Study on the influencing factors of waterfowl farmers' veterinary drug use behavior

Xingdong Wang,[1]* Mengqi Wang[2]

(1. School of Economics and Management, Jiangxi Rural Revitalization Strategy Research Institute, Jiangxi Agricultural University, Nanchang, 330045, People's Republic of China; 2. School of Economics and Management, Jiangxi Agricultural University, Nanchang, 330045, People's Republic of China)

Abstract

In recent years, with the transformation and upgrading of China's livestock industry, the normative use of veterinary drugs has gradually come under the spotlight. This study is based on an extended theory of planned behavior to investigate farmers' behavior in regulating the use of veterinary drugs according to the Veterinary Drug Administration Regulations (VDAR). To this end, the proposed conceptual model is tested by analyzing survey data from 527 participants in Jiangxi, Hubei, and Yunnan Provinces, China. The results indicated that attitude, subject norm, and perceived behavioral control (PBC) are related to farmers' behavior in using veterinary drugs. Perceived benefit influenced attitude, while perceived risk significantly influenced PBC. The results also provide good evidence that the extended theory of planned behavior enhances the explanatory power of predicting farmers' normative veterinary drug use behavior. The implications of the findings for the extended TPB are discussed.

Keywords:Theory of planed behavior；Ecological farming；Farmers' behavior；Perceived benefit；Perceived risk

[1]* Xingdong Wang (1979 -), male, Doctor of Management, Associate professor (wxd_email@126.com), researching in marketing, consumer behavior, rural consumption, farmer behavior.

[2] Mengqi Wang (1998 -), female, postgraduate (976052892@qq.com), researching in marketing, consumer behavior, rural consumption, farmer behavior.

Introduction

Historically, veterinary drugs have been widely used in poultry for therapeutic, preventive, and growth promotion purposes (Stolker and Zuidema et al., 2007; Reig and Toldrá, 2008; Novaes and Schreiner et al., 2017). However, the negative effects associated with the irrational use of veterinary drugs are gaining attention. As expected, the irrational use of veterinary drugs in food animals may have environmental and public health safety implications. It may also increase unnecessary risks (SIMONSEN and TAPSALL et al., 2004; Beyene and Tesega, 2014; Manyi-Loh and Mamphweli et al., 2018). More importantly, the use of veterinary drugs in food animals has the potential to produce residues in animal-derived products that pose a health hazard to consumers， such as allergies and problems with the human intestinal flora. (Cerniglia and Kotarski, 1999; Paige and Tollefson et al., 1999; Beyene and Assefa, 2015). In recent years, the application of veterinary drugs in the field of animal husbandry in China, for the treatment of about 25%, for animal disease prevention and growth promotion accounted for about 75%, of which the proportion of unreasonable use of drugs up to 40% ~ 85%. At the same time, about 60% of the pathogenic bacteria in humans originate from livestock and poultry (Jiang and Su, 2021). Because of this, the Chinese government promulgated the Veterinary Drug Administration Regulations（VDAR） to regulate the management of veterinary drug use. However, overuse and abuse are still prevalent (Wang and Deng et al., 2018).

Regulating the use of veterinary drugs can not only bring benefits to farmers but also help protect consumer health, protect the environment and solve public health problems. Therefore, it is imperative to clarify the determinants that drive farmers to regulate their behavior in the use of veterinary drugs (Pastoret, 1999; Lees and Shojaee Aliabadi, 2002; Ćupić and Dobrić et al., 2011). Some studies predict human intention or behavior based on the extending TPB model (e.g.(Botetzagias and Dima et al., 2015; Yadav and Pathak, 2016; Si and Shi et al., 2020)) Therefore, this study explored the drivers of farmers' veterinary drug use behavior based on the standard TPB model. By introducing two additional predictors, perceived benefit and perceived risk, the explanatory model is extended to better understand the decision-making process of farmers in using veterinary drugs based on VDAR.

The main objectives of this study are 1) to apply the extended TPB to explain farmers' behavior in normative use of veterinary drugs in agricultural activities；2) to Explore the pathways by which perceived benefits and perceived barriers to the proper use of veterinary drugs by farmers are generated. To achieve these goals, in the following section, we review the literature and hypothesize relationships between variables. Section 3 describes the methodology.

Section 4 presents the estimation results. The final section presents conclusions and discusses policy recommendations.

Theoretical framework and hypotheses development

Theory of Planned Behavior (TPB)

TPB is one of the most influential and commonly used psychological theories to explain pro-environmental behavior (Ajzen, 1985). It is also an important social cognitive model for predicting individual behavior and intention (Yazdanpanah and Forouzani, 2015). Different types of behavior and intention can be accurately predicted by attitude, subject norm, and perceived behavioral control (PBC) (Ajzen, 1991). Attitude is interpreted as people's positive or negative evaluations of their behaviors. In general, when an individual has a more positive attitude toward a behavior, he or she is more willing to perform this behavior (George, 2004; Botetzagias and Dima et al., 2015). It is a farmer's attitude to perform a characteristic behavior either negatively or positively after the awareness of something. The more positive and strong the attitude is, the more its willingness to behave will be transformed into behavior. For example, Meijer and Catacutan (2015) examined farmers' attitude towards tree planting in Malawi, they concluded that farmers with a positive attitude towards biodiversity conservation were more willing to conserve biodiversity on their farms. Subject norm refers to the pressure that people perceive from important others to perform or not to perform a behavior (Rivis and Sheeran et al., 2009). Specifically, Maleksaeidi and Keshavarz (2019) demonstrated that farmers' decision-making processes and intention towards biodiversity conservation are mainly influenced by friends and family members. That is, when farmers are making decisions about whether to use veterinary drugs in regulated livestock farming, pressure from important family members or government organizations, for example, may have an impact on their willingness to act, which in turn influences the farmers' behavior. Therefore, the following hypotheses are predicted:

H1:Attitude will positively influence farmers' intention of using veterinary drugs normatively.

H2:Subject Norm will positively influence farmers' intention of using of veterinary drugs normatively.

PBC is interpreted as the perception of the ease or difficulty of a behavior (Vasquez and Foditsch et al., 2019). Ajzen and Madden (1986) indicated that PBC could increase the prediction of intention. Besides, PBC may have a direct effect on behavior because PBC may reflect a person's actual control over behavior (Beck and Ajzen, 1991; Kaiser and Gutscher, 2003). Chengxing (2018) combined TPB theory to study the factors influencing the prophylactic use of household antibiotics in livestock farms, concluding that PBC will directly influence the implementation of specific farmer behaviors. Similarly, Kaiser and Gutscher (2003) used the TPB model to study the ecological behavior of Swiss residents which showed that PBC had the strongest explanatory power for behavior and intention. This means that if farmers themselves believe that they have strong ability and sufficient time and energy to regulate the use of veterinary drugs, the stronger their cognitive control of the behavior of regulated use, the stronger the farmers' willingness to regulate the use of veterinary drugs, and the greater the likelihood of utilization behavior occurring. Therefore, the following hypotheses are predicted:

H3:PBC will positively influence farmers' intention of using veterinary drugs normatively.

H4:PBC will positively influence farmers' behavior of using veterinary drugs normatively.

And according to Azjen (1980), the intention is the most important and the best predictor of behavior. Many behaviors in daily life can be considered to be controlled by the will because people can easily perform them if they have the will to do so (Ajzen, 1985). For example, Emekci (2019) studied consumers' green consumption behavior within the TPB and confirmed that consumers' environmental intention positively influences their green purchasing behavior. Therefore, the following hypotheses are predicted:

H5:Farmers' intention of using veterinary drugs normatively will positively influence behavior.

Construction of the extended TPB model

Although the effectiveness of TPB in predicting intention has been demonstrated in various domains, Ajzen (1991) noted that the theory is capable of increasing additional explanatory strength if the new structure can be shown to help explain much of the variance in intention and behavior. Therefore, a large number of applications of the TPB model to study the intention or behavior of individuals have attempted to add additional structure that would enhance the predictive power of the theory (e.g.(Cooke and Sniehotta et al., 2007; Al-Debei and Al-Lozi et al., 2013; Maleksaeidi and Keshavarz, 2019)).

As well as in the pro-environmental domains, the perceived benefit can be used as a predictor to increase the explanatory power of TPB models (Arora and Aggarwal, 2018).

Perceived Benefit is the perception of a positive consequence of a particular action (Leung, 2013; Melewar and Alwi et al., 2013). Yoon (2011) also suggested that perceived benefit is a belief about the positive consequence that affects behavioral attitude or behavioral intention. Hartmann and Apaolaza-Ibáñez (2012) pointed out that concern and awareness of environmental benefits will strengthen consumer attitudes towards green energy brands. So the perceived expected benefit is the key to motivate farmers to regulate the use of veterinary drugs, and can be used to judge farmers' behavioral attitudes. Therefore, the following hypotheses are predicted:

H6:Perceived benefit will positively influence farmers' attitude of using veterinary drugs normatively.

Perceived risk is the likelihood of negative outcomes perceived by individuals in the decision-making process (Wang and Deng et al., 2018). Baird and Thomas (1985) defined perceived risk as uncertainty, including an assessment of the controllability of such uncertainty. Sitkin and Weingart (1995) noted that people with extensive experience are likely to take more risks, which in part implies that perceived risk is also associated with PBC. Some scholars have demonstrated in other domains that perceived risk can have a negative impact on PBC (Lu and Yeh et al., 2016; Xie and Song et al., 2017). Farmers have an aversion to risk, and their behavioral logic is not to take risks to obtain higher returns, but to try to avoid risks and pursue safety and security, which may negatively affect the perceived behavioral control of farmers to regulate the use of veterinary drugs. However, the relationship between perceived risk and PBC in a pro-environmental context has not been studied. Therefore, the following hypotheses are predicted:

H7:Perceived risk will negatively influence farmers' PBC of using veterinary drugs normatively.

Hypothesis proposed

Based on the above literature review and discussion, we propose a conceptual model (Figure 1). Our theoretical framework involves six latent variables, one explicit variable, and seven hypotheses. In addition to the original TPB, we added perceived benefit and perceived risk to improve the explanatory strength.

Materials and methods

Measures

The constructed questionnaire was designed after reviewing the literature and based on the actual situation in the study area. The wording was revised in the case of an imperfect understanding of some items. On this basis, we refer to the guidance of Ajzen (2006) and use the measurement scales and indicators of Kim (1991), Jeong and Ham (2018), and Rezaei et al (2019) in the literature.

The final questionnaire was divided into two parts. The first part deals with demographic characteristics (including gender, age, education level and place of residence, etc.). There were 16 items in the second part. Attitude, subject norm, perceived benefit, and perceived risk were measured using 3 items each. Two items each were utilized to assess PBC and intention. The scoring was based on a 5-point Likert scale from 1 (very reluctant/strongly disagree) to 5 (very willing/strongly agree). One item was used for behavior. This statement was anchored by 1 ‘rarely’ and 5 ‘often’. The exact wordings of the statements used in all scales are reproduced in the Appendix.

Data collection and Geographical Context

Asia accounts for more than 80% of total waterfowl production, with China being the most important. And as the market demand for waterfowl gradually increases, the safety of the waterfowl industry is particularly important.

First, we conducted a random sampling based on the survey statistics of China's National Waterfowl Industry Technology System (CNWITS) on waterfowl production in 21 major waterfowl-producing provinces (cities and districts) in China, and the randomly selected target provinces were Jiangxi, Hubei, and Yunnan. Jiangxi Province is located south of the Yangtze River and has the largest freshwater lake in China with a humid and mild climate. The Waterfowl industry is a traditional advantageous characteristic industry in Jiangxi Province, which has played a positive role in local economic development and farmers' income. Hubei Province is located in the south of central China, and the good natural conditions have also laid a solid foundation for agriculture in it. The province is a major livestock province in China, and the Jianghan Plain is an important egg and duck breeding base, with a steadily developing waterfowl industry. Yunnan Province is located in the southwest of China with complex climate types. Known as the animal kingdom, its waterfowl species are also very rich and unique.

We recruited 11 volunteers in Jiangxi, Hubei, and Yunnan provinces to conduct the questionnaire survey, including 6 volunteers in Jiangxi, 3 volunteers in Hubei, and 2 volunteers in Yunnan. Each volunteer will distribute 50 original questionnaires, totaling 550 questionnaires. Before the survey, we trained the volunteers. Requirements in the selection of survey subjects must have many years of experience in farming or farming enterprises, cooperatives, etc., with as much research as possible in the provinces along the rivers and lakes of key farming areas. We eventually returned a total of 527 valid questionnaires, with a return rate of 95.8%.

Data analysis

We used the least significant difference (LSD) analysis to test whether there were any significant differences in the responses of the three different provinces. At $p < 0.05$, no significant differences were found in the profile of participants or the structure measured. Therefore, in all the analyses that follow, the data from the three provinces were combined.

With Structural Equation Modeling (SEM) in AMOS 21.0, it is possible to test a measurement model and a structural model at the same time[3]. A two-step procedure to test the research hypothesis (C. and W., 1988). In the first step, confirmatory factor analysis (CFA) is used to assess the fit of the measurement model and evaluate the reliability and validity of the construct. In the second step, the structural model is used to test the relationship between the hypotheses. Since the skew and kurtosis statistics showed deviations from the assumption of normality, a bootstrap method was used to adjust for the non-multivariate normality using the maximum likelihood estimation method (Satorra and Bentler, 1994; Markus, 2012).

Results

Participants' profile

The demographic characteristics of the respondents are shown in Table 2. 67% of the respondents are male and 33% are female. Their ages ranged from 21 to 88 years, with an average age of approximately 50 years (SD = 14.693). In addition, they have a low level of education, with 9.1% being illiterate. Only 9.9% have attended college and above. In terms of annual household income, nearly half (48.6%) are 20,000-60,000 yuan (3,076-9,227 USD). The average poultry stock of the participants from 2017 to 2019 was 1552.63 (SD = 7323.792),

[3] An ideal sample size target is a ratio of 20:1 of the number of participants to the number of model parameters (Suhr, 2006). The ratio in this study was 33.0:1, which meets the requirement of an adequate sample size.

2276.15 (SD = 10966.569) and 5083.98 (SD = 26041.042). This is consistent with the 2020 China Rural Statistical Yearbook.

As shown in Table 1, The mean values of attitude (3.85), perceived benefit (3.73), and intention (3.87) are higher, the mean scores for subject norm (3.69) and perceived risk (3.55) are moderate, while the mean scores for behavior (3.22) and PBC (3.14) are low. These results indicate that most farmers have good perceived interest and attitude towards the use of veterinary drugs according to specifications. And, they are easily influenced by themselves as well as others. However, they feel that they do not have enough control to regulate the use of veterinary drugs, probably because they do not have the financial and technical backing. In addition, participants have a strong intention (3.87) but do not fully translate them into behavior (3.22).

Reliability and validity testing

Several metrics were used to validate the applicability of the studied models to both the survey data analysis and the TPB model (Maleksaeidi and Keshavarz, 2019). The goodness-of-fit indices of the studied models are shown in Table 3. Clearly, all indices confirm the goodness of fit of the model. For example, the Chi-square ratio of TPB to degrees of freedom (x2/df) was estimated to be 1.717, which is less than 3 (Bagheri and Bondori et al., 2019). Meanwhile, the values of the goodness-of-fit index (GFI), comparative fit index (CFI), and Tacker-Lewis index (TLI) are higher than 0.9, which indicates that the extended TPB model is acceptable.

As shown in Table 4, Cronbach's alpha was used to test the internal consistency of the questionnaire. The coefficients of this questionnaire were mostly between 0.8 and 0.9, indicating high reliability of the research instrument (meeting standard). In addition, the mean square deviation AVE of each latent variable was greater than 0.5 and the combined reliability was greater than 0.7, which indicates ideal convergent validity.

As can be seen in Table 5, there is a significant relationship between the variables. Correlations are found between intention to normalize the use of veterinary drugs and most variables such as attitude, subject norm, perceived benefit, perceived risk, and PBC ($p<0.01$). Besides, the absolute values of the correlation coefficients were all less than 0.5 and were all less than the mean value of the corresponding AVE, which means that the latent variables were correlated and discriminated from each other, indicating that the scale data were desirable. However, it is important to note that the above analysis involves only correlations which do not necessarily reflect causality.

This study used Harmanns' one-way test to ensure that common method bias (CMB) did not alter the results of this study (Podsakoff and MacKenzie et al., 2003). This study also used a one-factor test, in which a fixed factor from all major constructs was used to explain less than 50% of the variance (Abdullah and Al et al., 2018). The results showed that the first principal factor explained only 43.9 % of the variance, indicating that the CMB did not seem to pose a threat to the relationship between the measures (Sun and Wang et al., 2015).

Structural equation model results

We used a structural equation approach to test the predictions of the proposed theoretical framework and the established, less complex model on the regulated veterinary drug use behavior of Chinese farmers. A rigorous theoretical test of a well-established theoretical model, a partial combination model, and a comprehensive overall model was conducted on a sample of 527 Chinese farm households.

First, the applicability of the TPB-based model is examined independently. Figure 3a shows the results of the TPB estimation model. Next, the model is extended by adding perceived benefits and perceived risks to the TPB model, respectively. The estimation results are shown in Figures 3b and 3c. Finally, Figure 3d shows the estimation results of the comprehensive model. The model fit indices of the TPB model, extended TPB model 1, extended TPB model 2, and the integrated model is shown in Table 6.

The model of TPB

In the first place, the TPB model was tested. According to the results of the structural equation analysis, the PBC of farmers is a key contributing factor in regulating veterinary drug behavior when farmers use veterinary drugs. In addition, attitude contributed the most to predicting intention, followed by subjective norm and PBC.

In terms of model fitting, the results showed that the standard TPB structural model performed well in predicting farmers' normative veterinary drug use behavior. Approximately 31% of the variance in veterinary drug use behavior was explained by a combination of intention and corresponding PBC. Furthermore, 58% of the variance in Intention to use veterinary drugs was explained by the proposed predictors based on TPB.

The entended TPB model 1

Second, the TPB model with the inclusion of perceived benefits was tested. According to the results of structural equation analysis, perceived benefit is an important contributing factor to influence farmers' attitude. Similar to the TPB model， attitude made an important contribution to the prediction of intention, followed by subject norm and PBC.

In terms of model fitting, the results showed that the extended TPB model 1 performed well in predicting the behavior of Chinese farmers in normative use of veterinary drugs. About 67% of the intention was explained by it.

The entended TPB model 2

Third, the TPB model that includes perceived risk was tested. According to the results of structural equation analysis, perceived risk is an important contributing factor to the control of farmers' perceived behavior control. Similar to the TPB model， attitude made an important contribution to the prediction of intention, followed by subject norm and PBC.

In terms of model fitting, the results showed that the extended TPB model 2 performed well in predicting the behavior of Chinese farmers in normative use of veterinary drugs. Approximately 34% of the variance in veterinary drug use behavior was explained by a combination of intention and PBC.

The comprehensive model

Finally, the comprehensive model was tested. The results were similar to the original TPB model, with attitudes contributing the most to the prediction of intention, followed by subject norm and PBC. Meanwhile, perceived benefit have a positive effect on farmers' attitude, and perceived risk also have a negative effect on PBC. In conclusion, all hypotheses were supported, proving the model to be reasonably robust.

The results showed that the integrated model performed well in predicting farmers' normative veterinary drug use behavior. Approximately 34% of the variation in use behavior was explained by a combination of interventions for intention and PBC. In addition, 67% of the intended variants were explained. The fit of all four models was acceptable, and the combined model outperformed the other models in predicting farmers' veterinary drug use behavior.

Discussion and implication

This study attempts to explore the factors influencing farmers' regulated veterinary drug use behavior in three Chinese provinces based on an extended version of TPB. A similar approach has not been reported in the literature regarding the behavior of farmers in normative veterinary drug use. Therefore, this study provides new insight and makes some theoretical contributions to better predict farmers' regulated veterinary drug use behavior. It helps to raise farmers' awareness of the normative use of veterinary drugs following veterinary regulations and is practically reflected in agricultural production.

The results of path analysis showed that among the variables of the expanded TPB regarding the intention to use veterinary drugs, each of the variables: attitude, subject norm, and PBC separately accounted for 68%, 14% and, 19%. In this study, farmers' attitude is the most important variable influencing their intention. And from the positive effect of perceived benefit on attitude, it can be concluded that farmers are motivated to develop a positive attitude because they care about the sense of accomplishment and favorable comments from regulated operations, which suggests some intrinsic motivation. Cary and Wilkinson (1997) noted that pro-environmental attitude does not translate into pro-environmental behavior unless there is an economic or another benefit to that behavior. Therefore it is necessary to improve the perceived benefit of farmers' use of veterinary drugs according to VDAR, which is not only an ecological effect but also an economic one. It is suggested that the government can improve the policy benefits of normative use of veterinary drugs by promoting the benefits of farmers after the normative behavior through the internet or other media, thus contributing to the positive coping attitude of farmers.

In terms of the subject norm, the importance of human factors in improving the norms of veterinary drug use is emphasized. Artikov and Hoffman (2006) argue that their perceptions of veterinary drugs will greatly influence the use and impact of veterinary drugs by focusing on changing the beliefs and values of farmers as well as their society. Therefore, from the subjective feelings of farmers, the sense of ownership of farmers on the use and management of veterinary drugs should be properly enhanced to improve the self-efficacy of farmers to regulate the use of veterinary drugs. The government should promote efficient and applicable veterinary drug use techniques and provide multi-level, multi-channel, and multi-form knowledge and technical training to farmers. It can be used to demonstrate the use of veterinary drugs in the form of households, a wide range of in-depth training, and popularization of the standardized use of veterinary drugs. Continuously improve their sense of self-efficacy to regulate the use of veterinary drugs, thereby improving the social recognition of the regulatory behavior of farmers using veterinary drugs.

There is a positive and significant relationship between PBC and farmers' behavior in normative use of veterinary drugs, which means that a strong perception of behavioral control motivates farmers to use veterinary drugs in a normative manner. Therefore, it can be inferred that the ease of implementation and manageability of veterinary regulations will motivate farmers to operate according to the standards. In agreement with the findings of other scholars (Onwezen and Antonides et al., 2013; Yazdanpanah and Hayati et al., 2014; Bai and Wang et al., 2019). In turn, the effect of perceived risk on PBC is negatively correlated, which means that if the regulated use of veterinary drugs causes some economic loss or increases problems, then farmers will feel that the matter is not so easy to control and thus affecting their judgment negatively. For this reason, it is necessary for the government to enhance comprehensive information on the hazards and rational use of veterinary drugs. It can build the confidence of farming subjects in the veterinary drug industry and reduce the uncertainty of farmers, thus reducing the perceived risk of their self-determination.

Of course, there are limitations to this study. First, this study only explored a random sample of poultry in three provinces in China, and the findings are limited to the behavior of poultry farmers using veterinary drugs, which is relatively small in scope and not representative enough. Second, although this study is an extension of the TPB model, considering the complexity of farmers' pro-environmental behavior other factors should be added to study the effects on farmers' behavior. Future research could focus on how demographic variables, past behaviors, and ethics influence farmers' behavior in regulating the use of veterinary drugs to better understand farmers' behavior on a larger scale. Finally, this study only considered egoism but did not start with altruism, ignoring the important role of irrational factors and altruistic motives in predicting behavior. As a result, more theoretical frameworks need to be combined to refine farmers' pro-environmental behavior.

References

Al Mamun, A., Mohamad, M. R., Yaacob, M. R. B., & Mohiuddin, M. 2018. "Intention and behavior towards green consumption among low-income households." Journal of environmental management 227: 73-86.

Ajzen, I. 1985. "From intentions to actions: A theory of planned behavior." In Action control .Springer, Berlin, Heidelberg.11-39

Ajzen, I. 1991. "The theory of planned behavior." Organizational behavior and human decision processes 50(2): 179-211.

Ajzen, I. 2006. "Constructing a theory of planned behavior questionnaire: Conceptual and methodological considerations." Retrieved September, 15, 2015.

Ajzen, I., & Madden, T. J. 1986. "Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control." Journal of experimental social psychology 22(5): 453-474.

Al-Debei, M. M., Al-Lozi, E., & Papazafeiropoulou, A. 2013. "Why people keep coming back to Facebook: Explaining and predicting continuance participation from an extended theory of planned behaviour perspective." Decision support systems 55(1): 43-54.

Arora, N., & Aggarwal, A. 2018. "The role of perceived benefits in formation of online shopping attitude among women shoppers in India." South Asian Journal of Business Studies 7(1): 91-110.

Artikov, I., Hoffman, S. J., Lynne, G. D., Zillig, L. M. P., Hu, Q., Tomkins, A. J., ... & Waltman, W. 2006. "Understanding the influence of climate forecasts on farmer decisions as planned behavior." Journal of Applied Meteorology and Climatology 45(9): 1202-1214.

Azjen, I. 1980. "Understanding attitudes and predicting social behavior." Englewood Cliffs 278

Bagheri, A., Bondori, A., Allahyari, M. S., & Damalas, C. A. 2019. "Modeling farmers' intention to use pesticides: An expanded version of the theory of planned behavior." Journal of environmental management 248: 109291.

Bai, L., Wang, M., & Gong, S. 2019. "Understanding the antecedents of organic food purchases: The important roles of beliefs, subjective norms, and identity expressiveness." Sustainability, 11(11), 3045.

Baird, I. S., & Thomas, H. 1985. "Toward a contingency model of strategic risk taking." Academy of management Review 10(2): 230-243.

Beck, L., & Ajzen, I. 1991. "Predicting dishonest actions using the theory of planned behavior." Journal of research in personality 25(3): 285-301.

Beyene, T., & Tesega, B. 2014. "Rational veterinary drug use: Its significance in public health." Journal of Veterinary Medicine and Animal Health 6(12): 302-308.

Beyene, T., Assefa, S., Ayana, D., Jibat, T., Tadesse, F., Nigussie, D., & Beyi, A. F. 2016. "Assessment of rational veterinary drugs use in livestock at Adama district veterinary clinic, central Ethiopia." J Veterinar Sci Techno 7(319): 2.

Botetzagias, I., Dima, A. F., & Malesios, C. 2015. "Extending the theory of planned behavior in the context of recycling: The role of moral norms and of demographic predictors." Resources, conservation and recycling 95: 58-67.

Anderson, J. C., & Gerbing, D. W. 1988. "Structural equation modeling in practice: A review and recommended two-step approach." Psychological bulletin 103(3): 411.

Cary, J. W., & Wilkinson, R. L. 1997. "Perceived profitability and farmers 'conservation behaviour." Journal of agricultural economics 48(1 - 3): 13-21.

Cerniglia, C. E., & Kotarski, S. 1999. "Evaluation of veterinary drug residues in food for their potential to affect human intestinal microflora." Regulatory Toxicology and Pharmacology 29(3): 238-261.

Chengxing, M. A. O. 2018. "Study on Antibiotic Prophylactic Use Behavior and Influencing Factors of Livestock and Poultry Breeding Farms and Households from Risk Cognitive Perspective." Asian Agricultural Research 10(4).

Cooke, R., Sniehotta, F., & Schüz, B. 2007. "Predicting binge-drinking behaviour using an extended TPB: Examining the impact of anticipated regret and descriptive norms." Alcohol and Alcoholism 42(2): 84-91.

Ćupić, V., Dobrić, S., Antonijević, B., & Čelebićanin, S. 2011. "The significance of rational use of drugs in veterinary medicine for food safety." Tehnologija mesa 52(1): 74-79.

Emekci, S. . 2019. "Green consumption behaviours of consumers within the scope of tpb." Journal of Consumer Marketing 36(3): 410-417.

George, & Joey, F. . 2013. "The theory of planned behavior and internet purchasing." Internet Research Electronic Networking Applications & Policy 14(3): 198-212.

Hartmann, P., & Apaolaza-Ibáñez, V. 2012. "Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern." Journal of business Research 65(9): 1254-1263.

Jeong, J. Y., & Ham, S. 2018. "Application of the Health Belief Model to customers' use of menu labels in restaurants." Appetite 123: 208-215.

Kaiser, F. G., & Gutscher, H. 2003. "The proposition of a general version of the theory of planned behavior: Predicting ecological behavior 1." Journal of applied social psychology 33(3): 586-603.

Kim, K. K., Horan, M. L., Gendler, P., & Patel, M. K. 1991. "Development and evaluation of the osteoporosis health belief scale." Research in Nursing & Health 14(2): 155-163.

Lees, P., & Aliabadi, F. S. 2002. "Rational dosing of antimicrobial drugs: animals versus humans." International journal of antimicrobial agents 19(4): 269-284.

Leung, L. 2013. "Generational differences in content generation in social media: The roles of the gratifications sought and of narcissism." Computers in human behavior 29(3): 997-1006.

Lu, C. Y., Yeh, W. J., & Chen, B. T. 2016. "The study of international students' behavior intention for leisure participation: Using perceived risk as a moderator." Journal of Quality Assurance in Hospitality & Tourism 17(2): 224-236.

Maleksaeidi, H., & Keshavarz, M. 2019. "What influences farmers' intentions to conserve on-farm biodiversity? An application of the theory of planned behavior in fars province, Iran." Global Ecology and Conservation 20: e00698.

Manyi-Loh, C., Mamphweli, S., Meyer, E., & Okoh, A. 2018. "Antibiotic use in agriculture and its consequential resistance in environmental sources: potential public health implications." Molecules 23(4): 795.

Markus, & Keith, A. . 2012. "Principles and practice of structural equation modeling by rex b. kline." Structural Equation Modeling A Multidisciplinary Journal 19(3): 509-512.

Meijer, S. S., Catacutan, D., Sileshi, G. W., & Nieuwenhuis, M. 2015. "Tree planting by smallholder farmers in Malawi: Using the theory of planned behaviour to examine the relationship between attitudes and behaviour." Journal of Environmental Psychology 43: 1-12.

Melewar, T. C., Alwi, S., Liu, M. T., Brock, J. L., Shi, G. C., Chu, R., & Tseng, T. H. 2013. "Perceived benefits, perceived risk, and trust." Asia Pacific Journal of Marketing and Logistics.25(2): 225-248

Novaes, S. F. D., Schreiner, L. L., Silva, I. P., & Franco, R. M. 2017. "Residues of veterinary drugs in milk in Brazil." Ciência Rural, 47(8): 1-7

Onwezen, M. C., Antonides, G., & Bartels, J. 2013. "The Norm Activation Model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour." Journal of economic psychology 39: 141-153.

Paige, J. C., Tollefson, L., & Miller, M. A. 1999. "Health implications of residues of veterinary drugs and chemicals in animal tissues." Veterinary Clinics of North America: Food Animal Practice 15(1): 31-43.

Pastoret, P. P. 1999. "Veterinary vaccinology." Comptes Rendus de l'Académie des Sciences-Series III-Sciences de la Vie 322(11): 967-972.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. 2003. "Common method biases in behavioral research: a critical review of the literature and recommended remedies." Journal of applied psychology 88(5): 879.

Reig, M., & Toldrá, F. 2008. "Veterinary drug residues in meat: Concerns and rapid methods for detection." Meat science 78(1-2): 60-67.

Rezaei, R., Safa, L., Damalas, C. A., & Ganjkhanloo, M. M. 2019. "Drivers of farmers' intention to use integrated pest management: Integrating theory of planned behavior and norm activation model." Journal of environmental management 236: 328-339.

Rivis, A., Sheeran, P., & Armitage, C. J. 2009. "Expanding the affective and normative components of the theory of planned behavior: A meta‐analysis of anticipated affect and moral norms." Journal of applied social psychology 39(12): 2985-3019.

Satorra, A., & Bentler, P. M. 1994. "Corrections to test statistics and standard errors in covariance structure analysis."

Si, H., Shi, J. G., Tang, D., Wu, G., & Lan, J. 2020. "Understanding intention and behavior toward sustainable usage of bike sharing by extending the theory of planned behavior." Resources, Conservation and Recycling 152: 104513.

Simonsen, G. S., Tapsall, J. W., Allegranzi, B., Talbot, E. A., & Lazzari, S. 2004. "The antimicrobial resistance containment and surveillance approach-a public health tool." Bulletin of the World Health Organization 82: 928-934.

Sitkin, S. B., & Weingart, L. R. 1995. "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity." Academy of management Journal 38(6): 1573-1592.

Stolker, A. A. M., Zuidema, T., & Nielen, M. W. F. 2007. "Residue analysis of veterinary drugs and growth-promoting agents." TrAC Trends in Analytical Chemistry 26(10): 967-979.

Suhr, D. 2006. "The basics of structural equation modeling." Presented: Irvine, CA, SAS User Group of the Western Region of the United States (WUSS).

Sun, Y., Wang, N., Yin, C., & Zhang, J. X. 2015. "Understanding the relationships between motivators and effort in crowdsourcing marketplaces: A nonlinear analysis." International Journal of Information Management 35(3): 267-276.

Vasquez, A. K., Foditsch, C., Dulièpre, S. A. C., Siler, J. D., Just, D. R., Warnick, L. D., ... & Sok, J. 2019. "Understanding the effect of producers' attitudes, perceived norms, and perceived behavioral control on intentions to use antimicrobials prudently on New York dairy farms." PloS one 14(9): e0222442.

Wang, J., Deng, Y., & Diao, H. 2018. "Perceived risk, expected benefits and pig farmers' behaviors of veterinary drug usage." International journal of environmental research and public health 15(8): 1716.

Xie, Q., Song, W., Peng, X., & Shabbir, M. 2017. "Predictors for e-government adoption: integrating TAM, TPB, trust and perceived risk." The Electronic Library 35(1): 2-20.

Yadav, R., & Pathak, G. S. 2016. "Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior." Journal of Cleaner Production 135: 732-739.

Yazdanpanah, M., Hayati, D., Hochrainer-Stigler, S., & Zamani, G. H. 2014. "Understanding farmers' intention and behavior regarding water conservation in the Middle-East and North Africa: A case study in Iran." Journal of environmental management 135: 63-72.

Yazdanpanah, M., & Forouzani, M. 2015. "Application of the Theory of Planned Behaviour to predict Iranian students' intention to purchase organic food." Journal of Cleaner Production 107: 342-352.

Yoon, C. 2011. "Theory of planned behavior and ethics theory in digital piracy: An integrated model." Journal of business ethics 100(3): 405-417.

Jiang L and Su S 2021. "The hazards of veterinary drug residues in animal food and preventive and control measures." Modern Animal Husbandry Technology (05): 10-11.

Tables

Table 1

Mean, standard deviation of items and subsections (n= 527).

Subsections	items	Mean score, standard deviation [A, B, C]
Attitude	Do you feel comfortable using veterinary drugs for breeding according to the Veterinary Drug Administration Regulations?	3.81 ±0.889[a]
	Farming in accordance with the relevant provisions of the Veterinary Drug Administration Regulations would make sense to you?	3.88 ±0.876[a]
	Do you think you should farm in accordance with the relevant regulations of the Veterinary Drug Administration Regulations?	3.85 ±0.891[a]
	Subsection mean scores	**3.85 ±0.483[α]**
Perceived Behavioral Control	Do you think the standard veterinary drug use is easy to implement?	3.21 ±0.963[a]
	Do you think you have enough technical support team, funding, etc. to provide for the smooth implementation of standard veterinary drug use?	3.06 ±1.039[b]
	Subsection mean scores	**3.14 ±0.014[β]**
Subjective Norm	Most of the people who are important to me think I should be farming according to the standard use of veterinary drugs?	3.73 ±0.862[a]
	Most people like me take standard veterinary use for farming?	3.73 ±0.888[a]
	Do I think I have a moral obligation to farm according to standard veterinary drug use?	3.61 ±0.931[b]
	Subsection mean scores	**3.69 ±0.050[γ]**
Perceived Benefit	I think using veterinary drugs in accordance with the relevant regulations of the Veterinary Drug Administration Regulations will enable me to get more benefits?	3.63 ±0.835[a]
	I think the use of veterinary drugs in accordance with the relevant provisions of the Veterinary Drug Administration Regulations will enable me to get a good response from consumers?	3.79 ±0.816[b]
	I think the use of veterinary drugs in accordance with the relevant provisions of the Veterinary Drug Administration Regulations can make me feel more accomplished?	3.77 ±0.802[b]
	Subsection mean scores	**3.73 ±0.002[δ]**
Perceived Risk	I think taking standard veterinary medicine use for breeding will make my breeding cost increase?	3.56 ±0.858[a]
	I think taking standard veterinary use for breeding will make me invest more effort?	3.60 ±0.847[a]
	I think taking standard veterinary use for breeding will add to my problems?	3.50 ±0.829[b]
	Subsection mean scores	**3.55 ±0.167[ε]**
Intention	Are you willing to use veterinary drugs in accordance with the Veterinary Drug Regulations when you farm in the coming year?	3.89 ±0.880[a]
	Are you willing to take some of the plots and farm them in accordance with the relevant provisions of the Veterinary Regulations?	3.84 ±0.919[b]
	Subsection mean scores	**3.87 ±0.355[α]**
Behavior	In the past year, how often did you use veterinary drugs in full compliance with the relevant provisions of the VDAR?	**3.22** ±1.329[a]
	Subsection mean scores	**3.22** ±1.329[β]

Note. A. Mean scores of the items superscripted by the same English alphabet are not significantly different from each other. B. Mean scores of the subsections superscripted by the same Greek letter are not significantly different from each other. C. At the 1% level of significance based on the Chi-square (χ^2) test.

Table 2 Demographic characteristics of respondents (n=527).

Characteristics	Category	n	Percentage (%)	X^2	Df	p
Gender	Male	353	67	60.8	1	0.80
	Female	174	33			
Age	From 21 to 30	64	12.1	291.1	4	0.00
	From 31 to 40	66	12.5			
	From 41 to 50	156	29.6			
	From 51 to 60	117	22.2			
	60 and above	124	23.8			
Education	Uneducated	48	9.1	217.2	4	0.03
	Primary school	135	25.6			
	Intermediate school	190	36.1			
	High school or junior college	89	16.9			
	University and above	52	9.9			
Household income (Yuan/RMB) [a]	Under 20,000	100	19.0	181.0	3	0.64
	20,000-60,000	256	48.6			
	60,000-100,000	125	23.7			
	More than 100,000	46	8.7			

[a] Note. An average of 6.425 China Yuan equals to 1USD at the time of survey.

Table 3 Fitting confidence index of the hypothetical model

Fit index	Recommended value	Estimate value
Normed Chi-Square (χ^2 / df)	<3	1.72
Goodness-of-fit index(GFI)	>0.9	0.97
Comparative fit index (CFI)	>0.9	0.99
Incremental fit index(IFI)	>0.9	0.99
Adjusted goodness-of-fit index(AGFI)	>0.9	0.95
Tacker-Lewis index(TLI)	>0.9	0.99
Root-mean square error of approximation (RMSEA)	<0.05	0.04

Table 4 Measurement Model Results

Measurements	Estimate	AVE	Cronbachs' alpha coefficient
ATT1	0.88		
ATT2	0.81	0.75	0.90
ATT3	0.86		
PBC1	0.88	0.71	0.83
PBC2	0.85		
SN1	0.83		
SN2	0.91	0.71	0.88
SN3	0.80		
PB1	0.73		
PB2	0.86	0.68	0.87
PB3	0.88		
PR1	0.86		
PR2	0.88	0.72	0.89
PR3	0.81		
INT1	0.90	0.81	0.90
INT2	0.90		

Note. ATT = Attitude, SN = Subjective Norm, PB = Perceived Benefit,PR = Perceived Risk, , PBC = Perceived Behavioral Control, , INT = Intention.

Table 5 Correlation coefficients between variables.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)Attitude	**0.86**						
(2)PBC	0.40***	**0.86**					
(3)Subject Norm	0.77***	0.49***	**0.74**				
(4)Perceived Benefit	0.66***	0.40***	0.61***	**0.83**			
(5)Perceived Cost	-0.00	-0.53***	-0.10	-0.01	**0.85**		
(6)Intention	0.80***	0.50***	0.70***	0.65***	-0.14	**0.90**	
(7)Behavior	0.32***	0.58***	0.37***	0.23***	-0.49***	0.37***	**1**

Note. The significance of test: ***$p < 0.001$. The numbers in the parentheses are the square root of the average variance extracted by each variable.

Table 6 Estimated parameters and goodness-of-fit indices of the test models (n = 527)

Path		TPB model	Extended TPB model 1	Extended TPB model 2	Comprehensive model
χ^2		178.90	243.33	278.30	354.65
χ^2/df		4.59	3.48	3.98	3.25
p		< 0.001	< 0.001	< 0.001	< 0.001
RMSEA		0.08	0.07	0.08	0.07
CFI		0.96	0.97	0.96	0.96
NFI		0.95	0.95	0.95	0.94
TLI		0.95	0.95	0.95	0.95
RMR		0.16	0.14	0.12	0.11
Adjusted R^2	**INT**	0.66	0.67	0.66	0.67
	ATT	/	0.46	/	0.46
	PBC	/	/	0.33	0.33
	BEH	0.31	0.31	0.34	0.34

Note. RMSEA, Root-Mean-Square Error of Approximation; CFI, Comparative Fit Index; NFI, Normed Fit Index; IFI, Incremental Fit Index; TLI, Tucker-Lewis Index; GFI, Goodness of-fit Index; BEH, behavior.

Figures

Figure 1 The proposed model

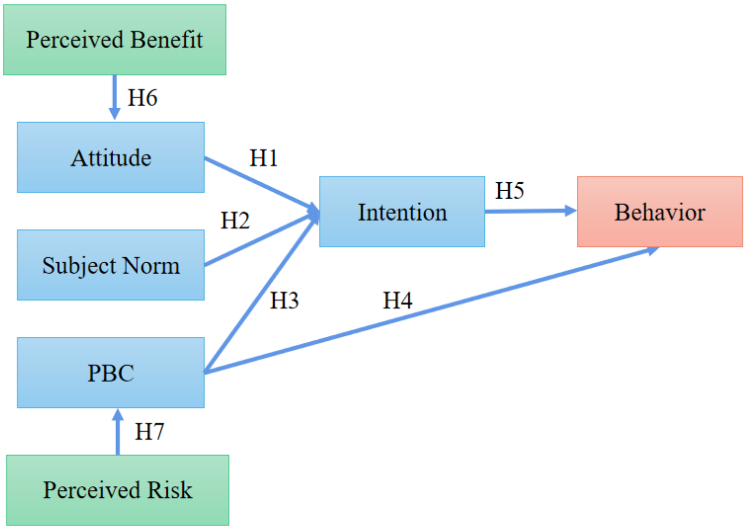


Figure 2 The survey area

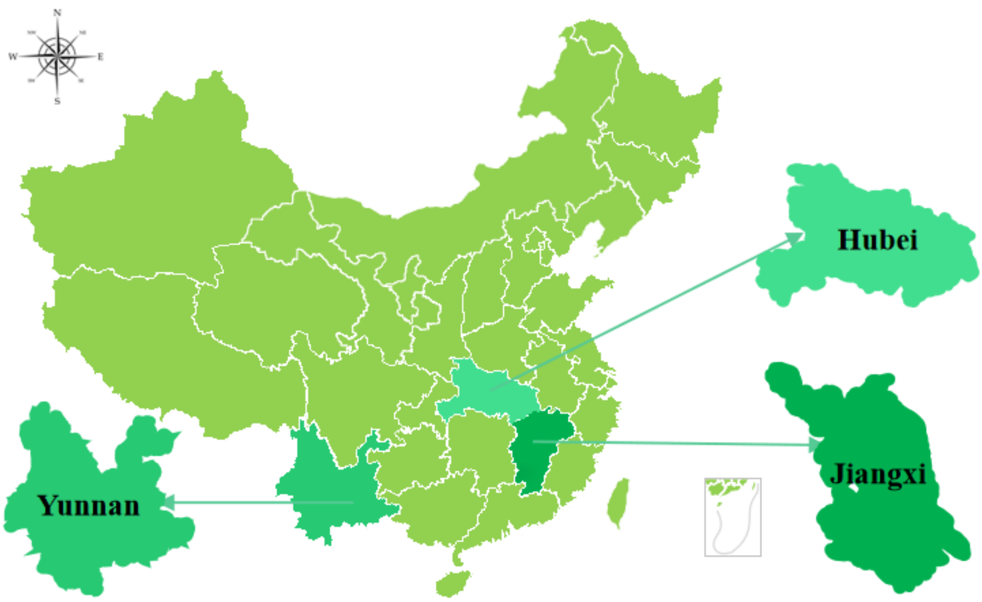
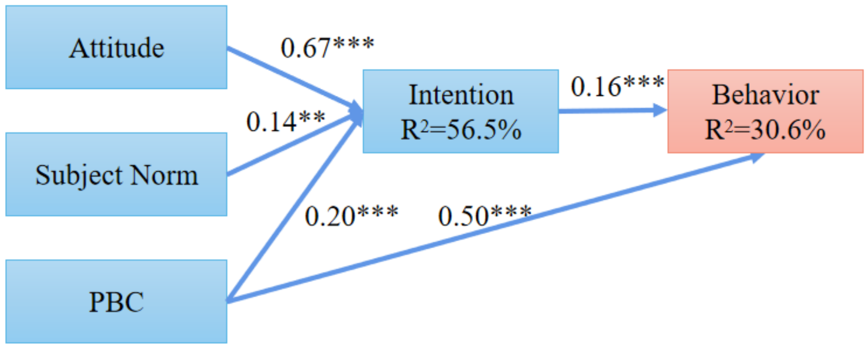


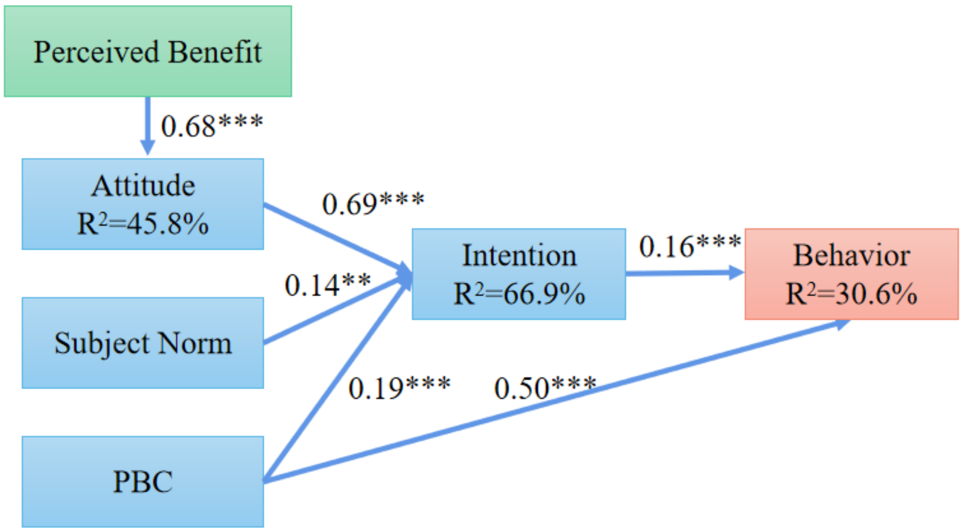
Figure 3a Structural equations modeling and standardized path coefficients (original TPB model)



Note. p* < 0.1; p** < 0.05; p*** < 0.01.

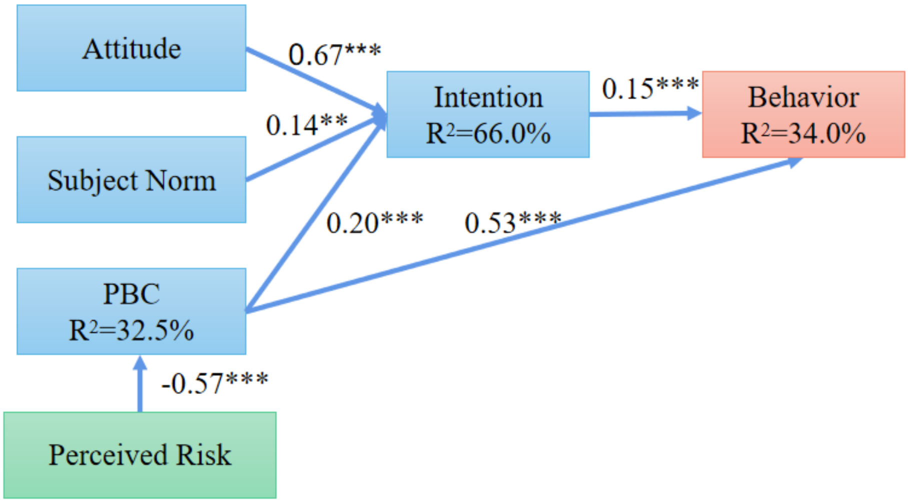
Figure 3b

Structural equations modeling and standardized path coefficients (extend TPB model with perceived benefit)



Note. p* < 0.1; p** < 0.05; p*** < 0.01.

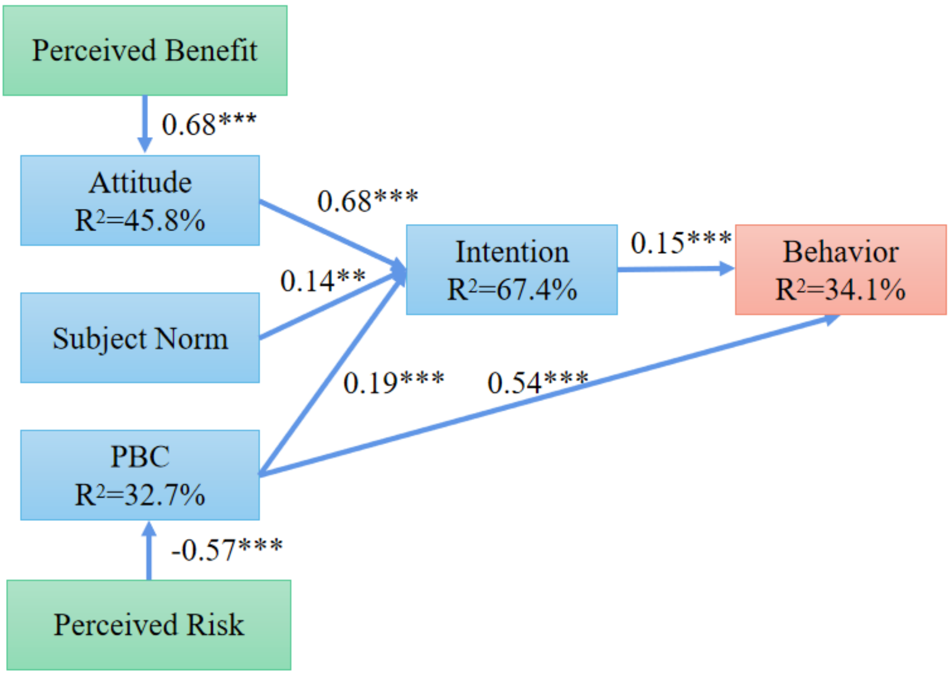
Figure 3c Structural equations modeling and standardized path coefficients (extend TPB model with perceived risk)



Note. p* < 0.1; p** < 0.05; p*** < 0.01.

Figure 3d

Structural equations modeling and standardized path coefficients (comprehensive model)



Note. p* < 0.1; p** < 0.05; p*** < 0.01.