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Study on the relationship between crisis awareness and medical waste separation behavior shown by residents during the COVID-19 epidemic

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HIGHLIGHTS
• The influence of crisis awareness on medical waste separation behavior was modeled.
• Environment-driven crisis awareness could not change residents’ classification habits.
• Spontaneous crisis awareness only promotes separation behavior by decision.
• Individuals were clustered into four types based on their crisis awareness.

GRAPHICAL ABSTRACT

ABSTRACT
Specific awareness is an important factor that affects individual behavioral decisions. This study explored the relationship between crisis awareness and medical waste separation behavior shown by urban residents during the COVID-19 epidemic in China. The results of a questionnaire survey data (N = 668) were subjected to statistical analyses, regression analyses, and cross-analyses. In terms of medical waste separation, the detection rate was 12.65%, among which, the waste separation behavior by citizens was the highest (24.56%). In terms of the relationship between crisis awareness and medical waste separation behavior, the crisis awareness generated by the environmental situation is significantly related to individuals’ participation in the separation of medical waste. In particular, individual spontaneous crisis awareness only had a significant positive correlation with the waste separation behavior for the decision factor. The residents were clustered into “sensitive”, “conscious”, “passive”, and “insensitive” types based on the original crisis awareness characteristics. The “sensitive” group was more actively involved in the separation of medical waste, while the “insensitive” group showed the worst performance for the separation of medical waste. A comparison of the separation behaviors shown by the “conscious” group and the “passive” group confirmed that environment-driven crisis awareness has a higher correlation with the separation of medical waste by residents.

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1. Introduction

According to the National Annual Report on the Prevention and Control of Environmental Pollution by Solid Waste in Large and Medium-
sized Cities in 2019 (MEERPC, 2019) issued by the Ministry of Ecology and Environment of China, the amount of urban medical waste increased between 2014 and 2018 by 67.1% per year. Furthermore, the COVID-19 epidemic is expected to substantially increase the output of medical waste in 2020 (Chang et al., 2020). Improper or incomplete treatment of medical waste will not only cause harm to the environment and human health but may even become a source of the epidemic (Dzekashu et al., 2017). Therefore, the disposal of medical waste has attracted the attention of a large number of researchers (Muduli and Barve, 2012; Barnett-Itzhaki et al., 2016; Nie, 2018). The effectiveness of source classification determines the difficulty associated with medical waste collection, transportation, and treatment, and is of great significance when attempting to strengthen the safe and harmless treatment of medical waste (Geller et al., 1982). How to guide separation behavior by residents and strengthen the management of medical waste separation have become an important and urgent issue for government and society.

It is thought that awareness has an important influence on individual behavior and decision making (Bargh, 2002; Casali et al., 2013), and this is also true in the field of environmental behavior (Krause, 1993). Kautish et al. (2019) conducted empirical research on Indian consumers and the results showed that individual environmental awareness significantly affected their environmental behavior. Shimoda et al. (2020) suggested that health awareness was a predictor of environmental and health behavior. Low carbon mental awareness is thought to be the main psychological attribution that promotes low-carbon consumption behavior and that internal and external contextual factors play a moderating role in the relationship between the two (Wang and Wang, 2011). Investigations about different kinds of waste separation and recycling have been conducted (e.g. Evison and Read, 2001; Chalak et al., 2016; Vassanadumrongdee and Kittipongvises, 2018; Chen et al., 2019; Papaioikonomou et al., 2020). According to these studies, awareness on a direct or indirect way, is an important factor in enhancing waste management.

In the field of modern psychology, awareness is defined as the “individual’s consciousness of external stimuli and their own feelings, experiences, and thoughts” (Block, 2007). The perception of external stimuli by an individual and their awareness of original memory and thinking are different forms of awareness. Crisis awareness is a specific type of awareness and it may be manifested as awareness during emergencies. It involves risk perception, and is partly based on individual memory and knowledge experience. Crisis awareness has a significant influence on individual behavior and decision making, especially environmental protection behaviors (Keshavarz and Karami, 2016; Maleksaedi and Keshavarz, 2019). For example, Kim et al. (2013) suggested that individual participation in environmental protection behavior is significantly affected by risk perception, including the perception of the severity of climate change-related consequences and the response effect of perception. Also, the crisis awareness generated by individual factors, such as information memory, knowledge, and experience, has been shown to have a direct impact on individual energy-saving behavior (Abrahamse et al., 2007) and green purchase behavior (Geppert and Stamminger, 2010). Previous studies on the relationship between crisis awareness and behavior have shown that individual implementation costs, social reference norms, and other contextual factors affect the transmission path for crisis awareness behavioral decisions (Cialdini et al., 1990).

In summary, crisis awareness arises from the perception of risk by an individual and their awareness of memory, knowledge, and experience. It has been shown to have an important influence on the implementation of individual behavior (Fig. 1). The COVID-19 epidemic provides an important context for studying the relationship between crisis awareness by residents and medical waste separation behavior. Therefore, this study investigated the correlation of the crisis awareness mechanism on medical waste separation behavior shown by urban residents during the COVID-19 epidemic.

2. Materials and methods

2.1. Literature review

2.1.1. Crisis awareness

Crisis awareness was defined in this study as “the combination of an individual’s perception of risk and awareness of their own feelings, experiences and thoughts”. Crisis awareness based on personal feelings, experiences, and thoughts is not necessarily related to the occurrence of risks. That is to say, it is the awareness that an individual has without external stimulation. Risk perception is formed through comprehensive judgments of various types of information (Schwing and Albers, 1982) and is concentrated in the cognitive and psychological responses to threatening situations (Setbon et al., 2005). Kaspersson et al. (2003) put forward the theory of risk amplification and suggested that risk perception arose from the interaction between disaster events, and psychology, society, institutions, and culture. Based on the above research, risk perception is summarized in this study as the “psychological feelings and cognitive behaviors toward emergencies shown by people”.

Research on crisis awareness is typically concentrated on public administration and corporate management. Risk perception arises in two

Fig. 1. Analysis of the relationship between crisis awareness and medical waste separation behavior.
main ways. One is that public acceptance and understanding of disasters play a major role in risk perception (Covello and Merkhofer, 1993; Huang et al., 2013). Also, media reports change personal perceptions of crises. For example, the number of media reports usually determines the perception of crises by a person (Wei et al., 2012). The development of the internet has magnified the level of public risk perception and behavior (Skraratidou et al., 2012). Related theories, such as resource dependence (Blau, 1964; Emerson, 1962), are used in the organization and management process. Previous studies have suggested that awareness of a crisis shown by company senior management depends on whether the key resources needed by the company are in the hands of other companies (Pfeffer and Salancik, 1978). On this basis, Wu et al. (2012) found that the crisis awareness shown by enterprise managers is mainly affected by the redundant resources of the enterprise.

Existing research conclusions suggested that crisis awareness mainly referred to individual perception of risk and the feelings, memory, and thinking shown by people. It could be affected by the public acceptance and understanding of disasters, the number of media reports, the development of the internet, and the key resource owners, redundant enterprise resources, and other factors available within an enterprise.

2.1.2. Medical waste separation

In general, waste is any substance that has no direct use and is permanently discarded (Shareefdeen, 2012). According to the Regulations on the Management of Medical Waste, issued by the State Council of the People’s Republic of China (SCRPC, 2003), medical waste refers to toxic or indirectly toxic, infectious, and other hazardous waste generated by medical and health institutions due to medical treatments, health care, prevention, and related medical activities. Medical waste is one of the types of waste that needs special treatment because it poses potentially high risks to human health and the environment. Some lower-middle-income countries, such as Bangladesh, suffer from poor medical waste management practices, which have now been put under further strain by the sudden increase in medical waste due to COVID-19 (Rahman et al., 2020). How to strengthen the separation and management of medical waste has become an important issue that government and society urgently need to solve.

At present, urban medical waste in China is mainly recycled and processed in a centralized manner, that is, medical waste from various medical units is collected and transported to a professional recycling center for centralized processing (Pu and Xia, 2018). During the COVID-19 epidemic, the daily production of medical waste in China significantly increased, which severely tested the national medical waste disposal system. To cope with the added pressure on medical waste treatment brought about by COVID-19, China has improved the medical waste disposal capacity in various places by building new, centralized disposal centers, adding mobile disposal facilities, and by transforming hazardous waste disposal facilities. As of March 21, 2020, the national medical waste disposal capacity was 6066.8 tons per day, an increase of 1164.0 tons per day from the 4902.8 tons per day before the epidemic (MEEPRC, 2019).

Compared to the medical waste generated by medical units, household medical waste has a small output and scattered production areas, so it is easily ignored. With the outbreak of the epidemic, the amount of medical waste generated by households using face masks, gloves, pills, vials, and medicinal liquids etc. has increased sharply and how to dispose of this kind of waste has attracted widespread attention (Chang et al., 2020). At present, China is guiding residents to participate in medical waste separation activities by setting up garbage bins in communities and public streets that are dedicated to household medical waste recycling. After recycling, this type of waste is sent to a centralized disposal center for processing. However, some residents arbitrarily discard domestic medical waste, which increases the pressure on medical waste disposal during the epidemic. Therefore, this study focuses on the medical waste generated by the family, such as face masks, gloves, pills, vials, and medicinal liquids, etc.

Gradually, it has been realized that relying on back-end waste disposal alone is not the best choice. The effectiveness of source separation determines the difficulty associated with medical waste treatment (Loan et al., 2017). A new approach based on separation at the front-end has been implemented in China (Hou et al., 2020). However, in general, the current situation regarding medical waste separation in China is not ideal, and effective guidance measures are needed.

2.1.3. The impact of crisis awareness on waste separation behavior

Behavioral psychology research regards awareness as a factor that determines behavior motivation and that behavioral ability further promotes behavior (Sharma and Bansal, 2013; Yue et al., 2013). Awareness internally affects individual information processing methods (Dijkstra et al. (2005) and emotions (Meneses, 2010), etc., which leads to explicit behavior differences. This recognition has led to a call for further research on the link between awareness and pro-environmental outcomes (Corsini et al., 2018). Chen et al. (2014) suggested that awareness reactions outweigh cognition in determining recycling behavior by residents.

Crisis awareness also has an impact on individual behavior. If conscious urban residents retain their thoughts on a crisis, they are more likely to change their behaviors (Walle et al., 2016). In crisis situations (such as in epidemics), improving the certainty of environmental perception and forming a set of self-consistent, subjective perceptions of epidemics can guide individual behavior and decision-making (Leppin and Aro, 2009). However, reports on public emergencies can also easily lead to public psychosocial crises, which can trigger rumors and increase panic (Verbeek, 2006). Also, the perception of crisis and risk is also considered to have a significant influence on environmental behavior. Some studies have suggested that a preventive focus has a significant predictive effect on the undesired environmental behavior of individuals. This conclusion is based on the adjustment focus theory (Higgins, 1997; Meyer et al., 2004).

The selection of individual behavior and the refinement of behavioral manifestations are conducive to systematic and professional research. This study drew on research by Chen et al. (2017a, 2017b, 2017c) and classified medical waste separation behaviors into four categories based on behavior motivation: These were (1) waste separation behavior by habit (HWBS), which is separation behavior based on their own living habits; (2) waste separation behavior by decision (DWBS), which is the separation behavior shown by urban residents after weighing up the interests of economy and health; (3) waste separation behavior by relationship (RWSB), which is the selection behavior shown by urban residents after they are affected by the behavior and attitude shown by other people toward garbage separation; and (4) waste separation behavior by the citizen (CWSB), which is the separation behavior shown by urban residents that is based on social responsibility and citizen awareness.

In summary, awareness is an important factor that affects individual behavior motivation and decision making. The peculiar psychological presentation of crisis awareness also has an effect on related behaviors. A large number of studies have investigated the relationship between risk perception and environmental behavior. However, few studies have performed an in-depth analysis of the relationship between crisis awareness and waste separation behavior, especially the effects of diverse crisis awareness sources on different forms of medical waste separation behavior. Therefore, this study explored how the crisis awareness is related to the separation behavior shown by residents during the COVID-19 epidemic.

2.2. Qualitative analysis

2.2.1. Sampling and data collection

Stratified sampling was used to determine the sample structure. To ensure the rationality of the sample, six cities (Jiaxing, Hangzhou, Xuzhou, Suzhou, Taiyuan, and Yinchuan) in four provinces distributed...
across eastern, western, and central China were selected for investigation. Eight samples were selected from each province. The age range of the samples was 21–55 years old and the samples had a normal distribution.

The interviews were based on structured questionnaires, and the main channels used to conduct the interviews were phone and social software (Wechat, Tencent QQ). The interview time for each resident was 25–40 min. During the interview, we adjusted and added questions based on the actual situation to ensure that the interview could be further extended. This study used the theoretical saturation test to determine whether the sampling for a certain structural category was saturated, which means that no additional information can be found. About 2/3 of the sample interviews were randomly selected for open coding, spindle coding, and selective coding analysis. The remaining 1/3 of the sample interviews were reserved for theoretical saturation testing.

2.2.2. Open coding
Open coding is a process of decomposing, testing, comparing, conceptualizing, and generalizing the collected data. The original interview records were conceptualized and categorized (see Appendix 1) and the structural elements related to crisis awareness were obtained. Space limitations meant that only representative original record sentences and initial concepts for each category are listed.

2.2.3. Spindle coding
The main task of spindle coding is to discover the potential logical connections between categories. During spindle coding, researchers only conduct an in-depth analysis of one category at a time and then further explore the correlations around this category. The various connections between the categories become more specific as the analysis deepens. Spindle coding identified the main category for crisis awareness (CA), which included individual spontaneous crisis awareness (ISCA) and environment-driven crisis awareness (ECA). Individual spontaneous crisis awareness refers to the crisis awareness that is not affected by the environment and takes into account civic responsibility, health, and habit consciousness. In contrast, ECA refers to the crisis awareness that is affected by the family environment, professional environment, and social environment. The specific coding process is shown in Appendix 2.

2.2.4. Selective coding
Selective coding identifies the core category from the main category and analyzes the connection relationship between the core category, and the main and other categories. It can then depict the phenomenon and context structure in the form of a “story line”. This study focused on the “story line”: “relationship between crisis awareness (CA) and medical waste separation behavior (MWSB) of urban residents”. A conceptual model was then constructed based on this “story line” that included CA and MWSB (Fig. 2).

2.2.5. Saturation testing and theory construction
Theoretical saturation is used to determine whether the sampling for a certain structural category is saturated. Saturation means that no additional information can be found. Therefore, researchers can develop characteristics for the category based on the available information. The results showed that the category dimensions and categories in the model shown in Fig. 2 have been sufficiently developed. No new categories and relationships were detected for the two crisis awareness sub-categories and no new constituent factors were discovered. The results suggested that the structural dimension of crisis awareness was theoretically saturated. Therefore, the hypotheses used in this study were as follows:

H1. ISCA has a positive relationship with the MWSB shown by urban residents.
H2. ECA has a positive relationship with the MWSB shown by urban residents.

2.3. Variables measurement and implementation

2.3.1. Variables measurement
The initial scale was obtained by revising and developing relevant items based on an existing maturity scale for waste separation behavior shown by urban residents (Chen et al., 2017a, 2017b, 2017c) and previous qualitative analyses. In order to test the feasibility of the scale, an online pre-survey was conducted from April 6 to 16, 2020. A total of 231 questionnaires were collected, and the final valid questionnaire count was 196. After pre-testing, we improved the description of two ambiguous items, based on feedback from interviewees during data collection, to ensure that each item of the questionnaire was accurate and easy to understand.

A formal survey questionnaire was obtained and the initial items were adjusted and modified based on the analysis results for reliability and validity. The questionnaire was divided into three parts. The first part was the basic information survey, which included gender, age, education, and monthly income level of the person, etc. In the second part, 22 items are used to measure CA (10 items for ISCA and 12 items for ECA) and 11 items are used to measure MWSB (3 items for HWSB, 2 items for DWSB, 3 items for RWSB, and 3 items for CWSB). A higher score indicated a stronger psychological tendency to engage in MWSB. The scales for CA and MWSB are shown in Appendix 3.

2.3.2. Research sample
Stratified sampling was used when conducting the formal survey. The sample objects of the survey were roughly determined for items...
such as sex, age and occupational fields. The study will try to ensure that there are as many females as males. In addition, about 40% of the samples between the ages of 18 and 30 will be investigated, and about 40% of the samples between the ages of 30 and 60 will be investigated. In terms of occupational fields, the study will also try to ensure that the proportion of respondent s in the non-industrial field is 50% - 60%. The official questionnaire was mainly distributed around cities in China that produced large amounts of medical waste during the epidemic, such as Wuhan, Shanghai, Suzhou, Tianjin, Jiaxing, Taiyuan, Yinchuan, Xuzhou, Beijing, and Guangzhou. The conditions caused by the epidemic meant that the questionnaires were mainly distributed in the form of online surveys (questionnaire links), but they were supplemented by on-site surveys, that is, the questionnaires were delivered in densely populated areas, such as residential and commercial areas. The sample distribution is shown in Appendix 4. The sample consisted of 53.6% female respondents. The average age was about 32 years old, and 44.9% of respondents was younger than 30. The overall education level of the sample was relatively high, 57.9% of the sample received undergraduate education and above. 64.1% of the sample was married. The average monthly income of the sample was mostly below 10,000 yuan, 21.7% of the sample’s monthly income was not higher than 2000 yuan, 32.2% of the samples’ monthly income was 2001–6000 yuan, 35.6% of the samples’ monthly income was 6001–10,000 yuan. And 40.6% of respondents worked in the industrial field. We used SPSS 22.0 (IBM Corp., Armonk, NY, USA) to analyze the 668 valid samples.

2.3.3. Reliability and validity testing, and factor analysis

The internal consistency test results for each dimension of the formal questionnaire are shown in Appendix 5 (Cronbach’s α > 0.66). The data showed that the scale was reliable.

Table 1
Descriptive statistical analysis results for urban residents.

| Variables | Mean  | Standard deviation | Inferiority value (mean < 3) |
|-----------|-------|--------------------|-----------------------------|
|           |       |                    | Frequency  | The detection rate(%) |
| MWSB      | 3.70  | 0.681              | 87        | 12.65% |
| HWSB      | 3.73  | 0.890              | 131       | 19.04% |
| DWSB      | 3.90  | 0.916              | 78        | 11.34% |
| RWSB      | 3.76  | 0.898              | 94        | 13.66% |
| CWSB      | 3.48  | 0.942              | 169       | 24.56% |

Also, a confirmatory factor analysis was conducted on the formal scale (Appendix 6). The statistical results showed that the structural fitting indicators of the two-factor model for CA and the four-factor model for MWSB reached an acceptable level, and the structural validity of the CA and MWSB were verified. Furthermore, the average extraction value of variance (AVE) for each factor was > 0.5, which indicated that the scale had good convergence validity.

3. Results

3.1. Descriptive statistical analysis

The Likert 5-point scale measurement in The Medical Waste Separation Behavior Measurement Scale was used in this study. Participants rated their agreement with each item on a scale from 1 (disagree strongly) to 5 (strongly agree). When the score was lower than 3, then an individual rarely showed any MWSB. Therefore, a MWSB score with a mean value of <3 points was defined as the inferior value (Chen et al., 2017a, 2017b, 2017c). According to Table 1, the overall average value for MWSB was 3.7 and the detection rate for inferiority was 12.65%. Also, the inferiority detection rates for HWSB and CWSB were relatively high at 19.04% and 24.56%, respectively.

3.2. Regression analysis

Each variable was first centralized (except demographic variables) and then a Pearson’s correlation analysis of each variable was conducted (Appendix 7). The analysis results showed that at a significance level of 0.05, the CA (ISCA and ECA) and the MWSB (HWSB, DWSB, RWSB, and CWSB) were significantly positively correlated. The VIP value for each item was between 1.861 and 1.903, and the D—W statistic was close to 2, which indicated that the data did not have any multicollinearity and autocorrelation issues.

Table 2 shows the regression analysis results for CA and MWSB. The addition of control variables (demographic variables, Appendix 8 shows how the variables were assigned) increased the goodness of fit of the model ($R^2 = 0.357 > R^2 = 0.314$). Based on model 6, ISCA was positively related to DWSB ($p < 0.05$), and models 2, 6, 8, and 10 indicated that ECA was positively related to DWSB, RWSB, and CWSB ($p < 0.01$). The results provided support for hypotheses H1 and H2. In terms of relationship between socio-demographics and medical waste separation behavior, residents aged 31–60 years old, marital status, and total
monthly income of 2001–6000 RMB and > 10,000 RMB passed the significance test.

3.3. Cross analysis

The residents were clustered into four groups based on the source characteristics for CA so that the relationship between CA and MWSB could be explored in depth. The performance characteristics of the different MWSB sample types were (1) individuals with high scores for ISCA (>3) and high scores for ECA (>3) were in the different MWSB sample types were (1) individuals with high scores for ISCA (>3) and high scores for ECA (>3) were in the “insensitive” group; (2) individuals with low scores for ISCA (<3) and low scores for ECA (<3) were in the “insensitive” group; (3) individuals with high scores for ISCA (>3) and low scores for ECA (<3) were in the “conscious” group; and (4) individuals with low scores for ISCA (<3) and high scores for ECA (>3) were in the “passive” group.

The average values for MWSB in the “sensitive”, “insensitive”, “conscious”, and “passive” groups were then analyzed (Fig. 3). The “sensitive” group had the highest average score for MWSB (3.88) and their scores for all the dimensions were higher than for the other groups. In other words, they participated in medical waste separation activities most frequently. In contrast, the “insensitive” group had the lowest average MWSB score (3.17), which meant they were least involved in medical waste sorting. The results indicated that individuals who showed a high level of crisis awareness due to spontaneous or environmental drive were most likely to take part in medical waste separation and classification. The remaining individuals did not exhibit high levels of MWSB, but they may undertake some medical waste classification. In particular, although ISCA only had positive correlation on HWSB, individuals with a high ISCA tended to undertake more MWSB.

The “insensitive” group was used as a reference to analyze the differences in the MWSB between the “passive” and “conscious” groups (see Table 3). The results showed that the “conscious” and “insensitive” groups did not demonstrate significant MWSB differences. However, the “passive” and “insensitive” groups had significantly different MWSB, DWSB, and RWSB values. This further showed that ECA had a higher correlation with on MWSB than ISCA.

4. Discussion

The descriptive analysis results showed that the detection rate for the inferiority value of medical waste separation behavior during the COVID-19 epidemic was low (12.65%). It is worth noting that the detection rate for waste separation behavior by citizens was the highest (24.56%), which shows that the level of citizenship among Chinese urban residents is relatively low when it comes to handling waste separation. In general, residents showed better medical waste separation

Table 3

| ISCA        | Levene test of variance equation | t-Test of variance equation | ECA        | Levene test of variance equation | t-Test of variance equation |
|-------------|----------------------------------|----------------------------|------------|----------------------------------|----------------------------|
| MWSB        | Assuming equal variances         | 0.913 0.341                | -0.888 0.376 | MWSB Assuming equal variances   | 1.13 0.29                  | -2.119 0.036               |
|             | Assuming that the variances are not equal |                      | -0.886 0.377 | Assuming that the variances are not equal | 2.200 0.030 |                   |
| HWSB        | Assuming equal variances         | 0.068 0.795                | -0.756 0.451 | HWSB Assuming equal variances   | 0.003 0.957               | -0.016 0.987               |
|             | Assuming that the variances are not equal |                      | -0.756 0.451 | Assuming that the variances are not equal |                   |                                  |
| DWSB        | Assuming equal variances         | 2.879 0.092                | -1.198 0.233 | DWSB Assuming equal variances   | 0.027 0.869               | -2.184 0.031               |
|             | Assuming that the variances are not equal |                      | -1.194 0.234 | Assuming that the variances are not equal |                   |                                  |
| RWSB        | Assuming equal variances         | 1.937 0.166                | -0.757 0.448 | RWSB Assuming equal variances   | 0.918 0.34                | -2.345 0.021               |
|             | Assuming that the variances are not equal |                      | -0.757 0.448 | Assuming that the variances are not equal |                   |                                  |
| CWB         | Assuming equal variances         | 1.673 0.198                | -0.158 0.875 | CWB Assuming equal variances    | 0.918 0.340              | -2.345 0.0210              |
|             | Assuming that the variances are not equal |                      | -0.158 0.875 | Assuming that the variances are not equal |                   |                                  |
behavior compared to their general waste separation behavior (Chen et al., 2017a, 2017b, 2017c). They also showed certain risk perceptions, and moderate fear and anxiety due to the epidemic (Wang and Ying, 2020), which may stimulate or increase their crisis awareness and promote their participation in medical waste classification activities. Furthermore, previous studies have shown that psychological distance has an effect on individual perception and judgment, thereby affecting their acceptance attitude and ability (Soderberg et al., 2015). Furthermore, public safety events that directly affect the life and health of individuals will shorten the psychological distance of an individual (Burns and Slovic, 2007; Rahmi et al., 2019). Also, the widespread application of mobile social media has greatly increased the amount of information and the number of information sources. These changes also reduce the psychological distance of individuals (Zhang and Gan, 2020). During the epidemic, the relevance and transparency of information may have had a certain effect on the psychological distance of residents, which meant that they better understood the importance and necessity of medical waste classification. This may be the reason why the residents showed an improved response attitude toward the medical waste separation policy.

The results of the relationship between crisis awareness and medical waste separation behavior showed that the different forms of crisis awareness had no correlation with the waste separation behavior for habit factor. The idea behind habitual behavior is that some people realize that they sometimes follow the same mindset (Marchetti and Rosenberg, 2017). For example, previous research has suggested that habitual behavior was a completely unconscious automated action process (Garndner, 2009), which took a long time to shape (Dewsbury and Bissell, 2015). However, the crisis awareness triggered by the COVID-19 epidemic was mostly an emergency response to a sudden situation. It is difficult to affect the way of thinking by residents over a short period of time, which means that residents do not form stable habits.

The cross-analysis results showed that environmentally-driven crisis awareness had a higher correlation with the separation of medical waste than spontaneous crisis awareness. This study confirmed the relationship between environmental stimuli and individual behavior reported in previous studies. According to the “stimulus-body-response” model, external stimuli drive individual emotional responses (consciousness), and their emotional responses (awareness) lead to individual behavior (Mehrabian and Russell, 1974). In the context of this research, the COVID-19 epidemic may stimulate individual emotional responses (environment-driven crisis awareness), and this emotional response (environment-driven crisis awareness) could improve their participation in medical waste separation. Also, Tversky and Kahneman (1974) suggested that individuals often adopt the principle of anchoring and adjustment when recognizing and judging new things, that is, they formed an “anchor” based on original knowledge and experience, and then adjusted the “anchor” by obtaining external information. This new information then determined related behavior and decision making by individuals. Spontaneously generated crisis awareness is the “anchor” and is based on long-term life judgments by residents. Related media news, national policies, and other information about the epidemic will prompt residents to adjust their corresponding awareness and stimulate their environment-driven crisis awareness, which makes it more relevant to separation behavior by residents.

Previous studies have shown that individual implementation costs (Mee et al., 2004), social reference norms (Saphores et al., 2012), relevant promotional measures (Stoeva and Alriksson, 2017), and other contextual factors affect individual waste separation behavior. Future research should extend the model outlined in this study and consider the impact mechanisms underlying other contextual factors that affect medical waste separation behavior. Although this study tried to ensure the representativeness of the sample as much as possible during sample selection, randomness could not be fully guaranteed in a sample and it was difficult to create a sample distribution that matched the actual distribution. The sample in this study was biased toward younger people with a higher education. Other data collection methods will be tried in future research.

5. Conclusions

Under the background of the COVID-19 epidemic, this study introduced the concept of crisis awareness combined with the results of a qualitative analysis, and has constructed a correlation model that includes crisis awareness and medical waste separation behavior. The data from 668 urban residents showed that the detection rate for individual medical waste separation behavior was 12.65%, among which, the detection rate for waste separation behavior by citizen was the highest (24.56%). The regression analysis results showed that environment-driven crisis awareness had a significant correlation with the medical waste separation behavior for citizen's factors and its related dimensions, while individual spontaneous crisis awareness only had a positive correlation with the waste separation behavior for decision factor. Therefore, strengthening resident crisis awareness maybe conducive to promoting their participation in medical waste separation. Based on the original characteristics of crisis awareness, residents can be clustered into “sensitive”, “conscious”, “passive”, and “insensitive” types. The “sensitive” group was more actively involved in the separation of medical waste. In contrast, the “insensitive” group showed the worst medical waste separation behavior according to the medical waste separation behavior results and the characteristics of its dimensions. Also, environmental-driven crisis awareness has a higher correlation with medical waste separation behavior by residents according to the comparison between the “conscious” groups and “passive” groups. We believe that the reinforcement of public awareness about environmental issues can increase resident participation in medical waste separation activities. The results provided important theoretical and practical support for medical waste separation.

CRediT authorship contribution statement

Feiyu Chen: Conceptualization, Methodology, Investigation, Writing – original draft, Project administration, Funding acquisition. Jingxuan Lou: Writing – review & editing, Software, Formal analysis. Jiangxin Hu: Software, Formal analysis. Hong Chen: Conceptualization, Validation, Resources, Writing – review & editing, Supervision. Ruyin Long: Supervision, Validation, Resources. Wenbo Li: Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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