The Effect of Regulatory Focus on App Users' Privacy Disclosure (Postprint)

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Abstract

The rational and full utilization of user data constitutes an important component of the internet economy. Data collection inevitably involves user privacy and necessitates obtaining user authorization, which is referred to as user privacy disclosure. Currently, relevant research on privacy disclosure lacks perspectives grounded in objective and group-level viewpoints, and the decision-making mechanism underlying privacy authorization remains unclear. This project, grounded in regulatory focus theory and operating at both individual and group levels, will systematically investigate the influence mechanisms of regulatory focus and regulatory fit on different stages of privacy disclosure by integrating behavioral experiments, eye-tracking measurements, and data mining methods. The research findings will contribute to understanding the functional mechanisms of regulatory focus in the privacy authorization process and will also hold potential application value for nudge design in privacy authorization.

Full Text

The Impact of Regulatory Focus on App Users' Privacy Disclosure

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Abstract

Fully and effectively utilizing user data is an important component of the Internet economy. Data collection inevitably involves user privacy and requires user authorization, a process known as privacy disclosure. Current research

on privacy disclosure lacks both objective, group-level perspectives and clarity regarding the decision-making mechanisms underlying privacy authorization. Grounded in regulatory focus theory, this project systematically investigates how regulatory focus and regulatory fit affect different stages of privacy disclosure at both individual and group levels, integrating behavioral experiments, eye-tracking measurements, and data mining methods. The findings will enhance understanding of the mechanisms through which regulatory focus operates during privacy authorization and hold potential application value for the design of privacy authorization nudges.

Keywords: regulatory focus, regulatory fit, privacy disclosure, message framing, App user

Classification Code: B849: C91

1. Problem Statement

In the information age, privacy is defined as an individual's control and decision-making authority over whether their information is collected (Rezgui et al., 2003). Users authorize service providers to access their personal information in exchange for more accurate and efficient personalized recommendations and enhanced user experiences (Zlatolas et al., 2015). However, recent incidents of personal information theft, misuse, and profit-making have become commonplace, raising concerns about privacy data disclosure. A survey of Android users revealed that over 80% of users reject at least one privacy authorization request (Wijesekera et al., 2015). Consequently, while enterprises require user data to provide better services and generate greater social and economic value, asymmetric information use between companies and users creates considerable uncertainty in users' privacy disclosure intentions, potentially leading to suboptimal choices even when faced with legitimate privacy authorization requests. To address this conflict between privacy disclosure and data services, optimizing the authorization process by gaining insight into the intrinsic mechanisms of individual privacy disclosure—while remaining reasonable and compliant—not only enhances user experience but also helps unlock the value of data to benefit society and the economy.

During the privacy authorization process, users' psychological traits play a crucial role, with different users exhibiting varied behavioral responses to identical authorization information. Regulatory focus refers to the specific manner or tendency individuals display in changing or controlling their thoughts and reactions during goal pursuit, generally categorized into two motivational systems: promotion focus and prevention focus (Higgins, 1997). Promotion focus emphasizes positive factors in the process and goal attainment, whereas prevention focus emphasizes negative factors and goal security. As a universal motivational principle, regulatory focus plays a significant role in fundamental psychological processes including cognitive evaluation, decision-making trade-offs, and behavioral strategies (Yao & Le, 2009). Recent studies have preliminarily examined the

role of users' different regulatory focus traits in social media usage and privacy protection behaviors, consistently finding that promotion-dominant individuals demonstrate stronger information disclosure intentions on social networking sites than prevention-dominant individuals (Mosteller & Poddar, 2017; Shen et al., 2020). However, current research examining the relationship between individual regulatory focus and privacy-related behaviors suffers from several systematic limitations.

Although consumer psychology research indicates that individuals' regulatory focus significantly influences various stages of purchase decision-making—including need identification, information filtering, and decision formation (e.g., Wang & Lee, 2006)—few studies have applied regulatory focus theory to explain individual privacy disclosure intentions, and most of these have stopped at demonstrating a simple correlation between the two constructs (e.g., Zhu et al., 2019). Moreover, most studies rely solely on questionnaire measurements (e.g., Shen et al., 2020), a methodological approach that limits sample size and ecological validity and creates discrepancies between measured intentions and actual privacy disclosure behaviors. While research on consumer psychology has shown that regulatory focus affects all stages of purchasing decisions, current privacy disclosure studies lack in-depth investigation into the decision-making characteristics and mechanisms of individuals with different regulatory focus types at various stages of App privacy authorization. Additionally, the predominant use of single questionnaire measures results in limited sample sizes and ecological validity, with measured intentions showing certain differences from actual privacy disclosure behaviors.

Regulatory focus not only directly affects information acceptance willingness but can also enhance information adoption through alignment with message framing, a phenomenon known as the regulatory fit effect (Higgins, 2000). Framing effects describe how objectively identical problems, when presented with different structures and wording, influence individual decision-making judgments. Closely related to individual regulatory focus is risk choice framing, which refers to changes in individuals' risk-taking willingness when a risk is described in terms of gains versus losses. Promotion-focused individuals show stronger acceptance of positive information emphasizing favorable outcomes or achievements, while prevention-focused individuals show stronger acceptance of information emphasizing the avoidance of negative outcomes and security needs (Cesario et al., 2013). This regulatory fit induces more elaborate information processing, thereby enhancing persuasiveness (Cesario et al., 2008). The question remains whether regulatory fit can also increase App users' acceptance of privacy authorization information. Existing research has found that matching between App authorization timing and message framing affects users' privacy disclosure intentions, with gain frames combined with immediate authorization and loss frames combined with advance authorization yielding higher privacy disclosure willingness (Pan & Xie, 2020). However, this study did not consider users' own regulatory focus levels. Teeny et al. (2020) noted in their review of persuasion research that messages matching the recipient's individual traits produce stronger

persuasive effects. In recent years, various online recommendation systems have demonstrated that "thousand-people-thousand-faces" personalized recommendations are effective, as this trait-based personalized information matching can generate higher self-relevance impressions (Moon, 2002). However, the current personalized recommendation domain primarily involves product and service customization, with virtually no attention to optimizing privacy authorization information. As user data authorization behaviors become increasingly frequent in the big data era, the "malleability"of individual privacy attitudes has attracted commercial organizations' attention. Acquisti et al. (2015) noted in their review that individual privacy authorization preferences can be influenced by presented authorization information. Therefore, when privacy information authorization is necessary, individuals show higher attention to information matching their own characteristics.

Thus, this project investigates the influence mechanisms of regulatory focus and regulatory fit on different stages of privacy disclosure from both individual and group dimensions, combining psychological and computer science research methods. This approach extends regulatory focus theory in the privacy disclosure domain from individuals to groups and from disclosure intentions to decision-making processes. At the application level, the findings can inform the design of regulatory focus-based privacy authorization nudge messages to enhance user experience. By achieving personalized matching of privacy authorization information based on regulatory focus, users can better understand and accept the role of privacy information disclosure. Additionally, the user regulatory focus text analysis model and privacy disclosure index system developed in this study can provide measurement tools for large-scale group privacy preference analysis.

2. Literature Review and Development Trends

2.1 Privacy Disclosure and Related Theories

Since the advent of the Internet age, the ancient concept of privacy has gradually become a hot topic across multiple disciplines including psychology, computer science, law, and management. Privacy information has been defined through various criteria. Westin (1967) first emphasized the subjectivity of privacy from a legal perspective, defining privacy information as personal-related information and feelings that a subject communicates to others based on self-will during social interactions. Banisar and Davies (1999) further subdivided privacy information into personal information, communication information, spatial information, and physical information. Qiu and Li (2012) argued that social network users' privacy information includes shared information, personal information, interpersonal relationship information, and data mining information. Thus, with changing times, the content of privacy information is dynamic and its scope continuously expands to include all basic information related to oneself, over which individuals have the right to prevent arbitrary acquisition, use, and control by others.

From an economic perspective, disclosing the aforementioned privacy information in the mobile Internet era can indeed bring certain value to users themselves. Despite criticism, the notion that "users are willing to exchange privacy for convenience" does exist to some extent. Factors such as service convenience and economic benefits can significantly enhance users' privacy disclosure intentions (Li et al., 2010). Privacy calculus theory posits that before making decisions, users weigh the losses caused by privacy leakage against the benefits brought by privacy disclosure, choosing to disclose personal information when perceived benefits exceed perceived risks (Vishwanath et al., 2018). For social network users, perceived benefits mainly refer to obtaining and maintaining connections with others, while perceived risks stem from the possibility of information theft or misuse (Poddar et al., 2009).

Privacy calculus theory is considered "the most useful framework for analyzing contemporary user privacy issues" (Awad & Krishnan, 2006), and its core perspective on measuring perceived benefits and risks has gained widespread recognition. However, current research based on this theory has several limitations: (1) The theory assumes a "rational person," yet users often exhibit bounded rationality when making privacy decisions (Acquisti et al., 2015), such as selectively attending to information and forming limited choice sets; (2) Almost all studies use questionnaire methods to collect privacy disclosure data, a methodological limitation that measures intentions rather than behaviors. Moreover, inconsistencies between individuals' privacy disclosure intentions and behaviors constitute the privacy paradox (Utz & Krämer, 2009). Therefore, this project treats users as boundedly rational individuals, considers individual regulatory focus traits as important variables affecting privacy decisions, and employs multimethod research paradigms to explore the impact of regulatory focus on privacy disclosure behaviors.

2.2 User Regulatory Focus and Privacy Disclosure Research

As previously mentioned, individuals often exhibit "bounded rationality" when facing decisions, and privacy disclosure is essentially a decision-making process that weighs benefits against risks. Research shows that the decision-making of boundedly rational individuals, particularly risk preferences, often changes due to how information is presented (Nie et al., 2018). Information with identical meaning, when conveyed through different presentation formats and wording, can produce different cognitions and judgments in recipients, thereby enhancing linguistic persuasiveness and achieving effective information transmission (Li & Tan, 2018). Risk choice framing includes gain frames and loss frames, with the former emphasizing benefits or positive consequences of an event, and the latter emphasizing risks and losses incurred if the event does not occur. Framing effects are crucial for consumer behavioral decision-making, and individual regulatory focus influences preferred message frame types. Some studies indicate that gain frames enhance information perceived effectiveness more than loss frames (van de Velde et al., 2010). Gain frames preserve a sense of behavioral

freedom and reduce feelings of coercion, whereas loss frames restrict behavioral freedom and create strong coercive feelings, triggering intense negative emotions and fear arousal (Niesta Kayser et al., 2016). Other studies find that compared to gain frames, consumers show stronger willingness to use environmentally friendly biofuels when facing loss frames emphasizing negative environmental consequences (Moon et al., 2016). Therefore, academic consensus has not been reached regarding which message frame more effectively enhances consumer responses (McDonald et al., 2021). One reason for these contradictory findings is the failure to consider how individual traits moderate framing effects. Regulatory focus represents an important individual trait sensitive to message framing, with different regulatory focus individuals' perceived risk levels moderating the effect of message frames (Lee & Aaker, 2004): gain frames are more effective under promotion-focused individuals' low risk perception, while loss frames are more effective under prevention-focused individuals' high risk perception—this is the regulatory fit effect in message framing.

Prospect theory (Kahneman & Tversky, 1979) posits that different individual traits determine the utility functions employed in decision-making. In practical applications, an increasing number of Internet service providers have begun establishing connections between message content and recipients (Teeny et al., 2020), with personalized matching considered the most reliable and effective nudging strategy (Carpenter, 2012; Noar et al., 2007; Rothman et al., 2020). Personalized recommendations based on users' Big Five personality traits (Shumanov et al., 2022), need for cognition (See et al., 2009), need for power (Moon, 2002), and sensation-seeking traits (Self & Findley, 2010) significantly enhance information acceptance willingness. However, these studies typically focus on how advertising information matching affects purchase intentions when consumers select products, with virtually no research applying user-based regulatory matching to privacy disclosure domains. Additionally, some researchers note that overly precise personalized matching may backfire, making users feel monitored and manipulated, thereby generating 反感 toward service providers (Kosinski et al., 2013). Therefore, whether privacy authorization message frames matched to individual regulatory focus can promote user privacy disclosure represents a worthwhile research question that will provide more comprehensive understanding of users' decision-making mechanisms when facing privacy authorization information "nudges."

3. Research Design

This project conceptualizes privacy disclosure authorization as a decision-making process, employing regulatory focus and regulatory fit theories as an integrated research framework to explore how individual regulatory focus affects privacy disclosure decisions and examining how regulatory fit-based authorization information promotes privacy disclosure mechanisms. Specifically, three sub-studies are proposed: Study 1 investigates differences in decision preferences and evaluations of privacy authorization information

among individuals with different regulatory focus; Study 2 uses behavioral and eye-tracking experiments to examine the promotional effects and underlying mechanisms of regulatory fit on individual privacy disclosure decisions; Study 3 generalizes these findings to the group level by analyzing public Weibo user data to validate the association between regulatory focus and privacy disclosure.

3.1 Study 1: The Impact of Regulatory Focus on Individual Privacy Disclosure Decision-Making

Based on regulatory focus theory, promotion-focused individuals' intrinsic needs for growth and development drive them to seek positive outcomes to achieve their goals or standards. As products of the mobile Internet, smartphone Apps enable users to obtain social capital (e.g., gaining more friends' attention) and use value (more accurate recommendations, optimized experiences) through information disclosure, representing a way for promotion-focused users to acquire benefits and positive outcomes (Dienlin & Trepte, 2015). Conversely, prevention-focused individuals' intrinsic safety needs motivate them to search for negative outcomes, leading them to prefer reducing their information disclosure to avoid negative consequences (Wu & Yao, 2022). However, due to the privacy paradox, questionnaire research results inevitably deviate to some extent from users' actual privacy disclosure decisions (Song et al., 2021). Therefore, Study 1 will use scenario-simulated App download behavioral experiments to examine whether individuals with different regulatory focus demonstrate consistent information disclosure preferences during the initial privacy authorization stage upon App download.

Based on the above, Study 1 proposes the following hypothesis:

H1: During the privacy authorization request stage following App download, promotion-focused individuals will demonstrate higher privacy authorization rates and stronger disclosure intentions compared to prevention-focused individuals.

After establishing differences in privacy disclosure intentions among individuals with different regulatory focus, this project will explore the decision-making patterns underlying these differences. According to privacy calculus theory, before making privacy authorization decisions, users weigh the losses caused by privacy leakage against the benefits brought by privacy disclosure, choosing to disclose personal information when perceived benefits exceed observed risks (Vishwanath et al., 2018). Some studies indicate that regulatory focus types significantly influence individual risk and benefit assessments. Prevention-focused individuals focus more on taking all necessary measures to avoid losses, while promotion-focused individuals focus more on adopting various possible approaches to obtain benefits (Higgins, 1997). The asymmetric frontal cortical activity observed for specific motivational and emotional activities provides the neurophysiological basis for this difference: motivation and emotion related to

benefits increase excitability in the left frontal cortex, while those related to losses increase excitability in the right frontal cortex (Davidson & Irwin, 1999). Amodio et al. (2004) demonstrated that promotion-focused individuals show relatively higher baseline activity in the left frontal cortex, while prevention-focused individuals show relatively higher baseline activity in the right frontal cortex. These findings collectively indicate that promotion-focused individuals are more sensitive to benefits than prevention-focused individuals.

Relevant questionnaire studies have assessed privacy disclosure risks and benefits through separate items. However, real decision-making often requires trade-offs between conflicting options, such as whether to exchange greater privacy disclosure for larger benefits while assuming more potential risks. Currently, many Apps employ personalized recommendation system algorithms that filter and screen information based on user characteristics and behavioral data to match products and services to users' preferences (Liu et al., 2013). The key factor affecting recommendation system effectiveness is data scale and quality: on one hand, to improve algorithm accuracy and transferability, Apps need to acquire as much user data as possible; on the other hand, for fixed algorithm models, richer and higher-quality user data yield better recommendation results. As renowned AI scholar Andrew Ng noted: "80% data + 20% model = better machine learning." However, precise recommendations require extensive user data authorization, which seemingly exacerbates user privacy concerns, creating a dilemma: in actual use, if users allow App developers to collect more data and permissions, their preferences can be more accurately inferred to provide more precise recommendation services, but the risk of information misuse and theft also increases (Zhou et al., 2019).

Therefore, unlike questionnaire methods that set different risk and benefit items separately, this project will directly present privacy disclosure with corresponding risks or benefits simultaneously in a single option. Using the titration procedure commonly employed in decision-making research, the experiment will quantify the risk and benefit magnitude corresponding to disclosure levels by having participants complete a series of choices to derive the psychological indifference point between two options. This method has been frequently used in intertemporal and risky decision-making research. Chen and He (2015) demonstrated through a series of experiments that in environmental domain intertemporal decision problems, the titration method enables participants to make judgments based on the psychological value of outcomes without showing preferences for specific inflection points or values.

Based on previous questionnaire and behavioral research results on regulatory focus and risk preference, this project proposes the following hypothesis:

H2: Compared to prevention-focused individuals, promotion-focused individuals tend to obtain higher privacy disclosure benefits and assume higher privacy disclosure risks.

3.2 Study 2: The Impact of Regulatory Fit on Individual Privacy Disclosure Intentions

While Study 1 characterizes the decision-making patterns of users with different regulatory focus regarding privacy disclosure authorization, Study 2 aims to explore whether matching authorization information to individuals' regulatory focus characteristics can promote their privacy authorization intentions. According to uses and gratifications theory (Katz et al., 1973), individuals' internal needs motivate their active selection and use of media, and they evaluate the degree to which media-provided products or services satisfy these needs. Regulatory focus, as an important motivational system, plays a significant role in this evaluation and matching process (Teeny et al., 2020). Individuals experience regulatory fit when receiving message frames consistent with their regulatory focus because differently framed information automatically activates corresponding regulatory orientations (promotion vs. prevention). Consumer psychology research shows that promotion-focused individuals evaluate advertisements emphasizing benefits more positively, while prevention-focused individuals evaluate advertisements emphasizing losses from not purchasing more positively, with variables such as perceived effectiveness and correctness mediating the relationship between regulatory fit and advertisement evaluation (Lee & Aaker, 2004; Updegraff & Rothman, 2013). Recently, some App developers have begun adjusting the wording of authorization requests to enhance users' privacy disclosure intentions. One study on the matching effect of authorization timing and message framing on privacy disclosure intentions found that under advance authorization, loss-framed privacy authorization information demonstrates higher persuasiveness by reducing perceived uncertainty (Pan & Xie, 2020). Perceived uncertainty refers to individuals' perception of their inability to predict decision outcomes and the probability of future events (Wang et al., 2019). Perceived uncertainty triggers risk perception, and individuals generally tend to avoid uncertainty (Shou & Zheng, 2017). Compared to directly asking participants about their risk perception levels, perceived uncertainty serves as a better indicator of risk perception. Therefore, perceived risk is both an internal variable affecting privacy disclosure decision preferences among individuals with different regulatory focus and a mediating mechanism between regulatory fit and privacy disclosure intentions. However, current research applying individual regulatory focus matching with information feature frames to privacy authorization processes remains scarce. In summary, based on regulatory fit effects found in traditional industries, Study 2 proposes the following hypotheses:

H3: The interaction between regulatory focus and message framing affects individuals' privacy disclosure intentions and perceived uncertainty.

H3a: Compared to prevention-focused individuals, promotion-focused individuals show greater privacy disclosure intentions toward gain-framed authorization materials.

H3b: Compared to promotion-focused individuals, prevention-focused individ-

uals show greater privacy disclosure intentions toward loss-framed authorization materials.

H4: Perceived uncertainty mediates the relationship between regulatory fit conditions and privacy disclosure intentions.

If regulatory fit promotes individuals' privacy disclosure intentions, this project further investigates how individuals process this regulatory fit information. Petty and Cacioppo (1986) proposed the Elaboration Likelihood Model (ELM), which distinguishes individuals' level of elaboration in processing persuasive messages and is one of the most widely validated and applied models in persuasion research. ELM posits that individuals at low elaboration levels treat persuasive messages merely as cues, while those at high elaboration levels treat them as arguments. Determining individuals' elaboration level is crucial because under high elaboration, information produces more lasting persuasive effects (Teeny et al., 2020).

Regarding the elaboration level of regulatory fit information, previous research presents some controversy. One perspective holds that regulatory fit information induces higher elaboration levels, while non-fit information induces lower elaboration. Under regulatory fit conditions, individuals show higher engagement with gain-framed information and higher vigilance toward loss-framed information (Lee & Aaker, 2004). The strength of message arguments influences persuasion effects differently depending on elaboration level. A health information experiment found that under regulatory fit conditions, individuals' perception and evaluation of health information were influenced by argument strength, showing more positive evaluation and selection tendencies toward strongly persuasive health messages; under non-fit conditions, this difference was not observed. This result indicates that under regulatory fit conditions, individuals carefully evaluate message content using more systematic processing, thereby forming different selection tendencies based on argument strength; under non-fit conditions, individuals do not engage in careful consideration and cannot distinguish between strong and weak arguments (Updegraff et al., 2007). However, other research finds that individuals show higher elaboration levels for non-fit compared to fit information. Under non-fit conditions, individuals' states are disrupted, they experience uncertainty, which prompts careful scrutiny of information (Levine et al., 2016). Koenig et al. (2009) demonstrated through a series of experiments that regulatory fit makes individuals more reliant on expert information and 倾向于 heuristic processing, while non-fit conditions lead individuals to engage in more argument scrutiny and systematic processing. A recent study found that individual motivation level moderates the relationship between regulatory fit conditions and elaboration level. Under high motivation, regulatory fit messages elicit longer attention, more careful search, and more elaborate processing, while under low motivation, non-fit messages 反而 elicit more careful search and more elaborate processing (Lee et al., 2019). For high-motivation individuals, regulatory fit itself becomes part of the message relevance, as fit information enhances self-relevance, increasing involvement or processing capac-

ity (Petty et al., 1988). For low-motivation individuals, regulatory fit serves as a heuristic cue facilitating rapid information processing, while non-fit generates a sense of "wrongness" (Aaker & Lee, 2006), prompting comprehensive information processing (Koenig et al., 2009). The App privacy authorization scenario addressed in this project occurs after individuals actively download Apps, placing them in a relatively high motivation state for using the App. One study showed that when motivated to complete tasks, regulatory fit maintains individuals in higher motivational states for task engagement (Vaughn et al., 2006). In summary, this project hypothesizes that individuals employ higher elaboration levels when processing regulatory fit privacy authorization information.

To test this hypothesis, this project adopts the following paradigm from relevant research to distinguish elaboration levels: design strong and weak persuasion versions for each message frame. If under regulatory fit conditions, individuals show greater acceptance of strongly persuasive materials, while under non-fit conditions, individuals show no significant difference in acceptance between strong and weak persuasive materials, this indicates that individuals use high elaboration processing for regulatory fit authorization information; conversely, it indicates low elaboration processing (Updegraff et al., 2007). ELM indicates that elaboration level influences affective (individual feelings and emotions), behavioral (actions based on emotions), and cognitive (thoughts and cognitions) dimensions. In privacy authorization contexts, high elaboration processing of regulatory fit authorization information should also reduce perceived risk at the cognitive level. Therefore, this project will examine whether individuals show more elaborate processing of regulatory fit privacy authorization information in privacy authorization contexts, leading to stronger privacy disclosure intentions at the behavioral level and lower perceived uncertainty at the cognitive level. The following hypotheses are proposed:

H5: The interaction between regulatory fit of privacy authorization materials and argument strength affects individuals' privacy disclosure intentions and perceived uncertainty.

H5a: When privacy authorization message frames match individuals' regulatory focus, individuals show greater privacy disclosure intentions and lower perceived uncertainty toward strongly persuasive privacy authorization materials.

H5b: When privacy authorization message frames do not match individuals' regulatory focus, argument strength shows no significant effect on individuals' privacy disclosure intentions and perceived uncertainty.

If behavioral experiments reveal that need-matching messages induce higher elaboration levels, eye-tracking data provides evidence from another perspective. Eye movement trajectories toward stimulus materials are driven by individuals' internalized cognitive models, formed through top-down cognitive processing patterns, reflecting the brain' s processing sequence and overall dynamics for visual stimuli (Noton & Stark, 1971). Generally, users fixate longer on content of interest and shorter on uninteresting content. Research shows that fixation

count and duration within areas of interest reflect the amount of information obtained and processing depth of stimuli (García et al., 2000). Eye-tracking studies indicate that fixation duration is a reliable indicator of processing level, with fixation duration increasing as task difficulty increases (Horstmann et al., 2009). Zhou et al. (2019) used average fixation duration as an indicator of processing complexity in their eye-tracking study of risky decision-making. In summary, higher elaboration levels for regulatory fit privacy authorization information should also be reflected in eye-tracking indicators related to fixation duration and count. Therefore, this study will use eye-tracking experiments to collect fixation count and duration data from individuals with different regulatory focus toward two types of message-framed privacy authorization information to examine attention and processing depth. The following hypothesis is proposed:

H6: When privacy authorization message frames match individuals' regulatory focus, individuals show longer fixation durations on authorization information and examine more option features before decision-making.

3.3 Study 3: Association Analysis Between Individual Regulatory Focus and Privacy Disclosure Based on Weibo Data

Although questionnaire studies have shown that promotion-focused individuals choose to disclose more personal information on social networking sites (Shen et al., 2020), self-reported data clearly deviates from actual behavior due to social desirability and other factors (Yu et al., 2015). The behavioral experiments in Studies 1 and 2 also cannot fully represent users' actual usage behaviors. Therefore, Study 3 will analyze users' actual privacy disclosure behaviors by examining their public Weibo texts, establishing associations with regulatory focus through computational measurement of text content.

Privacy-related decisions for social Apps occur not only during the authorization stage but also manifest in daily usage behaviors. In the big data era, data records traces of individual behavior (Yu et al., 2015). Users' textual and behavioral traces in social media provide effective clues for analyzing their actual privacy disclosure behaviors. This project will construct a privacy disclosure index system based on two types of Weibo data: personal profiles and original posts. Personal profile privacy disclosure will be calculated based on Banczyk et al.' s (2008) manual coding scheme, using computer code to automatically collect and calculate users' personal information privacy disclosure scores. This scheme' s core involves calculating whether users respond to various items requiring self-related information disclosure (e.g., age, gender) and the extent of their responses (e.g., number of interest tags). Users also disclose self-related information in their original Weibo posts, a form of privacy disclosure that is relatively more implicit. This project adopts Shu Cong's (2018) content analysis scheme for Weibo text information disclosure to analyze self-disclosure-related content in original posts and calculate users' textual privacy disclosure scores. Consequently, each user' s total privacy disclosure score includes both personal information privacy disclosure and textual privacy disclosure components.

After obtaining Weibo user groups' regulatory focus types and privacy disclosure levels, Study 3 will apply the Apriori machine learning association analysis algorithm to explore association rules and frequent item sets between regulatory focus types and privacy disclosure levels. Association rules refer to relationships between regulatory focus types and privacy disclosure levels derived from large datasets, while frequent combinations of these two elements are called frequent item sets (e.g., {prevention focus vs. low self-information disclosure}). Strong rules are those that satisfy both minimum support and minimum confidence thresholds. Based on previous questionnaire and behavioral research results, Study 3 proposes the following hypotheses:

H7: At the group level, promotion focus among Weibo users is strongly associated with high privacy disclosure levels.

H8: At the group level, prevention focus among Weibo users is strongly associated with low privacy disclosure levels.

Theoretical Contributions

This project constructs an overall framework for an App privacy authorization nudging mechanism based on regulatory focus and regulatory fit theories. In consumer psychology, regulatory focus and regulatory fit theories have been widely applied to research on the persuasive effects of marketing messages, demonstrating that when advertisement information (positive vs. negative) matches individuals' regulatory focus, consumers derive higher value from their purchase decisions, making them more susceptible to advertising persuasion and strengthening their purchase intentions (Awad & Krishnan, 2006). With the rapid development of the digital economy in the mobile Internet era, driven by the demand that "data is resource," data has become an intangible but important "commodity." App users' privacy information authorization behaviors have become increasingly frequent and important, essentially representing a process of persuading users to relinquish their personal information in exchange for corresponding services and experiences. Currently, few studies in the privacy disclosure domain have examined how individual privacy authorization behaviors are influenced by regulatory fit. The relationship between privacy disclosure and regulatory focus has been preliminarily confirmed in some questionnaire studies, but in-depth mechanism research is lacking. This project attempts to construct a theoretical mechanism model (Figure 1 [Figure 1: see original paper]), proposing that different regulatory focus types lead to differences in evaluating privacy disclosure risks and benefits, thereby affecting privacy disclosure intentions. Regulatory fit conditions between regulatory focus types and message frame types influence individuals' privacy disclosure decisions by affecting information processing levels and perceived risk.

First, regulatory focus, as a trait reflecting individuals' tendencies to consider "gains" versus "losses," importantly influences a series of decision-making behaviors. Privacy disclosure essentially involves individuals weighing privacy au-

thorization benefits against privacy leakage risks. Therefore, this project posits that users' regulatory focus types lead to different privacy risk preferences and will quantitatively characterize the evaluation and trade-off characteristics of privacy risks among individuals with different regulatory focus types (Study 1). After clarifying regulatory focus' s impact on privacy disclosure, the project further considers matching conditions between message frames and regulatory focus—specifically, whether individuals show stronger information acceptance intentions when their regulatory focus type matches the authorization message frame type. On this basis, it examines the mediating role of individuals' perceived risk levels on privacy disclosure intentions and differences in elaboration levels (Study 2). In summary, Studies 1 and 2 explore at the individual level how regulatory focus characteristics and message frame types affect App users' privacy disclosure intentions through perceived risk, providing a foundation for testing group-level data. Study 3 will analyze group user data from public social platforms, characterizing privacy disclosure from two dimensions: profile information disclosure behavior and textual self-presentation behavior. Then, through machine learning classification models, it will mine language feature differences among individuals with different regulatory focus in terms of motivational expression, emotional expression, and social processes. Finally, association analysis between regulatory focus and privacy disclosure behaviors will be conducted (Study 3). In conclusion, this project systematically explores the intrinsic mechanisms (perceived risk) and boundary conditions (message framing, processing level) of regulatory focus' s impact on privacy disclosure. The main theoretical contributions are as follows:

First, the project clarifies the decision-making patterns and driving mechanisms through which regulatory focus and regulatory fit affect privacy disclosure. Although previous research has analyzed the types and effects of factors influencing privacy disclosure in detail, individual-level and scenario-level factors have often been examined along separate lines, neglecting individuals' "bounded rationality" decision-making characteristics and the interaction between authorization contexts and psychological traits. Therefore, this project takes the trade-off between risks and benefits as its core, using the titration method from risk decision-making paradigms to quantitatively assess differences in how individuals with different regulatory focus perceive privacy benefits and risks. On this basis, it transforms the traditional unidirectional calculation of information and individuals into a bidirectional matching of regulatory focus and message frames, exploring how regulatory fit-based privacy authorization designs can nudge individual privacy decisions. The essence of nudging is precisely to design choice architectures based on individual traits to guide people toward better choices (Zhao et al., 2022). Therefore, under reasonable and compliant conditions, promoting individuals' correct understanding of privacy authorization information can reduce information asymmetry and facilitate data resource utilization. Research has shown that nudge designs for web security warning messages can effectively guide subsequent usage behaviors (Acquisti et al., 2017). Thus, matching privacy authorization request message frames to individual regulatory focus will

also promote privacy disclosure. On this basis, the project examines individuals' processing mechanisms for regulatory fit-based App privacy authorization information. In summary, exploring how regulatory fit between regulatory focus and message frames influences users' risk perception and information processing levels, thereby affecting privacy disclosure intentions, provides a more comprehensive research perspective that highlights the underlying mechanisms of regulatory focus on privacy disclosure and its close relationship with message framing.

Second, the project more completely examines the impact of regulatory focus on privacy disclosure across three levels: decision evaluation, decision preference, and actual decision behavior. Previous privacy disclosure research has primarily focused on decision preferences, with less exploration of decision evaluation and actual decision behavior. This project employs multiple research methods to investigate regulatory focus' s impact on the entire privacy disclosure decision process. For decision preference, scenario-simulation experiments will assess whether promotion-focused individuals show stronger privacy disclosure intentions than prevention-focused individuals. For decision evaluation, the titration method will quantitatively characterize differences in subjective equivalence points during privacy authorization decisions among individuals with different regulatory focus. For actual decision behavior, data mining and machine learning techniques will collect and analyze real text and behavioral data from social App user groups to examine whether promotion-focused individuals demonstrate more privacy disclosure behaviors in actual App usage. These studies help reveal the characteristics of regulatory focus' s effects on different stages of individual privacy disclosure decision-making.

Finally, the project provides a new perspective for privacy authorization research at the group level. Belanger and Crossler (2011) reviewed privacy-related literature and proposed that most existing research is individual-level, with more research needed at macro levels of groups, organizations, and society. This project leverages experimental research' s advantages in controlling variables and explaining causality in Studies 1 and 2 to explore regulatory focus and regulatory fit effects on individual privacy authorization. Study 3 employs data mining and machine learning techniques to enhance ecological validity and address limitations in sample size and ecological validity of existing research, supplementing regulatory focus and privacy disclosure theories with group-level conclusions. Additionally, unlike previous studies that typically collected only behavioral or questionnaire data, Study 3 collects information disclosed during individuals' actual App usage, including explicit personal profiles and implicit textual content, thereby presenting a more multidimensional and comprehensive association between privacy disclosure and regulatory focus. The resulting user regulatory focus text analysis model and privacy disclosure behavior index system can provide measurement tool references for subsequent research.

In summary, this project constructs a theoretical mechanism model of App user privacy disclosure from a regulatory focus perspective at both individual and

group levels, explaining the overall privacy disclosure decision process and the roles of perceived risk, message framing, and processing level, thereby deepening theoretical research in regulatory focus and privacy disclosure domains. In the digital economy era, massive personal data is a double-edged sword with coexisting opportunities and risks. Clarifying the conditions and mechanisms through which regulatory focus affects privacy disclosure can provide references for data collectors, reduce asymmetry in the privacy authorization process under reasonable and compliant conditions, help users fully perceive and understand the purposes of data collection, and provide psychological-level support for realizing the value of data economy and social benefits.

References

Chen, J., & He, G. (2015). Measurement of temporal discounting of environmental outcomes: A comparison of matching and titration methods. *Applied Psychology*, 21(1), 12-20.

Li, X., & Tan, P. (2018). Applied research on framing effects and their application techniques. *Advances in Psychological Science*, 26(12), 2230-2237.

Nie, C., Wang, T., Zhao, P., & Cui, N. (2018). The influence of explanation frames on evaluations of cultural mixing products—The moderating effect of comparison focus and explanation strategy. *Acta Psychologica Sinica*, 50(12), 1438-1448.

Pan, D., & Xie, H. (2020). The impact of matching between authorization timing and message framing on privacy disclosure intentions. *Foreign Economics and Management*, 42(11), 81-93.

Qiu, J., & Li, Y. (2012). Exploring user privacy security issues in social networks. *Information and Documentation Services*, (6), 34-38.

Shen, W., Gao, X., Dai, W., & Yang, B. (2020). Research on the privacy paradox in social networks based on construal level theory and regulatory focus theory. *Information Science*, 38(8), 12-127.

Shou, Z., & Zheng, W. (2017). Research on promotion strategies based on uncertainty: Theoretical review and latest developments. *Foreign Economics and Management*, 39(3), 90-98.

Shu, C. (2018). *The relationship between adult attachment and self-disclosure on social networks* (Master' s thesis). Southwest University, Chongqing.

Sun, S., & Huang, Y. (2012). Exploring user-generated content (UGC) models. *Library Science Research*, (13), 33-35.

Wu, Q., & Yao, L. (2022). Research on factors influencing Internet users' privacy disclosure behavior. *Modern Intelligence*, 42(6), 121-131.

Yang, Q., Liu, W., & Zhang, D. (2021). Small labels, big effects: Food labeling effects in marketing. *Advances in Psychological Science*, 29(9), 1669-1682.

Yao, Q., & Le, G. (2009). New developments in motivation theory: Regulatory focus theory. *Advances in Psychological Science*, 17(6), 1264–1273.

Yin, F., & Wang, Y. (2013). Regulatory focus in consumer behavior. *Advances in Psychological Science*, 21(2), 347–357.

Yu, F., Peng, K., & Zheng, X. (2015). Psychology in the big data era: Reconstruction and characteristics of Chinese psychology' s disciplinary system. *Chinese Science Bulletin*, 60(5-6), 520–533.

Zhao, N., Liu, X., Li, S., & Zheng, R. (2022). The nudging effect of default option settings: Evidence from meta-analysis. *Advances in Psychological Science*, 30(6), 1230–1242.

Zhou, J., Dong, X., & Cao, Z. (2019). Research progress on privacy protection in recommendation systems. *Journal of Computer Research and Development*, 56(10), 2033–2048.

Zhou, L., Li, A., Zhang, L., Li, S., & Liang, Z. (2019). Process comparison between risky decision-making and intertemporal decision-making: Using the certainty effect and immediacy effect as examples. *Acta Psychologica Sinica*, 51(3), 337–352.

Zhu, P., Li, L., & Marchionini, G. (2019). Research on social network user information sharing behavior based on regulatory focus theory. *Journal of the China Society for Scientific and Technical Information*, 38(3), 257–265.

Acquisti, A., Adjerid, I., Balebako, R. H., Brandimarte, L., Cranor, L. F., Komanduri, S., ···Wilson, S. (2017). Nudges for privacy and security: Understanding and assisting users' choices online. *ACM Computing Surveys*, 50(3), 1–41.

Acquisti, A., Brandimarte, L., & Loewenstein, G. (2015). Privacy and human behavior in the age of information. *Science*, 347(6221), 509–514.

Amodio, D. M., Shah, J. Y., Sigelman, J., Brazy, P. C., & Harmon-Jones, E. (2004). Implicit regulatory focus associated with asymmetrical frontal cortical activity. *Journal of Experimental Social Psychology*, 40(2), 225–232.

Awad, N. F., & Krishnan, M. S. (2006). The personalization privacy paradox: An empirical evaluation of information transparency and the willingness to be profiled online for personalization. *MIS Quarterly*, 30(1), 13–28.

Banisar, D., & Davies, S. (1999). Global trends in privacy protection: An international survey of privacy, data protection, and surveillance laws and developments. *John Marshall Journal of Computer & Information Law*, 18(1), 1–11.

Banczyk, B., Krämer, N., & Senokozlieva, M. (2008, May). "*The wurst*" *meets* "*fatless*" *in MySpace: The relationship between self-esteem, personality, and self-presentation in an online community.* Paper session presented at the meeting of the International Communication Association, Montreal, Canada.

Belanger, F., & Crossler, R. E. (2011). Privacy in the digital age: A review of information privacy research in information systems. *MIS Quarterly*, 35(4), 1017–1041.

Carpenter, C. J. (2012). A meta-analysis of the functional matching effect based on functional attitude theory. *Southern Communication Journal*, 77(5), 438–451.

Cesario, J., Corker, K. S., & Jelinek, S. (2013). A self-regulatory framework for message framing. *Journal of Experimental Social Psychology*, 49(2), 238–249.

Cesario, J., Higgins, E. T., & Scholer, A. A. (2008). Regulatory fit and persuasion: Basic principles and remaining questions. *Social and Personality Psychology Compass*, 2(1), 444–463.

Davidson, R. J., & Irwin, W. (1999). The functional neuroanatomy of emotion and affective style. *Trends in Cognitive Sciences*, 3(1), 11–21.

Dienlin, T., & Trepte, S. (2015). Is the privacy paradox a relic of the past? An in-depth analysis of privacy attitudes and privacy behaviors. *European Journal of Social Psychology*, 45(3), 285–297.

García, C., Ponsoda, V., & Estebaranz, H. (2000). Scanning ads: Effects of involvement and of position of the illustration in printed advertisements. *Advances in Consumer Research*, 27, 104–109.

Higgins, E. T. (1997). Beyond pleasure and pain. *American Psychologist*, 52(12), 1280–1300.

Higgins, E. T. (2000). Making a good decision: Value from fit. *American Psychologist*, 55(11), 1217–1230.

Horstmann, N., Ahlgrimm, A., & Glöckner, A. (2009). How distinct are intuition and deliberation? An eye-tracking analysis of instruction-induced decision modes. *Judgment and Decision Making*, 4(5), 335–354.

Johnsen, J. A. K., Vambheim, S. M., Wynn, R., & Wangberg, S. C. (2014). Language of motivation and emotion in an internet support group for smoking cessation: Explorative use of automated content analysis to measure regulatory focus. *Psychology Research and Behavior Management*, 7, 19–29.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263–291.

Katz, E., Blumler, J. G., & Gurevitch, M. (1973). Uses and gratifications research. *The Public Opinion Quarterly*, 37(4), 509–523.

Koenig, A. M., Cesario, J., Molden, D. C., Kosloff, S., & Higgins, E. T. (2009). Incidental experiences of regulatory fit and the processing of persuasive appeals. *Personality & Social Psychology Bulletin*, 35(10), 1342–1355.

Kosinski, M., Stillwell, D., & Graepel, T. (2013). Private traits and attributes are predictable from digital records of human behavior. *Proceedings of the*

National Academy of Sciences, 110(15), 5802–5805.

Lee, A. Y., & Aaker, J. L. (2004). Bringing the frame into focus: The influence of regulatory fit on processing fluency and persuasion. *Journal of Personality and Social Psychology*, 86(2), 205–218.

Lee, Y.-H., Getz, B., & Xiao, M. (2019). Does that sound right? The effects of regulatory fit and nonfit headline frames on motivated information processing. *Communication Monographs*, 86(3), 336–356.

Levine, J. M., Alexander, K. M., Wright, A. G., & Higgins, E. T. (2016). Group brainstorming: When regulatory nonfit enhances performance. *Group Processes & Intergroup Relations*, 19(2), 257–271.

Li, H., Sarathy, R., & Xu, H. (2010). Understanding situational online information disclosure as a privacy calculus. *Journal of Computer Information Systems*, 51(1), 62–71.

Liu, H., He, J., Wang, T., Song, W., & Du, X. (2013). Combining user preferences and user opinions for accurate recommendation. *Electronic Commerce Research and Applications*, 12(1), 14–23.

McDonald, K., Graves, R., Yin, S., Weese, T., & Sinnott-Armstrong, W. (2021). Valence framing effects on moral judgments: A meta-analysis. *Cognition*, 212, 104703.

Moon, S., Bergey, P. K., Bove, L. L., & Robinson, S. (2016). Message framing and individual traits in adopting innovative, sustainable products (ISPs): Evidence from biofuel adoption. *Journal of Business Research*, 69(9), 3553–3560.

Moon, Y. (2002). Personalization and personality: Some effects of customizing message style based on consumer personality. *Journal of Consumer Psychology*, 12(4), 313–326.

Mosteller, J., & Poddar, A. (2017). To share and protect: Using regulatory focus theory to examine the privacy paradox of consumers' social media engagement and online privacy protection behaviors. *Journal of Interactive Marketing*, 39(1), 27–38.

Niesta Kayser, D., Graupmann, V., Fryer, J. W., & Frey, D. (2016). Threat to freedom and the detrimental effect of avoidance goal frames: Reactance as a mediating variable. *Frontiers in Psychology*, 7, 632.

Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. *Psychological Bulletin*, 133(4), 673–693.

Noton, D., & Stark, L. (1971). Scanpaths in saccadic eye movements while viewing and recognizing patterns. *Vision Research*, 11(9), 929–942.

Pennebaker, J. W., Colder, M., & Sharp, L. K. (1990). Accelerating the coping process. *Journal of Personality and Social Psychology*, 58(3), 528–537.

Petty, R. E., & Cacioppo, J. T. (1986). The elaboration likelihood model of persuasion. *Advances in Experimental Social Psychology*, 19, 123–205.

Petty, R. E., Cacioppo, J. T., & Kasmer, J. A. (1988). The role of affect in the elaboration likelihood model of persuasion. In L. Donohew, H. E. Sypher, & E. T. Higgins (Eds.), *Communication, social cognition, and affect* (pp. 117–146). Lawrence Erlbaum Associates, Inc.

Poddar, A., Mosteller, J., & Ellen, P. S. (2009). Consumers' rules of engagement in online information exchanges. *Journal of Consumer Affairs*, 43(3), 419–448.

Rezgui, A., Bouguettaya, A., & Eltoweissy, M. Y. (2003). Privacy on the Web: Facts, challenges, and solutions. *IEEE Security & Privacy*, 1(6), 40–49.

Rothman, A. J., Desmarais, K. J., & Lenne, R. L. (2020). Moving from research on message framing to principles of message matching: The use of gain- and loss-framed messages to promote healthy behavior. *Advances in Motivation Science*, 7, 43–73.

See, Y. H. M., Petty, R. E., & Evans, L. M. (2009). The impact of perceived message complexity and need for cognition on information processing and attitudes. *Journal of Research in Personality*, 43(5), 880–889.

Self, D. R., & Findley, C. S. (2010). Sensation seekers as a healthcare marketing metasegment. *Health Marketing Quarterly*, 27(1), 21–47.

Shumanov, M., Cooper, H., & Ewing, M. (2022). Using AI predicted personality to enhance advertising effectiveness. *European Journal of Marketing*, 56(6), 1590–1609.

Song, Y. W., Lim, H. S., & Oh, J. (2021). "We think you may like this" : An investigation of e-commerce consumers' personalization consciousness and privacy paradox. *Psychology & Marketing*, 38(10), 1723–1740.

Teeny, J. D., Siev, J. J., Briñol, P., & Petty, R. E. (2020). A review and conceptual framework for understanding personalized matching effects in persuasion. *Journal of Consumer Psychology*, 31(2), 382–414.

Updegraff, J. A., & Rothman, A. J. (2013). Health message framing: Moderators, mediators, and mysteries. *Social and Personality Psychology Compass*, 7(9), 668–679.

Updegraff, J. A., Sherman, D. K., Luyster, F. S., & Mann, T. L. (2007). The effects of message quality and congruency on perceptions of tailored health communications. *Journal of Experimental Social Psychology*, 43(2), 249–257.

Utz, S., & Krämer, N. C. (2009). The privacy paradox on social network sites revisited: The role of individual characteristics and group norms. *Journal of Psychosocial Research on Cyberspace*, 3(2), 1–12.

van de Velde, L., Verbeke, W., Popp, M., & van Huylenbroeck, G. (2010). The importance of message framing for providing information about sustainability and environmental aspects of energy. *Energy Policy*, 38(10), 5541–5549.

Vaughn, L. A., O' Rourke, T., Schwartz, S., Malik, J., Petkova, Z., & Trudeau, L. (2006). When two wrongs can make a right: Regulatory nonfit, bias, and correction of judgments. *Journal of Experimental Social Psychology*, 42(5), 654–661.

Vishwanath, A., Xu, W., & Ngoh, Z. (2018). How people view and protect their privacy on Facebook: A cost-benefit view. *Journal of the Association for Information Science and Technology*, 69(5), 700–709.

Wan, E. W., Hong, J. W., & Sternthal, B. (2009). The effect of regulatory orientation and decision strategy on brand judgments. *Journal of Consumer Research*, 35(6), 1026–1038.

Wang, J., & Lee, A. Y. (2006). The role of regulatory focus in preference construction. *Journal of Marketing Research*, 43(1), 28–38.

Wang, Y., Wang, Y., Xie, L., & Zhou, H. (2019). Impact of perceived uncertainty on public acceptability of congestion charging: An empirical study in China. *Sustainability*, 11(1), 129.

Westin, A. (1967). *Privacy and freedom* (p. 7). New York: Atheneum.

Wijesekera, P., Baokar, A., Hosseini, A., Egelman, S., Wagner, D., & Beznosov, K. (2015). Android permissions remystified: A field study on contextual integrity. In J. Y. Jung (Eds.), *Proceedings of the 24th USENIX Conference on Security Symposium* (pp. 499–514). Berkeley, CA: USENIX Association.

Yaveroglu, I., & Donthu, N. (2008). Advertising repetition and placement issues in on-line environments. *Journal of Advertising*, 37(2), 31–44.

Zlatolas, L. N., Welzer, T., Heričko, M., & Hölbl, M. (2015). Privacy antecedents for SNS self-disclosure: The case of Facebook. *Computers in Human Behavior*, 45, 158–167.

Note: Figure translations are in progress. See original paper for figures.