Understanding the effects of doctors' online profile pictures on patients' decision-making

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Abstract

The effect of doctors' profile pictures in online healthcare platforms has been investigated in prior research. However, little attention has focused on professional signals conveyed by doctors' online profile pictures. To address the above-mentioned gap, this study examines the roles of doctors' profile pictures in patients' online decision-making based on cue utilization theory and impression management theory. Our research finds that a picture indicating professional information (e.g., professional attire and professional background) matters in attracting patients' interest and their decision-making. However, the impacts of professional information change according to patients' illness severity. Specifically, patients with low-severity illnesses care more about professional attire in the stage of glancing physicians, while patients with high-severity illnesses care more about professional attire in the stage of decision making. These findings contribute to the domain knowledge of online service design and delivery, especially in the arena of online health services.

Keywords: Online healthcare platforms, doctor profile pictures, illness severity, patients' interest, patients' decision-making

Introduction

Showing attributes of product, service, or personal information via pictures is a popular way in online markets (Luca, 2017). Designers and practitioners believe that online pictures can be regarded as a useful cue to deliver more information, attract consumers' interests, and give them good first impressions, which can significantly influence their purchase decisions (Xia et al., 2020). Specifically, various attributes in online pictures can stimulate consumers to receive visual information conveyed by pictures. Prior research has explored the effects of these attributes on consumers' perception and decisions in the two following perspectives: internal attributes of pictures (e.g., color, size, and shape) (Chi et al., 2021; Wu et al., 2021) and contents of pictures (e.g., the appearance of people or products in the picture, logo, and aesthetic elements) (Cao et al., 2020; Peng et al., 2020). In different online platforms, the visual information brought by pictures' attributes has long been recognized to influence consumers' decisions more than textual information, which affects the performances of product (service) providers in turn. For example, compared with cold colors, consumers in online accommodation-sharing platforms tend to choose pictures of houses with warm colors because they may perceive trust and hospitality through warm hues (Chi et al., 2021); In

e-commerce platforms, product sales are better for sellers with attractive and unattractive facial appearance than those with plain-looking people because they are regarded as more sociable and reliable (Peng et al., 2020). Hence, utilizing online pictures can be regarded as a useful way for consumers to improve their understanding of product or service in online markets.

Given the popularity of applying online pictures in helping consumers make decisions, doctor's profile pictures are also regarded as an important factor in promoting patients' doctor choice in online healthcare platforms (Ouyang & Wang, 2022). Doctors are allowed to upload their profile pictures in online healthcare platforms. The profile pictures are often placed in prominent position on websites to ensure that patients can see them in the first sight when browsing doctors' online homepages. Through this visual information, patients can quickly and directly understand doctors' professional image and perceive their professionalism, which, in turn, affects their decision-making. To the best of our knowledge, existing research mainly focuses on the following research streams to understand the role of doctor's online profile pictures: (1) whether doctors upload their profile pictures; (2) the facial characteristics of doctors in profile pictures. The first research stream has explored the effect of the existence of doctor's online profile pictures on patients' decision-making (D'Angelo & Van Der Heide, 2016). Most of the results suggest that doctor's online profile pictures can increase the number of online healthcare consultations. The second research stream has investigated how doctor's facial characteristics affect patients' doctor choice, such as the facial appearance of doctors, the level of doctors' beauty, and so on (Ouyang & Wang, 2022). Although the effectiveness of doctors' online profile pictures has been proven, little attention has been paid on the effect of professional signals conveyed by doctors' online profile pictures. To better understand the role of doctors' online profile pictures, more research needs to be done.

Our research adopts two factors to understand the role of doctors' online profile pictures in affecting patients' online behaviors, that is, attire and background. The reasons for choosing these two factors are as follows. First, doctors' attire has strong professional characteristics (Lill & Wilkinson, 2005). In the perspective of patients, doctors usually wear professional clothes at work (such as white coats), which adheres to the fixed image patients have of professional doctors. Therefore, professional attire in online profile pictures is an important factor for patients to judge the professional image of doctors. Second, background is one of the most important elements in doctors' online profile pictures, which can represent a doctor's working environment and then affect patients' judgement of doctors' professionalism. If doctors' profile pictures reflect their working environments (such as office or operating room) or their professional characteristics, patients can identify more closely with the working conditions and the atmosphere of doctors' consultations. Thus, doctors' online profile pictures that contain professional attire or a professional background can attract patients' interests and affect their decision-making.

In addition, the effects of doctors' online profile pictures may vary due to the heterogeneity of patients, like different levels of patients' illness severity. As one of the most important characteristics of illness (Yang et al., 2019), severity can reflect a patient's need for professional services (Zhang et al., 2019). When seeing doctors' profile pictures, patients with high-severity illnesses are more likely to show more interests and choose doctors with professional attire and background than patients with low-severity illnesses. Patients believe that these doctors can provide more professional and reliable healthcare advice. Therefore, illness severity may moderate the relationship between doctors' profile pictures, patients' interests, and patients' decision-making.

In this study, our research aims to investigate the influences of doctors' profile pictures on patients' interests and decision-making, as well as the moderating effects of illness severity in the stages of glancing doctors and patients' decision-making. This study aims to solve the following two research problems:

(1) Does professional attire and a professional background in online profile pictures affect patients' interest and decision-making?

(2) Does illness severity moderate the relationship between online profile pictures, patients' interest, and patients' decision-making?

Literature Review

Effects of online information on patients' decision-making

Healthcare services is closely associated with patients' well-being, which may result in patients' high attention when choosing an appropriate doctor for consultations. However, given that healthcare service is the main paradigm of expert services (Khurana et al., 2019), it is quite difficult for patients to make judgement on doctors. This indicates that related information cues or quality signals are needed for patients to choose doctors (Rao et al., 2018; Yang et al., 2020). Online healthcare platform has become an effective channel for patients to obtain some related doctors' information (Agarwal et al., 2010; Fichman et al., 2011). Patients can not only collect various types of doctor information (Huang et al., 2021) but also provide information to other patients based on their own experiences (Saifee et al., 2020) in online healthcare platforms. Existing research has demonstrated that online text, profile pictures and voice information are three important information for patients to judge doctors. With the utilization of these online information, patients can judge doctors based on their professional competence. In healthcare service, doctors' professional competence is the most important issue that patients concern about. Prior research has proposed that doctor's professional competence includes two parts, i.e., ability and service attitudes (Epstein & Hundert, 2002).

Doctor's ability can be reflected in their knowledge, technical skills, and clinical reasoning (Epstein & Hundert, 2002). In online healthcare platforms, patients can obtain information about doctors' title, ranking and hospital standing to judge whether this doctor has undergone a strict evaluation process (Guo et al., 2017). As for doctors' service attitudes, it mainly refers to their communication and emotions with patients (Epstein & Hundert, 2002). Online healthcare platforms provide online text (e.g., patients' online comments) (D'Angelo & Van Der Heide, 2016) and voice information (e.g., voice pitch, voice intensity) (Liu et al., 2020) for patients to judge doctors' service attitudes.

Different from text and voice information, online picture information mainly influences patients' perception and impression through visual cues. The appearance of doctors' online profile pictures can serve as a strong signal and help patients form the first impression at very few glances. Prior research has mainly investigated the effect of doctors' online profile pictures on patients' decision-making in the following aspects: facial appearance, skin condition, smile, and emotion (Ouyang & Wang, 2022). For example, prior research indicates that doctors with smile and better skin condition are more popular. Although the effectiveness of these elements has been proven in prior research, two research gaps still remain in the existing research about online doctor's profile picture. First, few research has focused on the effect of other visual cues (i.e., internal attributes of profile pictures) except for the doctor himself (i.e., content of profile pictures). Internal attributes, include color, background, shape, etc., can also affect patients' perception and impression on doctors. Second, few research has investigated the effect of professional competence conveyed by online profile pictures. Patients can judge whether the image of this doctor can meet the expectation of being a professional healthcare service provider. Hence, given that online profile picture is potentially important for patients to evaluate doctors' professional competence, our research mainly investigates the effect of pictures' attributes on patients' decision-making.

Effects of service providers' online profile pictures

As important visual cues, profile pictures can meet the needs of personal self-expression and can transmit more intuitive information to others (Peng et al., 2020; Van der Zanden et al., 2020), thereby affecting consumers' online behaviors. Existing research has investigated the effect of service providers' profile pictures in various online contexts, such as traveling (Banerjee & Chua, 2020), e-commerce (Peng et al., 2020), accommodation-sharing (Chi et al., 2021) and so on. Relevant literature can be divided into three categories: the influence of profile picture disclosure, the influence of facial attractiveness and expressions, and the influence of information cues in profile pictures.

First, the disclosure of service providers' online profile pictures is the main source for consumers to evaluate sellers. Online profile pictures can meet service providers' self-disclosure needs (Park et al., 2011), convey information and emotions (Luca, 2017), and manage impression (Willis & Todorov, 2006). This can enhance the trust of consumers, thereby promoting sales (Rong et al., 2022). Second, service providers' attractiveness and facial expressions in their online profile pictures also have significant effects on

consumers' behaviors (Peng et al., 2020). Facial attractiveness is capital that can not only attract more people's attention but can also result in the acquisition of more social resources. In the context of e-commerce, sellers' appearance can attract buyers to goods. For example, Cao et al. (2020) analyzed the profile pictures of female financial practitioners and found that highly attractive women have a stronger working ability and can attract more investors; Peng et al. (2020) applied survival analysis and empirical research models and found a U-shaped relationship between the appearance of sellers and the sales of their goods. Their findings indicate that more conventionally facial attractive sellers can attract more consumers to buy goods. Third, information cues in online profile pictures are also important factors that affect consumers' trust and decision-making. These information cues include the color, background, and richness of content in the pictures. For example, Chi et al. (2021) found that rental transactions are affected by picture color and textual cues related to colors.

Although the existing literature has explored the impact of online profile pictures on consumers' decision-making, these studies have focused mainly on the context of e-commerce. Scant research has examined the role of doctors' profile pictures in online healthcare markets. Healthcare belongs to the paradigm of expert services and, therefore, patients pay more attention to the professionalism of doctors. However, it is still unclear which visual information in doctors' online profile pictures can affect patients' attention and decision-making. To address this research gap, this study will build a research model to analyze the impact of doctors' profile pictures on patients.

Theoretical background and hypothesis development

This study combines cue utilization theory and impression management theory as the basis for a theoretical model and to develop our research hypotheses.

Cue utilization theory

Cue utilization theory was first proposed by Cox (1967) and was further developed by Olson and Jacoby (1972). This theory demonstrates that products and services consist of a range of cues and consumers can evaluate the quality of a product according to these cues. Cue utilization theory has been widely used to investigate the ways in which quality cues influence consumers' evaluations in different domains, such as marketing (Koschate-Fischer et al., 2012), commerce (Wang et al., 2016) and so on. Prior studies in the traditional commerce context have demonstrated that quality cues can help individuals to make judgments about products and services, and are the key elements that influence their behaviors (Gutjar et al., 2014; Konuk, 2021). However, in the e-commerce context, consumers, products, and services are separated from each other. Consumers need to rely on extrinsic online cues to form impressions about products and sellers before making their purchase decisions (Kukar-Kinney & Xia, 2017).

Furthermore, because of information asymmetry, consumers usually possess limited data about products and services in contrast to sellers. Thus, cue utilization theory is considered a useful theoretical framework to explain how sellers and consumers cope with information asymmetry. Sellers may offer useful cues for consumers to evaluate quality and to help them deepen their understanding of the products and services (Kirmani & Rao, 2000). We suggest that cue utilization theory can be used in the field of online healthcare to investigate the relationship between doctors' visual information and patients' behaviors.

Impression management theory

Impression refers to the overall evaluation of a person in the process of interpersonal communication (Asch, 1946; Lampel & Anderson, 1968). People obtain a first impression from a person's characteristics cues. In general, individuals use two types of cues to form impressions about other people: stereotypes and personal characteristics (Fiske & Pavelchak, 1986). A stereotype refers to a simplified cognitive schema that exists in individuals' processing systems (Ye et al., 2020). Personal characteristics refer to specific information about a person, such as personal behavior and traits (Ye et al., 2020). Impression management theory suggests that individuals can influence other people's impression perceptions and formations by controlling how they present themselves to others (Tedeschi, 2013). People usually use different perceived information to form impressions about other people (Xie et al., 2019). Especially in online situation, individuals utilize textual or visual cues to leave the impression they want on other people (Florea et al., 2018). Therefore, people can leave a set impression on others by designing relevant cues.

Hypothesis development

According to cue utilization theory (Cox, 1967) and impression management theory (Tedeschi, 2013), patients can utilize related cues to form an impression about doctors, to evaluate their quality, and to make decisions. Doctors' online profile pictures are one of the most important visual cues. Doctors' profile pictures are more attractive than other textual information to patients. When patients select doctors on online healthcare platforms, they should first consider doctors' visual information, which provides cues for decision-making. In addition to personal appearance, doctors' online profile pictures that can reflect their professional impression include two main factors: attire and background. Patients can use a professional attire and background in doctors' online profile pictures as quality cues to inform their decisions.

Doctors' attire can reflect the characteristics of their profession, which can then affect patients' perceptions about doctors' professionalism. For example, prior studies have shown that patients are more willing to consult doctors that wear professional attire, that is, white coats (Chung et al., 2012; Gherardi et al., 2009; Lill & Wilkinson, 2005). In general, professional attire is considered a strong cue concerning the doctors' career. In online healthcare platforms, patients may pay more attention to doctors who are wearing professional attire in their profile pictures. Patients feel that the professional attire worn in doctors' online profile pictures is more in line with their impressions of doctors. Therefore, professional attire in profile pictures could affect patients' decision-making.

Moreover, the background of the profile pictures is an important visual cue for patients. Considering that patients cannot have face-to-face consultations with doctors in online healthcare platforms, the background of the profile pictures can create a virtual context for patients. If a doctor's profile picture is taken in a professional setting (i.e., in a doctor's office), patients may feel that they are asking for medical advice in a doctor's office. Therefore, patients utilize the backgrounds of profile pictures as important cues to form professional impressions, which affects their decision-making. Hence, based on this discussion, we propose the following:

H1: Professional attire in doctors' online profile pictures positively affects patients' decision-making.

H2: A professional background in doctors' online profile pictures positively affects patients' decision-making.

According to cue utilization theory (Cox, 1967), individuals will experience the processes of cue search, cue evaluation, and decision-making. Related cues that improve individuals' interests are key to influencing their decision-making. Patients could visit the doctor's personal website to search for more information and cues. Doctors' profile pictures will be displayed on their personal websites. Profile pictures are often in a prominent position and can rouse a patient's interests. Patients' trust in a doctor may be affected by the doctor's professional image. The doctor's visual information will affect the patient's level of attention. When patients search for a doctor's related information and materials, they will use the attire and the background from the online profile picture. Professional attire and a professional background in profile pictures are strong cues that attract patients. When a doctor wears professional attire or takes photos in a professional setting, patients will think that the doctor is more likely to have professional knowledge and skills. These visual clues help patients to form a professional impression of the doctor, which then enhances the patients' trust in the doctor.

Moreover, an increase in a patient's interests in a doctor will affect their decision-making. Such attention will prompt them to search for more information and cues to be used to evaluate doctors' quality. The increase in patients' interests promotes the efficiency of the use of cues and affects patients' decision-making. Hence, patients' interests in a doctor has a mediating effect on the relationship between professional attire, professional background, and patients' decision-making. In line with this discussion, we propose our next hypotheses:

H3: Patients' interests in a doctor mediates the relationship between professional attire in a profile picture and patients' decision-making.

H4: Patients' interests in a doctor mediates the relationship between a professional background in profile pictures and patients' decision-making.

As one of the most important personal characteristics for patients, illness severity can affect their psychology and behaviors (Chen et al., 2020; Yang et al., 2019). Illness severity could affect the use of

relevant medical resources by patients. Patients with severe illnesses are more concerned about their clinical problems and have greater expectations about the results of their healthcare consultation.

Patients who have serious illnesses are inclined to pay more attention to a doctor's knowledge, expertise, and other characteristics that represent the doctor's professionalism because they believe that doctors with such qualities can provide them with useful and practical clinical suggestions for dealing with their serious problems (Yang et al., 2020). Doctors' use of professional attire and a professional background in their online profile pictures can represent the professionalism of a doctor. In a patient's decision-making process, patients with severe illnesses are more likely to pay attention to the profile pictures of doctors that are dressed in professional attire or are set in professional locations. These pieces of visual information send cues about professionalism to patients, which allows them to spend more time looking for information and forming professional impressions about doctors. Hence, illness severity plays a significant role in patients' decision-making. In line with this discussion, we propose our next hypotheses:

H5: Illness severity positively moderates the relationship between professional attire, professional background, and patients' attention.

H6: Illness severity positively moderates the relationship between professional attire, professional background, and patients' decision-making.

Figure 1 shows our research model.

Figure 1. Empirical model
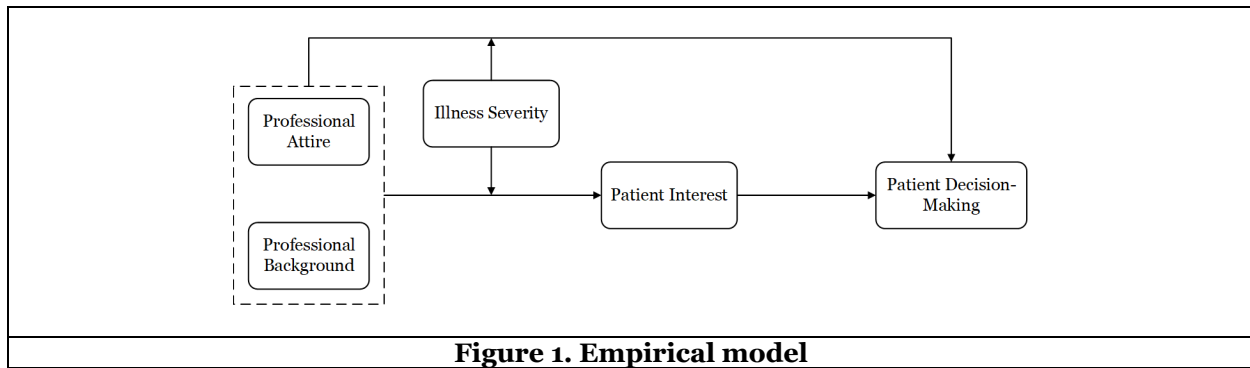
Research Method

Research context

We collected data from haodf.com (Good Doctors website), a leading Chinese online healthcare platform, to test our hypotheses. Good Doctors allows registered doctors to create their own online homepage. Patients can browse these homepages, which contain doctors' pictures and other information. Doctors' personal information, online profile picture, and service feedback are presented on the homepages. Patients can visit a doctor's homepage to make evaluations and a decision. Doctors can upload their personal profile picture to their homepage. From these profile pictures, patients can form impressions about the doctors, which helps them to make a final decision about which doctor to visit. Therefore, Good Doctors provides sufficient research data for our study.

Data collection and variables

To test our hypotheses, a Java program was written to automatically collect doctors' information, such as title, hospital ranking, number of patient visits, online profile picture, and service feedback, from their online homepages. We focused mainly on doctors who treated coronary heart disease, diabetes, leukemia, cerebral infarction, insomnia, headache, gastritis, and depression. We collected data for about 418 doctors over six months and excluded invalid data, such as incomplete doctor information or doctors who no longer used this website to offer online service.

There were two dependent variables in our empirical model: patient interests and patient decision-making. Patient interests is defined as patients who are keen to visit a doctor's online homepage. Thus, we use the number of visits to a doctor's online homepage as a proxy for patient attention. Patient decision-making is defined as the number of patients who have consulted this doctor.

One of the independent variables in our research model is doctors' attire in their online profile pictures. In this research context, there are two types of doctors' attire: professional and non-professional. Professional attire refers to clothes that represent doctors' professional characteristics, such as white coats or surgical gowns. Non-professional attire refers to clothes that do not represent doctors' professional characteristics, such as jackets, T-shirts, and skirts. We use a dummy variable (1 and 0, respectively) to indicate whether doctors are dressed in professional attire in their online profile pictures. Another independent variable in our research model is the background of doctors' online profile pictures. There are two types of backgrounds in doctors' online profile pictures: professional and non-professional. Professional backgrounds indicate that the doctor's profile picture has been taken in a work environment (i.e., in a hospital or in an office). Non-professional backgrounds appear in profile pictures taken in a non-working environment (i.e., in a park). We use a dummy variable (1 and 0, respectively) to indicate whether doctors' profile pictures were taken in a work environment. The summary statistics of our research data are as follows: Attire (Professional: 237; Non-professional: 181), Background (Professional: 372; Non-professional: 46).

In addition, the moderating variable in our research model is illness severity. Prior studies have demonstrated that illness severity can be divided into two types: lethal and non-lethal (Chen et al., 2020; Yang et al., 2021; Yang et al., 2015; Zhang et al., 2019). An illness severity of a lethal type refers to illnesses that have a high death rate while an illness severity of a non-lethal type refers to illnesses with a low death rate. Hence, the mortality rate of illnesses can be used as a proxy for illness severity. We also focused on the eight most common illness categories on the Good Doctors websites, according to data from prior studies (Chen et al., 2020; Yang et al., 2020; Yang et al., 2015; Zhang et al., 2019). These categories are coronary heart disease, diabetes, leukemia, cerebral infarction, insomnia, headache, gastritis, and depression. The first four diseases have a high death rate, which means that they are included in high-severity group. The last four diseases have a low death rate, which means that they are included in the low-severity group. If a patient consulted a doctor for the treatment of lethal illness, we placed the patient in the high-severity group (coronary heart disease, diabetes, leukemia, and cerebral infarction). If a patient consulted a doctor for the treatment of a non-lethal illness, we placed the patient in the low-severity group (insomnia, headache, gastritis, and depression). Hence, we used a dummy variable for illness severity to indicate whether a disease is included in the high-severity group (1 if yes, 0 otherwise).

The variables used in this research are summarized in Table 1. Their means, standard deviations, and correlations are shown in Table 2, which demonstrates the structure and distribution of the data. There is no complete multicollinearity in our research model according to correlations of the variables.

Type of variable	Variable	Description	Proxy
Dependent variable	Number of visits	Number of visits to the doctor's homepage	Number of visits
	Number of patients	Number of patients who have consulted this doctor	Number of patients
Independent variable	Attire	Clothes that reflect the professional characteristics of doctors in profile pictures	Professional and non-professional attire can be expressed as 1 and 0
	Background	Backgrounds that reflect the work environment of doctors in profile pictures	Professional and non-professional background can be expressed as 1 and 0
Moderating variable	Illness severity	Mortality of illness	High- and low-severity illnesses can be expressed as 1 and 0
Control variable	Feedback	Number of positive reviews from patients	Number of positive reviews
	Contribution	Active levels of doctors in online healthcare platform	Active levels of doctors calculated by online healthcare platform
	Gender	Doctor's gender	Male and female doctors can be expressed as 1 and 0
	Status	Doctor's comprehensive status can be reflected in three types of information: doctor's title, doctor's hospital's ranking, and doctor's city ranking	Status = Standard [Standard (Doctor's title) + Standard (Doctor's hospital ranking) + Standard (Doctor's city ranking)]
Table 1. Variables and descriptions			

Variable	Mean	Dev	1	2	3	4	5	6	7	8	9
1 Status	0.000	1.000	1								
2 Gender	0.482	0.499	0.136**	1							
3 Severity	0.330	0.470	0.409**	0.157**	1						
4 Attire	0.704	0.295	0.198**	−0.079*	0.072**	1					
5 Background	0.594	0.490	0.497**	0.026	0.395**	0.304**	1				
6 Contribution	5.749	3.079	0.495**	−0.001	0.403**	0.472**	0.417**	1			
7 Feedback	1.294	1.383	0.537**	−0.012	0.467**	0.219**	0.502**	0.440**	1		
8 Visit	10.525	2.347	0.508**	0.023	0.409**	0.457**	0.449**	0.479**	0.524**	1	
9 Patient	3.801	2.382	0.545**	0.004	0.475**	0.420**	0.451**	0.638**	0.511**	0.595**	1
Table 2. Descriptive statistics and correlations											

Note. ** and * means correlation (two-tailed) is significant at the 0.01 and 0.05 levels, respectively.

Model estimation

To test our hypotheses on the effects of doctors' attire and professional background in doctors' profile pictures on patients' interest and their decision-making, we used the collected data to construct a panel dataset and establish the following empirical models. Given that there is a large variance in the dependent and independent variables and the data do not meet the requirements of normal distribution, we developed the following logistic regression models:

$$Log(Visit_{it}) = \beta_0 + \beta_1 Log(Feedback_{it}) + \beta_2 Log(Contribution_{it}) + \beta_3 Status_i + \beta_4 Gender_i + \beta_5 Severity_i$$
$$+ \beta_6 Attire_i + \beta_7 Background_i + \beta_8 Severity_i * Attire_i + \beta_9 Severity_i * Background_i + \mu_i + \varepsilon_{it}$$

$$Log(Patient_{it}) = \beta_0 + \beta_1 Log(Visit_{it}) + \beta_2 Log(Feedback_{it}) + \beta_3 Log(Contribution_{it}) + \beta_4 Status_i + \beta_5 Gender_i$$
$$+ \beta_6 Severity_i + \beta_7 Attire_i + \beta_8 Background_i + \beta_{11} Severity_i * Attire_i + \beta_{12} Severity_i * Background_i + \mu_i + \varepsilon_{it}$$

where $i = 1, 2, \ldots N$ represents the doctor and t represents the period. In these empirical models, β_0 to β_{12} are the parameters to be estimated. The unobserved doctor-specific effects are captured in the term μ_i and ε_{it} is the error term. $Log(Visit_{it})$ and $Log(Patient_{it})$ represent the number of patients who visit the doctor's homepage and the number of patients who have consulted the doctor. $Attire_i$ and $Background_i$ are the key parameters that we focus on in this study. $Severity_i * Attire_i$ and $Severity_i * Background_i$ are the interaction terms used to express the moderating effects of illness severity. Moreover, we use $Log(Feedback_{it})$, $Log(Contribution_{it})$, $Status_i$, and $Gender_i$ as control variables.

The results of empirical analysis

We used fixed effects to estimate our empirical models. The results of the regression are shown in Table 3. The results indicate that the values of R-squared are reasonable and the F-values of the empirical models are significant. The Variance Inflation Factor statistics of the empirical models are less than 2.0, which indicates that there is no significant multicollinearity among the variables.

Hypothesis 1 predicts that professional attire in profile pictures is positively associated with patients' interests. According to Column 1 of Table 3, holding all other independent variables constant, professional attire is associated with a 127.9% increase in the number of patients who visit the homepage ($\beta = 1.279$, $t = 6.784$, $p < 0.001$), which supports Hypothesis 1.
Hypothesis 2 predicts that a professional background in doctors' profile pictures is positively associated with patients' interests. According to Column 1 of Table 3, holding all other independent variables constant, professional background is associated with a 29.8% increase in the number of patients who visit the homepage ($\beta = 0.298$, $t = 2.476$, $p < 0.01$), which supports Hypothesis 2.
Hypothesis 3 posits that professional attire in doctors' profile pictures is positively associated with patients' decision-making. According to Column 2 of Table 3, holding all other independent variables constant, professional attire is associated with a 32.8% increase in the number of patients who consult this doctor ($\beta = 0.328$, $t = 4.16$, $p < 0.001$), which supports Hypothesis 3.
Hypothesis 4 posits that a professional background in doctors' profile pictures is positively associated with patients' decision-making. According to Column 2 of Table 3, holding all other independent variables constant, professional background is associated with a 46.4% increase in the number of patients who consult this doctor ($\beta = 0.464$, $t = 4.16$, $p < 0.001$), which supports Hypothesis 4.

	Visiting Model	Decision Model
Constants	7.257***	-0.255
	(30.361)	(-1.81)
Status	0.804***	0.263***
	(6.274)	(3.48)
Gender	−0.573***	0.009
	(−3.665)	(0.10)
Log(Feedback)	0.171**	0.127**
	(2.267)	(2.83)
Log(Contribution)	0.441***	0.599***
	(27.483)	(63.20)
Severity	-1.695***	-0.544**
	(−5.743)	(-3.12)
Attire	1.279***	0.328***
	(6.784)	(4.16)
Background	0.298**	0.464***
	(2.476)	(4.16)
R^2	0.685	0.794
F\Wald	216.968***	973.20***
Table 3. Estimations of empirical models (N = 2,198)		

Note. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

We mainly use stepwise-test regression to examine the mediating effect of patient interest. The results are concluded in Table 4 and Table 5 as follows. From Column 1 in Table 4, we can see that the coefficient of attire is statistically positive (α = 0.314, t = 4.43, p < 0.001). From Column 2 in Table 4, we can see that the coefficient of attire is statistically positive (α = 0.261, t = 2.27, p < 0.05). From Column 3 in Table 4, we can that the coefficient of attire is statistically positive (α = 0.252, t = 3.84, p < 0.001) and the coefficient of log(visit) is statistically positive (α = 0.236, t = 17.43, p < 0.001). Hence, from these results, we can see that patient interest can mediate the relationship between attire and patients' decision-making. Moreover, from Column 4 in Table 4, we can see that the coefficient of professional background is statistically positive (α = 0.458, t = 4.12, p < 0.001). From Column 5 in Table 4, we can see that the coefficient of professional background is statistically positive (α = 1.318, t = 7.43, p < 0.001). From Column 6 in Table 4, we can see that the coefficient of professional background is not statistically positive (α = 0.147, t = 1.14, p > 0.05). This indicates that patient interest mediates the relationship between background and patients' decision-making.

	Attire – Decision Making	Attire – Patient Interest	Attire – Patient Interest – Decision Making	Background – Decision Making	Background – Patient Interest	Background – Patient Interest – Decision Making
Status	0.281***	0.908***	0.067	0.467***	1.099***	0.208**
	(3.73)	(7.43)	(0.94)	(7.14)	(10.52)	(3.33)
Gender	0.000	-0.530***	0.126	0.016	-0.427**	0.116
	(0.01)	(-3.57)	(1.48)	(0.17)	(-2.90)	(1.36)
Log(Feedback)	0.088	0.006	0.087*	0.102*	0.031	0.095*
	(1.96)	(0.08)	(2.09)	(2.27)	(0.44)	(2.27)
Log(Contribution)	0.604***	0.446***	0.499***	0.598***	0.416***	0.500***
	(66.55)	(30.33)	(48.23)	(63.17)	(27.56)	(47.66)
Severity	-0.561**	-1.819***	-0.131	-0.947***	-2.215***	-0.425**
	(-3.23)	(-6.47)	(-0.81)	(-6.11)	(-8.95)	(-2.89)
Attire	0.314***	0.261*	0.252***			
	(4.43)	(2.27)	(3.84)			
Background				0.458***	1.318***	0.147
				(4.12)	(7.43)	(1.41)
Log(Visit)			0.236***			0.236***
			(17.43)			(17.09)
R^2	0.795	0.513	0.8251	0.795	0.527	0.824
F\Wald	623.83***	169.65***	695.03***	622.68***	178.96***	688.99***
Table 4. The results of the mediation effect of patient interest						

Note. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$
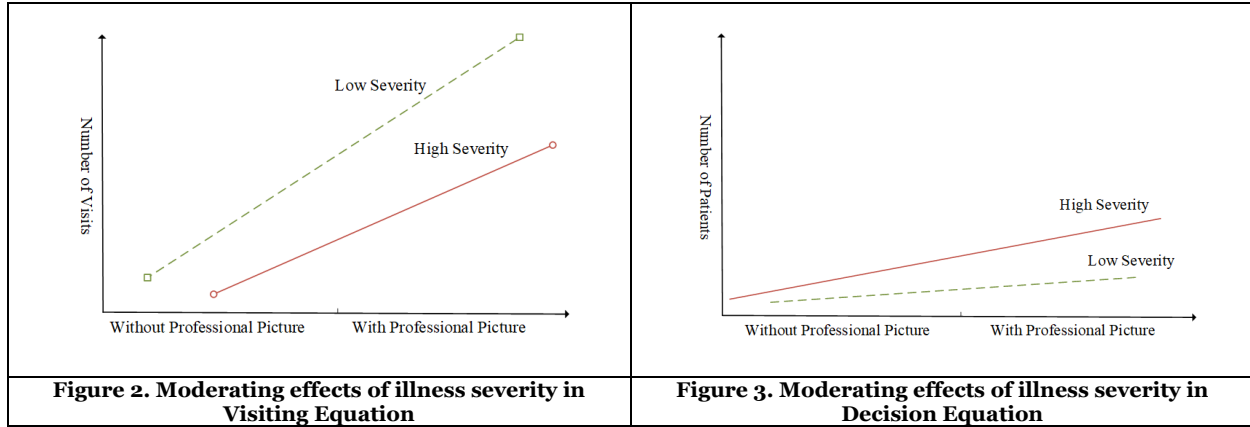
Moderating effects of illness severity

The moderating effects of illness severity in the empirical models are shown in Table 5. Hypothesis 5a proposes that patients that have more severe illnesses are more likely to be concerned about the attire and background in profile pictures than those with low-severity illnesses. From Column 1 (Visiting equation) in Table 4, the coefficient of the interaction term *severity*attire* is statistically negative ($\beta = -1.446$, $t = -7.818$, $p < 0.001$). This indicates that *severity*attire* is negatively related to patients' interests, which shows that patients that have low-severity illnesses are more concerned about doctors' attire than those with more severe illnesses. In addition, the coefficient of the interaction term *severity*background* is not statistically significant for patient interests ($\beta = -0.136$, $t = -1.021$, $p > 0.05$). This result demonstrates that there is no empirical evidence that supports the idea that patients that have more severe illnesses are more concerned about the background in doctors' profile pictures. These results are connected to our Hypothesis 5a.

We proposed in Hypothesis 5b that patients with more severe illnesses are more likely to consult with doctors who are dressed in professional attire in their profile picture or whose profile pictures were taken in a work environment. From Column 2 (Decision equation) in Table 5, the coefficient of the interaction term *severity*attire* is statistically positive ($\beta = 0.502$, $t = 3.695$, $p < 0.001$). This indicates that *severity*attire* is positively related to patients' decision-making. In addition, the interaction term *severity*background* is not statistically significant for patient's decision-making ($\beta = 0.053$, $t = 0.550$, $p > 0.05$). This demonstrates that there is no empirical evidence that supports the idea that patients with more severe illnesses are more likely to consult with doctors whose profile pictures were taken in a professional setting. Thus, these moderating results partially support Hypothesis 5b. Figures 2 and 3 also show the moderating effect of illness severity.

Variable	Visiting equation	Decision equation
Constants	5.978***	−1.574***
	(72.685)	(−14.305)
Status	0.013	0.133***
	(0.458)	(6.370)
Gender	0.146***	−0.085***
	(3.494)	(−2.808)
Log(Feedback)	0.437***	0.078***
	(20.422)	(4.616)
Log(Contribution)	0.444***	0.492***
	(41.412)	(47.424)
Log(Visit)		0.249***
		(16.088)
Severity	1.319***	−0.216**
	(8.252)	(−1.836)
Attire	0.986***	−0.347***
	(11.179)	(−5.279)
Background	0.856***	0.123***
	(14.661)	(2.779)
Severity*Attire	−1.446***	0.502***
	(−7.818)	(3.695)
Severity*Background	−0.136	0.053
	(−1.021)	(0.550)
R^2	0.838***	0.916***
F	1,266.486***	2,403.91***
Table 5. Moderating effects of empirical models (N = 2,198)		

Note. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Figure 2. Moderating effects of illness severity in Visiting Equation

Figure 3. Moderating effects of illness severity in Decision Equation

Robustness Check

We have used a propensity score matching (PSM) analysis to test our empirical results, which can help us to choose doctors from the treatment and control groups that have matching characteristics. We mainly use title ranking, hospital standing and city ranking to calculate doctors' propensity score. Two logit regression models are set as follows.

$$Logit\left(attire_i\right) = a_0 + a_1 * title_i + a_2 * hospital_i + a_3 * city_i + \theta_i$$

$$Logit\left(background_i\right) = b_0 + b_1 * title_i + b_2 * hospital_i + b_3 * city_i + \theta_i$$

where i = 1, 2, … N represents the doctor and a and b are the parameters to be estimated in logit regression. The algorithm of nearest-neighbor matching was used to link each treating doctor with the closest propensity score. The differences between before and after the matching for doctors' attire and picture's background are shown in Table 6. There is no statistical significance between the means of the treated and the control groups after matching, which indicates that our matching in PSM is helpful in reducing the bias that is related to the three control variables. We also investigate the effect of pictures' background on patients' decision-making after matching and conclude the results in Table 6. The results show that the covariate imbalance only exists in the group for "title". Hence, we used only the matching results for attire as the data for robustness check. We adopted the matching samples to rerun our research model again. The results are concluded in Table 7, which are in consistent with the moderating results, which verify our findings from the main model.

	Matching for doctors' attire									
	Before matching					*After matching*				
Variables	*Mean treated*	*Mean control*	*Percentage bias*	*t-value*	*p-value*	*Mean treated*	*Mean control*	*Percentage bias*	*t-value*	*p-value*
Title	*2.965*	*2.307*	*94.7*	*11.67*	*0.000*	*2.618*	*2.618*	*0.0*	*0.00*	*1.000*
Hospital	*2.979*	*2.670*	*53.3*	*6.91*	*0.000*	*2.798*	*2.797*	*0.1*	*0.03*	*0.973*
City	*3.003*	*2.877*	*18.0*	*2.52*	*0.012*	*2.862*	*2.860*	*0.2*	*0.05*	*0.958*
	Matching for pictures' backgrounds									
	Before matching					*After matching*				
Variables	*Mean treated*	*Mean control*	*Percentage bias*	*t-value*	*p-value*	*Mean treated*	*Mean control*	*Percentage bias*	*t-value*	*p-value*
Title	*3.248*	*2.390*	*126.6*	*28.76*	*0.000*	*3.248*	*3.237*	*1.6*	*0.38*	*0.702*
Hospital	*3.145*	*2.661*	*84.6*	*19.22*	*0.000*	*3.145*	*3.073*	*12.5*	*3.18*	*0.001*
City	*3.108*	*2.817*	*43.1*	*9.91*	*0.000*	*3.108*	*3.218*	*−16.3*	*−4.10*	*0.000*
Table 6. Differences between before and after matching for doctors' attire and pictures' background										

Variable	Visiting Equation	Decision Equation
Constants	6.033***	−1.546***
	(64.93)	(−11.47)
Status	0.097*	0.089**
	(2.32)	(2.82)
Gender	0.168**	−0.126**
	(3.08)	(−3.07)
Log(Feedback)	0.442***	0.078**
	(13.61)	(3.02)
Log(Contribution)	0.434***	0.484***
	(34.46)	(38.48)
Log(Visit)		0.244***
		(12.79)
Severity	1.344***	−0.172
	(7.75)	(−1.29)
Attire	1.031***	−0.347***
	(10.69)	(−4.62)
Background	0.838***	0.152**
	(12.38)	(2.85)
Severity*Attire	−1.405***	0.480**
	(−6.75)	(3.03)
Severity*Background	−0.296	0.034
	(−1.73)	(0.26)
R²	0.792	0.875
F	651.16***	1,078.46***
Table 7. Moderating results of equations after matching in robustness check		

Note. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Discussion and implication

Key findings

The results of our study provide three key findings. First, the results of our empirical model indicate that professional attire and a professional background in doctors' online profile pictures positively affect patients' decision-making. Prior studies on online healthcare services investigated mainly the effects of textual information on patients' decision-making. However, our study focuses on the influence of visual information on patients' decision-making. This study identities two types of visual information in doctors' profile pictures: professional attire and a professional background. Professional attire could improve patients' impressions and motivate them to choose certain doctors. Moreover, patients utilize the professional background in profile pictures as an important signal to judge doctors' trustworthiness. If doctors' profile pictures are taken in a work environment, patients will form a professional impression about the doctor. According to cue utilization and impression management theories, in the online context, patients can use related visual cues to form professional impressions about doctors. Both professional attire and background in doctors' online profile pictures can be used as visual cues for patients to form impressions, which can then affect patients' decision-making. On online healthcare platforms, visual information is as important as textual information and, thus, will affect patients' psychology and behaviors.

Second, we found that patients' interest has a mediating effect on the relationship between professional attire, professional background, and decision-making. Unlike the existing literature, which found that patient interest mediates the influence of textual information on patient behaviors, this study explores the mediating effects of patients' interest on the relationship between visual cues and patients' decision-making. The empirical results in Study 2 show that professional attire and background in doctors' online profile pictures positively affect patients' interest, which, thus, positively affects their decision-making. Moreover, the empirical results show that patient interest positively influences their decision-making. Therefore,

patients' interest has a partially mediating effect on the relationship between professional attire, professional background, and decision-making.

Third, this study found that illness severity moderates the relationship between professional attire, patients' interest, and patients' decision-making. *Our empirical results indicate that patients with low illness severity are more concerned about doctors' professional attire. This is because patients with low illness severity have milder conditions and can wait for treatment compared with patients with high illness severity. In order to receive better healthcare services, they will choose doctors who match the image of professional doctors in their impression for treatment. They will regard doctors with professional attire as the most suitable doctors for healthcare consultation. However, for patients with high illness severity, they are urged to find a doctor for treatment because their illness conditions are worse. Under this circumstance, they do not care about doctors whether they have worn professional attire. As for the effect of illness severity on the relationship between background, patients' interest and patients' decision-making, our research results find no empirical evidence. One of the possible explanations is that professional background is regarded as a less important professional signal conveyed to patients.*

Theoretical contributions

Our study makes several theoretical contributions to the literature. First, a key contribution of this study is that we extend cue utilization theory and impression management theory to online healthcare literature. Through combining these theories, our study adds to the literature on online healthcare services by investigating the effects of visual cues in doctors' profile pictures on patients' psychology and behavior. Although prior studies have explored the role of doctors' textual information on healthcare platforms, scant literature has investigated the influence of visual information on patients. Thus, this study provides theoretical evidence that visual cues in doctors' online profile pictures positively affect patients' attention and decision-making. Our research provides new perspectives for the study of online healthcare platforms.

Second, our study enriches the literature on visual information by exploring the role of professional attire and a professional background in profile pictures. Although prior studies have noted the influence of visual cues in social media and e-commerce markets, there is little literature that has investigated the role of visual cues in expert services and online healthcare markets. Unlike prior research, this study uses the more detailed variables of professional attire and background to explore the effects of visual cues on patients. These findings contribute to the existing literature by providing a better understanding of the roles of professional attire and backgrounds in doctors' online profile pictures.

Third, this paper extends the literature on visual information by investigating the mediating effects of patients' attention on the relationship between visual cues and patients' decision-making. Prior studies have found that patient attention has a mediating effect on the relationship between textual information and patient decision-making. However, unlike that literature, our research focused the mediating effects of patient attention on the relationship between visual cues and decision-making. Our findings help us to understand the influencing mechanism of visual cues in doctors' profile pictures on patients' psychology and behavior.

Fourth, our research contributes to the literature on online healthcare by exploring the moderating effects of illness severity on the relationship between visual cues, patients' attention, and patients' decision-making. Scant research has studied the moderating effects of patients' characteristics on the relationship between visual information, patients' psychology, and patients' behavior. To address this research gap, in this study, we investigated the moderating role of illness severity. We found that patients that have low-severity illnesses are more concerned about doctors' professional attire than those with more severe illnesses. However, patients that have severe illnesses are more likely to choose doctors who are wearing professional attire than those who less severe illnesses. Thus, these new findings extend the literature on online healthcare services.

Practical implication

Our findings provide some practical implications for doctors and for the designers of online healthcare platforms. First, the designers of online healthcare platforms should pay more attention to the role of doctors' profile pictures. Our study found that doctors' professional attire or a professional background are positively associated with patients' interests and their decision-making. Hence, given that patients'

impressions about doctors are greatly affected by doctors' attire or the background of doctors' profile pictures, we suggest that designers remind doctors to upload personal photos that meet these requirements. This can strongly influence patients' psychology and behavior.

Second, doctors should select their profile pictures according to the severity of their patients' illnesses. According to the findings of our research, the severity of patients' illnesses could moderate the relationship between visual information and patients' decision-making. Doctors who mainly treat patients that have severe illnesses should pay more attention to their professional attire in their profile pictures to improve their appeal to new patients. Likewise, doctors who mainly treat patients with less severe illnesses should wear professional attire in their profile pictures to attract patients.

Limitations and future work

Our research has certain limitations. First, we obtained doctors' profile pictures from real online healthcare platforms and used the manual classification method to classify them. However, this method uses individuals' subjective judgment, which may lead to inaccurate classification. For future research, we recommend collecting a greater amount of data on doctors and using the method of convolution neural network in machine learning to automatically classify the photos, which can improve the speed and accuracy of classification.

Second, this study focuses on doctors' attire and backgrounds in online profile pictures; however, it lacks an exploration of expressions, postures, colors, and other factors. These elements may also affect patients' attention and their choices of doctor. In future research, we recommend exploring more visual cues in doctors' profile pictures.

Third, we used laboratory experiments to investigate the causal relationship between independent variables (doctors' attire and picture backgrounds) and dependent variables (patients' interests and choice of doctor). However, during the experiments, we were unable to recreate the process of choosing a healthcare service, which may lead to a deviation of the sample results. In future studies, we recommend selecting real patients and recreating the medical treatment process as accurately as possible to improve the experiment.

Conclusion

Although prior studies have investigated the effects of textual information on patients' decision-making, scant research has explored the influences of visual cues on online healthcare platforms, especially the professional cues conveyed by doctors' online profile pictures. To address this research gap, we applied cue utilization theory and impression management theory to explore the impact of professional attire and background in doctors' online profile pictures on patients' interests and decision-making, under the moderating effects of illness severity. The results indicate that professional attire and background in profile pictures affect patients' decision-making. Moreover, patient interest partially mediates the relationship between professional attire, a professional background, and patients' decision-making. In addition, our study found that illness severity moderates the relationship between professional attire and patients' decision-making. Our study contributes to the literature on online healthcare platforms and provides important implications for doctors and for the designers of online healthcare platforms.

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