# Analysis of the Influence of Safety Psychology and Cognition on Safety Behavior: A Review

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## Abstract

**The occurrence of accidents brings economic losses to people and society, even threaten people's lives. As the principal part of social activities, the unsafe behavior of humans is the key factor of causing accidents, and personality traits and safety psychological cognition are the fundamental roles. The probability of accidents may effectively reduce by adopting effective manual intervention based on mining the influence path relationship between personality trait and social cognition on safety behavior. Based on the literature review of the influence of safety psychology and cognition on safety behavior, several problems were found that experimental data sets are less and models or methods used are more traditional, etc. To this end, the research trends and application prospects of the influence of safety psychology and cognition on safe or unsafe behaviors are proposed.**

## Keywords

**Safety Psychology, Social Cognition; Personality Trait, Safe Behavior, Theory of Planned Behavior (TPB).**

## 1. Introduction

The number of accidents has decreased during recent years with the development of economy, society and technology, but accident risks still occur frequently. The occurrence of accidents is inseparable from the three aspects, that is human, machine and environment. As the main body of production activities, human beings are also the main factor that stimulates the accident. Relevant data shows that 85% of accidents are caused by human unsafe behavior, and personality traits and social psychological cognition play an important role. By analyzing the path relationship between safety psychology and cognition on safety behaviors, mining the main variables of accident-causing factors. the occurrence of accidents can be effectively reduced through manual intervention (e.g., formulating norms, self-perceived control, etc.).

The researchers continue to deepen in the fields of social cognition, safety psychology characteristics, personality traits and behavior patterns with the development of safety psychology and cognition. The occurrence of accidents can effectively control by exploring human psychology-behavior patterns, psychological and behavioral intervention for safe behaviors and predicting and correct guiding human behavior. This paper aims to review the researches on the impact of safety psychology and cognition on safety behaviors and prospects the research trends and directions.

## 2. Basic Theories

The influence of safety psychology and cognition on safety behavior can be analyzed from two aspects: social cognition and personality traits, which both explain the influence of safety psychology and cognition on safety behavior from two perspectives. Social cognition is the process by which individuals make speculations and judgments about the mental state, behavioral motivation and intentions of others. Personality traits refer to the relative consistency of individual differences in thought, emotion and behavior patterns.

### 2.1 Social Cognitive Theory

Social cognitive theory is an educational theory put forward by the famous American psychologist Bandura in the late 1970s, and it developed rapidly in the 1990s [1]. Bandura added a cognitive

component to the traditional behaviorist personality theory, further forming its social cognitive theory, which includes three main parts, namely ternary interactive determinism, observational learning and self-efficacy.

#### 2.1.1 Ternary Interactive Determinism

For a long time, personal determinism and environmental determinism have explained from different angles whether a behavior is determined by internal or external forces. Personal determinism emphasizes the regulation and control of behavior by human internal psychological factors, while environmental determinism believes that the external environment plays a decisive role in the control of behavior. The ternary interactive determinism believes that the environment, behavior, and human subject factors are theoretical entities that are independent, interactive and mutually determined. Environment, behavior, and people are mutually causing and effect, and each of them has a mutually determining relationship.

#### 2.1.2 Observation Learning

Observational learning means that individuals obtain some new responses or correct certain behavioral response characteristics by observing the behavior of others. Observation learning is composed of four interrelated sub-processes: attention process, maintenance process, output process and motivation process, and it is realized based on these four processes.

#### 2.1.3 Self-efficacy

Self-efficacy is an individual's self-judgment on the effectiveness of the interaction between oneself and the environment. People with a strong sense of self-efficacy can be interested in new things and invest in them, and can constantly strive to overcome difficulties [2]. Self-efficacy can be acquired from three aspects: successful experience in practice, alternative experience, and verbal persuasion, and it can be cultivated in a social environment.

### 2.2 Behavior Theory

#### 2.2.1 Theory of Rational Behavior

The theory of reasoned action (TRA) was proposed by American scholars Fishbein and Ajzen in 1975. It is mainly used to analyze how attitudes and subjective norms consciously affect individual behavior, and focus on the process of attitude formation based on cognitive information [3]. The basic assumption is that people are rational and will consider the meaning and consequences of their actions before taking it. The theoretical model of rational behavior is shown in Fig.1. An individual's behavior is caused by behavioral intention, which is determined by two factors, which are the individual's attitude towards behavior and the subjective norms of behavior. Attitude is the evaluation of whether an individual likes a behavior or not. It is a stable tendency formed by acquired learning and determined by the individual's belief in the behavior result. The subjective norm is determined by the standard belief and the individual's motivation to comply with the standard belief.

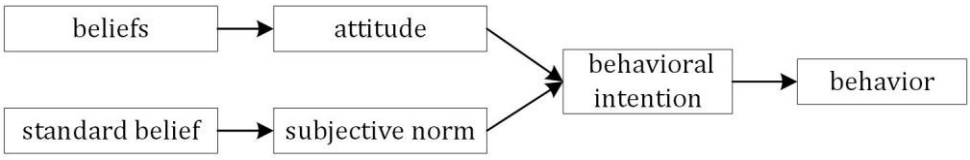


Fig.1 Model diagram of rational behavior theory

#### 2.2.2. Theory of Planned Behavior

The Theory of planned behavior (TPB) is proposed by Ajzen (1991) based on the theory of rational behavior [4]. It is believed that human behavior is not 100% voluntary, but is under control. Therefore, the rational behavior theory is expanded and a new concept of behavior control cognition is added (perceived behavior control). The theoretical model of the plan is shown in Fig. 2. Behavior is caused by behavior intention and perceived behavior control and behavior intention is jointly determined by

attitude, subjective norms and perceived behavior control. The combination of beliefs (i.e., behavioral beliefs, normative beliefs and control beliefs) influence behavioral intentions through three basic variables (i.e., attitude, subjective norms and perceived behavior control) [5].

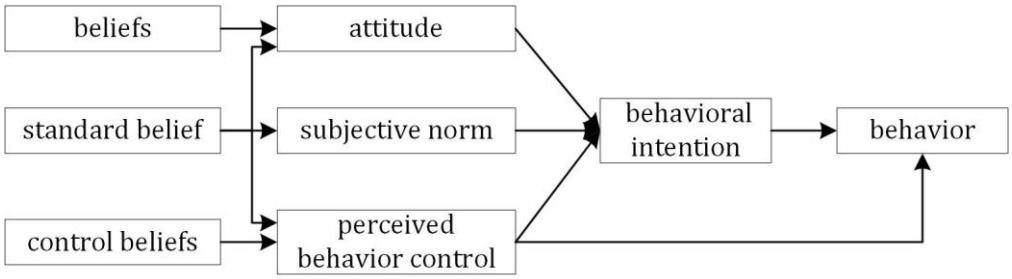


Fig. 2 Model diagram of the theory of planned behavior

### 2.3 Personality Traits

Personality traits refer to the relative consistency of individual differences in thought, emotion and behavior patterns. The performance of personality traits in safe behaviors can be divided into five types, which are named as sensation-seeking, aggression, anxiety, altruism and normlessness [6, 7]. Sensation-seeking is manifested as a tendency to seek excitement and stimulation. Aggression is manifested as a tendency to anger and frustration. Anxiety is manifested as a tendency to fear, worry and tension. Altruism is manifested as a tendency to actively relate to others in the course of behavior. Normlessness is manifested as the tendency to violate social rules for a certain purpose.

### 2.4 Safe Behavior

In the security field, the studies of behavior are divided into two aspects: unsafe behavior and safe behavior. Unsafe behaviors are abnormal behaviors that individuals show against their psychological characteristics, including behaviors that have caused safety accidents and behaviors that may cause safety accidents. Reason divided unsafe behaviors into errors and violations based on the human error model in 2000 [8]. Then, Lucidi et al. divided unsafe behaviors into violations, errors and mistakes in 2010 [9]. The current mainstream views of safety behavior can be divided into safety compliance and safety participation [10]. Safety compliance is an act that complies with relevant safety rules and regulations and social norms, and safety participation is active participation in enhancing safety affairs, including making safety recommendations.

## 3. The Influence of Social Cognition on Safe Behavior

Social cognition focuses on the studies of how dangerous attitudes, risk perception and social norms affect human safe behavior [11]. The research on the influence of social cognition on safe behavior mainly focuses on the influence of self-efficacy on safe behavior, and the influence of planned behavior theory on safety behavior.

### 3.1 The Influence of Self-Efficacy on Safe Behavior

Safety performance is a way to characterize safe behavior. Unsafe behavior also reflects safe behavior. Self-efficacy indirectly affects safety performance through intermediary variables, and then reflects the impact on safe behavior or unsafe behavior [12-14]. For different research objects, the introduced intermediate variables are different, and some use other indicators to characterize safety performance.

Sun et al. used safety participation, safety obedience, and safety results to characterize safety performance, and introduced safety motivation as an intermediary variable [15]. The research results showed that self-efficacy has a direct impact on safety participation and safety obedience, and indirectly affects safe results through safety motivation. Xu et al. introduced unsafe behavior as an intermediary variable to analyze the relationship between job burnout, self-efficacy and safety performance, and pointed out that job burnout affects safety performance by affecting unsafe

behaviors and safety performance plays a regulatory role among job burnout and unsafe behavior [16]. Wang et al. introduced safety awareness, safety motivation and safety cognition as the intermediary variables of self-efficacy and unsafe behaviors and proposed that self-efficacy indirectly affects unsafe behaviors through intermediary variables [17].

### 3.2 The Influence of TPB on Safety Behavior

The analysis of the influence of TPB on safe behavior is mainly through exploring the influence path and degree of the variables of TPB on safe behavior. For the basic variables of TPB (i.e., attitudes, subjective norms, and perceptual behavior control) affect behavior intentions and behaviors, the influence path and degree are not exactly when the research objects are different. Warner et al. analyzed the influence relationship path of the driver's speed selection behavior, and believed that subjective norms and perceptual behavior control are the main variables that affect driving behavior intention and driving behavior [18]. Chen et al. explored the factors of maintenance personnel's violation behaviors and formation process and pointed out that attitude of violation of regulations is the primary factor affecting maintenance personnel [19].

In recent years, many scholars have focused on adding extended variables based on the basic variables to research safe and unsafe behavior. More specifically, adding different extended variables for different research objects and cross-fields, and analyzing the influence path and degree of basic variables and extended variables on safe and unsafe behaviors. Most researchers considered that historical behavior is an important variable that affects behavioral intentions and behaviors, which can be explained well by adding it. For different research objects, historical behaviors can affect behavioral intentions and behaviors directly or indirectly through mediating variables, and can be used as mediating variables to affect behavioral intentions and behaviors. In the study of TPB on safety behavior, some scholars have analyzed the level of behavior intention, and some scholars have analyzed the level of behavior. Table 1 shows the related research of TPB on safety behavior.

Table 1 Related researches on the influence of TPB on safety behavior

| | *Extended variables* | Conclusion |
|---|---|---|
| Cao et al. [20] | *behavioral habit* | behavioral habits have a significant effect on behavioral intention |
| Gao et al. [21, 22] | historical behavior | historical behavior can explain behavior intention to a certain extent and can influence behavior through behavior intention |
| Li et al. [23] | historical behavior, travel environment | historical behavior directly affects behavior intention, and can also indirectly affect behavior intention through travel environment |
| Potard et al. [24] | historical behavior | perceived behavior control uses historical behavior as an intermediary variable to influence behavior intention |
| Zhang et al. [25] | social norms, herd tendency, travel environment | social norms, herd tendency, travel environment indirectly or directly explain behavior intentions |
| Gerard et al. [26] | management attitude, work pressure | management attitude affects behavior intention and behavior through attitude, subjective norms and works pressure |
| Chen et al. [19] | risk propensity, safety management | risk tendency indirectly affects behavior intention or directly influence behavior intention through attitude; safety management directly affects behavior intention |
| Li et al. [27] | social environment | social environment has a significant influence on behavior intention, which in turn affects behavior |
| Wang et al. [28] | moral obligation, historical behavior, individual background | moral obligations and individual background have a significant impact on behavior, and historical behavior has no significant impact on behavior |

## 4. The Influence of Personality Characteristics on Safety Behavior

The research on personality traits focuses on the predictive value of personality traits without evaluative and does not involve specific objects. The influence of personality traits on safe behavior is reflected in the influence of the connotation of personality traits on safe behavior. Specifically, the influence of feeling seeking, aggression, anxiety, altruism and non-standards on safe behavior. Relevant studies have shown that social cognitive variables (i.e., attitude and risk perception) play a mediating role in the influence of personality traits on safe behavior [6].

The researches of personality traits on safe behaviors mainly focus on the driving field, that is, the importance of personality traits is explored in dangerous driving behaviors, defensive driving behaviors, and safe driving behaviors. Ulleberg et al. earlier studied the relationship between personality traits and social cognition and safe behavior, and established a personality-attitude-dangerous driving behavior (PADDB) model for the dangerous driving behavior of young people [6]. The results showed that feeling seeking, aggressiveness and irregularity are positively correlated with dangerous driving behaviors (i.e., negatively correlated with safe behaviors), and altruism and anxiety are negatively correlated with dangerous driving behaviors (i.e., positively correlated with safe behaviors). More specifically, people with seek-feeling expect to seek excitement and stimulation in traffic behaviors, and are easy to adopt dangerous driving behaviors. Aggressive people are easily impulsive and show speeding and trailing behavior in traffic behavior. Unregulated people tend towards unapproved behavior in society cognitive impairment, which often violates social norms for a certain purpose, is reflected in traffic behavior as a violation of traffic regulations. The three personality traits reflect the intention and attitude of dangerous driving behavior, and negatively affect safe behavior. Altruistic people show concern for others and pay attention to other drivers in their driving behavior. Anxious people show fear and tension and are more aware of the risk of accidents and drive more cautiously. The two personality traits reflect the positive impact on driving attitude and positively affect safety behavior. At the same time, the research results also reveal that the variables of personality characteristics do not directly affect dangerous driving behaviors, but indirectly influence dangerous driving behaviors by influencing attitudes, which is set as an intermediary variable. Zheng and Wang et al. analyzed the influence of personality traits on unsafe driving behavior and pointed that social cognitive variables play an intermediary role in the personality-behavior relationship, and safety attitudes can directly affect dangerous driving behavior, while risk perception can only affect the impact of safety attitudes on driving behavior, which is different from the research conclusions of Ulleberg [29, 30]. Ulleberg believed that risk perception and attitudes together affect safety attitudes and are co-variable [6], while Zheng and Wang believed that risk perception is a precursor to safety attitudes, that is, personality traits affect safety attitudes by influencing risk perception, and then affect safety behavior [29, 30]. Based on previous studies, Chen only considered a social cognitive variable (that is, attitude) as an intermediary variable to explore the impact of personality traits on dangerous driving behaviors [31]. It is believed that irregularity is the most important factor affecting attitudes. Similar results can see in [32, 33].

However, the above-mentioned researches only considered the influence of the personality traits of young people on safe behavior, and did not consider the two groups of adult and elder. Lucidi et al. considered age factors and analyzed the influence of personality traits of different age groups (i.e., younger, adult and older) on dangerous driving behaviors. The research results showed that the non-standard traits of young driver have a stronger influence on attitudes than the elderly. The altruistic traits of adult driver have a positive influence on attitudes, while the altruistic traits of elder driver do not affect attitudes [34, 35]. Meanwhile, Lucidi et al. divided dangerous driving behaviors into violations, mistakes and errors, analyzed the influence of personality traits of different age groups on dangerous driving behaviors, and believed that the personality traits of different age groups with different operations (i.e. violations, mistakes and errors) on dangerous driving behaviors obtained varying degrees of impact [9, 34, 35].

The tendency of accidents reflects safe driving behavior from another angle, and the personality traits reflect the impact on safety behaviors by affecting the tendency of accidents. Zhao et al analyzed the relationship between personality traits and driving behavior characteristics, and introduced complex reaction capabilities and speed estimation capabilities to characterize accident propensity [36]. Complex reaction ability refers to the ability of an individual to make a correct response to external stimuli within a certain period and expressed by the number of wrong reactions and reaction time. Speed estimation ability refers to the accuracy of the individual's perception and judgment of the speed of an object. There is a strong positive correlation between complex reaction ability and speed estimation ability and the driver's aggressiveness, independence and courage, and a strong negative correlation between the driver's social orientation and stability. Drivers with strong sex, independence and courage lack self-control, which have weak perception of danger, and then belongs to dangerous people on the road and have a high tendency to accidents.

## 5. Conclusions and Prospects

### 5.1 Conclusions

The current research on the influence of safety psychology and cognition on safe behavior mainly focuses on the influence of social cognition or personality characteristics on safe behavior or unsafe behavior, and most of them are concentrated in high-risk industries (e.g., mining industry, construction industry, etc.) and driving behavior in the traffic field. In terms of the influence of social cognition on safety behavior, self-efficacy in social cognition theory influences safety performance through mediating variables, and then characterizes safe or unsafe behavior. On the correlation path of TPB that affects intention behavior and behavior, most scholars attempted to introduce different extended variables to analyze the correlation path of intentional behavior and behavior with basic variables according to different research fields and objects. In the analysis of the influence of personality traits on safe behaviors, the main focus is on the field of driving behavior, introducing social cognitive variables (i.e., risk perception and attitude) as intermediary variables to explore the correlation path and influence between personality traits, social cognitive variables and safe driving behavior (or dangerous driving behavior).

### 5.2 Prospects

Although the research on the influence of safety psychology and cognition on safety behavior is more detailed, they all collect data through questionnaires. Due to the limitation of the form of data collection (i.e., the data volume is small (generally does not exceed 500 samples) due to the questionnaire is difficult to recycle, the reliability and robustness of the data experimental analysis results are poor.

Furthermore, the used methods for the influence of safety psychology and cognition on safe behaviors are mostly (e.g., structural equation modeling, regression analysis, factor analysis, etc.), and it is difficult to mine the hidden correlation between social cognition variables, personality traits and safe behavior. To this end, consider applying fuzzy mathematics theory (e.g., fuzzy association rules), machine learning algorithms (e.g., grey correlation algorithm, improved association rule algorithm) and deep learning algorithms (e.g., neural networks) to mining the influence of safety psychology and cognitive variables on safe behavior and internal connection based on large sample data (which can be obtained through data sharing and integration).

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