about the reasoning behind their physician's recommendations or investigation results, patients do not have adequate resources to deal with their health problems and are thus less likely to carry out prosocial behaviors. Therefore, we propose:

H1. Physicians' action-facilitating support in physician-patient communication positively influences POR.

Although nurturant support becomes less frequent and varied in OHC compared with offline health consultation, for example, it is difficult for physicians to use encouraging tone, and physical contact towards patients due to the lack of nonverbal cue in CMSS [53], this study suggests that nurturant support delivered through OHC is still important for patients' emotion-focused coping. Disease can be psychologically devastating to patients which might not be anticipated by physicians [54]. To alleviate the psychological impacts, patients often turn to physicians for reassurance and comfort, which is seen as an important source of nurturant support for patients [50]. Moreover, some diseases may severely affect patients' personal relationships, which relies less on medical treatments and require more nurturant support to ease the emotion burden [55]. Physicians who have a caring and empathic communication style, such as often demonstrating understanding of patients' suffering, can help patients reduce their sense of isolation and offset the aversive emotional responses to illness [50]. There is evidence that physicians are rated higher regarding their job performance when they are more compassionate [50]. Therefore, physicians' nurturant support can help patients rebuild positive subjective appraisals of themselves, and patients tend to have reciprocal behaviors towards physicians as a result. Based on the above discussion, this research proposes the following hypothesis:

H2: Physicians' nurturant support expressed by physicians positively influences POR.

4.2. Communication depth

Communication depth refers to the extent to which physicians explain the service content and potential risks involved in the service process [56]. Physicians are supposed to provide patients with detailed instructions on how to take their medication or suggestions on how to manage their health [56]. With more information resources to cope with patients' health conditions, they are more confident in establishing a belief in recovery, which leads to more reciprocal behavior towards

physicians. Accordingly, the positive impact of action-facilitating support on POR will be strengthened.

Problem-focused and emotion-focused coping can impede or facilitate each other [8, 11, 40, 53]. Although the primary purpose of OHC for patients is seeking information, the inadequate explanation as to why a diagnosis is made or a test is performed may diminish the comforting effect of nurturant support [41]. On the contrary, when patients could perceive that their needs have been properly addressed with the detailed explanation, patients will be more reassured. Accordingly, the positive impact of nurturant support on POR will be strengthened. Therefore, we propose:

H3(a): The effect of action-facilitating support on POR is positively moderated by communication depth

H3(b): The effect of nurturant support on POR is positively moderated by communication depth.

4.3. Communication frequency

Communication frequency is one of the most important factors reflecting communication quality [26]. During the OHC, physicians need to interact with patients for several rounds to identify patients' needs, perceptions and make a diagnosis [29]. According to the media synchronicity theory, a high level of interaction during the communication can enable the sender's feedback and examine the recipient's agreement [22]. Therefore, physicians can effortlessly reach a consensus with patients at a high level of interaction. Meanwhile, frequent communication can also increase patients' perception of the usefulness and informativeness of physicians' messages and then help patients cope with problems effectively and instantly [23, 24]. Conversely, slow interaction may hinder patients' understanding and expectation for the treatment, which may affect the positive influence of action-facilitating support. Therefore, the positive impact of action-facilitating support on POR can be strengthened under high communication frequency.

Nurturant support will be less effective if physicians are not able to communicate information in a timely manner [53]. Because lower communication frequency can make patients feel that the physician is indifferent to their needs [27]. In contrast, patients perceive timely comforting messages from physicians as respectful. Accordingly, the positive impact of nurturant support on the POR will be strengthened. Therefore, we propose:

H4(a): The effect of action-facilitating support on POR is positively moderated by communication frequency.

H4(b): The effect of nurturant support on POR is positively moderated by communication frequency.

4.4. Readability

In many cases, coping resources are adequate, but patients cannot take full advantage of them when they are not adequate to internalize the resources [41]. Studies examining the impact of medical jargon on the physician-patient relationship suggest that reading difficulty limits patient engagement, which may negatively impact the quality of physician-patient communication [57]. According to the media synchronicity theory, fine-tuning the message is important for recipients who lack relevant experience and knowledge of the topic being discussed since it will help recipients understand the message accurately and effortlessly [22]. When it comes to patients' health problems and treatment options, they are far less knowledgeable than physicians [23]. Therefore, patients need to take extra effort to interpret the message. Additional effort and cognitive burden might weaken the positive impact of action-facilitating support on POR.

The message of poor readability can also widen the psychological distance between physicians and patients [23]. In contrast, highly readable information marks a physician more approachable, which in turn makes patients more willing to share their underlying concerns and neglected emotion. Existing studies have shown that patients' trust and confidence in OHC services will be enhanced when they are able to fully express their feelings in a nonjudgmental atmosphere [50]. Accordingly, the positive impact of nurturant support on the POR will be strengthened. Therefore, we propose:

H5(a): The effect of action-facilitating support on POR is positively moderated by Readability.

H5(b): The effect of nurturant support on POR is positively moderated by Readability.

5. Research methodology

5.1. Data collection

To test our research model, we collected data from the Chinese OHC platform (haodf.com) which provide professional and high-quality health services. W collected the data by accessing the physician's personal website and the contents of the physician-patient communication.

Each physician has one homepage which provides a general description of physician professional capital and online information (e.g., the number of thanks letters, the number of virtual gifts from patients, the number of patients' votes and the registration time). The personal website also reports physician service information (e.g., online written consultation service,

online telephone service, private doctor service, medical teams service). The resulting sample consists of 2358 doctors from Beijing and 23748 written consultation records between patients and physicians from 2017 to 2020.

5.2. Research procedures

The data processing process of this study is divided into two phases, text analysis and empirical analysis (see Figure 2). We conducted text mining first to extract independent variables from the unstructured textual data of physician-patient communication. Based on that, an empirical analysis was afterwards performed to explore the direct impact of the physicians' support as well as the moderating effect of media factors on POR

We extracted the independent variables from the unstructured text data for later empirical analysis which include physicians' action-facilitating support (advice, teaching, referral, situation appraisal and share personal experience) and nurturant support (relationship, confidentiality, empathy, sympathy, encouragement, prayer, belief of blame, compliments, and validation). The process of extracting independent variables is presented in Figure 2. First, we processed the raw data and transformed it into appropriate data representations. Second, we manually tagged 5000 samples of physician-patient communication text. Third, we used Jieba in Python to segment the text sample and remove stop words. Forth, the labelled text data was randomly divided into training sets and test sets to train the LSTM model. Finally, we used the trained classifier to extract the variables from the untagged text data, followed by the obtaining of the independent dependent of this study.
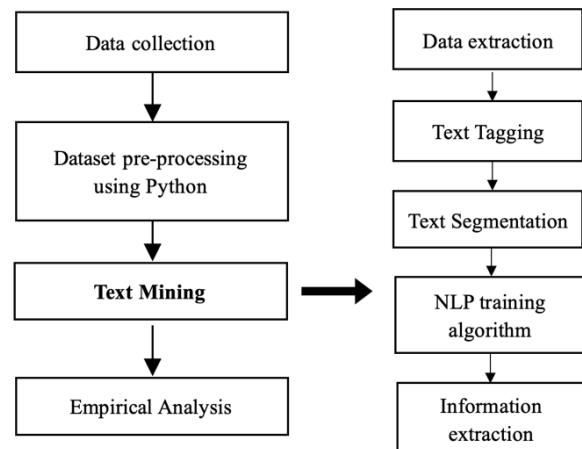

Figure 2. Research procedures

5.3. Operationalization of variables

The dependent variable of this research is POR. In this study, we used the number of virtual gifts physicians received as a proxy for POR. In the platform, patients can buy virtual gifts to physicians if they are satisfied with the service [6]. Figure 3 illustrates the example of virtual gifts one physician received. Physicians' action-facilitating support and nurturant support were measured by the average rate of subcategories. We manually tagged physicians' responses into binary categories as training data to determine whether a post fall into certain subcategories of action-facilitating support or nurturant support. We adopted the LSTM model to classify the training data and use the classifier to generate the possibility rate of each subcategory for physician posts. Then, we extracted the independent variables by calculating the average rate of subcategories of action-facilitating support and nurturant support. The detailed process of the data extraction is presented in Figure 2.

For moderators, the communication depth was calculated through the average word count of physicians' responses for each physician [24, 31]. The readability score was operationalized through the reciprocal of the average percentage of total medical terminologies in physicians' posts for each physician. Communication frequency was operationalized by using the average number of posts initiated by the physician divide the consultation duration for each physician [23-25].

In addition, we included three control variables (i.e., academic title, hospital rank and online seniority) in the research model. Physician's academic title has the following types: professor, associate professor, represent lecturer, researcher, associate researcher, assistant. We used 7 to represent professor, 6 to represent associate professor, 5 to represent lecturer, 4 to represent researcher, 3 to represent associate researcher, 2 to represent assistant, 1 to represent none [3, 23]. Hospital level information is evaluated and published by government health departments. Hospital levels were coded into six stages, 1 (none), 2 (First-level),3 (First-level grade-A), 4 (Second-level), 5

Figure 3. Example of virtual gift

(Second-level grade-A), 6 (Third-level) and 7 (Third-level grade-A) from low to high [3]. Online seniority was operationalized by the number of years between the current date (i.e., 2021) and the date of registration [58, 59]. Table 2 presents the descriptive statistics and correlations of variables.

6. Results

The dependent variables are discrete non-negative integers, and their variance is much greater than their mean values. Therefore, we choose the negative binomial regression model for our study. The empirical results are shown in Table 3. The first model contains all the control variables include the academic title, online seniority, and hospital rank. The second model adds all the independent variables. The third model adds all the independent variables with moderating variables. The fourth model tests the moderating effect of communication depth. The fifth model tests the moderating effect of communication frequency. The sixth model tests the moderating effect of readability.

The results indicate that both the physician' action-facilitating support ($\beta = 0.780$, $p < 0.01$ in Model 2) and nurturant support ($\beta = 10.744$, $p < 0.01$ in Model 2) have positive and significant effects on POR. Therefore, H1 and H2 are supported. The moderating effects of communication depth on the effects of physicians'

Table 2. Descriptive statistics and correlations(N=2358)

Variables	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9
1.Virtual gift	16.74	77.17	0	1996	1								
2.Communication depth	103.9	110.0	1.538	1288.6	0.206	1							
3.Commincation frequency	2.219	1.614	0.067	19.600	0.069	0.02	1						
4.Readability	0.692	1.524	0.015	35.000	0.031	0.058	0.155	1					
5.Action-facilitating support	0.735	0.651	0.004	9.424	0.067	0.203	-0.277	-0.153	1				
6.Nurturant support	0.081	0.015	0.0006	0.111	0.067	0.089	0.051	-0.015	-0.035	1			
7.Academic title	2.13	2.130	1	7	0.224	0.192	0.179	0.053	-0.049	0.086	1		
8.Online seniority	5.46	3.634	1	13	0.253	0.253	0.183	0.076	-0.066	0.097	0.460	1	
9.Hospital Rank	6.48	1.190	1	7	0.065	0.094	0.026	-0.022	0.053	0.011	0.120	0.126	1

action-facilitating support (β = 0.002, p < 0.01 in Model 4) on POR is positive, thus supporting H3a. While conversely, communication depth does not have a moderating effect on the relationship between nurturant support and POR (β = - 0.025, p >0.1 in Model 4) and thus H3b is not supported. The moderating effects of communication frequency on the effects of physicians' action-facilitating support (β = 0.580, p < 0.01 in Model 5) on POR is positive, thus supporting H4a. While conversely, communication frequency does not have a moderating effect on the relationship between action-facilitating support and POR (β = -2.102, p >0.1 in Model 5) and thus H4b is not supported. The moderating effects of readability on the effects of physicians' action-facilitating support (β = 0.561, p < 0.01 in Model 6) and nurturant support (β = 3.936, p < 0.01 in Model 6) on POR is positive and significant thus supporting H5a and H5b.

6.1. Robustness check

We conducted two checks to assess the robustness of our results. First, we tested the robustness of the

results by removing all control variables [23]. Second, we used alternative operationalization of the dependent variable to verify the six models. The number of thanks letters was used as another proxy of POR. Overall, all results were consistent with those from the previous model. Therefore, it was concluded that the results of this research are robust.

7. Discussion

Based on the results, our research model can predict the direct effect of physician's support on POR. First, our findings suggest that POR is affected by physicians' action-facilitating support and nurturant support. Physicians' action-facilitating support can meet patients' problem-focused needs. Physicians' nurturant support can help patients establish positive subjective appraisal of themselves, which meets patients' emotion-focused needs. This finding is consistent with the result in the context of mobile health consultation [23].

Second, this study verifies the interaction effects of three media capabilities on POR in OHC. Physicians'

Table 3. Regression results

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Communication depth			0.006*** (0.0006)	0.009*** (0.003)		
Communication frequency			0.246*** (0.038)		0.037** (0.251)	
Readability			0.206*** (0.051)			0.386* (0.234)
Action facilitating support		0.780*** (0.117)	0.766*** (0.117)	0.738*** (0.136)	0.030*** (0.171)	0.602*** (0.151)
Nurturant support		10.744*** (3.999)	8.364** (3.729)	9.693** (5.112)	19.276** (7.815)	8.622** (5.075)
Communication depth * Action-facilitating support				0.002*** (0.0004)		
Communication depth * Nurturant support				- 0.025 (0.037)		
Communication frequency * Action-facilitating support					0.580*** (0.107)	
Communication frequency * Nurturant support					-2.102 (2.821)	
Readability * Action-facilitating support						0.561*** (0.186)
Readability * Nurturant support						3.936*** (3.216)
Academic title	0.145*** (0.035)	0.121*** (0.028)	0.122*** (0.028)	0.138*** (0.031)	0.094*** (0.026)	0.107*** (0.027)
Online seniority	0.338*** (0.020)	0.343*** (0.018)	0.290*** (0.016)	0.303*** (0.017)	0.339*** (0.018)	0.345*** (0.018)
Hospital Rank	0.174*** (0.062)	0.174*** (0.047)	0.095*** (0.040)	0.131*** (0.049)	0.132*** (0.047)	0.178*** (0.047)

*Notes: *** p<0.01, ** p<0.05, * p<0.1, standardized coefficients are reported; Robust standard errors in parentheses*

detailed communication content and prompt response positively moderate the relationship between physician's action-facilitating and POR, whereas both media capabilities did not have a moderating effect on the relationship between physician's nurturant support and POR. Physicians usually provide medical information and instructions through multiple rounds of interactions or long-winded explanations [23]. Nurturant support messages, by contrast, are far less frequent and are often used as a concluding line to the online consultation. Therefore, communication frequency and depth have no moderating impact on the relationship between nurturant support and POR. The positive moderating effects of communication depth and frequency suggest that patients find the detailed explanation and high interactive communication more useful. Accordingly, patients are more inclined to undertake voluntary actions in favor of their physicians. In addition, readability positively moderates the relationship between two types of CMSS and POR. This indicates that plain language is not only perceived as more useful and but also brings psychological distance between physicians and patients closer.

7.1. Theoretical implications

First，this study is one of the first to explore the mechanism of POR in OHC based on text mining. This study provides a unique opportunity to better understand patients' perception of CMSS during the OHC and its influence on POR, which complements the antecedents for POR in the context of OHC. Our findings also confirm the role of prosocial behavior in patients receiving the CMSS from physicians.

Second, this study explores the moderating effect of media capabilities on CMSS in OHC based on the media synchronicity theory. Several studies have examined the direct impact of media capabilities on the service delivery process [26, 27, 56, 57]. Our study supplements these findings by examining the positive moderating effect of communication depth, communication frequency and readability on the link between two types of CMSS and POR. It contributes to a more comprehensive understanding of the impact of CMSS on POR in the context of OHC. To summarize, our study gains in-depth insight for physicians on how to build their online reputation through strategic physician-patient communication.

7.2. Practical implications

Our findings also have some practical implications. First, our study can provide practical solutions to help physicians develop communication strategies to better communicate with health consumers. Our findings suggest not only providing professional knowledge can help patients develop coping strategies concerning their stressful demands, but also nurturant support can assist patients to deal with their discomfort associated with illness.

Second, our study shows that physicians need to adjust their interaction behavior accordingly when using different media to communicate with patients. Physicians are advised to use plain language, high frequency, and depth of communication styles, which allows for effectively identify patients' perceptions, promote mutual understanding and help regulate patients' emotions. As a result, patients have both problem-based and emotion-based coping resources to manage their health conditions. In contrast, a physician's CMSS is perceived as less useful and its impact on POR diminishes if the physician fails to respond promptly and provide in-depth and understandable information.

For developers of the OHC platform, our study suggests developers add more assistive tools to facilitate action-facilitating support and nurturant support, and assist physicians to have an interactive, understandable, and thorough communication with patients. For example, the platform can provide physicians with suggested content that contains detailed explanations of medical information physicians mention during the communication. The platform can also notify the doctors if they do not reply to the patient promptly.

7.3. Limitation and future research

Our study has some limitations and calls for future research. First, our study uses cross-sectional data. Future studies could use panel data to explore the effects of CMSS on POR. Second, it is hard to establish the causal effect of physicians' CMSS since physicians' and patients' preferences for the two types of CMSS are endogenously determined. A potential avenue for further research is to incorporate some patient-level controls. Third, we use word count to measure the communication depth. However, the number of words in physicians' posts may simply reflect their communication style, or current conversations require detailed explanation. There is a need to adopt a new indicator to improve the measurement accuracy of the communication depth. Forth, we treat every consultation as the same service which may ignore the different media capabilities of different health services in OHC. In the future, we expect to explore the media capabilities of different services options. Fifth, the effect of text classification for nurturant support is inferior since nurturant support messages are far less frequent than action facilitating support. Future studies could improve the classifier accuracy or adopting other algorithms to optimize the variable extraction process.

Finally, our study focuses mainly on the context of healthcare in China, the findings may not be generalized to other countries. Future studies may examine our conclusion in other countries.

8. References

[1] H. Wang, P. Song, Y. Gu, E. Schroeder, and C. Jin, "Rapid health systems change: online medical consultations to fight COVID-19," *Ann. Transl. Med.*, vol. 8, no. 11, pp. 726–726, Jun. 2020.

[2] Z. Gong, Z. Han, X. Li, C. Yu, and J. D. Reinhardt, "Factors Influencing the Adoption of Online Health Consultation Services: The Role of Subjective Norm, Trust, Perceived Benefit, and Offline Habit," *Front. Public Heal.*, vol. 7, p. 286, Oct. 2019.

[3] S. Guo, X. Guo, Y. Fang, and D. Vogel, "How Doctors Gain Social and Economic Returns in Online Health-Care Communities: A Professional Capital Perspective," *J. Manag. Inf. Syst.*, vol. 34, no. 2, pp. 487–519, Apr. 2017.

[4] Y. Li, X. Ma, J. Song, Y. Yang, and X. Ju, "Exploring the Effects of Online Rating and the Activeness of Physicians on the Number of Patients in an Online Health Community," *Telemed. e-Health*, vol. 25, no. 11, pp. 1090–1098, Nov. 2019.

[5] Y. Wang and J. Vassileva, "A review on trust and reputation for web service selection," 2007.

[6] Z. Deng, Z. Hong, W. Zhang, R. Evans, and Y. Chen, "The Effect of Online Effort and Reputation of Physicians on Patients' Choice: 3-Wave Data Analysis of China's Good Doctor Website," *J. Med. INTERNET Res.*, vol. 21, no. 3, 2019.

[7] J. Li, J. Tang, L. Jiang, D. C. Yen, and X. Liu, "Economic Success of Physicians in the Online Consultation Market: A Signaling Theory Perspective," *Int. J. Electron. Commer.*, vol. 23, no. 2, pp. 244–271, Apr. 2019.

[8] S. Folkman and J. T. Moskowitz, "Coping: Pitfalls and promise," *Annu. Rev. Psychol.*, vol. 55, pp. 745–774, 2004.

[9] J. T. Ptacek and G. R. Pierce, "Issues in the study of stress and coping in rehabilitation settings.," *Rehabil. Psychol.*, vol. 48, no. 2, p. 113, 2003.

[10] S. Cobb, "Social support and health through the life course," *Fam. Stress. coping Soc. Support / Ed. by Hamilt. McCubbin, A. Elizab. Cauble, Joan M. Patterson*, 1982.

[11] P. A. Thoits, "Social Support as Coping Assistance," *J. Consult. Clin. Psychol.*, vol. 54, no. 4, pp. 416–423, 1986.

[12] X. Liu, X. Guo, H. Wu, and T. Wu, "The Impact of Individual and Organizational Reputation on Physicians' Appointments Online," *Int. J. Electron. Commer.*, vol. 20, no. 4, pp. 551–577, Oct. 2016.

[13] H. Yang, X. Guo, T. Wu, and X. Ju, "Exploring the effects of patient-generated and system-generated information on patients' online search, evaluation and decision," *Electron. Commer. Res. Appl.*, vol. 14, no. 3, pp. 192–203, May 2015.

[14] G. (Gordon) Gao, B. N. Greenwood, R. Agarwal, and J. S. McCullough, "Vocal Minority and Silent Majority," *MIS Q.*, vol. 39, no. 3, pp. 565–590, Apr. 2015.

[15] Y. Wang, H. Wu, X. Lei, J. Shen, and Z. Feng, "The Influence of Doctors' Online Reputation on the Sharing of Outpatient Experiences: Empirical Study," *J Med Internet Res*, vol. 22, no. 12, 2020.

[16] H. Wu and N. Lu, "How your colleagues' reputation impact your patients' odds of posting experiences: Evidence from an online health community," *Electron. Commer. Res. Appl.*, vol. 16, pp. 7–17, Mar. 2016.

[17] G. Aref-Adib *et al.*, "A qualitative study of online mental health information seeking behaviour by those with psychosis," *BMC Psychiatry*, vol. 16, no. 1, pp. 1–10, 2016.

[18] W. Wang and N. Yu, "Coping with a New Health Culture: Acculturation and Online Health Information Seeking Among Chinese Immigrants in the United States," *J. Immigr. Minor. Heal.*, vol. 17, no. 5, pp. 1427–1435, Oct. 2015.

[19] H. Wu and Z. Deng, "Knowledge collaboration among physicians in online health communities: A transactive memory perspective: SSIS," *Int. J. Inf. Manage.*, vol. 49, p. 13, Dec. 2019.

[20] L. M. L. Ong, J. C. J. M. De Haes, A. M. Hoos, and F. B. Lammes, "Doctor-patient communication: a review of the literature," *Soc. Sci. Med.*, vol. 40, no. 7, pp. 903–918, 1995.

[21] S. A. Lee and R. J. Zuercher, "A current review of doctor–patient computer-mediated communication," *J. Commun. Healthc.*, vol. 10, no. 1, pp. 22–30, 2017.

[22] A. R. Dennis, R. M. Fuller, and J. S. Valacich, "Media, tasks, and communication processes: A theory of media synchronicity," *MIS Q.*, vol. 32, no. 3, pp. 575–600, 2008.

[23] H. Tan and M. Yan, "Physician-user interaction and users' perceived service quality: evidence from Chinese mobile healthcare consultation," *Inf. Technol. People*, vol. 33, no. 5, pp. 1403–1426, Jun. 2020.

[24] H. Yang, X. Guo, and T. Wu, "Exploring the influence of the online physician service delivery process on patient satisfaction," *Decis. Support Syst.*, vol. 78, pp. 113–121, Oct. 2015.

[25] J. Jiang, A. F. Cameron, and M. Yang, "Analysis of massive online medical consultation service data to understand physicians' economic return: Observational data mining study," *JMIR Med. Informatics*, vol. 8, no. 2, Feb. 2020.

[26] K. Hadwich, D. Georgi, S. Tuzovic, J. Buettner, and M. Bruhn, "Perceived quality of e-health services: A conceptual scale development of e-health service quality based on the C-OAR-SE approach," 2010.

[27] J. Jiang, A. F. Cameron, and M. Yang, "Analysis of massive online medical consultation service data to understand physicians' economic return: Observational data mining study," *JMIR Med. Informatics*, vol. 8, no. 2, p. e16765, Feb. 2020.

[28] H. Li, Y. Liu, and R. Suomi, "Measurement of E-service Quality: An Empirical Study in Online Travel Service," 2009.

[29] Y. Yang, X. Zhang, and P. K. C. Lee, "Improving the effectiveness of online healthcare platforms: An empirical study with multi-period patient-doctor consultation data," *Int. J. Prod. Econ.*, vol. 207, pp. 70–80, Jan. 2019.

[30] U. Dulleck and R. Kerschbamer, "On doctors, mechanics, and computer specialists: The economics of credence goods," *Journal of Economic Literature*, vol. 44, no. 1. pp. 5–42, Mar. 2006.

[31] S. Khurana, L. Qiu, and S. Kumar, "When a doctor knows, it shows: An empirical analysis of doctors' responses in a Q&A forum of an online healthcare portal," *Inf. Syst. Res.*, vol. 30, no. 3, pp. 872–891, Jul. 2019.

[32] R. Bapna, L. Qiu, and S. C. Rice, "Repeated Interactions vs. Social Ties: Quantifying the Economic Value of Trust, Forgiveness, and Reputation Using a Field Experiment," *Forthcoming, MIS Quarterly, NET Inst. Work. Pap.*, no. 14–07, Oct. 2014.

[33] R. Bapna, A. Gupta, S. Rice, and A. Sundararajan, "Trust and the Strength of Ties in Online Social Networks: An Exploratory Field Experiment," *MIS Q.*, vol. 41, no. 1, pp. 115–130, 2017.

[34] D. Proserpio and G. Zervas, "Online reputation management: Estimating the impact of management responses on consumer reviews," *Marketing Science*, vol. 36, no. 5. INFORMS Inst.for Operations Res.and the Management Sciences, pp. 645–665, Sep. 01, 2017.

[35] W. P. Carey and Q. Ye, "First Step in Social Media: Measuring the Influence of Online Management Responses on Customer Satisfaction Bin Gu," *Prod. Oper. Manag.*, vol. 23, no. 4, pp. 570–582, 2013.

[36] P. A. Pavlou and A. Dimoka, "The nature and role of feedback text comments in online marketplaces: Implications for trust building, price premiums and seller differentiation," *Inf. Syst. Res.*, vol. 17, no. 4, pp. 392–414, 2006.

[37] S. C. Rice, "Reputation and uncertainty in online markets: An experimental study," *Inf. Syst. Res.*, vol. 23, no. 2, pp. 436–452, 2012.

[38] S. Ba and P. A. Pavlou, "Evidence of the effect of trust building technology in electronic markets: Price premiums and buyer behavior," *MIS Q. Manag. Inf. Syst.*, vol. 26, no. 3, pp. 243–268, 2002.

[39] S. A. Paul, L. Hong, and E. H. Chi, "Who is Authoritative? Understanding Reputation Mechanisms in Quora," *arXiv:1204.2991*, Apr. 2012.

[40] C. E. Cutrona and D. W. Russell, "Type of social support and specific stress: Toward a theory of optimal matching.," in *Social support: An interactional view.*, Oxford, England: John Wiley & Sons, 1990, pp. 319–366.

[41] R. S. Lazarus and S. Folkman, *Stress, appraisal, and coping*. Springer publishing company, 1984.

[42] Antonina Bambina, *Online Social Support: The Interplay of Social Networks and Computer mediated communication*. New York: Cambria Press, 2007.

[43] Y. Qian and Y. Mao, "A content analysis of online social support behaviors of overseas Chinese prenatal and postnatal women," *China Media Rep. Overseas*, vol. 6, no. 4, pp. 43–55, Oct. 2010.

[44] P. K. H. Mo and N. S. Coulson, "Exploring the Communication of Social Support within Virtual Communities: A Content Analysis of Messages Posted to an Online HIV/AIDS Support Group," *CYBERPSYCHOLOGY Behav.*, vol. 11, 2008.

[45] N. S. Coulson, H. Buchanan, and A. Aubeeluck, "Social support in cyberspace: A content analysis of communication within a Huntington's disease online support group," *Patient Educ. Couns.*, vol. 68, no. 2, pp. 173–178, Oct. 2007.

[46] G. M. Turner-McGrievy and D. F. Tate, "Weight loss social support in 140 characters or less: use of an online social network in a remotely delivered weight loss

intervention," *Transl. Behav. Med.*, vol. 3, no. 3, pp. 287–294, Sep. 2013.

[47] M. Zhang and C. C. Yang, "Using content and network analysis to understand the social support exchange patterns and user behaviors of an online smoking cessation intervention program," *J. Assoc. Inf. Sci. Technol.*, vol. 66, no. 3, pp. 564–575, Mar. 2015.

[48] R. J. Gooden and H. R. Winefield, "Gender Differences and Similarities Breast and Prostate Cancer Online Discussion Boards: A Thematic Analysis of," *103 J Heal. Psychol*, vol. 12, 2007.

[49] Y. Zhang, D. He, and Y. Sang, "Facebook as a platform for health information and communication: A case study of a diabetes group," *J. Med. Syst.*, vol. 37, no. 3, pp. 1–12, Jun. 2013.

[50] J. F. Ha and N. Longnecker, "Doctor-patient communication: a review," *Ochsner J.*, vol. 10, no. 1, pp. 38–43, 2010.

[51] G. Alessandri, G. V. Caprara, N. Eisenberg, and P. Steca, "Reciprocal Relations Among Self-Efficacy Beliefs and Prosociality Across Time," *J. Pers.*, vol. 77, no. 4, pp. 1229–1259, Aug. 2009.

[52] G. V. Caprara, G. Alessandri, and N. Eisenberg, "Prosociality: The contribution of traits, values, and self-efficacy beliefs," *J. Pers. Soc. Psychol.*, vol. 102, no. 6, pp. 1289–1303, Jun. 2012.

[53] S. Atanasova, T. Kamin, and G. Petrič, "The benefits and challenges of online professional-patient interaction: Comparing views between users and health professional moderators in an online health community," *Comput. Human Behav.*, vol. 83, pp. 106–118, 2018.

[54] H. Livneh and E. Martz, "An Introduction to Coping Theory and Research BT - Coping with Chronic Illness and Disability: Theoretical, Empirical, and Clinical Aspects," E. Martz and H. Livneh, Eds. Boston, MA: Springer US, 2007, pp. 3–27.

[55] B. Liang and D. L. Scammon, "E-Word-of-Mouth on health social networking sites: An opportunity for tailored health communication," *J. Consum. Behav.*, vol. 10, no. 6, pp. 322–331, 2011.

[56] S. Singh Gaur, Y. Xu, A. Quazi, and S. Nandi, "Relational impact of service providers' interaction behavior in healthcare," *Manag. Serv. Qual. An Int. J.*, vol. 21, no. 1, pp. 67–87, Jan. 2011.

[57] A. López, A. Detz, N. Ratanawongsa, and U. Sarkar, "What Patients Say About Their Doctors Online: A Qualitative Content Analysis," *J. Gen. Intern. Med.*, vol. 27, no. 6, pp. 685–692, 2012.

[58] L. Chen, A. Baird, and D. Straub, "A linguistic signaling model of social support exchange in online health communities," *Decis. Support Syst.*, vol. 130, Mar. 2020.

[59] T. C. Lin, J. S. C. Hsu, H. L. Cheng, and C. M. Chiu, "Exploring the relationship between receiving and offering online social support: A dual social support model," Inf. Manag., vol. 52, no. 3, pp. 371–383, Apr. 2015.