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An exploration of the influencing factors of privacy fatigue among mobile social media users from the configuration perspective

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Privacy fatigue caused by privacy data disclose and the complexity of privacy control has become an important factor influencing people's privacy decision-making behavior. At present, academia mainly studies privacy fatigue as a key determinant to explain the privacy paradox problem, but there is insufficient attention to its influencing factors and specific pathway of occurrence. Exploring the antecedents of privacy fatigue is of great significance for alleviating users' subjective privacy detachment and promoting privacy protection. Based on the Stressor-Strain-Outcome (SSO) theoretical framework, this study aims to explore the antecedents of privacy fatigue through the qualitative comparative analysis method of fuzzy set (fsQCA). The results show that there are three patterns of pathways which lead to privacy fatigue, namely the rational pattern, emotional pattern, and strain pattern. This study not only provides theoretical reference for understanding the antecedents of privacy fatigue among users but also offers new practical solutions for user privacy management.

Social media, as a content production platform based on user relationships, has experienced rapid development relying on advancements in internet technology, gradually becoming an indispensable part of people's daily lives. However, with an increasing amount of user personal information being disclosed on mobile social media, users' privacy security faces growing risks, for example, in 2020, the personal information of 5.38 billion Weibo users was priced for sale, and in 2021, the personal information of 5.53 billion Facebook users was leaked[1,2]. Privacy management has gradually become a challenge that social media users must confront in the digital age.

This has also made privacy issues one of the focal points of attention in the field of information management, with scholars focusing on exploring the relationship between privacy attitudes and privacy behavior. Privacy concern is considered a core concept in measuring privacy attitudes in the field of information management[3]. It measures the extent to which users are concerned about the risks of controlling, collecting, and using their personal information and is believed to be a key factor influencing privacy behavior, such as engaging in more privacy protection strategies[4], reducing information disclosure and sharing[3], concealing privacy information, etc[5]. However, these known factors may not account for all privacy decisions, as the complexity and required effort for privacy assurance protocols continue to increase[6]. Several studies have suggested that complex privacy policies and management could lead to a negative psychological state called privacy fatigue, which even surpasses the influence of privacy concern on privacy behavior decisions[6,7]. This privacy fatigue, caused by the complexity of data disclose and privacy controls, can lead people to engage in behaviors of abandoning privacy protection, thereby exacerbating the discrepancy between privacy concern and the willingness to engage in privacy protection behaviors[8], and is one of the powerful perspectives for explaining the privacy paradox among social media users in the new stage[7,9]. Therefore, the emergence of privacy fatigue in the development stage of mobile social media has become an issue that deserves attention in safeguarding the security behavior of social media users. However, despite research emphasizing the universality and importance of privacy fatigue among social media users[8], explicitly exploring the antecedent variables of privacy fatigue is scarce, and there is a lack of exploration of the patterns of its occurrence.

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Based on this, this paper takes the phenomenon of privacy fatigue among mobile social media users as the starting point, and proposes the core research question of this paper: What are the specific antecedents of privacy fatigue phenomenon? The question mainly covers the following aspects: In the context of mobile social interaction, which factors influence the emergence of user privacy fatigue? Do these factors have certain combination rules, leading to the occurrence of privacy fatigue among mobile social media users?

In order to answer the research questions above, this study introduced Stressor-Strain-Outcome (SSO) to construct the research model suitable to the research context. In addition, in order to analyze the "joint effects" and configuration effects of various factors on privacy fatigue, this study adopts the Fuzzy-Set Qualitative Comparative Analysis (fsQCA) method to explore the specific influencing factors and specific pathways of privacy fatigue, aiming to provide important theoretical references for understanding the privacy behavior of users on social media and help reduce users' privacy fatigue and solve their privacy issues.

The rest of this paper is organized as such. Section 2 is the theoretical backgrounds, including literature review which briefly discusses prior studies concerning privacy fatigue, as well as the theoretical framework of this paper, namely the Stressor-Strain-Outcome theory. Section 3 outlines the research design of the paper, proposing the study's research framework and variable settings based on the theoretical foundations, introducing the research method of Fuzzy-Set Qualitative Comparative Analysis, and also elaborating on the questionnaire design and data collection methods of this study. The process of data analysis and the directional comparative analysis results of the phenomenon of privacy fatigue are presented in Sect. 4. Finally, Sect. 5 provides the summary of the paper.

Literature review
The research of privacy fatigue

Fatigue is described as a subjective, unpleasant feeling of physical or mental exhaustion[8]. Specifically, fatigue stems from a sense of exhaustion commonly experienced when facing high demands and unattainable goals, which may initially lead to psychological stress and potentially result in a permanent state of fatigue, known as "burnout," affecting individuals' behavioral decisions, mainly manifested in individuals' inclination to make decisions to reduce workload[10]. In the realm of mobile social media, facing an increasingly challenging privacy environment, frequent data disclose have heightened users' skepticism about their ability to control their own privacy, corresponding to the increasing online and complex measures for personal privacy protection, while also raising doubts among users about the effectiveness of the measures they take. This fatigue caused by the complexity of data leaks and privacy control is referred to as privacy fatigue[8].

The phenomenon of user privacy fatigue is believed to be primarily characterized by cynicism and emotional exhaustion. Cynicism is a negative attitude that arises when target expectations cannot be met, while emotional exhaustion represents the depletion of personal emotional resources[9]. In terms of behavioral outcomes, previous studies have suggested that "behavioral disengagement" is a major result of fatigue, manifested as individuals reducing efforts due to excessive stress, resulting in relaxation of routine security practices[9], or even directly abandoning the conquering of high task demands[11]. Specific protective disengagement behaviors also include users directly skipping the reading of privacy policies and choosing to accept[8], increasing personal information disclosure[6], and choosing to use default settings (i.e., making every individual on the website publicly accessible)[12]. Hargittai & Marwick's study summarized through interviews that users' spiritual alienation or cynicism toward privacy issues is an important reason for the disconnection between privacy concerns and privacy disclosure behavior[13]; Zhu et al.'s latest research also shows that in e-commerce, social media, and other scenarios, users invest a considerable amount of time, money, and cognitive effort, resulting in very high sunk costs. In such situations, privacy fatigue as a coping mechanism promotes disclosure behavior[7].

Currently, most research on "fatigue" focuses on the analysis of factors influencing social media fatigue. The research found that the fatigue generated by users is influenced by two factors: individual characteristics and external environmental factors. Among them, individual factors include users' individual characteristics[14], privacy attitudes[15], information literacy[16], and cost considerations[17], while environmental influences include interpersonal pressure[18], information overload[19], and forced use[17].

However, it is important to note that social media fatigue and privacy fatigue are two distinct concepts. Social media fatigue reflects users' negative emotions about their motives for using social media[20], it mainly triggers discontinuance and displacement behaviors of users towards social media[21,22], while privacy fatigue emphasizes users' negative attitudes toward privacy protection decisions, its main outcome is in the results of privacy-protective behavior, privacy disclosure behavior[23,24]. The latest research has attempted to use privacy fatigue as a new behavioral indicator to explain the emergence of the privacy paradox phenomenon[25], which provides a better understanding of the privacy behavior of social media users. Although some studies have attempted to use privacy fatigue as the latest behavioral evidence to explain the presentation of privacy paradox phenomena[21], they have paid less attention to the determinants of privacy fatigue. Privacy fatigue is important, but previous literature has paid less attention to the causes of privacy fatigue, so to fill the research gap in exploring the causes of privacy fatigue, this paper will use the SSO theoretical framework and employ the fsQCA method to explore the antecedent variables and causal condition combinations of privacy fatigue, contributing a new research perspective to promoting user privacy protection.

Stressor-strain-outcome (SSO) model

In 1993, based on the Maslach Professional Burnout Inventory (MBI), Koeske et al. proposed the Stressor-Strain-Outcome (SSO) model. This model, initially applied in psychology, aimed to study the internal psychological processes of how external environmental stressors influence employee fatigue[26]. Privacy fatigue is a psychological state of fatigue experienced by users in the mobile social media domain and the domain of privacy. Using the SSO theoretical model, it can reveal the psychological process of users facing pressure

and causing privacy fatigue. The SSO theoretical framework indicates that stimuli from internal and external environments (Stressor) lead to a series of stress-strain activities (Strain), which consequently result in negative behavioral responses (Outcome). Among them, "stressor" refers to stimuli factors that induce stress and negative emotions in individuals, perceived and interpreted by actors as trouble and potential disruption, such as information overload, technological threats, etc[27,28]. ; "strain" refers to the physiological or psychological imbalance and negative emotions experienced by individuals under the influence of stressors, such as anxiety, unease, irritability, etc[29,30]. ; "outcome" refers to the direct behavioral or performance consequences resulting from prolonged exposure to strain, such as fatigue, behavioral disengagement, etc[31]. It is evident that the psychological process reflected in the "pressure source-stress-outcome" model of the SSO theoretical framework is consistent with the internal logic of privacy fatigue, which is caused by data leaks and the complexity of privacy control as an external pressure source[6], and characterized by negative emotions of cynicism and emotional exhaustion, ultimately leading to "behavioral detachment"[7]. Therefore, the SSO theoretical framework's "pressure source-stress-outcome" model is applicable in exploring the specific causes of privacy fatigue. Unlike the "Stimulus-Organism-Response" (SOR) model primarily used in the consumer domain, the SSO theoretical model can explain the intrinsic correlation and dynamic development between environmental stimuli and strain outcomes from the perspectives of stress coping and behavioral responses, revealing the underlying mechanisms and hierarchical processes leading to outcome generation by various influencing factors. This theoretical framework aligns well with the research approach of this paper focusing on factors and causal condition combinations related to privacy fatigue.

The SSO theoretical model has made progress in studying the relationship between stress and strain outcomes in the context of social media and has shown significant effectiveness in explaining fatigue phenomena. For example; Fu et al.'s research indicated that information overload and social overload lead individuals to experience social media fatigue, resulting in negative psychological consequences[32]; Ma et al. (2022) pointed out that stressors and unmet information needs may lead users in short video platforms to experience pressure and negative reactions to recommendation algorithms[33]. Existing studies indicate that the SSO theoretical framework is a good theoretical framework for explaining the process of various negative emotions among users in the social media domain. Overall, the SSO theory has been repeatedly used to explain the negative impacts of new technology use and has been shown to be applicable in explaining the process of various negative emotions among users in the social media domain. Figure 1 shows the basic framework of the Stressor-Strain-Outcome (SSO) theoretical model adopted in this chapter.

Research design
Research model
The developed SSO model for privacy fatigue research is relatively vague and does not reflect the complexity of external environmental tasks. Combining previous literature and existing research in the privacy domain, this study constructs a research model based on the SSO theoretical framework, as shown in Fig. 2, treating information overload, perceived control, and perceived cost as stressors, self-cognitive biases, and cynicism as strains under the influence of stressors, and privacy fatigue as the ultimate outcome, constructing an SSO theoretical model of privacy fatigue influencing factors.

Stressors
(1) Perceived Control.
Perceived control affects user satisfaction, with higher perceived control leading to a higher expectation of achieving ideal results after handling events[34]. In the field of information dissemination, perceived control is considered a factor influencing user decisions on social media use, with users making decisions consistent with their perceived control status during social media participation. Wang et al. pointed out that perceived control, as a direct precursor of perceived risk, negatively affects consumers' willingness to disclose personal information[35]. In the context of privacy fatigue, perceived control refers to the degree to which users perceive control over the risk of privacy information[36]. Given the theoretical framework of this study, perceived control is considered a stressor factor that triggers users' strain responses and leads to the outcome of privacy fatigue.
(2) Information Overload.
Research has found that information overload leads to negative emotions for users in various contexts, such as SNS fatigue in the context of social networking sites[37], and job satisfaction reduction in the context of Mobile ICTs[38]. In the field of social media, numerous studies have shown that information overload can lead to user social media fatigue. Bright (2015) and others pointed out that this is because a large amount of information makes it more difficult for users to understand and increases their mental energy investment in information filtering, leading to fatigue[15]; based on the SSO perspective, Lee (2016) and others regard perceived overload as a stressor for social media fatigue and found that it leads to the generation of social media user fatigue[37]. In research on social media privacy, privacy information overload refers to the large amount of information about privacy management that exceeds users' capacity to receive and process, and when information exceeds the
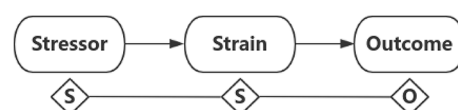

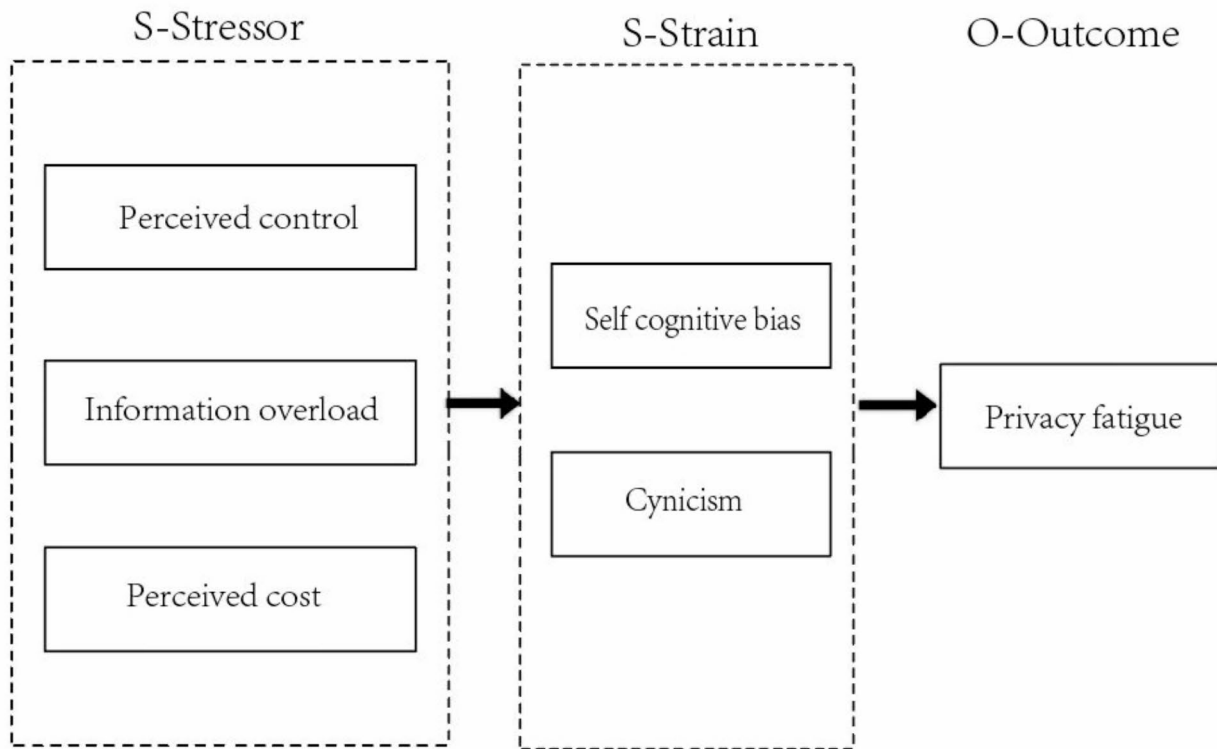**Fig. 1**. Conceptual model.

Fig. 2. Stressor-Strain-Outcome theoretical framework applied privacy fatigue.

"critical point," it leads to the emergence of privacy fatigue, manifested as a state of passive fatigue[15]. Therefore, this study considers information overload as one of the stressors.

(3) Perceived Cost.

Perceived cost in privacy contexts refers to users' risk assessment of anticipated loss of benefits, often applied in privacy calculus theory. This theory suggests that privacy decisions fundamentally represent the evaluation of perceived benefits and risks of privacy disclosure by software users. When the expected benefits of disclosing personal information outweigh the potential risks, users will exchange risks and benefits and disclose their personal privacy information[39]. Privacy concerns are often considered the main privacy cost, namely anxiety about others accessing personal information and concerns about privacy information leakage. In addition, perceived risk is also a significant inhibitory factor, as Hajli et al. found that perceived control is negatively correlated with perceived privacy risk and information sharing attitudes[40]. Perceived cost is considered a reliable predictor of protective and cautious privacy intentions and behaviors. Therefore, this study includes perceived cost as a stressor in the research model.

Strains
(1) Self-Cognitive Biases.

Users, constrained by the use of (inappropriate) cognitive heuristics that people apply to deal with data limitations, information processing limitations, or a lack of expertise, may develop cognitive biases in estimating the risks of privacy disclosure[41]. Users' cognitive biases often manifest as: ① Optimistic bias, which reflects people's optimistic bias due to not having experienced negative risks firsthand. For example, a study in South Korea found that experiencing privacy infringement affects people's optimism; those who have not experienced infringement are more optimistic and therefore more inclined to adopt privacy protection behaviors[42]. ② Overconfidence bias, where users have an overconfidence in their ability to cope with privacy disclosure or infringement risks. Research found that among users who rated their privacy protection technology assessment highly, less than a quarter actually understood how to defend against privacy risks through technical means[43]. ③ Affective bias, where perceived benefits prompt people to generate positive emotions, leading them to overlook risks when making behavioral decisions, resulting in the emergence of the privacy paradox. Studies have shown that people are easily influenced by their momentary emotional states when conducting privacy assessments[44]. ④ Hyperbolic discounting, where users' perception and evaluation of short-term and long-term benefits are influenced by time factors. Users tend to underestimate long-term benefits and losses because they are in the future and are more inclined to obtain immediate convenience[45]. Since users' cognitive biases are influenced by environmental factors and also act on privacy fatigue, cognitive biases are considered burdens caused by stressors.

(2) Cynicism:

Cynicism typically refers to a negative, pessimistic attitude or belief toward an object, accompanied by frustration, hopelessness, and disillusionment. It mainly develops from unmet expectations. In the field of information management, Hoffmann et al. first proposed the concept of privacy cynicism in 2016, which has gradually gained widespread recognition and extensive research in the privacy domain[46]. Choi et al. pointed out that cynicism and emotional exhaustion constitute core components of privacy fatigue, further applying cynicism to the explanation of user privacy behavior and the process of privacy fatigue. Other scholars have also found that cynicism also functions as a coping mechanism and is an important factor in explaining privacy fatigue and privacy behavior. When individuals are highly privacy cynical, they might feel that efforts to cope with risks are futile or unsuccessful, thus being less motivated to scrutinize the pros and cons of data disclosure and putting less effort into making privacy decisions, which leads to more privacy disclosure behavior, detrimental to users' privacy protection[25]. Previous studies have shown that perceived control, information disclosure, and perceived cost can influence cynicism. For example, Iris van Ooijen pointed out that, under the mediating role of cynicism, the negative relationship between information overload and response costs and privacy protection behavior is weaker for highly cynical individuals[25]. In this research model, cynicism, as a coping mechanism for stressors, exists as a strain and ultimately leads to the outcome of privacy fatigue.

Research methodology

The QCA method, as a "case-oriented" approach used to address the interdependence of configurational phenomena and the complexity of causality, was first proposed by Ragin in 1987.[47] It is divided into two methods: Crisp-Set Qualitative Comparative Analysis (csQCA) and Fuzzy-Set Qualitative Comparative Analysis (fsQCA). One of the most popular methods used in current research is fsQCA, which is different from traditional quantitative analysis. Instead of focusing on the individual effects of multiple factors on a complex matter, fsQCA pays attention to the combined effects of these factors in producing a specific outcome. Therefore, it is more suitable for analyzing the conditions that lead to various outcomes when multiple factors are involved and has gradually been applied in the fields of social media and privacy[48]. In the privacy domain, fsQCA has contributed to the elucidation of processes such as privacy protection behavior and privacy disclosure behavior from a configurational perspective. However, no study has yet applied fsQCA to the analysis of antecedent variables of privacy fatigue. Moreover, due to the heterogeneity and complexity of privacy fatigue, its occurrence may be the result of the interaction and combination of these motives. Therefore, after exploring the influencing factors and possible internal connections of privacy fatigue based on the SSO theory, this study further chooses to use fsQCA, a research method that connects qualitative and quantitative strategies, to break through the limitations of traditional regression analysis and qualitative research methods, which are mainly suitable for exploring the "net effects" of individual factors, and to study how a combination of variables causes a particular outcome .

Questionnaire design

This study adopts a questionnaire survey method, and the measurement indicators of the questionnaire are derived from existing domestic and foreign literature, with slight modifications to fit the actual situation of mobile social media in China. The questionnaire design is mainly divided into two parts. The first part includes demographic variables, such as the respondent's gender, age, education level, frequency of using WeChat, etc. The second part focuses on the investigation of factors related to the model, including Perceived control, Information overload, Perceived cost, Self-cognitive bias, Cynicism, and other 5 variables. The questionnaire uses a Likert five-point scale, ranging from "1" to "5," where "1" represents "strongly disagree" and "5" represents "strongly agree". Specific measurement items are shown in Table 1. This study collects data samples from users on the mobile social media platform WeChat in China.

Data collection

To verify and check causal relationships, the study used online questionnaire to collect relevant data. The survey was administered by applicable guidelines and regulations and was reviewed and approved by the School of History and Culture at Henan University. Currently, the social media platform with the highest number of daily active users in China is WeChat. Therefore, this chapter selects WeChat users as the data collection sample. The main method of collecting questionnaires is through snowball sampling, where friends, relatives, etc., are invited to participate in the survey, and then the respondents are asked to invite their acquaintances to participate in the survey. Participants voluntarily click on the link to fill out the questionnaire. Before filing out the questionnaire, they have been informed that "submitting answers" is considered informed consent and that the data they met would be used only for this study, and anonymity was guaranteed. Participants can exit at any time during the questionnaire filling process. A total of 1301 questionnaires were collected in this study. After excluding invalid questionnaires with less than 60 s of completion time, more than 1000 s of completion time, and identical answers to all items, 1134 valid questionnaires were obtained, with an effective rate of 87.1%. The demographic characteristics of the sample are shown in Table 2..

Directed comparative analysis results of privacy fatigue generation pathways
Calibration of conditional and outcome variables

For fsQCA analysis, it is necessary to calibrate the data first, converting the absolute values of conditions and outcomes into corresponding fuzzy set memberships, with thresholds set at "fully membership," "cross-over point," and "full nonmembership," three levels. After calibration, the values of the set memberships range between 0 and 1[54]. To ensure the objectivity of calibration, this study, based on the cases themselves, combined with thematic literature from other qualitative comparative analysis methods, chose the direct calibration method

latent variable	Measured item	Question item	Document source
Perceived control	Pcon1	When social media requires me to agree to a privacy agreement in order to use it, I have to agree to a privacy agreement.	Milne et al.[49]
	Pcon2	I think it's easy for me to take steps to protect my private information.	
Information overload	IO1	When my private information was disclosed, I was able to tell which social media platform had done it.	Xu et al.[50]
	IO2	There is too much information about privacy on social media for me to handle	
Perceived cost	Pcost1	When the security of personal privacy information is threatened, I think it takes a lot of energy to take action to protect it	
	Pcost2	When the disclose of personal privacy information threatens the interests of friends around, I think it is necessary to take protective actions	
	Pcost3	When the disclosure of personal privacy information threatens economic interests, I think it is necessary to take protective action	
Self-cognitive bias	SCB1	I think privacy violations are less likely to happen to me	Cho et al.[51]
	SCB2	I don't think my private information is valuable enough to warrant a privacy violation	
Cynicism	CYN1	I became skeptical about the importance of privacy issues on social networks	Schaufeli et al.[52]
	CYN2	When it comes to adopting privacy measures in a social network environment (such as signing a privacy agreement, setting up a circle of friends to be visible, etc.), I get bored	
	CYN3	Privacy disclose happen so often that I don't bother to take any further steps	
Privacy fatigue	PF1	If in the process of using online services, I need to sign a privacy statement agreement, I will not read it and will directly choose to agree	Krasnova et al.[53]
	PF2	If the privacy statement protocol provided by the online service provider is complicated, I will give up understanding and simply choose to agree	
	PF3	I don't want to think about responding if personal information I have provided to an online service provider is disclosed	

Table 1. Questionnaire measure.

Items	Choices	Frequency	Percent%
Gender	male	565	49.83%
	female	569	50.17%
Age	<20	93	8.19%
	≥20 and <30	391	34.47%
	≥30 and <40	580	51.19%
	≥40 and <50	58	5.12%
	≥50	12	1.03%
Highest education level	Senior high school and below	225	19.80%
	Undergraduate and junior college	414	36.52%
	Postgraduates	375	33.1%
	Doctoral students	120	10.58%
Average daily time spent on Wechat usage	<1h	55	4.85%
	≥1h and <3h	221	19.49%
	≥3h and <5h	371	32.72%
	≥5h and <8h	282	24.87%
	≥8h	205	18.08%
Number of WeChat friends	<100	139	12.29%
	≥100 and <300	550	48.47%
	≥300 and <600	290	25.60%
	≥600 and <1000	109	9.56%
	≥1000	46	4.08%

Table 2.. Sample demographic information

provided by Ragin[54], with the 95%, 50%, and 5% quantiles of each continuous variable set as anchor points[55]. After calibration processing, the closer the variable value is to 1, the higher its membership in the relevant set; conversely, the closer the variable value is to 0, the lower its membership in the relevant set. Specific assignment details can be found in Table 3.

After data calibration, this study conducted a necessary condition analysis of single variables, and the results are shown in Table 4. Through data analysis, it was found that when the outcome variable is privacy fatigue and the conditional variables are perceived control, information overload, perceived cost, self-cognitive bias, and cynicism, the consistency level of each single variable did not exceed 0.9[54], indicating the absence of necessary conditions. Therefore, this study needs to conduct sufficiency analysis on combinations of multiple conditional variables.

Variable		Anchors		
		Fully membership	Cross-over point	Full nonmembership
outcome variable	Privacy fatigue	4	2.666667	1
conditional variables	Perceived control	4.5	3	2
	Information overload	4	3	2
	Perceived cost	5	4	2.333333
	Self-Cognitive bias	4	2.5	1
	Cynicism	4	3	1.666667

Table 3. Calibration anchors for each variable.

Conditions	Consistency	Coverage
Pcon	0.727851	0.745253
~Pcon	0.561027	0.626126
IO	0.652102	0.694551
~IO	0.637090	0.682258
Pcost	0.693110	0.745078
~Pcost	0.609545	0.646780
SCB	0.743456	0.806304
~SCB	0.580531	0.610684
CYN	0.852087	0.732313
~CYN	0.475718	0.670852

Table 4. Necessary conditions for privacy fatigue. Note: ~ means the operational logic of "non".

Configuration solution

When conducting fsQCA analysis, P.C. Fiss suggests that when the sample size exceeds 150, the case frequency threshold should be set at 3[56]. Ragin recommends setting the consistency threshold at 0.75, but considering the actual circumstances of this study, the consistency threshold is set at 0.85, with a case frequency threshold of 8, and cases with pri consistency below 0.65 are manually adjusted to 0[57,58]. The results of fsQCA analysis yield three different levels of simplification: complex solution, intermediate solution, and parsimonious solution. It is widely recognized in academia that the discussion of analysis results should primarily focus on intermediate solutions. By using XY Plot in fsQCA, the presence or absence of conditional variables can be determined. This study constructs XY Plot for each antecedent variable and the outcome variable, showing that all conditional variables are either present or absent conditions, as shown in Table 5. This implies that complex solutions are equivalent to intermediate solutions. Therefore, this paper reports intermediate solutions supplemented by parsimonious solutions[56]. In this study, Fiss's classification[56] is used for conditional classification. Different conditions are defined for different situations, where core conditions appear in parsimonious solutions, and all conditions appearing in intermediate solutions but excluded from parsimonious solutions are referred to as secondary conditions, as shown in the empirical results listed in Table 6.

In the expression of configuration diagrams, core conditions and secondary conditions are represented by large circles and small circles, respectively, while conditions with no impact are shown as blank spaces. From the results of Table 7, the overall coverage of the model is 0.715, meaning that the results explain 71.5% of the pathways of privacy disclosure. Moreover, at the consistency level, the values of the five solutions all reach 0.85, indicating that the combination of the above factors can be considered as consistent and sufficient conditions for privacy disclosure.

Path analysis

Based on the aforementioned configuration solutions, three paths of privacy fatigue phenomena can be summarized (S1-S5).

(1) Rational Model-Driven: S1 path: Perceived control*Perceived cost* Self-cognitive bias, with an original coverage of 0.472, indicating that approximately 47.2% of cases can be explained by this combination path. This configuration suggests that when users perceive satisfaction in perceived control, perceived cost, and self-cognitive bias, the probability of experiencing privacy fatigue increases. Among them, perceived cost and self-cognitive bias play the most critical roles. S5 path: Information overload* Perceived cost*Self-cognitive bia*Cynicism, with an original coverage of 0.4339, indicating that approximately 43.39% of cases can be explained by this combination path. In this path, perceived cost and self-cognitive bias also play the most critical roles. According to the Privacy calculus theory, perceived cost is a manifestation of rational calculation

Table 5.. Plots for predictive validity.

of behavioral benefits, which indicates that individuals decide to disclose personal information when potential gains surpass expected losses. In addition, behavioral economics and existing research in the privacy field have shown that human decision-making is affected by cognitive biases. This cognitive bias is a rational judgment of the probability of risk occurrence. Due to this limited rationality, users may underestimate potential privacy risks, affecting their calculation of risks and benefits. This pattern conforms to the Privacy calculus theory, where users, under the influence of stressors such as perceived cost, engage in rational calculations, and the stressor factor of self-cognitive bias under limited rationality further facilitates the emergence of privacy fatigue.

Configuration		Raw coverage	Unique coverage	Consistency
1	Perceived control*Perceived cost* Self-cognitive bias	0.472265	0.026835	0.909809
2	Perceived control*Self-cognitive bias* Cynicism	0.545123	0.0474937	0.895503
	~Information overload *~Perceived cost *Self- cognitive bias*Cynicism	0.396912	0.0383293	0.902723
	Perceived control*~Information overload* Perceived cost*Cynicism	0.40426	0.0534232	0.901293
3	Information overload* Perceived cost*Self- cognitive bia*Cynicism	0.433953	0.0265715	0.91756
	Solution Coverage, SCV		0.714905	
	(Solution Consistency, SCS)		0.850429	

Table 6. Intermediate solutions. Note: * represents the logical operator "and" in Boolean arithmetic, indicating that the connected conditions exist at the same time.

Variable	S1	S2	S3	S4	S5
Perceived control	●	●		●	
Information overload			⊗	⊗	●
Perceived cost	●		⊗	●	●
Self-cognitive bias	●	●	●		●
Cynicism		●	●	●	●
Solution Coverage, SCV = 0.714905					
Solution Consistency, SCS= 0.850429					

Table 7. Distribution of configurations.

(2) Burden Model-Driven: S2 path: Perceived control*Self-cognitive bias* Cynicism, with an original coverage of 0.545, indicating that approximately 54.5% of cases can be explained by this combination path. This configuration suggests that when users perceive satisfaction in perceived control, self-cognitive bias, and cynicism, they are more likely to experience privacy fatigue, with self-cognitive bias and cynicism playing the most critical roles. S3 path: ~Information overload *~Perceived cost *Self-cognitive bias*Cynicism, with an original coverage of 0.397, indicating that approximately 39.7% of cases can be explained by this combination path, where self-cognitive bias and cynicism still play the most critical roles. In previous studies, scholars believed that users' disclosure behavior is driven by bounded rationality, meaning that due to limitations in users' knowledge, their decisions are influenced by cognitive biases. These cognitive biases lead to users' incorrect estimation of the risk level of the environment or their ability to cope with risks[42]. The pressure caused by these error estimations, if accompanied by feelings of uselessness, powerlessness, and mistrust toward the handling of personal data, rendering privacy protection subjectively futile, users are more likely to experience privacy fatigue. This pattern conforms to the assumptions of the SSO theory model, where users' burden responses induced by stressors facilitate the emergence of privacy fatigue.

(3) Emotion Model-Driven: S4 path: Perceived control*~Information overload* Perceived cost*Cynicism, with an original coverage of 0.404, indicating that approximately 40.4% of cases can be explained by this combination path. This configuration suggests that when users' information overload does not occur and the elements of perceived control, perceived cost, and cynicism are simultaneously satisfied, users are more likely to experience privacy fatigue. Among them, cynicism plays the most critical role. Previous research has shown that an attitude of cynicism negatively predicts users' privacy decisions and intentions to disclose privacy, and is an important reason leading to the decoupling of privacy concern and privacy protection behaviors[13,59]. The emotion model-driven pattern confirms these studies. Scholars have also found that when perceived costs exceed users' tolerance levels, it triggers negative fatigue emotions in privacy-cynical individuals. Users may adopt an attitude of cynicism toward privacy protection behavior[25], even if they feel that the time and effort required to perform behaviors aimed at protecting their privacy are reasonable. Similarly, scholars also argue that privacy cynicism negatively moderates the relationships between self-efficacy and response efficacy and privacy protection behavior. Therefore, when users' cynicism is strongly pronounced, this affective coping mechanism plays an important role, leading to the emergence of privacy fatigue along with the two stressor factors of perceived control and perceived cost.

Robustness test of fsQCA
Methods for robustness testing include adjusting calibration thresholds, adjusting case frequency thresholds, adjusting consistency thresholds, and increasing or decreasing cases, among others. In this study, robustness testing was conducted by adjusting the case frequency threshold, setting it to 9, while keeping other thresholds unchanged for configurational analysis. After adjustment, the solution scenarios are shown in Table 8. By comparison, it was found that except for cynicism becoming a marginal condition instead of a core condition in Path 4, and ~ Information overload becoming a core condition while self-cognitive bias shifted from a core to a marginal condition in Path 1, the existing configurations were generally consistent with previous solutions. The

Variable	S1	S2	S3	S4	S5
Perceived control	●	●		●	
Information overload	⊗		⊗	⊗	●
Perceived cost	●		⊗	●	●
Self-cognitive bias	●	●	●		●
Cynicism		●	●	●	●
Solution Coverage, SCV = 0.704683					
Solution Consistency, SCS = 0.854639					

Table 8. The result of robustness testing.

coverage of solutions slightly decreased, while consistency slightly increased after adjustment. The test results showed a clear subset relationship with the previous results, and the obtained solutions had a consistent internal explanatory mechanism with the previous ones[60]. Based on this, it can be considered that this study is robust.

Discussion of the results

In the privacy field, existing studies have emphasized the universality of privacy fatigue and its importance in promoting privacy protection, explaining privacy paradox, and so on[8]. However, there is a lack of exploration into the antecedents and processes of privacy fatigue. To fill this research gap, this study empirically examines the influencing factors and pathways of privacy fatigue, contributing a new research perspective to explain the phenomenon of privacy fatigue. Based on the SSO theoretical model, this paper analyzed the causal pathways of privacy fatigue by introducing the fsQCA method. This research found that Perceived control, Information overload, and Perceived cost are stressor factors in the process of privacy fatigue, while Self-cognitive bias and Cynicism are strain factors. Building on this, according to fsQCA analysis, three pathways of privacy fatigue were identified. Firstly, the burden model emphasizes that when users react with a burden response due to the influence of stressors, the phenomenon of privacy fatigue is more likely to be induced. Secondly, there are rational and emotional models. The rational model emphasizes that when users make rational calculations under the influence of stressors such as perceived cost and exhibit limited rational burden responses due to self-cognitive biases, privacy fatigue is more likely to be induced. This is consistent with existing research in the privacy domain and the results of Privacy calculus theory research. This study further supplements the emotional model, emphasizing the important role of users' psychological processes and emotions in the process of privacy fatigue, especially the crucial role played by cynicism, which is consistent with previous research, indicating that cynicism also functions as a coping mechanism[4,25].

Theoretical implications

This paper provides important theoretical insights for a better understanding of privacy behaviors among social media users. Firstly, privacy fatigue has been identified as a key factor influencing user privacy behavior, yet research on privacy fatigue is scarce, especially regarding its formation mechanism. This paper fills this gap by incorporating Perceived control, Information overload, Perceived cost, Self-cognitive bias, and Cynicism into the factor model based on the SSO theoretical model. Secondly, through research, this paper identifies three causal pathways of privacy fatigue composed of the aforementioned five factors: the rational model, the burden model, and the emotional model. This conclusion offers new explanatory perspectives for interpreting the phenomenon of privacy fatigue in the digital era. Lastly, this paper introduces the fsQCA method into the study of privacy fatigue among social media users for the first time. Due to the complexity of privacy fatigue dynamics, where the causal factors interact with each other, traditional regression perspectives are insufficient QCA, as a representative method of configuration theory, is suitable for analyzing the combined effects of various factors on specific behavioral outcomes, thereby providing interpretations of the equivalent pathways of privacy fatigue. Therefore, the qualitative comparative analysis of privacy fatigue phenomena using fsQCA in this chapter is highly applicable and innovative.

Practical implications

In practice, the conclusions of this study contribute to enhancing users' awareness of privacy fatigue and promoting platform service providers to optimize privacy protection measures. Firstly, users' sense of privacy fatigue will directly lead to disengagement from privacy protection behaviors and increase dissatisfaction with service providers (Zhang et al., 2016). This necessitates platform service providers to optimize means of acquiring user privacy and reduce the difficulty for users to understand privacy acquisition policies. Simultaneously, transparency in user privacy management needs to be enhanced to empower users with better control over the flow of their personal data. Secondly, the SSO model suggests that "burden" often serves as a key variable leading to privacy fatigue among social media users. Therefore, platform service providers should pay more attention to users' negative emotions and cognitive responses, establish more secure and reliable mechanisms for protecting personal information, and alleviate users' concerns and feelings of helplessness regarding privacy disclose. Lastly, the research results indicate that five paths with different combinations of factors will lead to privacy fatigue among social media users. This may provide a new approach for platform service providers in formulating privacy acquisition and protection policies: using personalized measures to prevent users from experiencing privacy fatigue and further disengaging from privacy protection behaviors.

Limitations and future research

Limitations in the current study should be acknowledged. Firstly, although this paper analyzes the pathways of privacy fatigue among social media users, it is limited to the WeChat platform, which primarily focuses on private social interactions. Emerging open social platforms, such as those centered around real-time live streaming or short video sharing, have different privacy acquisition policies. Therefore, attention should still be paid to the behavioral differences of users across multiple platforms under the phenomenon of privacy fatigue. Hence, exploring the dissimilarities between new modes of mobile social media users and traditional ones regarding privacy fatigue could be a future research direction. Secondly, in this study attempt, the differentiation of privacy fatigue pathways among users of different age groups is somewhat limited. Therefore, specific pathway differences in the occurrence of privacy fatigue among user groups with different personality characteristics may be a future research direction. Additionally, this study relies on Likert scale-form questionnaires for limited exploration of users' subjective information. Subsequent research can utilize in-depth interviews, repeated surveys, etc., to check the pathways of privacy fatigue in this study and explore other factors that may affect privacy fatigue.

Data availability

The datasets generated during and analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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Author contributions

Wj.Wang designed the study. Qk. Wu was responsible for data collection and and analysis. Dq. Li helped with manuscript preparation. Xl.Tian directed the research, supported data analysis, and facilitated the writing of the final version of the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Ethics declarations

The survey was administered by applicable guidelines and regulations and was reviewed and approved by the School of History and Culture at Henan University. Before filing out the questionnaire, they have been informed that "submitting answers" is considered informed consent. The anonymity and confidentiality of the participants were guaranteed, and participation was completely voluntary. Therefore, all subjects who submitted the questionnaire have obtained informed consent.

Additional information

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