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REGULAR ARTICLE

Continuance Intention to use MOOCs: The Effects of Psychological Stimuli and Emotions

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Abstract This study investigates the impact of psychological stimuli on students' continuance intention to use massive open online courses (MOOCs), through the mediation effects of emotions under a stimulus-organism-response framework. Perceived competition, perceived risk, and curiosity are the psychological stimuli. Four emotions (happiness, interest, sadness, and anxiety), enjoyment, and stress are considered as the organism. Continuance intention to use MOOCs for learning is the response. To test the hypotheses empirically, 574 valid responses were collected from individuals who claimed that they had learning experience on the Chinese University MOOC. This is a well-known, official online learning platform supported by the Chinese Education Ministry and has the largest number of active MOOC users in China. The study employs partial least squares structural equation modeling to validate the research model. The results show that perceived competition has both positive and negative effects, perceived risk has no significant effect, curiosity only has a beneficial effect, and the four emotions play important mediation roles. This research unveils the internal effect mechanisms of psychological factors and emotions on continuance intention in the context of online learning.

Keywords Continuance intention · Perceived competition · Perceived risk · Curiosity · Emotions

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Introduction

With the rapid development of the internet, online learning platforms have flourished due to their convenience. People can participate in courses regardless of the time or location, and online courses have lower financial cost compared with offline courses. Although online learning platforms can bring many benefits, there are some problems. Massive open online courses (MOOCs) have a high dropout rate (Yousef et al., 2014). According to Dong et al. (2020), in online learning, only 16.3% of the students complete the courses. To address this problem, researchers have explored persistence in online learning. Some researchers focus on the effects of course dimensions, such as course difficulty (Huang et al., 2017), course design (Xing, 2019), and course content (Hone & El Said, 2016). Some examine perceptions of the system, including interactivity, media richness (Zhao et al., 2020), and sociability (Huang & Ren, 2020). And some focus on the characteristics of the learners, like curiosity, attitude (Dai et al., 2020b), and metacognition (Tsai et al., 2018).

However, scant literature explores the psychological antecedents of why people choose to study and how emotions influence their intention to continue to use online learning platforms. Many researchers have recognized the important effect of emotion on behavior. The extant literature mainly concentrates on the effects of general emotions, for example, interest (Tsai et al., 2018) and perceived enjoyment, on continuance intention (Chen & Policy, 2017). But emotion is complicated, different behaviors can be generated by different emotions (Burns et al., 2019), and the effects of nuanced, discrete emotions are still not clear, especially in the context of online learning. In addition, the literature largely highlights the direct effects of emotions (Camacho-Morles et al., 2021; Dhar & Bose, 2022; Ismagilova et al.,

2020), but emotional states can serve in a mediation role between stimuli and human behavior (Jiang, 2020). Furthermore, the effects of motivations like competition and curiosity on learning performance have mainly been discussed and highlighted separately in the offline learning setting (Anning-Dorson et al., 2017). Their effects through emotions on continuance intention and in the circumstances of online learning need to be further explored. It is important to gain insights into the internal effect mechanism of granular emotions, to facilitate platforms and teachers gaining a better understanding of students' psychological states and processes, thus helping to retain more students. Therefore, our research questions are the following:

RQ1: How do inner psychological antecedents affect continuance intention?
RQ2: How do nuanced emotions mediate the relationship between inner psychological stimuli and continuance intention?

This paper investigates the psychological antecedents of individuals' learning behavior and how the discrete emotions induced by those antecedents affect people's intention to continue online learning. The study takes a step further by exploring the effects of psychological influencing factors and fine-grained emotions, extending the knowledge on continuance intention and to keep students learning and platforms and teachers holding onto students. The study adopts the stimulus-organism-response (S–O-R) framework, which is an effective and widely accepted model used to illustrate the influence of an environmental or internal stimulus on human emotions and behaviors (Jiang, 2020). Under the S–O-R framework, stimuli from the outside environment or internal psychological status can evoke change in human affective states and lead to behaviors (Zhu et al., 2020). In this study, individuals' perceived competition, perceived risk, and curiosity act as psychological stimuli to evoke affective states and push the individuals to participate in online learning. The study adopts Burns et al. (2019) classification of emotions, which includes four typical emotions—happiness, interest, sadness, and anxiety. Partial least squares structural equation modeling (PLS-SEM) is employed to validate the effects.

Literature Review and Theoretical Framework

Continuance Intention in the Online Learning Context

Online learning continuance intention is beneficial for learners to acquire knowledge and for learning platforms to hold onto users. Prior research has paid special attention to this topic by studying the influencing factors from the external or internal perspective. External factors are those from the environment, mainly including the characteristics of technology, such as system quality (Al-Samarraie et al., 2018), web design (Hong et al., 2017), and perceived ease of use (Venkatesh, 2000); perceived usefulness (Venkatesh, 2000); media richness (Rodriguez-Ardura & Meseguer-Artola, 2016a); teacher presence (Kim & Song, 2021); course characteristics, such as course quality (Yang et al., 2017), course design (Cheng, 2021), and course resources (Qi et al., 2021); task technology fit (Kim & Song, 2021); teachers' characteristics, such as teachers' self-efficacy (Sun et al., 2021), attitude (Rodriguez-Ardura & Meseguer-Artola, 2016b), responsiveness (Ramadiani et al., 2019), and interaction (Shao & Chen, 2021); and other environmental factors, such as social influence (Liu & Pu, 2021).

Internal factors are those originate from the learners' inner selves, driving them to continue to learn, which is the present study focuses on. Various theoretical frameworks are utilized to study the internal factors. The most popular ones are the expectation-confirmation model (Wang et al., 2021b) and the technology acceptance model (Ashrafi et al., 2021). Task-technology fit (Chauhan et al., 2021), flow theory (Lu et al., 2019), and value theory (Qi et al., 2021) are also widely adopted. Other frameworks that are frequently employed encompass the uses and gratifications theory (Zhang et al., 2022), diffusion of innovation theory (Taghizadeh et al., 2021), unified theory of acceptance and use of technology (Taghizadeh et al., 2021), and theory of planned behavior (Dalvi-Esfahani et al., 2020). The S-O-R model (Shao & Chen, 2021), technology-user-environment framework (Gupta & Maurya, 2021), social cognitive theory (Shao, 2018), and motivation theory (Venter & de Wet, 2019) are also leveraged. This study uses the S-O-R framework to examine the impacts of internal factors.

Among the specified internal factors, researchers have emphasized cognitive factors, for example, self-efficacy (Shao, 2018), perceived social recognition (Wu & Chen, 2017), perceived social value (Qi et al., 2021), perceived challenge (Venter & de Wet, 2019), perceived readiness (Gupta & Maurya, 2021), and perceived hedonic value (Guo et al., 2016). Scholars have mentioned that curiosity is an important stimulus that can motivate users' continuance (Dai et al., 2020b; Venter & de Wet, 2019). Emotion-related factors are also stressed, such as affection (Dalvi-Esfahani et al., 2020; Zhang et al., 2022), enjoyment (Ashrafi et al., 2021; Huang, 2020), and interest (Lu et al., 2019). Other internal factors involving flow (Wang & Lin, 2021), habit (Dai et al., 2020a), and hope (Ding, 2019) are also underlined. This study mainly investigates the effects of three internal factors—cognitive factors (perceived competition and perceived risk) and curiosity—on continuance intention through emotions in the context of MOOC learning.

Emotion is an important driver of continuance intention in the use of online technologies (Yan et al., 2021). The extant

research mainly mentions emotion as a whole (Zhang et al., 2022) or focuses on one aspect of emotion (Lu et al., 2019); however, the effects of all the discrete emotions have also been highlighted and gained much attention (Horner et al., 2021). Limited research has conducted deep and detailed analysis from the psychological and emotional perspectives on students' continuance intention in MOOCs. Our research extends the extant research and makes a comprehensive contribution to understanding students' continuance intention, from the psychological and emotional perspectives.

Stimulus-Organism-Response Framework

The S-O-R framework originates from environmental psychology. It describes the interaction between stimulus and behavioral response. Stimulus is the influence that can cause individuals' approach or avoidance behavior (Triantoro et al., 2019). The stimuli are processed by the internal component, that is, the organism, and lead to behavioral response (Mehrabian & Russell, 1974). The organism refers to affective or cognitive states, which mediate the influence of stimuli on responses (Casagrande et al., 2020).

The S-O-R framework has also been utilized in the online learning research context. Shao and Chen (2021) employ the S-O-R framework to investigate how interactivity affects students' MOOC continuance intention through the mediation of engagement. Zhao et al. (2020) adopt the S-O-R framework to examine how technological environmental factors influence the continuance intention to use MOOCs through virtual experience. Whereas prior studies mainly focused on the tenet of external stimulus, our research applies the S-O-R framework to explore how internal psychological stimuli affect MOOC continuance intention through emotional experience.

Research Model and Hypotheses

Based on the S-O-R framework, along with the cue of psychological stimulus–emotional experience–response, we disclose the internal influence mechanism from the perspective of users' inner psychological and emotional experience. Figure 1 displays our research model.

The present study focuses on the psychological stimuli of perceived competition, perceived risk, and curiosity; the organism of emotional experience; and the response of continuance intention. Emotions refer to individuals' affective reactions to situations (Coleman & Williams, 2013), and once emotions are aroused, responses will be incurred (Casaló et al., 2021). Emotions include happiness, interest, anxiety, and enjoyment (Burns et al., 2019). Individuals' emotional state encompasses enjoyment (Tsai et al., 2018) and stress (Neil et al., 2016). We call emotions and their following emotional states emotional experience.

Emotions are treated as a mediator, given that they are induced by some stimuli and lead to human behavior (Leutner, 2014). Emotions are affected by external or internal events and then engender response (Kim et al., 2016). Positive emotion can be aroused by positive stimulus and result in a positive consequence (Randle et al., 2016). Negative emotion can be brought out by negative stimulus and give rise to a negative consequence (Xu et al., 2021). Kranzbühler et al. (2020) systematically review the literature and derive that the appraisal of experience could affect discrete emotions, which will affect the user's behavior, with discrete emotions playing mediation roles. Specifically, stress mediates the relationship between deep acting and employee performance (Rajak et al., 2021). Many scholars also point out that the mediating effects of emotions are realized through students' perceptions and then affect students' behaviors. For example, emotions mediate the relationship between perceived competition and academic achievement (Forsblom et al., 2022), self-efficacy and learning engagement (Deng et al., 2021), and perceived achievement pressure and study commitment (Hagenauer et al., 2018). It is widely agreed that emotions could be stimulated by students' inner cognition, like self-efficacy belief (Jeong et al., 2019), self-compassion (Park et al., 2018), and perceived teacher support (Liu et al., 2021). It is also a broadly shared opinion that emotions could affect students' behavior, such as academic achievement (Xing et al., 2019), learning outcome (Jeong

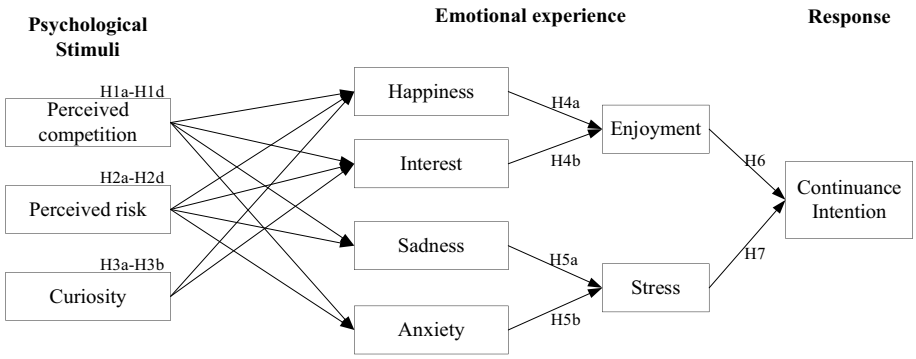

Fig. 1 Research Model

et al., 2019), and learning performance (Burr & Beck Dallaghan, 2019). Altogether, it is reasonable that emotions play the mediating roles. In higher education, motivation can rouse students' emotions, which affect their cognitive states, which affect their academic achievement in a cascading manner with emotions mediating the effects (Acosta-Gonzaga & Ramirez-Arellano, 2021). Personal well-being significantly affects positive emotions, and positive emotions significantly affect school experience, which finally positively affects academic achievement (Phan & Ngu, 2020). The present study proposes that emotional experience mediates the relationship between psychological stimuli and continuance intention. This section explains the hypotheses on the relationship between psychological stimuli and emotional experience and the relationship between emotional experience and continuance intention.

Psychological Stimuli and Emotional Experience

Perceived Competition Competition is omnipresent in learning, working, and business. People can compete with themselves and others (Alessi & Trollip, 2001). In MOOC learning, although students learn by themselves, they confront competition from the real world, which generates their perceived competition. Competition may be with classmates, colleagues, or even themselves. It has been confirmed that performance can be enhanced by various forms of competition. Perceived competition could lead to affective effects, making people feel happy (Vorderer et al., 2003) or increasing their happiness (Fu et al., 2009). Competition can also stimulate the participants' interest (Plass et al., 2013). Nebel et al. (2016) prove that perceived competition has a significant and positive relationship with triggered and maintained feelings of situational interest. Thus, in the context of MOOC learning, we propose the following hypotheses:

H1a Perceived competition is positively associated with happiness.

H1b Perceived competition is positively associated with interest.

However, competition may also result in negative effects (Van Eck & Dempsey, 2002), as it increases cognitive load, including intrinsic and extrinsic load. Thus, competition increases the overall difficulty of a social task compared with isolated tasks (Nebel et al., 2016). Ter Vrugte et al. (2015) find that if students' capability is above average, competition inspires positive performance. In contrast, if students' capability is below average, competition results in negative performance. Cheng et al. (2009) find that competition causes social comparison and may evoke emotions such as tension, anxiety, frustration, and inferiority in learning. Thus, in the context of MOOC learning, we propose the following hypotheses:

H1c Perceived competition is positively associated with sadness.

H1d Perceived competition is positively associated with anxiety.

Perceived Risk Perceived risk refers to the individual's perception of the probability of the occurrence of potential disaster or the seriousness of the possible loss. In learning, students face many risks, which may be aligned with graduation and employment pressure. Perceived risk can activate affective states and has a tight connection to people's emotional condition (Zhang et al., 2020). Perceived risk induces anxiety (Casagrande et al., 2020). Chuah (2019) validates that consumers' perceived physical and privacy risks induce anxiety. Yıldırım and Güler (2021) find that COVID-19-related risk can significantly increase individuals' death anxiety and decrease their happiness. Accordingly, the perceived risk increases their sadness as well. Therefore, in the context of MOOC learning, we posit the following hypotheses:

H2a Perceived risk is negatively associated with happiness in MOOC learning.

H2b Perceived risk is positively associated with anxiety in MOOC learning.

H2c Perceived risk is positively associated with sadness in MOOC learning.

However, perceived risk may also induce individuals' motivation to avoid the occurrence of unexpected situations. Chen (2017) finds that consumers' perceived risk can strengthen their intention to take precautions to avoid potentially negative effects. When they envisage risk, people make a greater effort and try their best to evade the potential consequences (San Martín et al., 2011), just like smokers with higher perception of risk show more interest in screening for lung cancer (Hahn et al., 2006). In the learning environment, individuals experience graduation and job pressure from society. Perceived risk acts as an incentive for students to learn better, and it preconsciously pushes students to show greater interest in learning. Therefore, this kind of risk causes individuals to be interested in acquiring new knowledge to improve themselves. Based on this, in the context of MOOC learning, we propose the following hypothesis:

H2d Perceived risk is positively associated with interest.

Curiosity Curiosity is the desire to seek novelty and is considered to be a motivator for positive emotion (Dai et al., 2020b). Shapiro et al. (2017) find that one of the reasons for participating in MOOCs is the motivation to gain new knowledge. Therefore, curiosity can also be regarded as an antecedent of learning in MOOCs. According to Kashdan et al. (2004), curiosity is a positive emotional-motivational system. Thus, curiosity can only generate positive emotions. Curiosity can bring in positive emotions and promote customers' continuance intention (Fang et al., 2021), and it can result in positive effects on persistence in MOOCs (Dai et al., 2020b). Based on this, in the context of MOOC learning, we posit the following hypotheses:

H3a Curiosity is positively associated with happiness.

H3b Curiosity is positively associated with interest.

Emotional Experience and Continuance Intention

Emotions *Happiness* Happiness is a type of hedonic emotion that can have a significant impact on people's experience (Waterman et al., 2008) and performance (Salas-Vallina et al., 2018). Happy consumers tend to engage more in enjoyment. Happy students are more likely to enjoy the learning process and have a high level of academic engagement (Heffner & Antaramian, 2016). Happiness also has a positive connection with academic achievement (Datu et al., 2017). It is not easy for anyone to learn new knowledge, but happier people tend to be more optimistic about learning. They do not treat learning as a burden; on the contrary, they indulge themselves in the enjoyment of gaining more knowledge. Therefore, in MOOC learning, we posit the following hypothesis:

H4a Happiness is positively associated with enjoyment.

Interest Interest is a type of positive emotion (Burns et al., 2019). Positive emotions obviously result in greater hedonic well-being, the representative of which is enjoyment (Wang et al., 2021a). Interest is confirmed to be helpful for promoting enjoyment (Jack & Lin, 2018). Interest can make people feel good, motivating them to be more pleased with and enjoy learning. Hong et al. (2016) find that interest in learning can significantly improve students' satisfaction, which is proxied by enjoyment, implying that interest positively affects enjoyment. Thus, in MOOC learning, we posit the following hypothesis:

H4b Interest is positively associated with enjoyment.

Sadness When negative outcomes or uncontrollable consequences are expected, sadness, which is a negative emotion (Diener et al., 1995), is generated (Burns et al., 2019). Sadness may evoke a stressed psychological state (Ashkanasy & Humphrey, 2011). Stress is a "psychological reaction to some sort of an imbalance between a person and the environment" (Cooper et al., 2001), and an anticipated negative consequence leads to stress (El Halabieh et al., 2018). Thus, in MOOC learning, we propose the following hypothesis:

H5a Sadness is positively associated with stress.

Anxiety Academic stress is significantly related to individuals' mental health, such as anxiety and depression among college students (Barker et al., 2018). If a teacher is experiencing anxiety, the teacher may feel nervousness or breathlessness, which are symptoms of stress (Uzuntiryaki-Kondakci et al., 2020). Rassaby et al. (2021) find that there is a significant relationship between anxiety and stress. Therefore, in the MOOC learning context, we posit the following hypothesis:

H5b Anxiety is positively associated with stress.

Enjoyment Researchers have identified the connection between enjoyment and continuance intention. Enjoyment can positively influence users' satisfaction with mobile instant messaging and their willingness to continue usage (Oghuma et al., 2016). Sällberg and Bengtsson (2016) validate that intrinsic motivation, operationalized as enjoyment, has a significant and positive effect on computer and smartphone continuance intention. This relationship is consolidated by Huang (2020). Tsai et al. (2018) also corroborate that in online learning, enjoyment is positively related to students' continuance use of MOOCs. Thus, for MOOC learning, we put forward the following hypothesis:

H6 Enjoyment is positively associated with continuance intention.

Stress Stress can lead to dysfunctional behavior and aggressive interactions. People may have a flight response in a stressful situation (Jordan et al., 2019). Individuals who are experiencing stress feel that things are difficult (DeCelles et al., 2019). Thus, in an online learning situation, it is plausible that students who are undergoing stress may give up their learning. Stress theory illustrates that stress may give rise to harmful results (Neil et al., 2016). Stress arouses exhaustion, which can be described as users' weariness of activities (Maier et al., 2015), and exhaustion foments discontinuance behavior (Fu et al., 2020). Therefore, for MOOC learning, we posit the following hypothesis:

H7 Stress is negatively associated with continuance intention.

Methods

Participants and Research Context

We empirically examine our conceptual model by analyzing the results of an online survey. Our main focus is online learning platforms and in this investigation, we use the Chinese University MOOC (iCourse) as an example. The Chinese University MOOC, which was launched in 2014, is a well-known official online learning platform supported by the Chinese Education Ministry. It is widely accepted by students and universities and has the largest number of active MOOC users in China (Wu & Chen, 2022). Students who had at least one experience in learning through the Chinese University MOOC were invited to participate in a survey between October and December 2020. Participation was voluntary, and the participants were told that "they are free to choose whether to participate, they can withdraw from the study anytime without any negative repercussions." They received a monetary payment after they finished the survey. To assure quality, we communicated that only those who carefully answered the questions would receive the compensation. Responses were received from 614 students, among which 40 of the respondents had never used MOOCs. Thus, there were 574 valid responses, from 391 (68.1%) females and 183 (31.9%) males. In China, the age range of students in university spans from 18 to 25. In the sample of survey respondents, 51 students (8.9%) were younger than 18 years, 396 (69%) were between 18 and 25 years, 81 (14.1%) were between 26 and 30 years, and 46 (7.9%) were older than 30 years. (Table 4, in the Appendix, provides more details on the respondents' demographic information.)

Instruments

The measurement items were selected and developed from the relevant literature (Table 1). To fit the Chinese University MOOC, we slightly modified the statements for some of the items. For all the measurements, we adopted a 7-point Likert-type scale. There are 10 constructs in this research, and they were measured by using multiple-item perceptual scales. Table 1 displays the constructs and measurement information.

Data Analysis

We employ PLS-SEM to validate our hypotheses for three main reasons. (1) PLS-SEM is widely utilized to confirm hypotheses from a predictive perspective, consistent with this study, and PLS-SEM can estimate much more complex models with smaller sample sizes, meaning that PLS-SEM is not so sensitive to sample size, especially when using bootstrapping (Hair et al., 2019). (2) Latent variable scores can be obtained through PLS-SEM without extra specification modifications (Hair et al., 2017). (3) PLS-SEM is an appropriate method for mediation testing, which is needed in our research (J Henseler et al., 2015).

SmartPLS, a widely applied software for PLS-SEM in research, is adopted in the present study (Durcikova et al., 2018). Common method bias (CMB), the measurement model, and the structural model and mediation effect are assessed in the next section.

Results

Common Method Bias

To eliminate concern about CMB, we carefully designed the survey and conducted the CMB statistical test. First, all the questions in the survey were selected from the existing literature, and to ensure clarity and non-confusion in the questions, a comprehensive pre-test and pilot test were implemented (Podsakoff et al., 2003). Furthermore, all the respondents answered the questions anonymously and confidentially. For the CMB statistical test, we employed the Harman single factor test ($<=40\%$) (J.Babin et al., 2016), highest value in inter-construct correlation matrix ($<=0.9$) (Bagozzi. et al., 1991), and pathological VIF values ($<=3.3$) (Kock, 2015). The results are 18.395%, 0.789, and 1.465 to 2.689, respectively, and we can see that there is no CMB in our survey.

Measurement Assessment

To assess the measurement, factor loadings ($>=0.708$) and composite reliability (CR) ($>=0.7$) were utilized to check internal consistency (Hair et al., 2019); average variance extracted (AVE) ($>=0.5$) was employed to check convergent validity (Fornell & Larcker, 1981); and comparison between the square root of the AVE and the correlation coefficients of the constructs was adopted to check discriminant validity (J Henseler et al., 2015). The factor loadings and CR results are displayed in Table 2, and all the CR and AVE values meet the standards, showing good internal consistency and convergent validity. Construct correlation is shown in Table 3. The diagonal values in bold are the square roots of the AVEs, and they are all greater than the correlation value, showing good discriminant validity.

Table 1 Constructs and measurements

Construct	Items	Source
Perceived competition	Instructions: "Please indicate your level of agreement with the following statements."	Spence and Helmreich (1983)
	I enjoy working in situations involving competition with others	
	It is important to me to perform better than others on a task	
	In general, I feel that winning is important	
Perceived risk	Instructions: "Please indicate your level of agreement with the following statements."	Chen and Chang (2012)
	I think not learning well is risky and dangerous	
	There is a considerable risk if not learning well	
	On the whole, considering all factors combined, it is very risky if I don't learn well	
Curiosity	Instructions: "Please indicate your level of agreement with the following statements."	Dai et al. (2020b)
	I am interested in learning new contents and knowledge	
	When I am given a new kind of problem in learning, I enjoy imagining solutions	
	When I am given an incomplete problem in learning, I try and imagine the final solution	
Happiness	Instructions: "When you think about MOOCs, to what extent do you feel…"	Burns et al. (2019)
	Glad	
	Happy	
	Joyful	
Interest	Instructions: "When you think about MOOCs, to what extent do you feel…"	Burns et al. (2019)
	Alert	
	Curious	
	Interested	
Sadness	Instructions: "When you think about MOOCs, to what extent do you feel…"	Burns et al. (2019)
	Sad	
	Unhappy	
	Discouraged	
Anxiety	Instructions: "When you think about MOOCs, to what extent do you feel…"	Burns et al. (2019)
	Nervous	
	Threatened	
	Uneasy	
Stress	Instructions: "Please indicate your level of agreement with the following statements."	Zheng et al. (2020)
	It's difficult to relax when studying in MOOCs	
	I feel very uneasy when studying in MOOCs	
	I feel upset when studying in MOOCs	
Enjoyment	Instructions: "Please indicate your level of agreement with the following statements."	Pekrun et al. (2011)
	I'm excited about participating in MOOC courses	
	I'm glad that I participate in MOOC courses	
	It's a pleasure for me to participate in MOOC courses	
Continuance intention	Instructions: "Please indicate your level of agreement with the following statements."	Lu et al. (2019)
	I intend to continue to use MOOCs in future	
	I plan to use MOOCs in the future	
	I will continue using MOOCs	

Structural Model and Mediation

Chi-square test, χ^2/df, standardized root mean residual (SRMR), and normal fit index (NFI) are popularly utilized to show model fit, with recommended values larger than 0.05, lower than 3 (Hooper et al., 2008), lower than 0.08, and higher than 0.9, respectively (Hu & Bentler, 1999). Our model's chi-square test is 0.11, χ^2/df is 2.75, SRMR is 0.069, and the NFI is 0.912, meaning that there is good model fit.

We conducted the significance tests for our hypotheses by means of bootstrapping with 5,000 samples, and the detailed results are displayed in Table 5, in the Appendix. It can be seen that all the hypotheses are confirmed except those for the relationship between perceived risk and emotions (H2a, H2b, H2c, and H2d).

Table 2 Measurement statistics

Variable	Indicators	Factor loadings	Cronbach's alpha	Composite reliability	Average variance extracted
COM	COM-1	0.830	0.837	0.902	0.755
	COM-2	0.897			
	COM-3	0.878			
RISK	RISK-1	0.910	0.911	0.944	0.849
	RISK-2	0.920			
	RISK-3	0.934			
CUR	CUR-1	0.865	0.870	0.920	0.793
	CUR-2	0.909			
	CUR-3	0.898			
HAP	HAP-1	0.945	0.950	0.967	0.908
	HAP-2	0.960			
	HAP-3	0.954			
INT	INT-1	0.599	0.762	0.864	0.687
	INT-2	0.925			
	INT-3	0.919			
SAD	SAD-1	0.966	0.966	0.978	0.936
	SAD-2	0.969			
	SAD-3	0.968			
ANX	ANX-1	0.941	0.927	0.954	0.873
	ANX-2	0.925			
	ANX-3	0.936			
ENJ	ENJ-1	0.887	0.920	0.950	0.863
	ENJ-2	0.948			
	ENJ-3	0.951			
STR	STR-1	0.883	0.919	0.949	0.861
	STR-2	0.950			
	STR-3	0.951			
CI	CI-1	0.946	0.945	0.965	0.901
	CI-2	0.951			
	CI-3	0.952			

ANX anxiety; *CI* continuance intention; *CUR* curiosity; *ENJ* enjoyment; *HAP* happiness; *INT* interest; *SAD* sadness; *COM* perceived competition; *RISK* perceived risk; *STR* stress

Table 3 Correlation and discriminant validity

	COM	RISK	CUR	HAP	INT	SAD	ANX	ENJ	STR	CI
COM	**0.869**									
RISK	0.561	**0.922**								
CUR	0.618	0.509	**0.891**							
HAP	0.540	0.389	0.727	**0.953**						
INT	0.624	0.460	0.717	0.726	**0.829**					
SAD	0.346	0.157	0.162	0.156	0.321	**0.968**				
ANX	0.376	0.211	0.215	0.279	0.428	0.768	**0.934**			
ENJ	0.524	0.340	0.614	0.715	0.795	0.289	0.363	**0.929**		
STR	0.363	0.203	0.167	0.186	0.337	0.749	0.716	0.303	**0.928**	
CI	0.484	0.372	0.622	0.789	0.720	0.093	0.207	0.735	0.124	**0.949**

ANX anxiety; *CI* continuance intention; *CUR* curiosity; *ENJ* enjoyment; *HAP* happiness; *INT* interest; *SAD* sadness; *COM* perceived competition; *RISK* perceived risk; *STR* stress

Mediation effects were obtained through bootstrapping with 5,000 subsamples at the 95% confidence interval, following Hair et al. (2017). The mediation results are shown in Table 6, in the Appendix. According to the mediation test, the mediation role of the four emotions is supported except in the relationship between perceived risk and continuance intention.

The final results are shown in Fig. 2. We can conclude that perceived competition has a positive influence on happiness, interest, sadness, and anxiety; perceived risk has no influence on the four discrete emotions; and curiosity has a positive influence on happiness and interest. Happiness and interest have a positive influence on enjoyment, and sadness and anxiety have a significant influence on stress. Happiness, interest, sadness, anxiety, enjoyment, and stress play significant mediation roles in the relationship between perceived competition and continuance intention, but they exert no mediation effect on the relationship between perceived risk and continuance intention. Happiness, interest, and enjoyment vitally mediate the relationship between curiosity and continuance intention.

Discussion and Implications

Key Findings and Theoretical Implications

We have proposed a model to address the continuance intention of students in MOOC learning, based on the S-O-R framework, and empirically validated the influence of three psychological stimuli—perceived competition, perceived risk, and curiosity—on continuance intention through the mediation of emotional experience.

First, the results reveal that the psychological stimulus of perceived competition affects students' MOOC continuance intention through all four of the emotions considered—happiness, interest, sadness, and anxiety. It is interesting to see that psychological stimulus can evoke both positive and negative emotions, leading to different emotional states of enjoyment or stress. On the one hand, competition increases people's happiness, consistent with the findings of Nebel et al. (2016). People feel happiness when they think they have won in a competition no matter whether they are competing with others or themselves (Gupta et al., 2020). When people feel the competition around them, they devote greater effort so that they will not lose in the competition, which will incentivize their interest (Anning-Dorson et al., 2017). A consensus has been reached in the extant literature that positive emotions strengthen individuals' enjoyment and enjoyment plays a vital mediation role (Yan et al., 2021). Our results corroborate this effect by validating that happiness and interest induce enjoyment, which then enables people to persist in MOOC learning, in accordance with Huang and Ren (2020). On the other hand, our results also confirm that competition gives rise to negative emotions of sadness and anxiety, in line with the results of Cheng et al. (2009). Sadness affects people's psychological state and is harmful to well-being (Lomas, 2018). Anxiety plays a negative role in continuance intention (Meng et al., 2021). Psychological research has confirmed that sadness can make humans feel stressful (Millgram et al., 2019), and alleviation of sadness weakens stress (Poljac et al., 2011). A large body of research agrees that anxiety is closely related to stress (Daviu et al., 2019; Husky et al., 2020). Our results further support that sadness and anxiety bring about stress, and stress is detrimental to MOOC continuance. Moreover, our results show that the effect of competition on positive emotions is greater than its effect on negative ones.

Our research enriches the existing literature by introducing perceived competition into understanding continuance intention in MOOCs. Competition is underscored in the traditional offline course context, but it is ignored in the online context, given its characteristic of self-learning. However, perceived competition is a broad concept. It can occur anywhere, between one and oneself or one and one's perceived competitors. The perceived competitors may

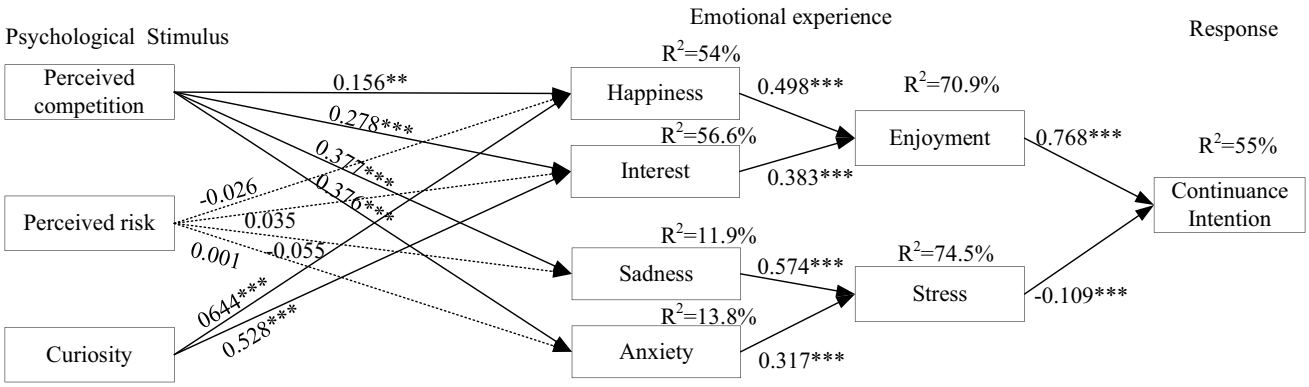

Fig. 2 Structural Model with Standardized Estimates

be one's classmates or companions in the real world, but also in virtual online courses, which have become more common and popular in the present learning situation. Our results extend the concept of perceived competition, broadening and confirming its prominent effect in the online learning context.

Second, going against our expectation, the results disclose that the psychological stimulus of perceived risk has no effects on the four emotions and thus exerts no influence on continuance intention through emotions. Prior literature has recorded that perceived risk arouses confounding emotions (Otieno et al., 2013). It can reduce happiness (Yıldırım & Güler, 2021), increase interest (Hahn et al., 2006; Sales & Sheth, 2019), exacerbate sadness (Yıldırım & Güler, 2021), and aggravate anxiety (Ari et al., 2020). Instead, our results indicate that perceived risk has no effect on continuance intention. However, this is reasonable since our research context is online learning, which is distinct from the e-commerce or medical research background of other studies. It is thus understandable that perceived risk may have a different influence with the variation in circumstances. Given that most students learn online to enrich their knowledge (Watted & Barak, 2018), it is rational that most students do not have a very strong motivation to achieve good performance in learning and do not experience this kind of risk. Thus, perceived risk does not exhibit a significant effect in the MOOC context.

Our research further supplements the extant research through the finding that perceived risk plays a role in emotions contingent on the situation. In different settings, perceived risk generates different effects, and sometimes it does not have an effect. With the development of society, risk is not a good persuasive reason for encouraging students to learn. Students continue to learn purely due to their inner yearning for knowledge and to become more competent. Our results provide a more comprehensive understanding of students' motivation for continuously learning.

Third, not surprisingly, the results affirm that the psychological stimulus of curiosity acting as a positive motivation enables people's positive emotions, consistent with the findings of Ainley et al. (2002) and Dai et al. (2020b). Curiosity usually incentivizes positive emotions (Fayn et al., 2018). It enhances happiness (van Lieshout et al., 2020) and evokes people's interest (Peterson & Hidi, 2019). Our results also validate the positive effect of curiosity on happiness and interest. Curious individuals are more likely to have positive emotions about learning in MOOCs. They show a higher level of interest and happiness, and those emotions increase the feeling of well-being from learning, which would lead to greater persistence in MOOCs. Our research adds evidence on the effect of curiosity, extending the existing literature by affirming the influence of curiosity on continuance intention through the mediation of the emotions of happiness and interest.

In addition, the results highlight the important role of emotions in students' online learning. Emotional experience significantly impacts students' continuance learning intention in MOOCs. Emotion has broadly been considered the core experience influencer of decisions (Bagozzi et al., 1999). Emotion has gained a lot of attention and there has been a call for a fine-grained study of its discrete components (Kranzbühler et al., 2018). Researchers have reached a consensus that emotions have prominent effects on strategy making (Xu et al., 2020) and behavior response (Wyer et al., 2019). Educational research has pointed out that students' emotions play important roles in their academic achievements (Valiente et al., 2012). Students' positive emotions could enhance their attention (Li et al., 2020) and negative emotions could lead to irrational behavior (Rezapour et al., 2022). Our results also show that positive emotions promote students' intentional willingness and negative emotions give rise to the negative result of lower continuance intention. Rajak et al. (2021) confirm that stress has a positive influence on employees' performance in higher education. By contrast, our results show that stress dampens students' continuance intention in the online learning context, reflecting that stress may generate different effects in different environments. Many scholars also confirm that enjoyment would be beneficial for individuals' response, such as learning persistence (Yu et al., 2020) and academic achievement (Xing et al., 2019). Our results also show that enjoyment has a positive effect on continuance intention, consistent with these findings. Given that students' emotions can also be affected by their inner cognition, such as self-efficacy (Hayat et al., 2020), a large body of literature argues that emotions have a mediation effect (Yang & Bahli, 2015). Essentially, emotion is triggered by stimulus (Ding, 2019), which results in behavior (Rockmann et al., 2018), reflecting its mediation role. In offline math learning, students' perceived competition could affect their emotions, which would further affect their academic achievement, forming an effect chain (Forsblom et al., 2022). In classroom learning, Acosta-Gonzaga and Ramirez-Arellano (2021) conceptually propose that students' motivation could affect their emotions and then influence their academic achievements. Our results support these findings by confirming the effects of perceived competition on emotions, which finally impact continuance intention. Furthermore, our study comprehensively validates how the four discrete emotions—happiness, interest, sadness, and anxiety—mediate the relationship between psychological stimuli and continuance intention and captures the benefits and harmfulness of the different emotions.

In the virtual learning literature, students' emotions are mainly studied through concepts related to emotion (e.g., "satisfaction"), with few studies treating emotions as states

(Henritius et al., 2019). Deng et al. (2021) focus on online learning engagement, stating the important mediation role of emotion in the relationship between regulatory focus, self-efficacy, and engagement. Our results corroborate the important effects of emotions. The effects of specific emotions have not received much attention in the online learning context, whereas they have been emphasized in e-commerce (Yi & Jai, 2020). For example Heckel & Ringeisen (2019) and Tzafilkou et al., (2021) highlight the effects of anxiety. Our results further validate the effects of more fine-grained emotions. Yu et al. (2020) highlight the critical importance of emotions in mediating the relationship between students' external interactions and online learning persistence. Our results further supplement the extant literature through verifying the prominent mediating effects of emotions on the relationship between students' internal stimuli and online learning continuance intention. By using an S-O-R framework, we confirm and highlight the significant mediating role of emotional experience in continuance intention and clearly disclose the effect chain mediated by emotion, unveiling in detail the discrete emotional mechanism of MOOC continuance intention. Our results add knowledge to the online learning literature.

In sum, there is a lack of requisite knowledge of the psychological factors and emotions in learning, especially in online learning. Our results provide insightful implications for disentangling the relationship between psychological factors, emotions, and continuance intention and clearly uncover the effect mechanisms through the S-O-R framework.

Practical Implications

The results of our research have practical implications. First, more elements with a moderate level of competition could be added to online courses. Platform designers and instructors can introduce more competition elements into their courses, but they need to pay special attention to the extent of competition because it can have opposite effects. Educational games, a form of competition, can be introduced into courses. Platform designers can add elements like a progress bar, which visually displays students' learning progress, or a word counter, which records the total number of words a learner has acquired, to the online learning webpage. The platform designer can also set a billboard on the right side of the course webpage to display students' outstanding performance anonymously and publicly, and students can check their performance privately on their own webpages. Teachers could introduce the traditional rank order grading policy, which would reflect competition in online learning. And teachers are recommended to introduce gamification elements to incorporate competition into the online learning process. For example, teachers can assign different badges, like gold, silver, or copper, and different numbers of badges to students according to their performance, like whether students submit homework on schedule and whether the homework is completed correctly.

Second, perceived risk has no effect on users' emotions and therefore continuance intention in online learning. Platforms and teachers do not need to emphasize the risk or loss due to not using MOOCs. Nowadays, society has developed and is full of opportunities. Thus, students do not feel much risk; instead, they tend to enjoy the learning process and are not threatened by the seriousness or cruelty of society. These general attitudes toward risk coincide with the features of contemporary students no matter whether they are studying in offline or online universities (Shi & Lin, 2021). Unlike many for-profit educational institutions, MOOC platforms do not need to advertise employment risk. Given that MOOC learners mostly aim to equip themselves with more knowledge with no special utilitarian purpose, MOOC platforms and teachers are encouraged to remind students that through MOOC learning, they will gain more knowledge.

Third, the pure positive effect of curiosity inspires platforms and teachers to devote great effort toward fostering it. Curiosity can be classified into epistemic curiosity, which is related to complex ideas that motivate people to ask questions, and perceptual curiosity, which arises from complex or ambiguous patterns that motivate visual and sensory inspection (Wagstaff et al., 2021). Therefore, teachers are recommended to adopt the problem-posing methodology in online education (Freire, 2018). Teachers could put forward interesting questions that are related to students' lives or a current topic, before stepping into the main body of the course. Teachers and MOOC platforms are encouraged to prepare ample resources that can appeal to students' visual or auditory attention. Platform developers could highlight or add some innovative elements; for example, they could provide short animation videos or bold questions that would attract students' attention on the course webpage. Teachers could place interesting pictures in their PowerPoints, or add animated voices to inspire students' curiosity.

Furthermore, our findings remind platforms and teachers of the importance of considering students' psychological and emotional state. They should try their best to improve learners' emotional experience in MOOC learning, provoking their emotions of happiness and interest, which will impact the final continuance decision. Platform designers could ensure that the webpage uses bright colors and is clear and concise (Rosen & Purinton, 2004). These practices can help learners to feel happy and enjoy browsing the webpage. Teachers could embed entertaining short videos into teaching (Choi, 2018), which would help students to enjoy the learning experience.

Conclusion, Limitations, and Future Research

Our research used an S-O-R framework to unveil the effect mechanism of psychological stimuli on MOOC continuance intention. We confirmed that perceived competition significantly affects the four discrete emotions of happiness, interest, sadness, and anxiety; perceived risk unexpectedly has no effect on the four emotions; and curiosity only has effects on happiness and interest. Happiness and interest have positive impacts on enjoyment, and sadness and anxiety entail significant impacts on stress. Both enjoyment and stress strikingly affect students' continuance intention. The results extend the extant research on continuance intention under the MOOC learning setting and can help platforms and teachers better understand students in the online learning process.

Our research has some limitations, which could be explored in future research. First, the effect of perceived competition has two sides. Researchers should further examine the level of the perceived competition that would increase the positive effects. Second, we only utilized four discrete emotions. Additional emotions (anger, excitement, and so forth) could be further studied. Third, we did not account for individuals' different types of cognitive states in their MOOC learning process, which could be treated as a moderating role in future research. Lastly, our respondents are limited to China. Respondents from other countries could be included and their cultural backgrounds could be considered, using Hofstede's culture measurements in research in the future.

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Data Availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests The authors declare that they have no competing interests.

Appendix

See Tables 4, 5 6.

Table 4 Respondents' demographic information

Variable	Category	Frequency	Percent
Gender	Female	391	68.1
	Male	183	31.9
Age (years)	< 18	51	8.9
	18–25	396	69
	26–30	81	14.1
	31–40	30	5.2
	41–50	14	2.4
	> 50	2	0.3
Education	Technical college or below	74	12.9
	Undergraduate	268	46.7
	Postgraduate	219	38.2
	Doctor or higher	13	2.3
Occupation	Student	401	69.9
	Faculty	173	30.1
MOOC use experience	Fewer than 6 months	136	23.7
	6 months to 1 year	235	40.9
	1–3 years	151	26.3
	More than 3 years	52	9.1
Use frequency in one month	Less than twice	196	23.7
	2–5 times	234	40.8
	6–10 times	93	16.2
	More than 10 times	51	8.9
Number of finished courses within the past six months	0	82	14.3
	1–2	328	57.1
	3–4	114	19.9
	> 5	50	8.7

Table 5 Significance test results

Relationship	Coefficient	T-statistic	*P*-value	Results
COM—> HAP	0.156**	3.267	0.001	Supported
COM—> INT	0.278***	6.317	0.000	Supported
COM—> SAD	0.377***	8.485	0.000	Supported
COM—> ANX	0.376***	8.249	0.000	Supported
RISK—> HAP	−0.026	0.557	0.577	Unsupported
RISK—> INT	0.035	0.827	0.408	Unsupported
RISK—> SAD	-0.055	1.204	0.229	Unsupported
RISK—> ANX	0.000	0.001	0.999	Unsupported
CUR—> HAP	0.644***	16.217	0.000	Supported
CUR—> INT	0.528***	12.771	0.000	Supported
HAP—> ENJ	0.498***	10.064	0.000	Supported
INT—> ENJ	0.383***	7.429	0.000	Supported
SAD—> STR	0.574***	10.113	0.000	Supported
ANX—> STR	0.317***	5.629	0.000	Supported
ENJ—> CI	0.768***	29.796	0.000	Supported
STR—> CI	−0.109***	4.455	0.000	Supported

** = significant at the 5% level; *** = significant at the 1% level

Table 6 Mediation results

Relationship	Standard deviation (STDEV)	T-statistic (|O/STDEV|)	*P*-value	Decision
COM—> INT—> ENJ	0.023***	4.678	0.000	Supported
COM—> INT—> ENJ—> CI	0.018***	4.571	0.000	Supported
COM—> HAP—> ENJ	0.026***	2.978	0.003	Supported
COM—> HAP—> ENJ—> CI	0.020***	2.945	0.003	Supported
COM—> SAD—> STR	0.032***	6.802	0.000	Supported
COM—> SAD—> STR—> CI	0.006***	3.657	0.000	Supported
COM—> ANX—> STR	0.025***	4.703	0.000	Supported
COM—> ANX—> STR—> CI	0.004***	3.372	0.001	Supported
RISK—> INT—> ENJ	0.016	0.835	0.404	Unsupported
RISK—> INT—> ENJ—> CI	0.013	0.829	0.407	Unsupported
RISK—> HAP—> ENJ	0.024	0.554	0.579	Unsupported
RISK—> HAP—> ENJ—> CI	0.018	0.551	0.581	Unsupported
RISK—> ANX—> STR	0.016	0.001	0.999	Unsupported
RISK—> ANX—> STR—> CI	0.002	0.001	0.999	Unsupported
RISK—> SAD—> STR	0.026	1.198	0.231	Unsupported
RISK—> SAD—> STR—> CI	0.003	1.093	0.274	Unsupported
CUR—> INT—> ENJ	0.031***	6.583	0.000	Supported
CUR—> INT—> ENJ—> CI	0.025***	6.338	0.000	Supported
CUR—> HAP—> ENJ—> CI	0.032***	7.727	0.000	Supported
CUR—> HAP—> ENJ	0.038***	8.333	0.000	Supported
INT—> ENJ—> CI	0.042***	7.044	0.000	Supported
HAP—> ENJ—> CI	0.042***	9.080	0.000	Supported
SAD—> STR—> CI	0.016***	3.992	0.000	Supported
ANX—> STR—> CI	0.009***	3.713	0.000	Supported

***Significant at the 1% level

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