Rebellious youth and ineffective advice: A study of Vietnamese adolescents' capability to deal with digital threats

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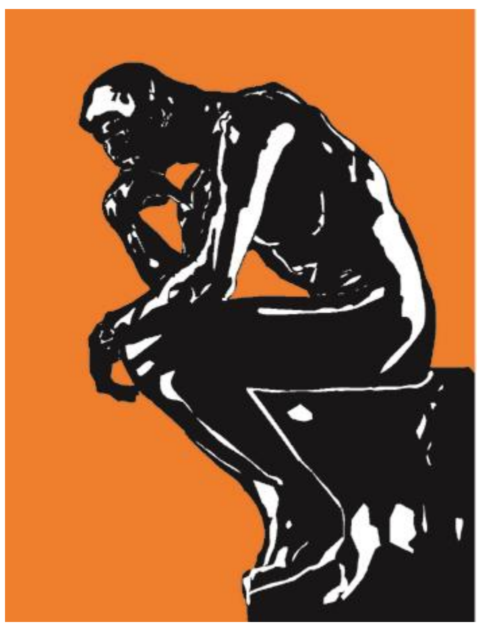

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Abstract

The digital era brings various benefits to adolescents. However, operating on the digital environment without sufficient knowledge and skills will expose them to multiple types of risks, especially in the country with low digital safety education rate like Vietnam. The current study examines factors that can contribute to cultivating adolescents' digital resilience using the information-processing reasoning of the Mindsponge Theory. A UNESCO dataset of 1061 Vietnamese high school students was analyzed using the Bayesian Mindsponge Framework analytics. It is found that adolescents' daily Internet usage frequency, parents' Internet safety guidance, and teachers' safety guidance are positively associated with digital resilience. However, the effects of parents' and teachers' Internet safety guidance on digital resilience are conditional on the daily Internet usage frequency. Parents' guidance only enhances adolescents' digital resilience if they use the Internet less than four hours per day. In contrast, the positive effect of teachers' guidance on adolescents' digital resilience becomes stronger when the students spend more time on the Internet (more than 1 hour). Based on these findings, we suggest that adolescents can learn to minimize risks and protect themselves by exposing more to the digital environment. Parents' and teachers' supports are important in enhancing adolescents' capability to deal with digital threats, but types of supports need to be carefully considered to avoid reverse impacts on adolescents' resilience.

Keywords: digital risks, safety, Internet usage, school support, parental support, BMF analytics

> "If you want to find food, you have to go where the food is. Flying far only makes one tired; it doesn't guarantee anything."
>
> from "Food" in the *Kingfisher Story Collection* (2022)

1. Introduction

Nowadays, the development of science and technology makes access to the digital environment a more common thing for people around the globe. The wide availability of information communication technology (ICT) allows us to communicate with each other easily, quickly, conveniently, and at a reasonable cost (Rahmatullah et al., 2022). The advantages of ICT are myriad, especially for children and adolescents. They can use ICTs to learn, entertain, explore, or even work to earn money. Indeed, it is not difficult to find success stories of teenagers becoming millionaires through computational entrepreneurship (Vuong, 2019), such as JoJo Siwa with It's JoJo Siwa Youtube channel, Adam Hildreth with Dubit Limited (a social-networking website for teenagers), Nick D'Aloisio with Summly (a web platform and smartphone application that provides algorithmically-generated summaries), etc. However, digital spaces also contain many threats to adolescent users.

A majority of adolescents use digital devices and the Internet regularly. They use digital technology and media so frequently that they are labeled “digital natives” or “the net generation” by multiple scholars (Oblinger & Oblinger, 2005; Prensky, 2001). The International Telecommunication Union (ITU) estimated that the number of youths using the Internet in 2020 accounted for 71% of the world’s youth, 1.24 times higher than the remaining population (International Telecommunication Union, 2023). In Vietnam, 89% of adolescents between the age of 16-17 use the Internet, and 87% of them utilize the Internet daily with an average time of 5-7 hours per day, according to the survey conducted by the Vietnamese Department of Children’s Affairs in the third quarter of 2022 (Quyen & Tam, 2023). Despite the high percentage of adolescents’ Internet usage, only 36% report receiving education regarding digital safety (Quyen & Tam, 2023). The juxtaposition of Vietnamese adolescents’ Internet usage rate and digital education rate underlines the urgent research demand into factors improving Vietnamese adolescents’ digital resilience. The problem can be even more dramatic as adolescents (ages 11-18) are in the transition period from children to adults, when the establishment of autonomy, personal identity development, and future orientation occur while the self-regulation mechanism is not fully developed (Oliva et al., 2019; Sanders, 2013).

Major threats in the digital environment are various, including multifaceted aspects, such as content, contact, commercial, and privacy risks (Bremer, 2005; Livingstone & Haddon, 2008; Valcke et al., 2011). Content risks refer to the users’ exposure to harmful content, like images or text showing pornography, violence, racism, or hate. A recent study in Vietnam indicates that adolescents aged 15 to 18 have a very high overall exposure rate to sexually explicit Internet material: 84.10%. The passive exposure rate is also high at 58.3% (Nguyen et al., 2021). Contact risks refer to risky situations arising from online contacts. Cyberbullying and sexual solicitation are two common types of contact risks. While cyberbullying is defined as “an aggressive, intentional act carried out by a group or individual, using electronic forms of contact, repeatedly and over time against a victim who cannot easily defend him or herself” (Smith et al., 2008), sexual solicitation occurs “when children or adolescents are asked to engage in sexual activities, sexual talk, or to give personal sexual information on the Internet” (Hornor, 2020; Mitchell, Wolak, et al., 2007).

When operating in the digital environment, adolescents are more likely to pass personal information to others, resulting in privacy threats. Several studies have suggested that adolescents are likely to disclose their identities, ages, residences, and telephone numbers on the Internet (Dowdell, 2011; Kierkegaard, 2008). Besides giving out personal information, adolescents may also face privacy invasion and hacking (Livingstone & Haddon, 2008). Unwanted face-to-face interaction, harassment, or abuse may result from this invasion of privacy, so Valcke et al. (2011) deem privacy risks as antecedents of offline contact risks. In addition, empirical evidence shows the negative effects of cyberbullying on adolescents' health and well-being (Nixon, 2014; Noll et al., 2022). Specifically, cyberbullying victims are likely to experience anxiety, depression, emotional distress, trauma symptomatology, sadness, hopelessness, powerlessness, delinquent behavior, and substance use (Mitchell, Ybarra, et al., 2007; Raskauskas & Stoltz, 2007; Wigderson & Lynch, 2013; Ybarra et al., 2006). Experiencing online bullying is even more stressful than that of offline bullying, partly due to its anonymity (Sourander et al., 2010). Not knowing the cyberbullying perpetrators can contribute to the victims' fear, as perpetrators can be anyone, even their closest friends (Bauman, 2010; Raskauskas & Stoltz, 2007). Commercial risks, like advertising/commercial exploitation, illegal downloading, or gambling, are also another major type of threat for adolescents. However, this kind of risk is not focused on the current study due to data limitation.

Building digital resilience is imperative for safeguarding the youth from digital threats while still keeping them employing the utilities of the digital environment (Sage et al., 2021). Despite the importance, most studies about Internet use and resilience focus on its mediator or moderator role in buffering the effects of Internet harms (Sage et al., 2021). Few studies examine the factors improving children's and adolescents' digital resilience. For example, a study on Vietnamese high school students shows that digital resilience is positively associated with digital literacy (Tran et al., 2020). Hammond et al. (2022) use a mixed qualitative methodology to study pre-teens (8-12 years old) and find that digital resilience can be improved through a collective endeavor involving children at an individual level, parents/carers within home environments, youth workers, civil society, teachers, and schools at a community level, along with governments, policymakers, and the education system and Internet corporations at a societal level (Hammond et al., 2022). This finding aligns with Valcke et al. (2011)'s suggestion that parental supervision and school-based approaches are among the main methods promoting adolescents' safe Internet use. However, much involvement of parents and teachers can cause negative effects on good-capacity children and adolescents' development (Vuong et al., 2021a). These adverse effects can be exacerbated in the case of digital learning, in which children and adolescents are likely to acquire greater Internet knowledge and skill levels than their parents (Grossbart et al., 2002).

The knowledge regarding the interplay effects of digital usage frequency and parents' and teachers' guidance of Internet safety on digital resilience remain limited in the current literature. Therefore, the present study aims to examine how digital usage frequency and support from teachers and parents contribute to cultivating Vietnamese adolescents' digital resilience. The theoretical reasoning was conducted using the information-processing framework of the mindsponge theory, while Bayesian Mindsponge Framework (BMF) analytics was employed on a United Nations Educational, Scientific, and Cultural Organization (UNESCO) dataset of 1061 Vietnamese high school students for validation.

2. Materials and Method

2.1. Theoretical foundation

2.1.1. Overview of the mindsponge theory

The current study's models were constructed based on the information-processing reasoning of Mindsponge Theory (Vuong, 2023), so it is essential to understand the theory and how it helps lay a theoretical foundation for the study. In their pioneering research on acculturation and global mindset, Quan-Hoang Vuong and Nancy K. Napier coined the term "mindsponge mechanism," which describes a dynamic process of how a mindset assimilates new cultural norms and discards waning ones in response to circumstances (Vuong & Napier, 2015). The original mindsponge mechanism supports a number of different theories and frameworks in psychosocial contexts, such as those developed by Abraham Maslow (Maslow, 1981), Geert Hofstede (Hofstede et al., 2005), Inoue Nonaka (Nonaka & Konno, 1998), Henry Mintzberg (Mintzberg, 1973), Icek Ajzen (Ajzen, 1991) and Michael Porter (Porter, 2011), etc. It has also been used in many studies investigating psychological and behavioral issues (Nguyen & Jones, 2022a, 2022b; Vuong et al., 2023; Vuong, Le, et al., 2022; Vuong et al., 2021b).

Later, the mindsponge mechanism was expanded into a theory of how the mind processes information based on the newest evidence from brain and life sciences (Vuong, 2023). Being inspired by the meta-physics assumption that our world is constructed from information so that anything can be examined in terms of information (Adriaans, 2020; Davies & Gregersen, 2014; Dyson, 1999), the theory is also constructed through the information-processing perspective. According to the mindsponge theory, the mind is a collection-cum-processor of information that incorporates biological and social systems of varying degrees of complexity and has the following characteristics:

1) It represents the underlying patterns of the biosphere.
2) It is a dynamic and balanced process.
3) It uses a cost-benefit analysis and aims to maximize perceived benefits while lowering the perceived cost for the system.
4) It complies with the principle of energy conservation.
5) It follows objectives and priorities based on the needs of the system.
6) Its major function is to sustain the continuous existence of the system (manifested as survival, growth, and reproduction).

Within a mind (or an information collection-cum-processor), the mindset is a collection of highly trusted information stored in the system's memory, which influence the mental processes (including the information-filtering process) and behaviors of the individual. Based on the content of the current mindset, the filtering mechanism determines what information from the external environment enters or is ejected from the mindset. During the information filtering process, the trust mechanism (selective prioritization) may be employed to speed up the filtering process while still conserving energy (Le et al., 2022).

2.1.2. Mind, environment, and updating mechanism

In the mindsponge theory, the mind and environment are two primary components. The mind exists within the environment, so the environment can be defined as all external information outside the individual's mind (or an information collection-cum-processor). Because living systems are not isolated, the mind is not a constant information set. It is continually updating, given the information exchange nature of cells and the plasticity of neurological systems. The activities of neurons and their synapses, which follow the biochemical rules of molecular interactions, underpin the functioning of the human brain (Procès et al., 2022). Human social perceptions and behaviors are the outcomes of information processes occurring in different areas of the cerebral cortex (Maliske & Kanske, 2022).

Due to neuroplasticity, the updating processes in human minds are "live-wiring" as opposed to the dominant "hard-wiring" manner in simpler systems (e.g., more dependent on predetermined genetic information) (Eagleman, 2015). For humans, information absorbed from the environment and integrated into the mindset is stored in the form of trusted values (beliefs) (Vuong, La, et al., 2022). An individual cannot understand the surrounding world, navigate within it, and make decisions to adapt to a changing external environment without the information absorption process. Accessibility and availability of information are two fundamental conditions for an individual to absorb information. Availability refers to the objective availability of information in the environment, whereas accessibility refers to the mind's ability to access or be receptive to available information. Thus, absorption depends not only on the information available in the environment, but also on the physical capacity of the sensory systems and the information stored in mind. In other words, the mind's content shifts to fit mental representations to reality better on a continuous timeline (Nguyen et al., 2023). Bayes' Theorem (presented below) is helpful when examining the information process of belief updating (Gill, 2014).

$$p(\boldsymbol{\theta}|\mathbf{X}) \propto L(\mathbf{X}|\boldsymbol{\theta})p(\boldsymbol{\theta})$$

This can be interpreted as follows: the posterior probability (or current belief) $p(\boldsymbol{\theta}|\mathbf{X})$ is proportional to the prior probability (or prior belief) $p(\boldsymbol{\theta})$ and the likelihood function (or new evidence) $L(\mathbf{X}|\boldsymbol{\theta})$.

2.1.3. Proposed hypotheses

Before delving into how digital resilience can be formed and improved among adolescents, it is important to elucidate what digital resilience is. The concept of resilience has its roots in ecology, but it has since spread to various disciplines, including the behavioral and psychological sciences (Buikstra et al., 2010; Norris, 2011), the study of mental health

(Southwick et al., 2014), economics (Pant et al., 2014), and disaster management (Tadele & Manyena, 2009). It can be generally defined as an individual's ability to withstand, overcome, and adapt to the adversities occurring within the environment (Masten, 2007; Salignac et al., 2019; Sun et al., 2022). The scoping review of Sun et al. (2022) suggests that the concept of digital resilience in the educational field consists of five attributes:

1) Understanding online threats
2) Knowing solutions
3) Learning knowledge and skills
4) Recovering from stress
5) Moving forward through self-efficacy

As we examined the individual's resilience through the information-processing perspective, we defined digital resilience following the mindsponge-based definition of Nguyen, Khuc, et al. (2022): "the individual's capability to manage information within the mind and information absorbed from the external environment to deal with and recover from" digital adversities (or adversities occurring within the digital environment). This definition still aligns with the first four main attributes of digital resilience in the educational field. Nguyen, Khuc, et al. (2022) also suggest that the capability of managing information can be built and cultivated by increasing the amount and types of information stored within the mind and improving the mind's capability to process information associated with digital issues. The reasoning is supported by empirical evidence that higher digital literacy is associated with higher digital resilience

Operating within the digital environment is one primary to absorb digital information. Doing so will help adolescents cultivate their digital literacy by allowing them to absorb and process information, make informed decisions, receive feedback from the environment, and update their knowledge and skills. Such digital knowledge and skills will have more choices and flexibility in response to adversities, thus building digital resilience. Following this logic, it is assumed that the higher the frequency of using digital devices, the higher the amount of digital information students absorb, which improves their digital knowledge and skills. As a result, they are more likely to develop a higher capacity to deal with situations with digital threats, such as cyberbullying, harassment, privacy violations, etc. We proposed the following hypothesis (H):

> **H1: The** Internet usage frequency of Vietnamese students has a positive relationship with the ability to deal with digital threats.

In addition to the frequency of interaction with the digital environment, the student's home and school information space are potential factors contributing to students' digital knowledge and skills accumulation. Teachers and parents are students' primary sources of information, so regularly educating students about digital safety is expected to improve students' knowledge and skills to deal with digital threats. We hypothesized that:

H2: The frequency with which Vietnamese students are instructed to use the Internet safely by their parents is positively correlated with the ability to deal with digital threats.

H3: The frequency with which Vietnamese students are taught to use the Internet safely is positively correlated with the ability to deal with digital threats.

If Hypothesis 1 is true, students with different frequencies of Internet users are more likely to have different mindsets and, therefore, different value evaluation systems. More competent students may need more freedom or autonomy, while less capable students may need more guidance (Vuong et al., 2021a). These trends can lead to different or even contradictory effects of the same teaching method on the development of different students. For this reason, we hypothesized that:

H4: Effect of frequency of parents teaching safe Internet use on students' ability to deal with digital threats depends on how often children use the Internet

H 5: The effect of teachers' frequency of safe Internet use on students' ability to deal with digital threats depends on how often students use the Internet

2.2. Model construction

2.2.1. Variable selection and rationale

The current study employed a secondary dataset of Vietnamese students' attitudes, behaviors, competency levels, and information and communication technology (ICT) skills (Le et al., 2019). The dataset contained 1061 observations, which were obtained from 20 surveyed senior high school students across five provinces and cities in Vietnam (Lao Cai, Hanoi, Danang, Lam Dong, and Can Tho). The data collection was a part of the "Digital Kids Asia Pacific (DKAP)" research, which investigated the ICT proficiency levels of school students in the Asia-Pacific region using four pilot nations: Vietnam, Bangladesh, Fiji, and the Republic of Korea. The DKAP research was carried out by UNESCO in Bangkok as a component of the "Fostering Digital Citizenship through Safe and Responsible Use of ICT" project.

The theoretical foundation for the survey design was based on Bronfenbrenner's bio-ecological model, which describes a child's maturity in interactions with multiple levels of sociodemographic, cultural, and societal elements that constitute their community (Bronfenbrenner & Ceci, 1994). During the survey distribution process, the research team adhered strictly to the UNESCO survey protocol, which was as follows: (i) holding the consultancy workshop in July 2018 to review and develop the modified version of the survey questionnaire; (ii) running the survey's pilot test at two Hanoi schools and making the necessary adjustments in August 2018; (iii) getting in touch with the target schools' administrators and coordinators and conducting administrative work for the investigation; and (iv) implementing the survey.

In the current study, five variables were employed to investigate the study's objectives. The variable description is shown in Table 1.

Table 1: Variable description

Variable	Meaning	Type of variable	Value
Sex	The respondents' gender	Binary	Female: 1; Male: 2
DigitalUsageFrequency	Amount of time accessing the Internet using digital devices per day	Numerical	Never: 1; Hardly ever: 2; Sometimes: 3; Often: 4; Very often: 5; All the time: 6
ParentsSafetyGuide	The level of support from parents on ways to use the Internet safety	Numerical	Never: 1; Hardly ever: 2; Sometimes: 3; Often: 4; Very often: 5; All the time: 6
TeachersSafetyGuide	The level of support from teachers on ways to use the Internet safety	Numerical	Never: 1; Hardly ever: 2; Sometimes: 3; Often: 4; Very often: 5;

			All the time: 6
CapabilityAgainstDigitalThreat	The number of response measures to deal with digital threats that the adolescents can think of	Numerical	N/A

The adolescents' sex is indicated by the *Sex* variable, with female coded as 1 and male coded as 2. The variable was generated from variable *f1* in the dataset.

The amount of time that the student accessed the Internet per day was measured and represented by the *DigitalUsageFrequency* variable. The variable was generated from variable *g2* in the dataset. The variable was measured by a six-point Likert Scale, ranging from 1 ('Never') to 6 ('All the time').

ParentsSafetyGuide and *TeachersSafetyGuide* are variables used to measure the level of support from parents and teachers on Internet safety, respectively. These two variables were generated from variables *h6_1* and *h6_2* in the dataset. The variables were measured by a six-point Likert Scale, ranging from 1 ('Never') to 6 ('All the time').

To measure the adolescents' digital resilience, we used questions inquiring about how they respond when being in scenarios exposed to threats. In particular, the adolescents were asked how they would respond when the following scenarios happen:

1) When they are exposed to unwanted, disturbing files or websites (e.g., pornography websites, violent media)
2) When they receive unwanted, disturbing messages, including annoying messages or embarrassing pictures
3) When they find that their personal information is misused, compromised, or acquired without permission online
4) When they are bullied online by friends or others

For each question, a range of response measures was provided for the students to choose from (e.g., block and report the contact, delete the contact, talk with parents/caregivers, keep the evidence of bullying, etc.). The total number of options the adolescents chose will be considered their capability to respond to adversities, as knowing more options to deal with risks will give them more choices and flexibility in solving and overcoming the problems. Thus, the higher the score of *CapabilityAgainstDigitalThreat*, the higher the adolescents' digital resilience will be. The *CapabilityAgainstDigitalThreat* variable was generated by summing the responses of four variables *b15*, *b16*, *b17*, and *b18*. It should be noted that the 'Don't know what to do' option was not included in the summation.

2.2.2. Statistical models

We employed three multilevel regression models to test the proposed hypotheses in Subsection 2.1, starting with the simplest. In each model, we also examined whether there is a sexual effect on the *CapabilityAgainstDigitalThreat* by applying varying intercepts on *Sex*. Specifically, we constructed Model 1 to examine Hypothesis 1:

$$CapabilityAgainstDigitalThreat \sim normal(\mu, \sigma) \quad (1.1)$$

$$\mu_i = \alpha_{Sex[i]} + \beta_{DigitalUsageFrequency} * DigitalUsageFrequency_i \quad (1.2)$$

$$\alpha \sim normal(M_\alpha, S_\alpha) \quad (1.3)$$

$$\beta \sim normal\left(M_\beta, S_\beta\right) \quad (1.4)$$

The probability around μ is determined by the form of the normal distribution, whose width is specified by the standard deviation σ. μ_i indicates the adolescent i's digital resilience; $Sex[i]$ indicates the sex of adolescent i; $DigitalUsageFrequency_i$ indicates the daily Internet usage frequency of adolescent i. Model 1 has four parameters: the coefficient, $\beta_{DigitalUsageFrequency}$, the intercept of female adolescents, $\alpha_{Sex[Female]}$, the intercept of male adolescents $\alpha_{Sex[Male]}$, and the standard deviation of the "noise", σ. The parameters of the intercepts of male and female adolescents are distributed as a normal distribution around the mean denoted M_α and with the standard deviation denoted S_α; the coefficient of the variable $DigitalUsageFrequency_i$ is distributed as a normal distribution around the mean denoted M_β and with the standard deviation denoted S_β.

We tested Hypotheses 2 and 3 by incorporating variable $ParentsSafetyGuide_i$ $TeachersSafetyGuide_i$ into Model 1:

$$CapabilityAgainstDigitalThreat \sim normal(\mu, \sigma) \quad (2.1)$$

$$\begin{aligned}\mu_i = \alpha_{Sex[i]} &+ \beta_{DigitalUsageFrequency} * DigitalUsageFrequency_i + \\ &\beta_{ParentsSafetyGuide} * ParentsSafetyGuide_i + \beta_{TeachersSafetyGuide} * \\ &TeachersSafetyGuide_i\end{aligned} \quad (2.2)$$

$$\alpha \sim normal(M_\alpha, S_\alpha) \quad (2.3)$$

$$\beta \sim normal\left(M_\beta, S_\beta\right) \quad (2.4)$$

$ParentsSafetyGuide_i$ indicates the support level regarding Internet safety from patients that adolescent i received; $TeachersSafetyGuide_i$ indicates the support level regarding Internet safety from teachers that adolescent i received; $\beta_{TeachersSafetyGuide}$ and $\beta_{ParentsSafetyGuide}$ are coefficients of $TeachersSafetyGuide$ and $ParentsSafetyGuide$, respectively.

Finally, for testing Hypotheses 4 and 5, we constructed Model 3 to include the interaction variables between $ParentsSafetyGuide_{\,i}$ and $DigitalUsageFrequency_{\,i}$, and between $TeachersSafetyGuide_{\,i}$ and $DigitalUsageFrequency_{\,i}$:

$$CapabilityAgainstDigitalThreat \sim normal(\mu, \sigma) \tag{3.1}$$

$$\mu_i = \alpha_{Sex[i]} + \beta_{DigitalUsageFrequency} * DigitalUsageFrequency_{\,i} + \beta_{ParentsSafetyGuide} * ParentsSafetyGuide_{\,i} + \beta_{TeachersSafetyGuide} * TeachersSafetyGuide_{\,i} + \beta_{DigitalUsageFrequency*ParentsSafetyGuide} * DigitalUsageFrequency_{\,i} * ParentsSafetyGuide_{\,i} + \beta_{DigitalUsageFrequency*TeachersSafetyGuide} * DigitalUsageFrequency_{\,i} * TeachersSafetyGuide_{\,i} \tag{3.2}$$

$$\alpha \sim normal(M_\alpha, S_\alpha) \tag{3.3}$$

$$\beta \sim normal(M_\beta, S_\beta) \tag{3.4}$$

$\beta_{DigitalUsageFrequency*TeachersSafetyGuide}$ and $\beta_{DigitalUsageFrequency*ParentsSafetyGuide}$ indicates the coefficient of the non-additive effects of $DigitalUsageFrequency_{\,i} * TeachersSafetyGuide_{\,i}$ and $DigitalUsageFrequency_{\,i} * ParentsSafetyGuide_{\,i}$ on $CapabilityAgainstDigitalThreat$. The logical model of Model 3 can be plotted in Figure 1.

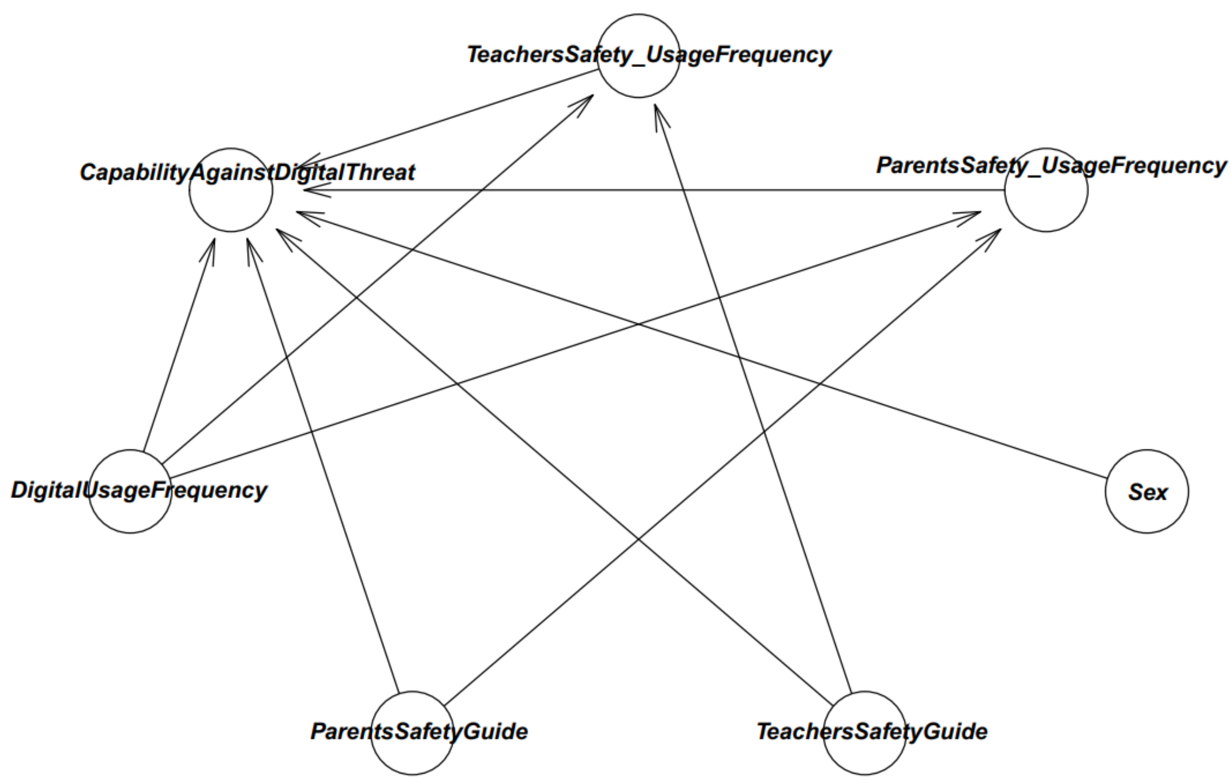

Figure 1: Model 3's logical network

2.3. Analysis and validation

The current study employed Bayesian Mindsponge Framework analytics, which incorporate the Mindsponge Theory and Bayesian inference with the Markov Chain Monte Carlo (MCMC), for several reasons (Nguyen, La, et al., 2022a, 2022b). Firstly, Bayesian inference was well suited to the mindsponge mechanism. By treating a probabilistic analysis of all properties (Csilléry et al., 2010; Gill, 2014), Bayesian inference enables precise prediction using parsimonious models. The MCMC technique's benefits can be utilized for implementing the Bayesian approach to a range of models, like multilevel modeling, offering researchers great flexibility (Dunson, 2001; Nguyen & Vuong, 2007; Nguyen et al., 2005). Besides, the Bayesian approach reduces the risk of over-dependence on the *p*-value by using credible intervals for result interpretation (Wagenmakers et al., 2018).

Pareto-smoothed importance sampling leave-one-out (PSIS-LOO) diagnostics were employed to measure the models' goodness-of-fit (Vehtari & Gabry, 2019; Vehtari et al., 2017). It is computed as:

$$LOO = -2LPPD_{loo} = -2\sum_{i=1}^{n} \log \int p(y_i|\theta)p_{post(-i)}(\theta)d\theta$$

$p_{post(-i)}(\theta)$ is the posterior distribution calculated through the data minus data point *i*. *K*-Pareto values are employed in the PSIS method to compute leave-one-out cross-validation in the R "LOO" package. This aids in identifying observations that have a significant impact on the PSIS estimate. For accurate estimation of the leave-one-out cross-validation, observations with *k*-Pareto values greater than 0.7 are normally considered to be influential. When a model's *k* values are less than 0.5, it is typically regarded as being fit.

Markov chains' convergence was diagnosed via trace plots, Gelman-Rubin-Brooks plots, and autocorrelation plots. The effective sample size (n_eff) and the Gelman-Rubin shrink factor (Rhat) were also employed for statistical convergence evaluation. The Markov chains are convergent, and the effective samples are sufficient for precise inference if *n_eff* is greater than 1000. The *Rhat* value (Gelman-Rubin shrink factor) can also be used to assess the Markov chain convergence. The model may not be convergent if the value is greater than 1.1. The model is deemed convergent if *Rhat* = 1. The Rhat value is calculated as:

$$\hat{R} = \sqrt{\frac{\hat{\mathrm{V}}}{W}}$$

In the formula, $\hat{R}$ is the Rhat value, $\hat{\mathrm{V}}$ is the estimated posterior variance, and W is the within-sequence variance.

Given the objectives and requirements of the current study, we used the bayesvl R package to conduct Bayesian analysis (La et al., 2022). It is simple to use, openly accessible, and has excellent visualization capabilities. All the coefficients' prior distributions were set as uninformative to avoid subjective bias because the current study is exploratory in nature. Uninformative priors are flat prior distributions that provide the least amount of prior information possible to the model estimation. Although the prior information still exists, it is so small that it can be negligible (Diaconis & Ylvisaker, 1985). The MCMC setup for the analytical model consists of 5000 iterations, 2000 warmup iterations, and four chains. All data and code snippets were uploaded to an Open Science Framework server in order to increase transparency and lower the cost of reproduction (https://osf.io/zum9g/) (Vuong, 2018, 2020).

3. Result

3.1. Model comparison

We compared the weights of Pseudo-BMA without Bayesian bootstrap, Pseudo-BMA without Bayesian bootstrap, and Bayesian stacking to determine which model had the most predictive weight. Table 2 demonstrates that Model 3 weighs best in all categories, meaning it best fits the data. As a result, we decided to continue the analysis using Model 3.

Table 2: Model comparison and weight ranking

Weights	Pseudo-BMA without Bayesian bootstrap	Pseudo-BMA with Bayesian bootstrap	Bayesian stacking
Model 1	0.004	0.070	0.120
Model 2	0.126	0.248	0.128
Model 3	0.871	0.682	0.752
Most predictive model	Model 3	Model 3	Model 3

Before evaluating the estimated results, it is necessary to assess the model's goodness of fit. All computed *k*-values of Model 3 are less than 0.5, as shown by the PSIS diagnostic plot in Figure 2, indicating that the model specification is appropriate.

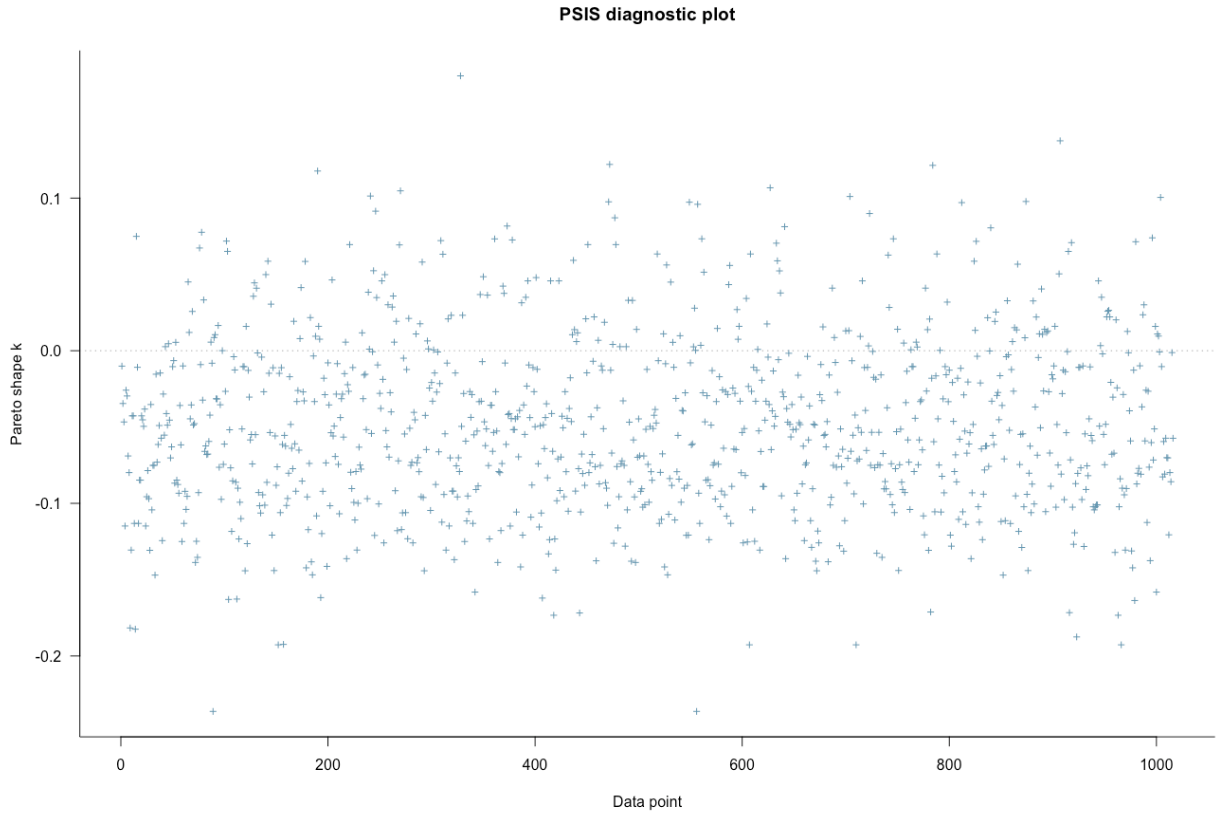

Figure 2: Model 3's PSIS-LOO diagnosis plot

3.2. Convergence diagnostics

We only present the estimated results, diagnostic statistics, and visualizations for Model 3, which serves as the primary model in the current study, in the main text, while those of other models are shown in the Supplementary (see Tables S1 and S2 and Figures S1-S6).

Table 3: Estimated results of Model 3

Parameters	Mean	Standard deviation	n_eff	Rhat
DigitalUsageFrequency	0.06	0.33	5040	1
ParentsSafetyGuide	1.03	0.39	4671	1
TeachersSafetyGuide	-0.79	0.47	4159	1
*ParentsSafetyGuide*DigitalUsageFrequency*	-0.23	0.10	4649	1

*TeachersSafetyGuide*DigitalUsageFrequency*	0.28	0.12	4212	1
Sex[Girls]	10.11	1.34	5204	1
Sex[Boys]	9.66	1.33	5204	1
Constant	9.22	3.13	2219	1

Based on convergence diagnosis statistics, the simulation of all models can be regarded as well-convergent. In particular, all model parameters have *n_eff* values above the standard of 1000, and all *Rhat* values are equal to 1 (see Table 3 for Model 3 and Table S1-S2 for other models).

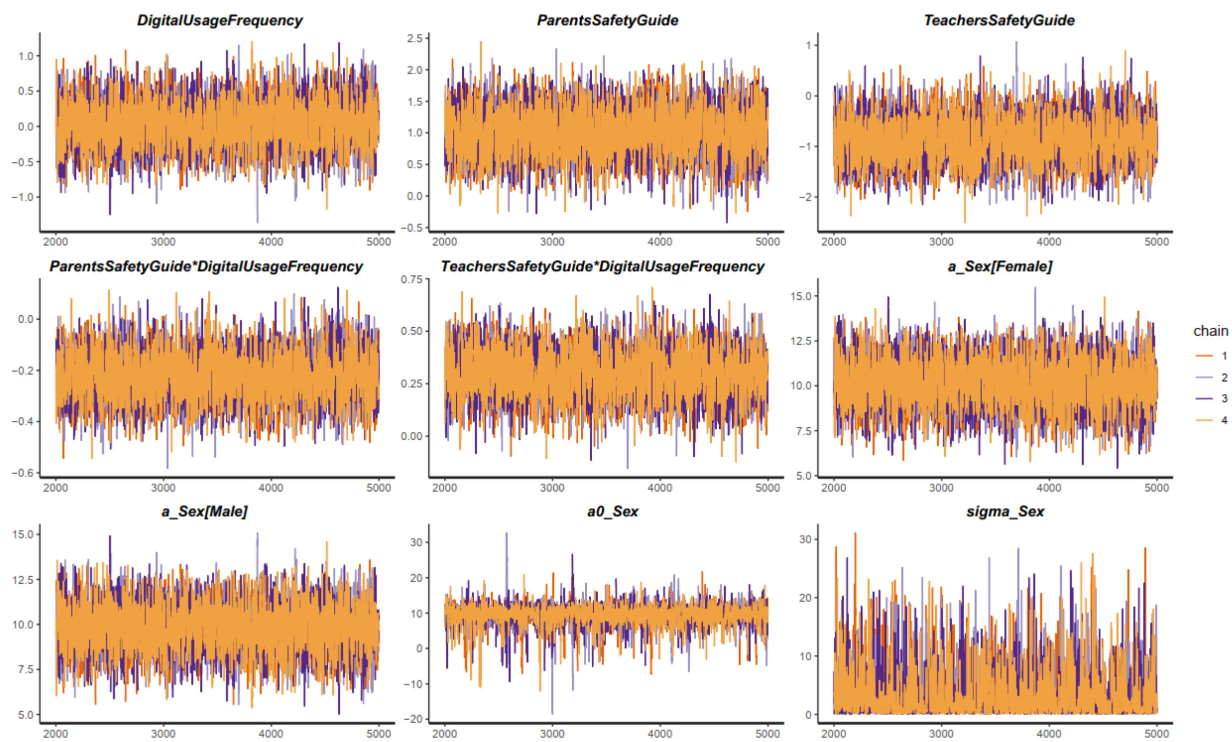

Figure 3: Model 3's trace plots

The Markov chains in the trace plots in Figure 3 fluctuate around a central equilibrium, which indicates good convergence. The shrink factors for all parameters in the Gelman-Rubin-Brooks plots rapidly decrease to 1 during the warmup phase, confirming the convergence of Model 3 (see Figure 4).

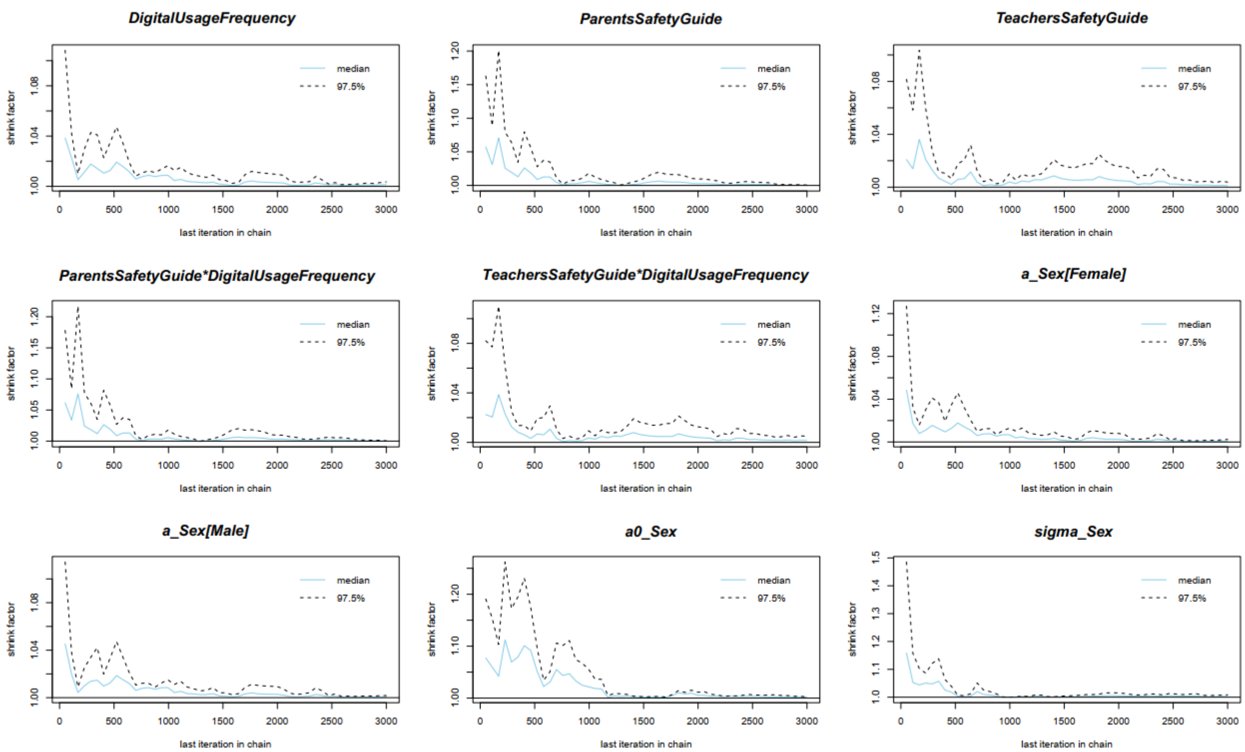

Figure 4: Model 3's Gelman–Rubin–Brooks plots

The autocorrelation for all parameters in the autocorrelation plots is rapidly eliminated (values dropping to 0), also indicating the model's convergence (see Figure 5).

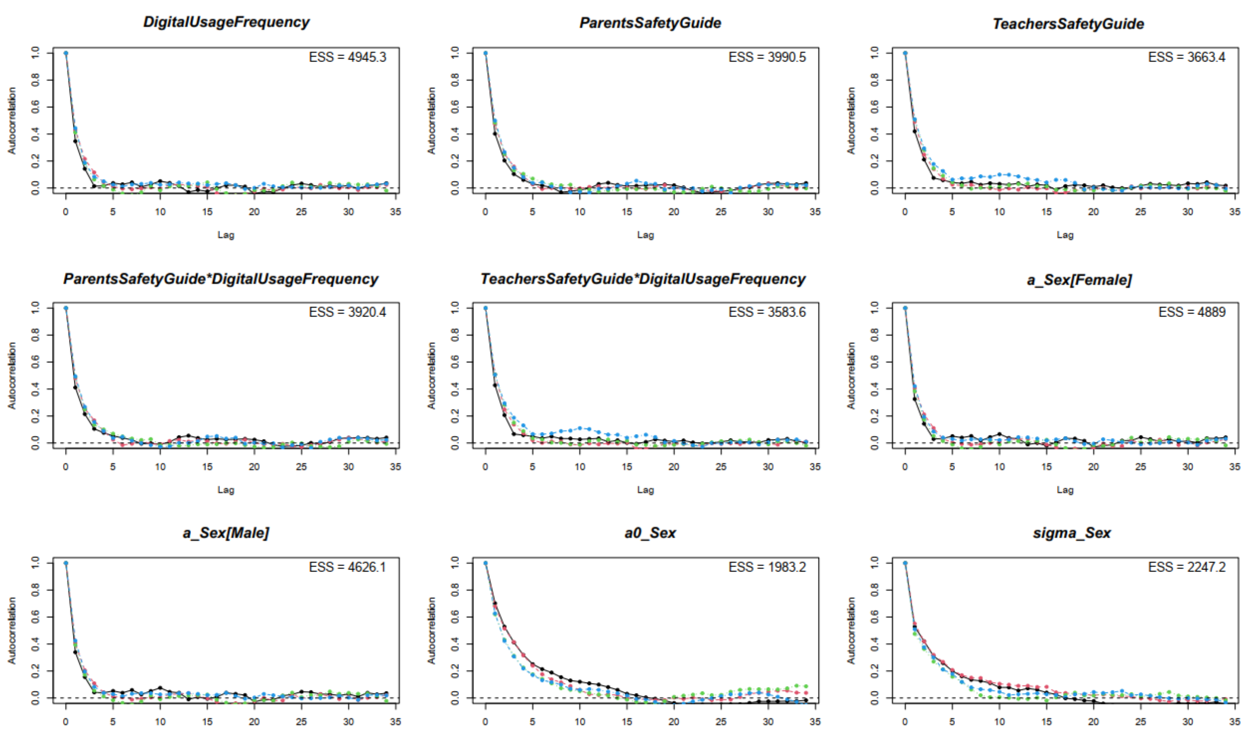

Figure 5: Model 3's autocorrelation plots

3.3. Result interpretation

As seen from Table S2, *DigitalUsageFrequency*, *ParentsSafetyGuide*, and *TeachersSafetyGuide* all have positive impacts on adolescents' digital resilience. The effects are reliable as the mean values of *DigitalUsageFrequency*, *ParentsSafetyGuide*, and *TeachersSafetyGuide* are much higher than their standard deviations. These results validate Hypotheses 1-3.

When adding the interaction variables *DigitalUsageFrequency*ParentsSafetyGuide* and *DigitalUsageFrequency*TeachersSafetyGuide* into the model, the effects of *DigitalUsageFrequency*, *ParentsSafetyGuide*, and *TeachersSafetyGuide* on *CapabilityAgainstDigitalThreat* become more complex. Visualization of results is required for better interpretation.

However, before doing so, checking the effects' reliability is necessary. Figure 6 shows the coefficients' posterior distributions of Model 3 with their 89% Highest Posterior Density Intervals (HPDI). The thick black line in the middle of the distribution presents the HPDI. 89% HPDIs of all coefficients (except for *DigitalUsageFrequency*) lie entirely on either the positive or negative side of the *x*-axis, implying the high reliability of the effects. Also, from Figure 7, we can see no clear difference between the two sexes in digital resilience.

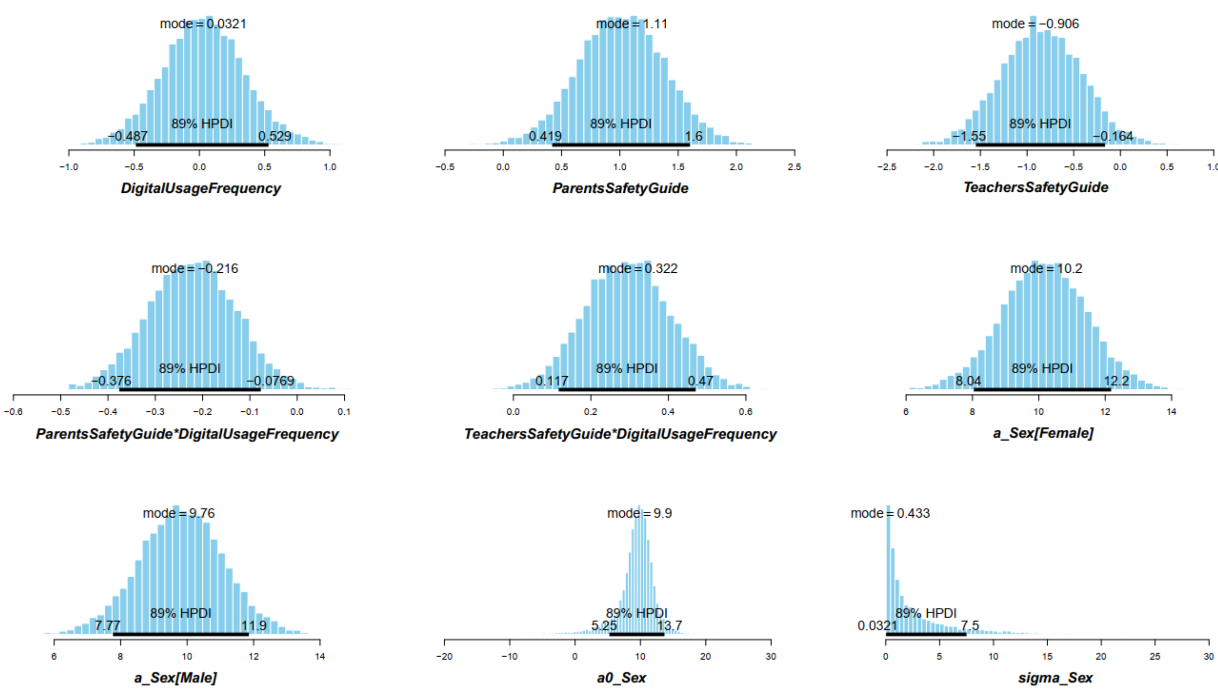

Figure 6: Model 3's posterior distributions

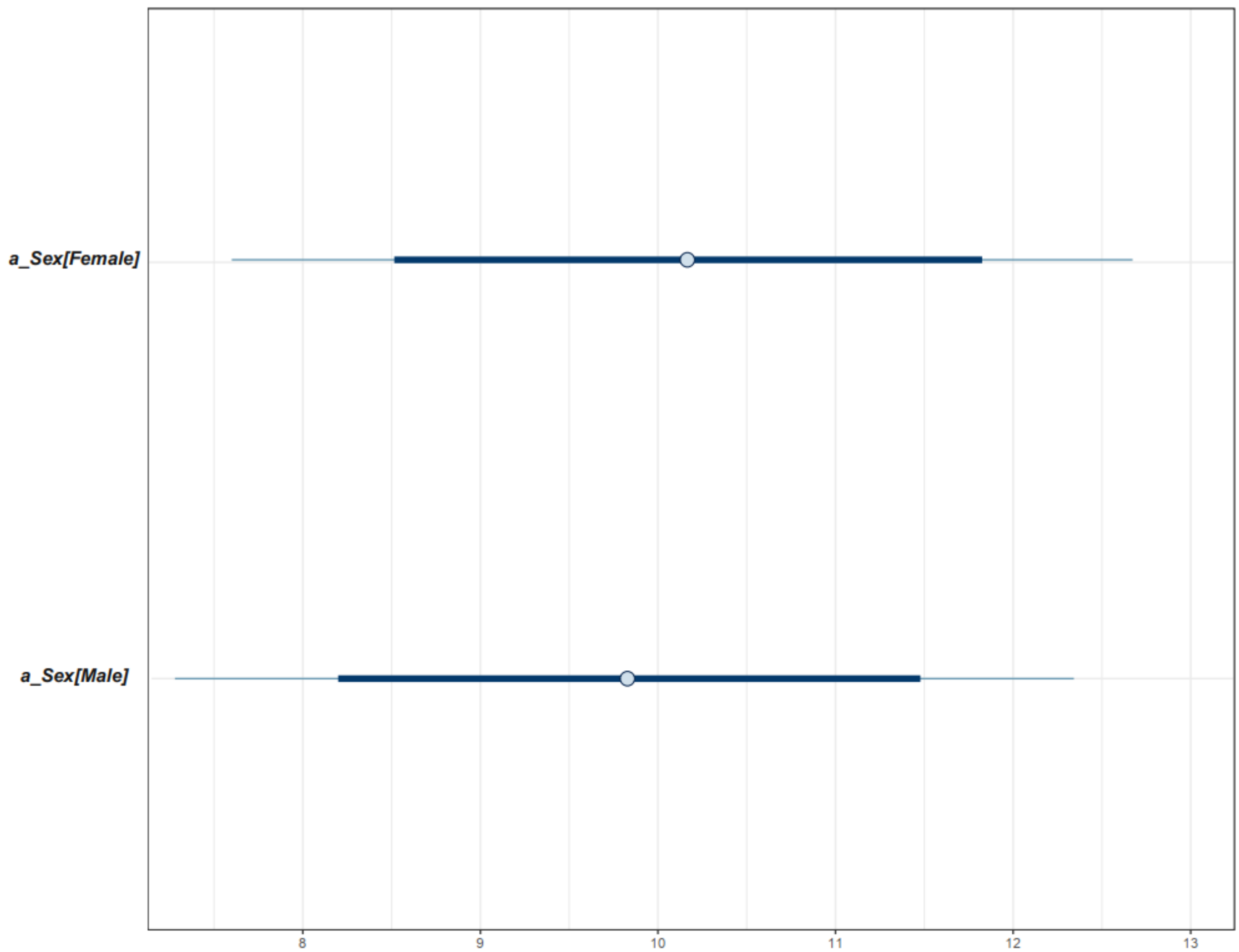

Figure 7: Model 3's posterior distributions of female and male intercepts

Employing Equation 3.2 and the estimated mean values of parameters in Table 3, we estimated the adolescents' capability to respond to digital threats. Figure 8 shows the estimated adolescents' response capability toward digital threats in different scenarios of parents' safety guidance and Internet usage frequency, while teachers' safety guidance is set as 'never.' Figure 9 shows the estimated adolescents' response capability toward digital threats in different scenarios of teachers' safety guidance and Internet usage frequency, while parents' safety guidance is set as 'never.'

Both Figures 8 and 9 indicate that parents' and teachers' guidance positively impacts the adolescents' digital resilience, but these impacts are conditional on the digital device usage frequency of the adolescents. Specifically, the less time the adolescents use the Internet per day, the more substantial the positive impact of parents' safety guidance on adolescents' digital resilience will become. Nevertheless, if adolescents use the Internet more than 5 hours a day, the effect of parents' guidance becomes negative. In contrast, the positive effect of teachers' guidance on adolescents' digital resilience becomes stronger when the students spend more time on the Internet (more than 1 hour). The effect of teachers' guidance becomes negative when adolescents hardly ever use or use the Internet for less than an hour a day. These findings validate Hypotheses 4 and 5.

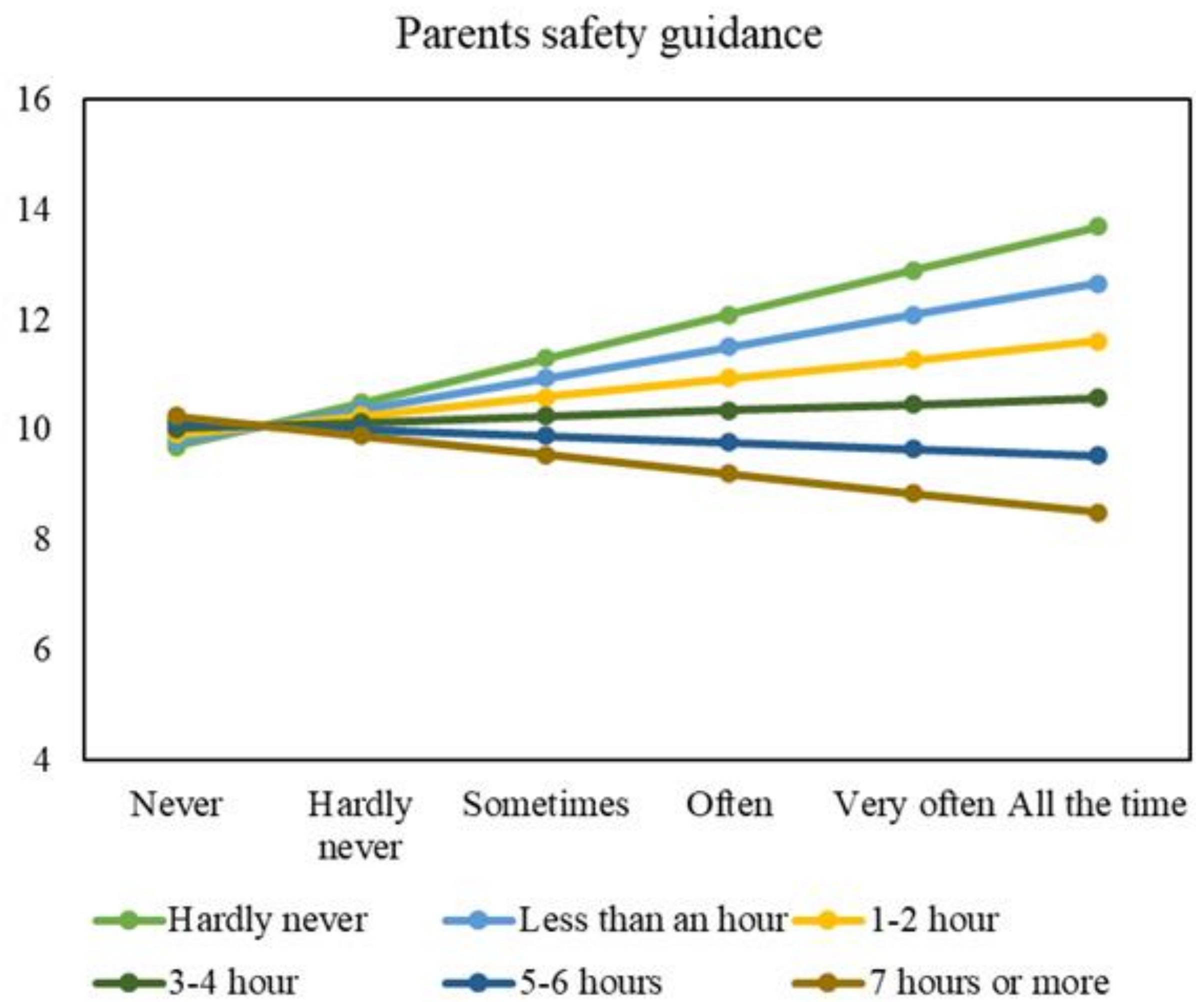

Figure 8: Students' response capability toward digital threats in different scenarios of parents' safety guidance and Internet usage frequency

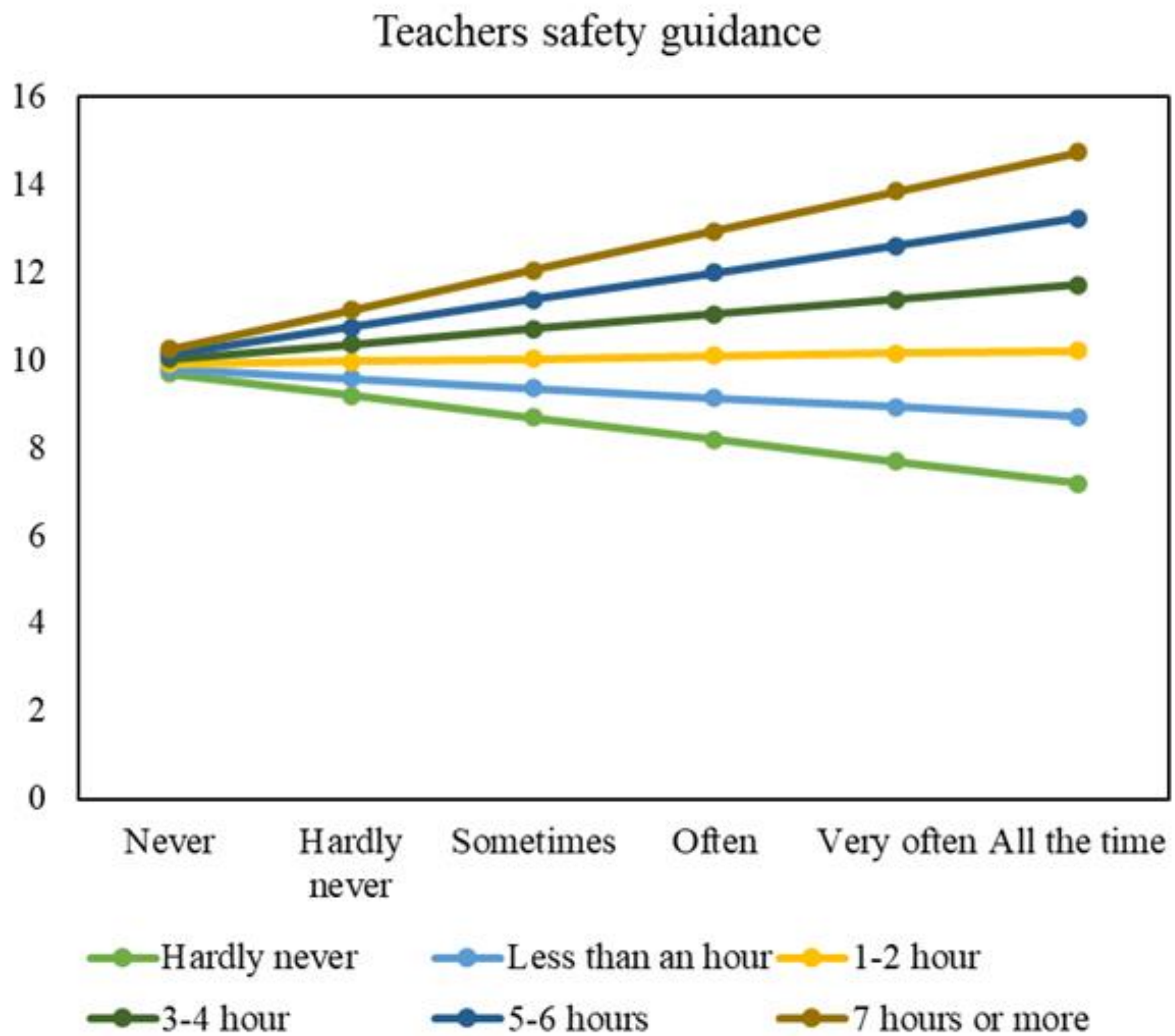

Figure 9: Students' response capability toward digital threats in different scenarios of teachers' safety guidance and Internet usage frequency

4. Discussion

The current study employed the Mindsponge Theory to explain how the interplay between Internet usage frequency and parents' and teachers' safety guidance affects adolescents' digital resilience. Analyzing the dataset of 1061 Vietnamese high school students using BMF analytics helps validate the explanation. We found that Internet usage frequency and parents' and teachers' safety guidance have positive impacts on digital resilience. Nevertheless, when the interactions of usage frequency with parents' and teachers' safety guidance were added into the model, the effects of parents' and teachers' safety guidance became conditional on the adolescents' Internet usage frequency per day.

Regarding the interplay effect between Internet usage frequency and parents' safety guidance, our finding showed that parents' guidance only enhances adolescents' digital resilience if they use the Internet less than four hours per day. For adolescents that spend more than four hours per day, parents' guidance will negatively affect the development of digital resilience. This finding can be explained through the mindsponge theory perspective incorporating the cultural characteristics of the parenting method in Vietnam.

Evidently, adolescents with more time operating on the Internet are likely to have the better digital capability (knowledge, skills, and resilience) and perceive more benefits of digital devices and the Internet than those with less usage time, possibly leading to the development of different mindsets between those two groups (or distinct sets of information in mind). Such different mindsets will affect the subsequent information-filtering process distinctively. Adolescents with better digital capability tend to have higher self-efficacy and prefer more autonomy (Cera et al., 2013; Sitzmann & Yeo, 2013; Tilfarlioglu & Ciftci, 2011). Suppose the parental safety guidance imposes control over their thinking and behaviors. In that case, they might perceive such information as costly and are more likely to resist, eject, or even oppose absorbing safety information. Adolescents with low capability tend to prefer direct guidance from parents (Vuong et al., 2021a).

Helfrich et al. (2020) find that communication and monitoring are two main strategies parents use to prevent and minimize the negative effects of online threats, like cyberbullying. While the communication strategy does not affect the youth's autonomy, the monitoring strategy tends to pose more control over how the youth should use the Internet. Due to the deep-root of Confucianism values in Vietnamese culture, the dominant parenting style in Vietnam is authoritative according to core tenets of 三纲五常 (three principles and five virtues) (Mestechkina et al., 2014; Wǔcháng, 2009), so the control will be high. Therefore, adolescents with high Internet usage frequency tend to resist, eject, or even oppose absorbing safety information if parents' involvement level increases. This reasoning is supported by other studies, suggesting that parental control does not affect gifted students' extrinsic motivations and even degrade their intrinsic motivations, while parental support for autonomy significantly improves students' intrinsic and extrinsic motivations (Al‐Dhamit & Kreishan, 2016; Garn & Jolly, 2015; Garn et al., 2010).

The interplay effect between Internet usage frequency and teachers' safety guidance is quite different from that of parents' safety guidance, possibly because of the Vietnamese education structure. Following 1976, Vietnamese education reforms aimed to pursue the Soviet education model to promote universal education and increase educational accessibility (Nguyen et al., 2020). Although the reform increased school enrollment dramatically, the increase in class size is a drawback. Upper secondary school classes may approach 45-50 students (Parandekar & Sedmik, 2016). Because teachers do not have the time or energy to differentiate the material, product, and process to meet the needs of the students, what they can do is creating a general infosphere of Internet safety and expect all students can absorb it. This strategy can increase the availability of information but cannot help all students absorb the information effectively. In such an environment, students with high Internet usage frequency tend to absorb safety-related information better because they can see the information's values and process and connect them to their background knowledge. Nevertheless, students that hardly ever use or use the Internet for less than one hour a day tend to lack sufficient knowledge to understand the information and its values, which might increase their perceived cost of absorbing/learning the safety information. If the guidance happens frequently, the students might lose their self-efficacy and, thus, their motivation when comparing themselves with peers with greater progress. In addition, when the perceived cost of learning the safety information is reinforced over a long period of time, the students may develop avoidance thinking, making their minds oppose or even eject safety-relevant information. Eventually, their digital resilience declines.

Based on these findings, we advocate that "children can benefit from making mistakes online" (Hammond, 2022), so allowing adolescents to use the Internet is a better alternative to safeguard them rather than restricting their usage. Sonck and de Haan (2013) discover that young people who spend less time on the Internet are less likely to experience risks online. Still, they are more likely to be harmed by seeing inappropriate or restrictive content. Moreover, the use of the Internet aids young people in cultivating knowledge and skills and integrating with the world's development, creating future career opportunities. However, parents and teachers should guide the use of the Internet to help adolescents avoid negative consequences like internet addiction (Bisen & Deshpande, 2018; Chou et al., 2005).

When guiding adolescents about Internet safety issues, parents and teachers should be aware of the adolescents' digital capability to design differentiated content. Here, we suggest using daily Internet usage frequency as a useful signal for differentiation purpose. For adolescents with high Internet usage frequency, parents should employ communication (e.g., promoting perspective and empowerment) and active monitoring (e.g., co-use and discussion of media use) strategies to help prevent and minimize digital risks (Helfrich et al., 2020). Regarding school-based education, teachers of large classrooms should cultivate students' digital resilience through group work. It can help enhance comprehension of course material, reduce anonymity associated with large lecture classes, and promote student accountability (Yazedjian & Kolkhorst, 2007). Moreover, a group-learning setting can facilitate the information exchange between adolescents with low and high Internet frequency usage, which helps increase the pool of digital knowledge among low Internet frequency usage adolescents and exposes them to the benefits of digital networks (Vuong, 2023).

The study is not without limitations (Vuong, 2020). First, the dataset only covers Vietnamese samples, so the generalization of the results should be cautious. Future studies are encouraged to validate the information-processing reasoning approach of Mindsponge

Theory in other countries and contexts with different age groups. Moreover, the current study considered the number of adolescents' response measures to deal with digital threats as a proxy for digital resilience. Although this approach is appropriate, it is overstated to claim it can represent the whole of digital resilience, which is a wide-spectrum concept. Thus, the current study's findings should be validated using different digital resilience proxies for robustness.

Supplementary

Table S1: Results of Model 1

Parameters	Mean	SD	n_eff	Rhat
DigitalUsageFrequency	0.17	0.12	5837	1
Sex[Girls]	10.86	0.50	5990	1
Sex[Boys]	10.32	0.48	6420	1
Constant	9.59	3.34	1035	1

Table S2: Results of Model 2

Parameters	Mean	Standard deviation	n_eff	Rhat
DigitalUsageFrequency	0.22	0.12	7538	1
ParentsSafetyGuide	0.15	0.10	7202	1
TeachersSafetyGuide	0.27	0.13	7195	1
Sex[Girls]	9.49	0.64	8425	1
Sex[Boys]	9.03	0.61	8442	1
Constant	8.57	3.07	827	1.01

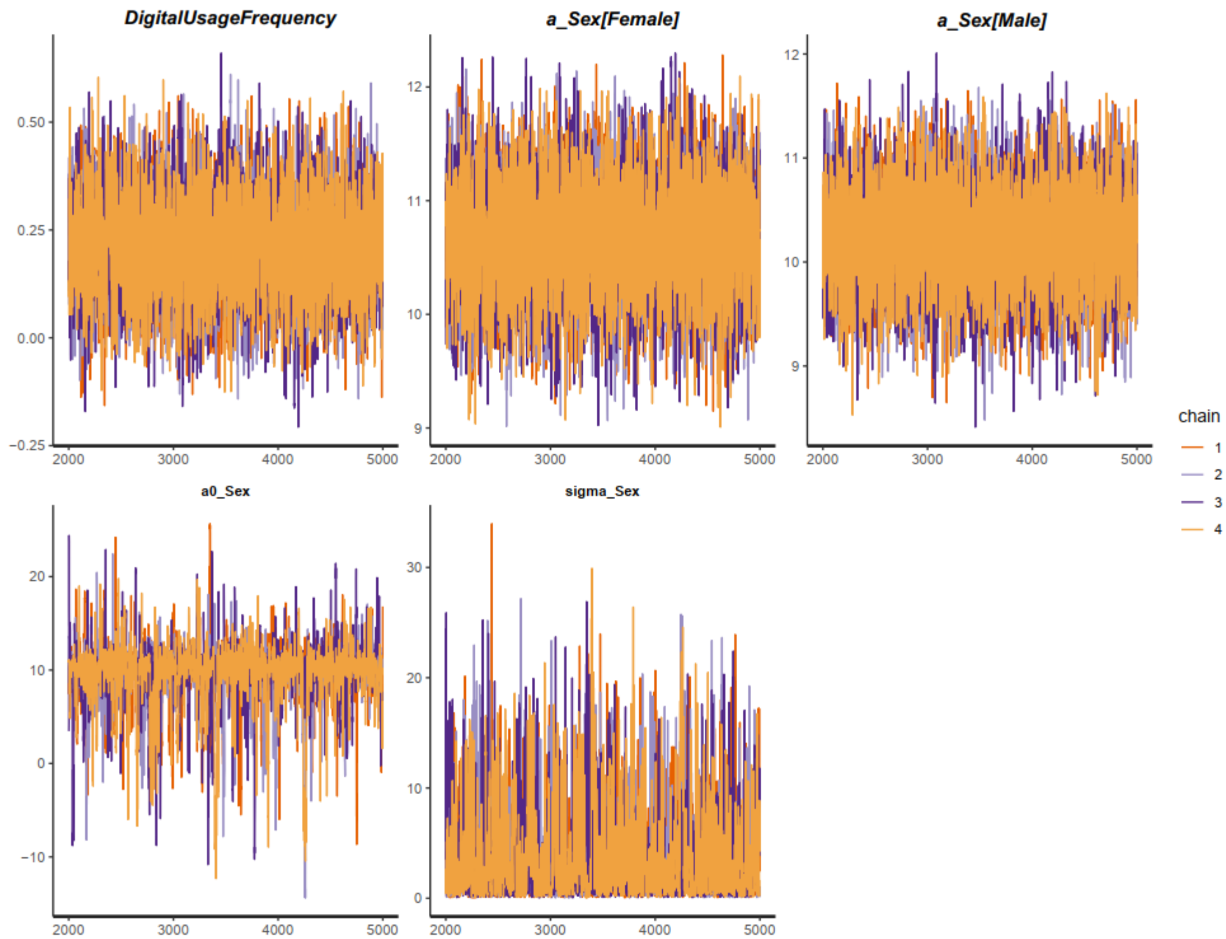

Figure S1: Model 1's trace plots

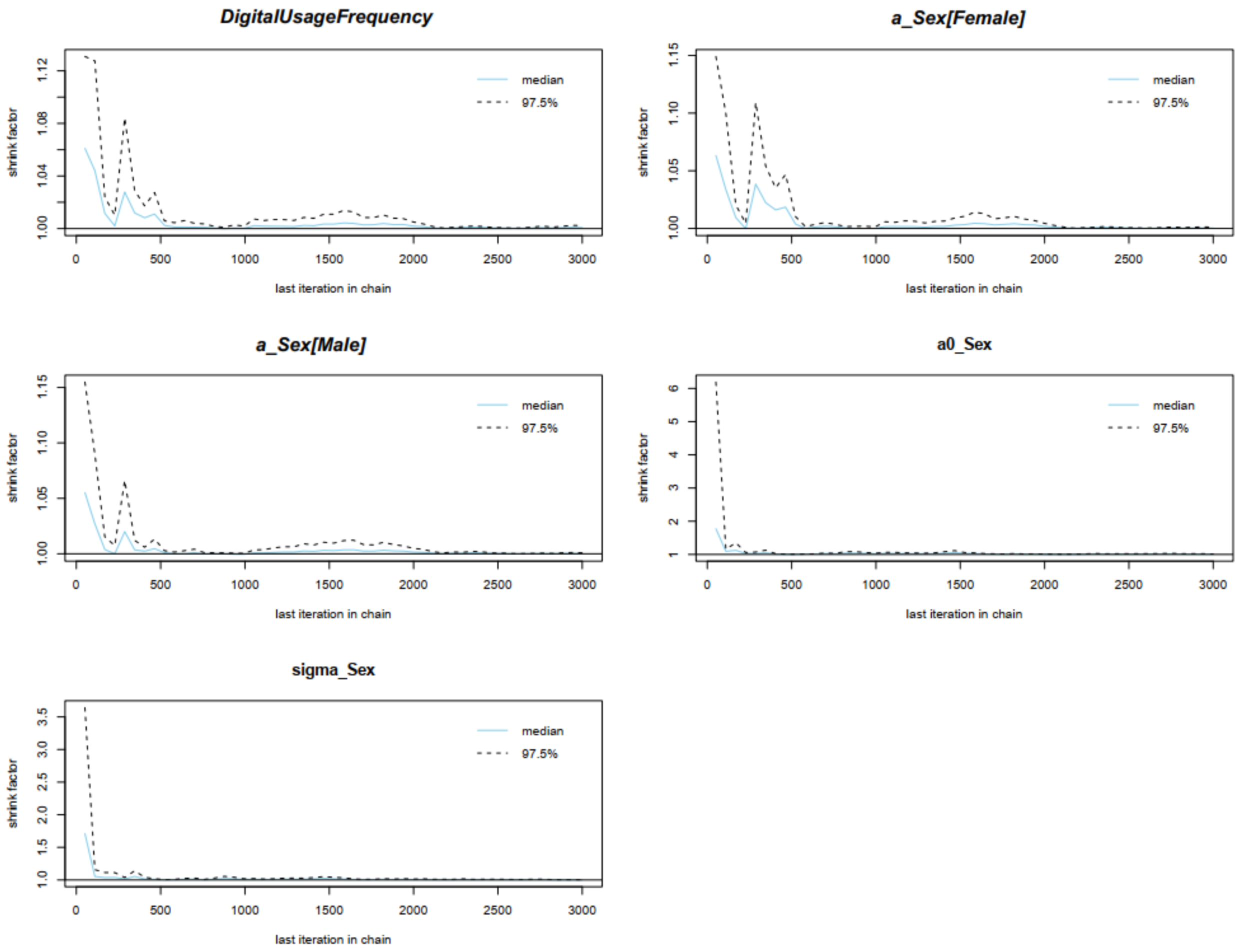

Figure S2: Model 1's Gelman-Rubin-Brooks plots

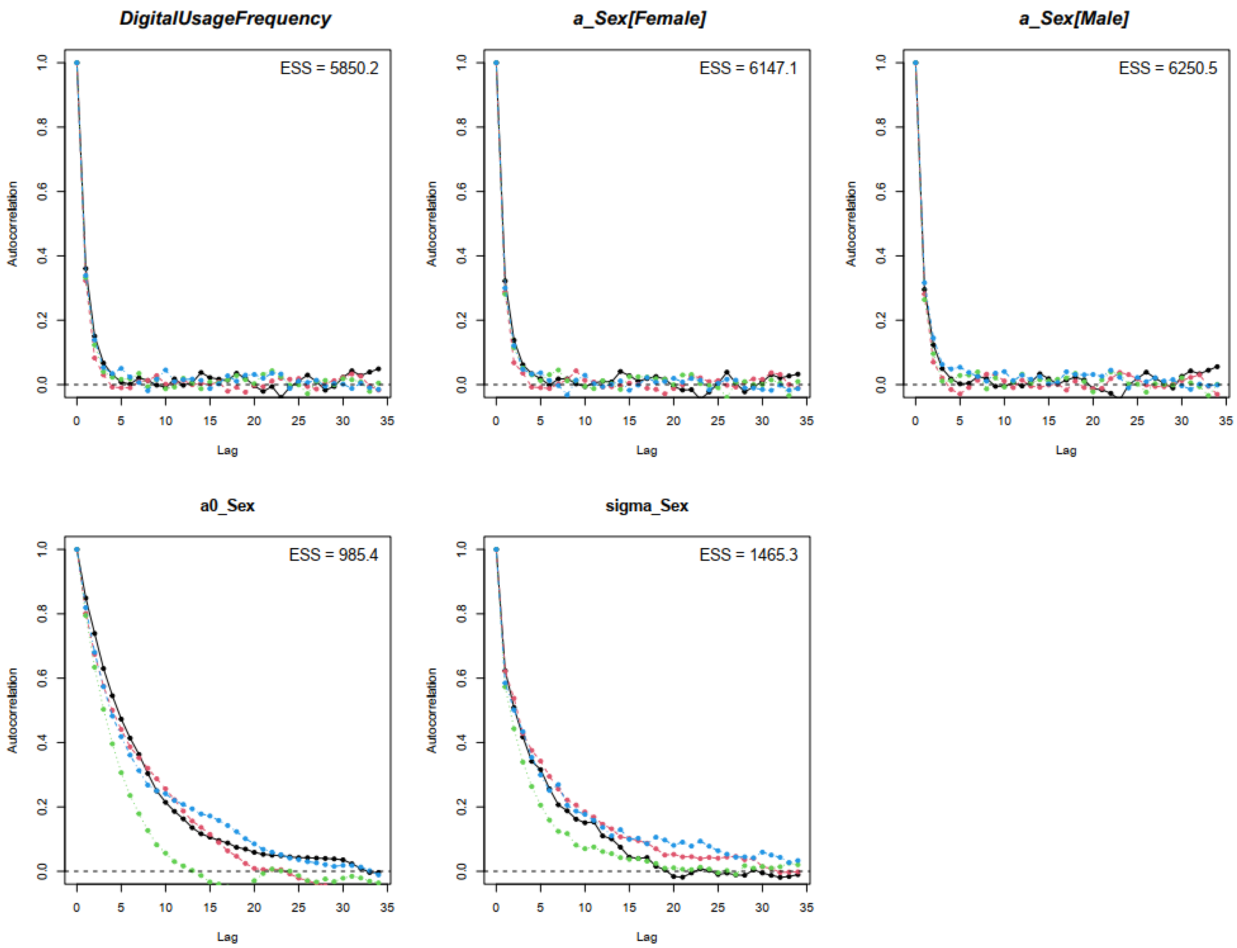

Figure S3: Model 1's autocorrelation plots

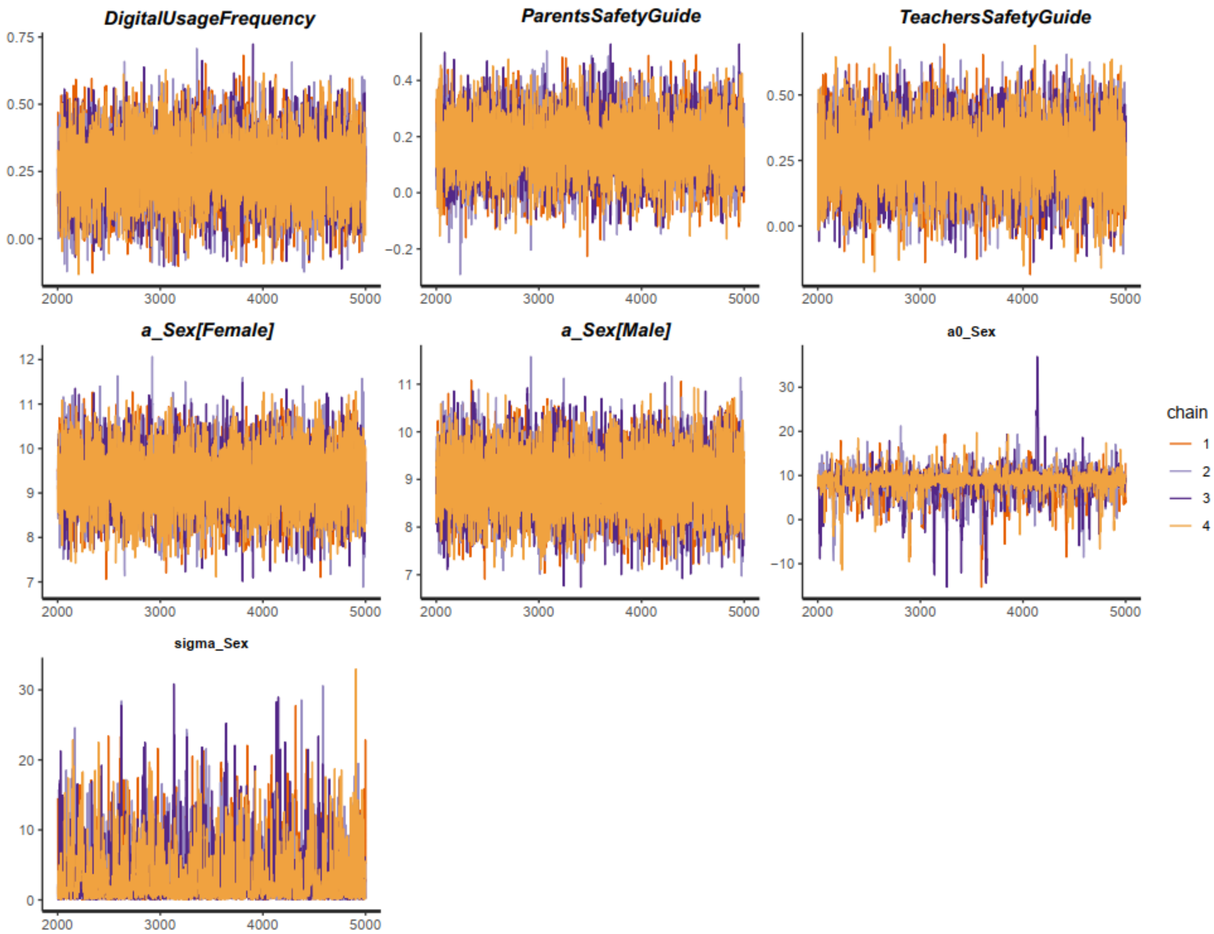

Figure S4: Model 2's trace plots

Figure S4: Model 2's trace plots

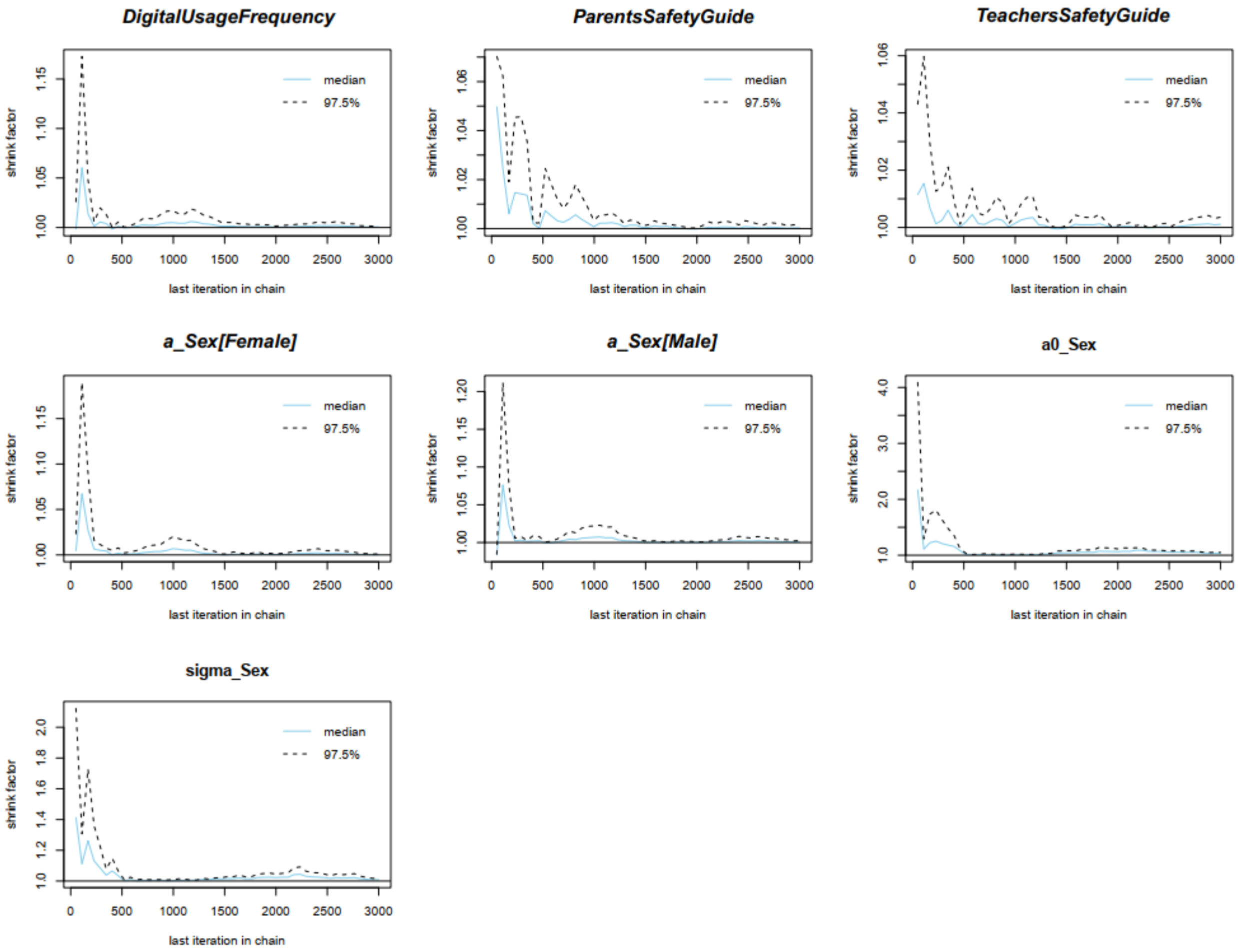

Figure S5: Model 2's Gelman-Rubin-Brooks plots

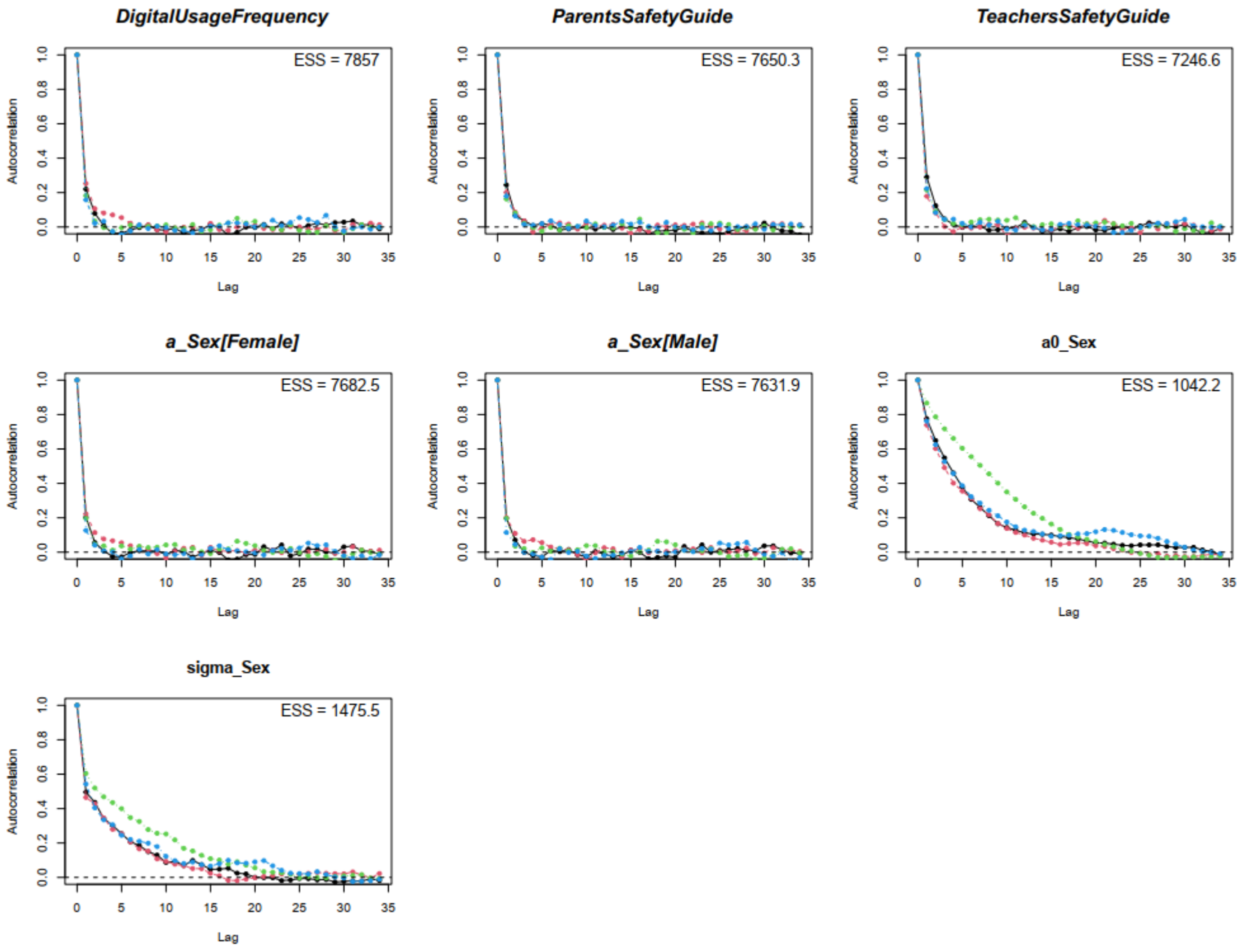

Figure S6: Model 2's autocorrelation plots

References

Adriaans, P. (2020). Information. In *Stanford Encyclopedia of Philosophy*. Stanford: Stanford University.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Al-Dhamit, Y., & Kreishan, L. (2016). Gifted students' intrinsic and extrinsic motivations and parental influence on their motivation: from the self-determination theory perspective. *Journal of Research in Special Educational Needs*, *16*(1), 13-23.

Bauman, S. (2010). Cyberbullying in a rural intermediate school: An exploratory study. *The Journal of Early Adolescence*, *30*(6), 803-833.

Bisen, S. S., & Deshpande, Y. M. (2018). Understanding internet addiction: a comprehensive review. *Mental Health Review Journal*, *23*(3), 165-184.

Bremer, J. (2005). The internet and children: advantages and disadvantages. *Child and Adolescent Psychiatric Clinics*, *14*(3), 405-428.

Bronfenbrenner, U., & Ceci, S. J. (1994). Nature-nuture reconceptualized in developmental perspective: A bioecological model. *Psychological review*, *101*(4), 568.

Buikstra, E., Ross, H., King, C. A., Baker, P. G., Hegney, D., McLachlan, K., & Rogers-Clark, C. (2010). The components of resilience—Perceptions of an Australian rural community. *Journal of Community Psychology*, *38*(8), 975-991.

Cera, R., Mancini, M., & Antonietti, A. (2013). Relationships between metacognition, self-efficacy and self-regulation in learning. *Journal of Educational, Cultural and Psychological Studies*, *4*(7), 115-141.

Chou, C., Condron, L., & Belland, J. C. (2005). A review of the research on Internet addiction. *Educational Psychology Review*, *17*, 363-388.

Csilléry, K., Blum, M. G., Gaggiotti, O. E., & François, O. (2010). Approximate Bayesian computation (ABC) in practice. *Trends in Ecology and Evolution*, *25*(7), 410-418. https://doi.org/10.1016/j.tree.2010.04.001

Davies, P., & Gregersen, N. H. (2014). *Information and the nature of reality: From physics to metaphysics*. Cambridge University Press. https://doi.org/10.1017/CBO9781107589056

Diaconis, P., & Ylvisaker, D. (1985). Quantifying prior opinion. In J. M. Bernardo, M. H. DeGroot, D. V. Lindley, & A. F. M. Smith (Eds.), *Bayesian Statistics* (Vol. 2, pp. 133-156). North Holland Press.

Dowdell, E. B. (2011). Risky internet behaviors of middle-school students: Communication with online strangers and offline contact. *CIN: Computers, Informatics, Nursing*, *29*(6), 352-359.

Dunson, D. B. (2001). Commentary: practical advantages of Bayesian analysis of epidemiologic data. *American journal of Epidemiology*, *153*(12), 1222-1226. https://doi.org/10.1093/aje/153.12.1222

Dyson, F. (1999). *Origins of life*. Cambridge University Press.

Eagleman, D. (2015). *The Brain: The Story of You*. Canongate Books.

Garn, A. C., & Jolly, J. L. (2015). A model of parental achievement-oriented psychological control in academically gifted students. *High Ability Studies*, *26*(1), 105-116.

Garn, A. C., Matthews, M. S., & Jolly, J. L. (2010). Parental influences on the academic motivation of gifted students: A self-determination theory perspective. *Gifted Child Quarterly*, *54*(4), 263-272.

Gill, J. (2014). *Bayesian methods: A social and behavioral sciences approach* (Vol. 20). CRC press.

Grossbart, S., Hughes, S. M., Pryor, S., & Yost, A. (2002). Socialization aspects of parents, children, and the Internet. *ACR North American Advances*, *29*, 66-70.

Hammond, S. (2022). Children can benefit from making mistakes online. *LSE Blogs*. https://blogs.lse.ac.uk/parenting4digitalfuture/2022/12/14/digital-resilience-2/

Hammond, S. P., Polizzi, G., & Bartholomew, K. J. (2022). Using a socio-ecological framework to understand how 8–12-year-olds build and show digital resilience: A multi-perspective and multimethod qualitative study. *Education and Information Technologies*, 1-29.

Helfrich, E. L., Doty, J. L., Su, Y.-W., Yourell, J. L., & Gabrielli, J. (2020). Parental views on preventing and minimizing negative effects of cyberbullying. *Children and Youth Services Review*, *118*, 105377.

Hofstede, G., Hofstede, G. J., & Minkov, M. (2005). *Cultures and organizations: Software of the mind*. McGraw-Hill.

Hornor, G. (2020). Online sexual solicitation of children and adolescents. *Journal of Pediatric Health Care*, *34*(6), 610-618.

International Telecommunication Union. (2023). *Youth Internet use*. International Telecommunication Union. Retrieved 25 March from https://www.itu.int/itu-d/reports/statistics/2021/11/15/youth-internet-use/

Kierkegaard, S. (2008). Cybering, online grooming and ageplay. *Computer Law and Security Review*, *24*(1), 41-55.

La, V.-P., Vuong, Q.-H., Tran, T., Nguyen, M.-H., Ho, M.-T., & Ho, M.-T. (2022). The bayesvl package: An R package for implementing and visualizing Bayesian statistics. *SoftwareX*, *20*, 101245.

Le, A.-V., Do, D.-L., Pham, D.-Q., Hoang, P.-H., Duong, T.-H., Nguyen, H.-N., . . . Vuong, Q.-H. (2019). Exploration of Youth's Digital Competencies: A Dataset in the Educational Context of Vietnam. *Data*, *4*(2), 69. https://www.mdpi.com/2306-5729/4/2/69

Le, T.-T., Nguyen, M.-H., & Vuong, Q.-H. (2022). Trust in mindsponge: a new perspective on information reliability. In Q.-H. Vuong, M.-H. Nguyen, & V.-P. La (Eds.), *The mindsponge and BMF analytics for innovative thinking in social sciences and humanities* (pp. 67-86). De Gruyter. https://doi.org/10.2478/9788367405119-009

Livingstone, S., & Haddon, L. (2008). Risky experiences for children online: Charting European research on children and the internet. *Children and Society*, *22*(4), 314-323.

Maliske, L., & Kanske, P. (2022). The Social Connectome – Moving Toward Complexity in the Study of Brain Networks and Their Interactions in Social Cognitive and Affective Neuroscience. *Frontiers in Psychiatry*, *13*, 845492. https://doi.org/10.3389/fpsyt.2022.845492

Maslow, A. H. (1981). *Motivation and personality*. Prabhat Prakashan.

Masten, A. S. (2007). Resilience in developing systems: Progress and promise as the fourth wave rises. *Development and Psychopathology*, *19*(3), 921-930.

Mestechkina, T., Son, N. D., & Shin, J. Y. (2014). Parenting in Vietnam. In H. Selin (Ed.), *Parenting across cultures: Childrearing, motherhood*

fatherhood in non-western cultures (pp. 47-57). Springer.

Mintzberg, H. (1973). *Nature of managerial work*. Harper & Row.

Mitchell, K. J., Wolak, J., & Finkelhor, D. (2007). Trends in youth reports of sexual solicitations, harassment and unwanted exposure to pornography on the Internet. *Journal of Adolescent Health*, *40*(2), 116-126.

Mitchell, K. J., Ybarra, M., & Finkelhor, D. (2007). The relative importance of online victimization in understanding depression, delinquency, and substance use. *Child Maltreatment*, *12*(4), 314-324.

Nguyen, L., Tran, T., Nguyen, T., Nguyen, D., Beazley, H., & Giang, M. (2021). Exposure to sexually explicit Internet material among adolescents: a study in Vietnam. *Health Psychology Report*, *9*(3), 227-239.

Nguyen, M.-H., & Jones, T. E. (2022a). Building eco-surplus culture among urban residents as a novel strategy to improve finance for conservation in protected areas. *Humanities & Social Sciences Communications*, *9*, 426. https://doi.org/10.1057/s41599-022-01441-9

Nguyen, M.-H., & Jones, T. E. (2022b). Predictors of support for biodiversity loss countermeasures and bushmeat consumption among Vietnamese urban residents. *Conservation Science and Practice*, *4*(12), e12822. https://doi.org/10.1111/csp2.12822

Nguyen, M.-H., Khuc, Q. V., La, V.-P., Le, T.-T., Nguyen, Q.-L., Jin, R., . . . Vuong, Q.-H. (2022). Mindsponge-based reasoning of households' financial resilience during the COVID-19 crisis. *Journal of Risk Financial Management*, *15*(11), 542. https://doi.org/10.3390/jrfm15110542

Nguyen, M.-H., La, V.-P., Le, T.-T., & Vuong, Q.-H. (2022a). Bayesian Mindsponge Framework analytics: a novel methodological approach for social sciences and humanities. In Q.-H. Vuong, M.-H. Nguyen, & V.-P. La (Eds.), *The mindsponge and BMF analytics for* *innovative thinking in social sciences and humanities* (pp. 87-116). De Gruyter. https://doi.org/10.2478/9788367405119-010

Nguyen, M.-H., La, V.-P., Le, T.-T., & Vuong, Q.-H. (2022b). Introduction to Bayesian Mindsponge Framework analytics: an innovative method for social and psychological research. *MethodsX*, *9*, 101808. https://doi.org/10.1016/j.mex.2022.101808

Nguyen, M.-H., Le, T.-T., & Vuong, Q.-H. (2023). Ecomindsponge: A novel perspective on human psychology and behavior in the ecosystem. *Urban Science*, *7*(1), 31. https://doi.org/10.3390/urbansci7010031

Nguyen, V. B. H., Vu, T. M. H., Hoang, T. K. H., & Nguyen, T. M. N. (2020). Vietnamese education system and teacher training: Focusing on science education. *Asia-Pacific Science Education*, *6*(1), 179-206.

Nguyen, V. H., & Vuong, Q.-H. (2007). On the martingale representation theorem and on approximate hedging a contingent claim in the minimum deviation square criterion. In R. Jeltsch, T.-T. Li, & I. H. Sloan (Eds.), *Some topics in industrial and applied Mathematics* (pp. 134-151). World Scientific.

Nguyen, V. H., Vuong, Q.-H., & Tran, M. N. (2005). Central limit theorem for functional of jump Markov processes. *Vietnam Journal of Mathematics*, *33*(4), 443-461.

Nixon, C. L. (2014). Current perspectives: the impact of cyberbullying on adolescent health. *Adolescent Health, Medicine and Therapeutics*, *5*, 143-158.

Noll, J. G., Haag, A.-C., Shenk, C. E., Wright, M. F., Barnes, J. E., Kohram, M., . . . Bonanno, G. A. (2022). An observational study of Internet behaviours for adolescent females following sexual abuse. *Nature Human Behaviour*, *6*(1), 74-87.

Nonaka, I., & Konno, N. (1998). The concept of "Ba": Building a foundation for knowledge creation. *California Management Review*, *40*(3), 40-54.

Norris, F. H. (2011). Behavioral science perspectives on resilience. *CARRI Research Paper*, *11*, 50.

Oblinger, D. G., & Oblinger, J. L. (2005). *Educating the net generation* (Vol. 272). Brockport Bookshelf.

Oliva, A., Antolín-Suárez, L., & Rodríguez-Meirinhos, A. (2019). Uncovering the link between self-control, age, and psychological maladjustment among Spanish adolescents and young adults. *Psychosocial Intervention*, *28*(1), 49-55.

Pant, R., Barker, K., & Zobel, C. W. (2014). Static and dynamic metrics of economic resilience for interdependent infrastructure and industry sectors. *Reliability Engineering and System Safety*, *125*, 92-102.

Parandekar, S., & Sedmik, E. (2016). Unraveling a secret: Vietnam's outstanding performance on the PISA test. *World Bank Policy Research Working Paper*(7630).

Porter, M. E. (2011). *Competitive advantage of nations: creating and sustaining superior performance*. Simon & Schuster.

Prensky, M. (2001). Digital natives, digital immigrants part 2: Do they really think differently? *On the Horizon*, *9*(6), 1-6.

Procès, A., Luciano, M., Kalukula, Y., Ris, L., & Gabriele, S. (2022). Multiscale Mechanobiology in Brain Physiology and Diseases. *Frontiers in Cell and Developmental Biology*, *10*. https://doi.org/10.3389/fcell.2022.823857

Quyen, N., & Tam, T. (2023). *Gần 90% trẻ em Việt Nam truy cập và sử dụng internet*. Pháp Luật. Retrieved March 25 from https://plo.vn/gan-90-tre-em-viet-nam-truy-cap-va-su-dung-internet-post719782.html

Rahmatullah, A. S., Mulyasa, E., Syahrani, S., Pongpalilu, F., & Putri, R. E. (2022). Digital era 4.0: The contribution to education and student psychology. *Linguistics and Culture Review*, *6*(S3), 89-107.

Raskauskas, J., & Stoltz, A. D. (2007). Involvement in traditional and electronic bullying among adolescents. *Developmental Psychology*, *43*(3), 564.

Sage, M., Randolph, K., Fitch, D., & Sage, T. (2021). Internet use and resilience in adolescents: A systematic review. *Research on Social Work Practice*, *31*(2), 171-179.

Salignac, F., Marjolin, A., Reeve, R., & Muir, K. (2019). Conceptualizing and measuring financial resilience: A multidimensional framework. *Social Indicators Research*, *145*(1), 17-38.

Sanders, R. A. (2013). Adolescent psychosocial, social, and cognitive development. *Pediatrics in Review*, *34*(8), 354-358.

Sitzmann, T., & Yeo, G. (2013). A meta-analytic investigation of the within-person self-efficacy domain: Is self-efficacy a product of past performance or a driver of future performance? *Personnel Psychology*, *66*(3), 531-568.

Smith, P. K., Mahdavi, J., Carvalho, M., Fisher, S., Russell, S., & Tippett, N. (2008). Cyberbullying: Its nature and impact in secondary school pupils. *Journal of Child Psychology and Psychiatry*, *49*(4), 376-385.

Sonck, N., & de Haan, J. (2013). How the internet skills of European 11-to 16-year-olds mediate between online risk and harm. *Journal of Children and Media*, *7*(1), 79-95.

Sourander, A., Klomek, A. B., Ikonen, M., Lindroos, J., Luntamo, T., Koskelainen, M., . . . Helenius, H. (2010). Psychosocial risk factors associated with cyberbullying among adolescents: A population-based study. *Archives of General Psychiatry*, *67*(7), 720-728.

Southwick, S. M., Bonanno, G. A., Masten, A. S., Panter-Brick, C., & Yehuda, R. (2014). Resilience definitions, theory, and challenges: interdisciplinary perspectives. *European Journal of Psychotraumatology*, *5*(1), 25338.

Sun, H., Yuan, C., Qian, Q., He, S., & Luo, Q. (2022). Digital resilience among individuals in school education settings: a concept analysis based on a scoping review. *Frontiers in Psychiatry*, *13*, 858515.

Tadele, F., & Manyena, S. B. (2009). Building disaster resilience through capacity building in Ethiopia. *Disaster Prevention and Management: An International Journal*, *18*(3), 317-326.

Tilfarlioglu, F. Y., & Ciftci, F. S. (2011). Supporting self-efficacy and learner autonomy in relation to academic success in EFL classrooms (A case study). *Theory and Practice in Language Studies*, *1*(10).

Tran, T., Ho, M.-T., Pham, T.-H., Nguyen, M.-H., Nguyen, K.-L. P., Vuong, T.-T., . . . Khuc, Q. (2020). How digital natives learn and thrive in the digital age: Evidence from an emerging economy. *Sustainability*, *12*(9), 3819. https://doi.org/10.3390/su12093819

Valcke, M., De Wever, B., Van Keer, H., & Schellens, T. (2011). Long-term study of safe Internet use of young children. *Computers and Education*, *57*(1), 1292-1305.

Vehtari, A., & Gabry, J. (2019). *Bayesian Stacking and Pseudo-BMA weights using the loo package*. In (Version loo 2.2.0) https://mc-stan.org/loo/articles/loo2-weights.html

Vehtari, A., Gelman, A., & Gabry, J. (2017). Practical Bayesian model evaluation using leave-one-out cross-validation and WAIC. *Statistics and computing*, *27*(5), 1413-1432. https://doi.org/10.1007/s11222-016-9696-4

Vuong, Q.-H. (2018). The (ir)rational consideration of the cost of science in transition economies. *Nature Human Behaviour*, *2*, 5. https://doi.org/10.1038/s41562-017-0281-4

Vuong, Q.-H. (2019). Computational entrepreneurship: From economic complexities to interdisciplinary research. *Problems Perspectives in Management*, *17*(1), 117-129. https://doi.org/http://dx.doi.org/10.21511/ppm.17(1).2019.11

Vuong, Q.-H. (2020). Reform retractions to make them more transparent [World View]. *Nature*, *582*, 149. https://doi.org/10.1038/d41586-020-01694-x

Vuong, Q.-H. (2022). *The kingfisher story collection*. https://www.amazon.com/Kingfisher-Story-Collection-Quan-Hoang-Vuong-ebook/dp/B0BG2NNHY6

Vuong, Q.-H. (2023). *Mindsponge Theory*. De Gruyter. https://books.google.com/books?id=OSiGEAAAQBAJ

Vuong, Q.-H., La, V.-P., & Nguyen, M.-H. (2022). *The mindsponge and BMF analytics for innovative thinking in social sciences and humanities*. De Gruyter.

Vuong, Q.-H., Le, T.-T., Jin, R., Khuc, Q. V., Nguyen, H.-S., Vuong, T.-T., & Nguyen, M.-H. (2023). Near-suicide phenomenon: An investigation into the psychology of patients with serious illnesses withdrawing from treatment. *International Journal of Environmental Research and Public Health*, *20*(6), 5173. https://doi.org/10.3390/ijerph20065173

Vuong, Q.-H., Le, T.-T., La, V.-P., & Nguyen, M.-H. (2022). The psychological mechanism of Internet information processing for post-treatment evaluation. *Heliyon*, *8*(5), E09351. https://doi.org/10.1016/j.heliyon.2022.e09351

Vuong, Q.-H., Nguyen, M.-H., & Le, T.-T. (2021a). Home Scholarly Culture, Book Selection Reason, and Academic Performance: Pathways to Book Reading Interest among Secondary School Students. *European Journal of Investigation in Health, Psychology and Education*, *11*(2), 468-495. https://doi.org/10.3390/ejihpe11020034

Vuong, Q.-H., Nguyen, M.-H., & Le, T.-T. (2021b). *A mindsponge-based investigation into the psycho-religious mechanism behind suicide attacks*. De Gruyter. https://books.google.com/books?id=88I-EAAAQBAJ

Vuong, Q. H., & Napier, N. K. (2015). Acculturation and global mindsponge: An emerging market perspective. *International Journal of Intercultural Relations*, *49*, 354-367. https://doi.org/10.1016/j.ijintrel.2015.06.003

Wagenmakers, E.-J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., . . . Epskamp, S. (2018). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic bulletin review*, *25*(1), 35-57. https://doi.org/10.3758/s13423-017-1343-3

Wigderson, S., & Lynch, M. (2013). Cyber-and traditional peer victimization: Unique relationships with adolescent well-being. *Psychology of Violence*, *3*(4), 297.

Wǔcháng, S. (2009). Three fundamental bonds and five constant virtues. *Berkshire Encyclopedia of China*, *5*, 2252-2255.

Yazedjian, A., & Kolkhorst, B. B. (2007). Implementing small-group activities in large lecture classes. *College Teaching*, *55*(4), 164-169.

Ybarra, M. L., Mitchell, K. J., Wolak, J., & Finkelhor, D. (2006). Examining characteristics and associated distress related to Internet harassment: findings from the Second Youth Internet Safety Survey. *Pediatrics*, *118*(4), e1169-e1177.