Exploring factors contributing to creativity performance among entrepreneurs using the Bayesian Mindsponge Framework

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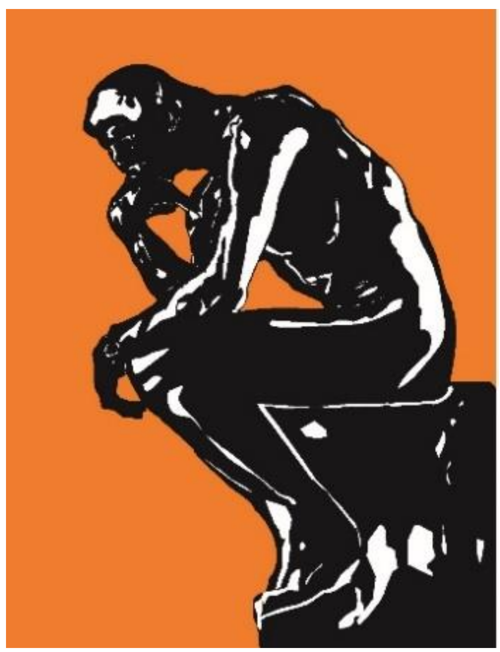

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Abstract

Creativity is a crucial aspect of entrepreneurship. However, research on the information-processing mechanism of creativity in relation to entrepreneurship is still very limited. To explore factors contributing to creativity performance among entrepreneurs in terms of information processing, we applied the Bayesian Mindsponge Framework. We used the Serendipity-Mindsponge-3D (SM3D) knowledge management theory to construct models and conducted Bayesian analysis on the most comprehensive and well-designed dataset of 3071 Vietnamese entrepreneurs up to date. We found that entrepreneurs who give more time to their startup attempts are likely to have lower levels of creativity. Both factors of higher levels of knowledge within one's discipline and better connections to out-of-discipline knowledge are positively associated with more creativity. While the effect of openmindedness on the relationship between within-discipline knowledge and creativity is unclear, openmindedness was found to have a positive moderating effect on the association between out-of-discipline knowledge and creativity. These findings support entrepreneurs in understanding the information processing mechanisms behind creativity for creating more effective knowledge management strategies.

Keywords: creativity, Bayesian Mindsponge Framework, entrepreneurship

"— It has been a very difficult fishing season. If we want to be full, we have to create a joint venture."

from "Joint Venture" in the *Kingfisher Story Collection* (2022)

1. Introduction

A wide range of studies in entrepreneurship and economics highlighted that entrepreneurs play a key role in economic growth (Tu & Yang, 2013). New businesses occupy 20 per cent of the United States' total job creation, and high-growth businesses account for nearly 50 per cent of it (Decker et al., 2014). Some investigations proposed that large enterprises are an important driver of the economy (Audretsch et al., 2002). The others discovered that small businesses might be the sources of economic growth (Decker et al., 2014; McMillan & Woodruff, 2002). Furthermore, a bundle of the literature shows that entrepreneurs and their businesses significantly stimulate economic growth and development (Acs, 2006; Ács et al., 2014; Stel et al., 2005).

Considering the importance of entrepreneurs, a change in the business has been identified recently: converting entrepreneurship from knowledge-based activities to creativity and innovation (Oke et al., 2009). Generally, knowledge-based activities and creativity are different in that creativity is the creation of something new or imaginative, while knowledge-based activities do not involve creative work but rather are the applications of existing beliefs and experiences. Creativity enables entrepreneurs to gain more business opportunities and competitive advantages in the increasing globalization (McMullen & Shepherd, 2006). It is the basis for innovation and economic growth (Bilton, 2007). Guilford (1950) proposed that creativity is the ability of creative people and determines whether the individual can exhibit creative behavior to a noteworthy degree. Ferrari et al. (2009) defined creativity as the ability to make new connections, generate new ideas, think divergently, and produce original and valuable outcomes. Kampylis and Valtanen (2010) compared most of the existing definitions and found that they all intersect at four key components: 1) a key ability of individuals; 2) an internal activity; 3) occurring in a specific context; and 4) generating novel and valuable products.

Controversy still exists in prior studies about creativity and entrepreneurship. Although some researchers pointed out that creativity, innovation, and entrepreneurship may be interchangeable (Fillis & Rentschler, 2005; Stevenson & Jarillo, 1990), others proposed that they are different parts of the entrepreneurial process (Amabile, 2019; Dyer et al., 2008; Phan et al., 2010). On the one hand, creativity is the ability to develop something original, innovation is the application of creativity, and the success of entrepreneurship needs creativity and innovation to offer something unique to the market. On the other hand, entrepreneurship involve activities of pursuing opportunities without regard to the resources entrepreneurs can control (Stevenson & Jarillo, 1990) and investment in new revenue streams (Bratnicka & Bratnicki, 2013), but Stammerjohan et al. (2019) found that entrepreneurs might see creativity as separate from opportunity recognition, programmatic implementation, and building networks.

Even though the views of these terms are intertwined and even conflicting, there is an overall agreement that creativity is always a major contributor to entrepreneurship and economic growth (Schmidt et al., 2013; Stammerjohan et al., 2019). A significant association has been discovered between creativity and entrepreneurial performance (Barrett et al., 2005). Due to its importance to entrepreneurship, the role of creativity in entrepreneurial activities should be examined clearly (Stammerjohan et al., 2019). However, hitherto relevant studies are still scarce in Asia, particularly in Vietnam. The main objective of this investigation is to examine the information mechanism of entrepreneurial creativity in Vietnam.

Normally, people's creativity is always considered to be linked to individual personality. Studies find that neuroticism, extraversion, and openness are significantly associated with individual creativity (Carson et al., 1995; Feist, 1998; Furnham & Bachtiar, 2008; Furnham et al., 2008). Divergent thinking fluency is also shown to be positively related to creativity through the mediation of extraversion and openness (Chamorro-Premuzic & Reichenbacher, 2008; Furnham & Bachtiar, 2008). Self-rated creativity is found to be linked to emotional stability and openness (Furnham et al., 2008).

However, existing literature of creativity in entrepreneurs focuses on the traits predisposing the entrepreneurship (Berglund & Wennberg, 2006). The creativity of entrepreneurs is viewed as a function of the general characteristics of new business rather than their personalities (Carson et al., 1995). Risk-taking behavior, being able to control rather than be controlled, being independent, and not being afraid to fail are the traits conducive to creativity in entrepreneurial marketing (Fillis & McAuley, 2000). Expertise, access to resources, entrepreneurial alertness, and intrinsic motivation are important predictors of entrepreneurial creativity (Dayan et al., 2013). However, little has been known about the mechanism behind the emergence of creativity in entrepreneurship.

This study is going to fill this gap by examining the information mechanism of entrepreneurial creativity in Vietnam using the Serendipity-Mindsponge-3D (*SM3D)* knowledge management framework (Vuong, La, et al., 2022; Vuong, Le, La, et al., 2022). The SM3D knowledge management theory provides an information-processing-based approach to studying psychosocial processes. It is a newly developed research framework based on a series of conceptions and theories on the mind, including serendipity (Napier & Vuong, 2013), the mindsponge mechanism (Vuong & Napier, 2015), and the triple-discipline (3D) principle of creativity (Vuong & Napier, 2014). Creativity is suggested not to be an exclusively human function but rather the function of any natural or artificial system implementing the creative process (Pisapia & Rastelli, 2022). This idea aligns with the core concept of mindsponge-based information processing (Vuong, 2023). The SM3D framework is effective in explaining the psychosocial information processes on both individual and collective levels in relevant study fields (Vuong, Le, La, et al., 2022; Zhang, 2022). On this theoretical foundation, research conceptualization and analysis can be conducted following the Bayesian Mindsponge Framework due to its compatibility (Vuong, La, et al., 2022). Additionally, for this purpose, our study used a comprehensive dataset that was systematically designed to be highly suitable for the information processing approach with complex conceptual reasoning (Vuong, 2016).

Serendipity is one of the most important core mechanisms in human innovation (Vuong, 2022b). It is suggested to be driven by survival instincts, both in terms of social and natural aspects (Le, 2022). Creativity can be deemed a more systematic capitalization of serendipity strikes (Nguyen, 2022). Therefore, entrepreneurial creativity is assumed to be driven by the social survival desire of the entrepreneurs. In other words, the greater the pressure entrepreneurs have to bear, the higher the chance they will generate creative products. One of the common pressures faced by entrepreneurs is time constraints. Therefore, we have the first hypothesis (H) as follows.

> **H1:** Entrepreneurs giving more time to their startup attempts are less likely to generate creative outcomes.

Pressure can help improve the individuals' desire to survive and thrive (within the market) and thus increase the chance of serendipity attainment. However, conditions are required to systematically capitalize on serendipity strikes and turn them into creative products/services/business models. The SM3D suggests that creativity can be enhanced by adopting three fundamental principles as follows (Vuong, Le, La, et al., 2022; Vuong & Napier, 2014).

- Having the best expertise within one's own discipline
- Being capable of connecting to new knowledge from outside of one's own discipline
- Following a disciplined process when carrying out work until insights/innovations are generated.

Based on the first two conditions, we derive the following hypotheses. Note that the principle of disciplined processes is not examined in the present study due to data insufficiency.

> **H2:** Vietnamese entrepreneurs with better within-discipline knowledge are more likely to generate creative outcomes

> **H3:** Vietnamese entrepreneurs with better connections to out-of-discipline knowledge are more likely to generate creative outcomes

It is also suggested that entrepreneurial openness has a positive effect on the entrepreneur's creativity (Peljko & Auer Antončič, 2022). Regarding the mindsponge information processing mechanism, values entering the mind are subjected to evaluation and filtering. If a person is more open to new information, they will face less cognitive dissonance (or less perceived cost) in absorbing new values, which might enhance the roles of acquired knowledge. We have the following hypotheses.

> **H4:** Entrepreneurs' openness to new ways of thinking, acting and beliefs positively moderates the effect of better within-discipline knowledge on creative outcomes.

> **H5:** Entrepreneurs' openness to new ways of thinking, acting and beliefs positively moderates the effect of better out-of-discipline knowledge on creative outcomes.

We also expect that the moderating effect of an open mindset with out-of-discipline knowledge is stronger than that with within-discipline knowledge due to the difference in information unfamiliarity.

2. Materials and method

2.1. Materials

The data used in this study were retrieved from a dataset about the entrepreneurs' perceptions of the likelihood of entrepreneurial success (Vuong, 2016). The data were obtained from a direct survey of participants of seminars, conferences, and meetings in Hanoi, Ho Chi Minh City, Buon Ma Thuat, and Da Nang of Vietnam. For further details on the data set, see Vuong Q. H. (Vuong, 2016). In total, the data set contains 3071 records.

Following the theoretical foundation presented above, we generated five variables to be used for Bayesian analysis (see Table).

Table 1: Variable description

Variable	Meaning	Value
Creativity	Self-evaluation of creativeness of product/services/business model	Creative = 4; somewhat creative = 3; hopefully = 2; not at all = 1.
InternalInfor	Previous job	Yes = 1; No = 0.
ExternalInfor	Studying others' failures	Careful study = 3; exploring few noteworthy cases = 2; no need = 1.
TransMind	Entrepreneurial efforts to transform ways of thinking, acting, and beliefs	Strong = 4; some aspects = 3; negligible = 2; none = 1.
TimeforEntre	How much time for the entrepreneurial attempt	Less than 12 months = 1; 12-24 months = 2; until success = 3.

The outcome variable is *Creativity*, created from the question, "Self-evaluation of creativeness of product/services/business model?" Answers range from 'creative', 'somewhat creative', 'hopefully', to 'not at all'.

If the entrepreneurs have a job before their startup, they are considered as having expertise within the discipline, which is demonstrated by the *InternalInfor* variable. Besides, the out-of-disciplined knowledge is illustrated by the *ExternalInfor* variable and measured by how much they learn from others' failures.

The entrepreneurs' openness (*TransMind* variable) to novel ways of thinking, acting, and beliefs are rated on a four-point Likert scale ranging from one ('none') to four ('strong'). The time (*TimeforEntre* variable) that entrepreneurs allow for their startup to become a functioning business is given three options: 'less than 12 months', '12 to 24 months', and 'until success'.

Based on the aforementioned hypotheses, four models were constructed as follows. The models' weights were compared to choose the model most fitted with the data at hand (see the Results section).

Model 1: $Creativity \sim TimeforEntre$

Model 2: $Creativity \sim TimeforEntre + ExternalInfor + ExternalInfor * TransMind$

Model 3: $Creativity \sim TimeforEntre + InternalInfor + InternalInfor * TransMind$

Model 4: $Creativity \sim TimeforEntre + ExternalInfor + ExternalInfor * TransMind + InternalInfor + InternalInfor * TransMind$

2.2. Methods and Validation

This study employs the reasoning and analytical approach of the Serendipity-Mindsponge-3D (SM3D) knowledge management framework in entrepreneurs' creativity-making process (Vuong, Le, La, et al., 2022; Vuong & Napier, 2014). The SM3D knowledge management framework is an information-based thinking approach which incorporates the mindsponge mechanism, 3D creativity management theory, and serendipity theory (Nguyen et al., 2022b; Vuong, 2022b; Vuong et al., 2021; Vuong & Napier, 2015). Specifically, the four models are constructed based on the SM3D framework and statistically analyzed using the Bayesian approach aided by the Markov Chain Monte Carlo (MCMC) technique.

The Bayesian approach is employed in this study because of several advantages. The frequentist approach over-relies on the *p*-value, posing the risk of reproducibility problems, big data issues, or misinterpretations (Bhatti & Kim, 2021). In contrast, the Bayesian inference measures all the properties probabilistically, allowing for accurate prediction with parsimonious models (Nguyen et al., 2022a). Besides, since this study is exploratory in nature, uninformative priors are used. The results of this study can act as prior information to update our beliefs in future related studies.

A four-pronged validation strategy is employed to validate the simulated posteriors. Firstly, the models' goodness-of-fit is checked using Pareto-smoothed importance sampling leave-one-out (PSIS-LOO) diagnostics (Vehtari et al., 2017). A model can be deemed good when k values are below 0.5. Secondly, the convergence of Markov chains can be validated visually through trace plots, Gelman-Rubin-Brooks plots, and autocorrelation plots, and statistically through the effective sample size (*n_eff*) and the Gelman-Rubin shrink factor (*Rhat*).

To compare models' weights, we employ Pseudo-BMA without Bayesian bootstrap, Pseudo-BMA with Bayesian bootstrap, and Bayesian stacking to choose the optimal predictive one. The model with better predictive accuracy is used for discussion and computing the probabilities of creativeness among entrepreneurs. Further explanation and interpretation of diagnostic statistics, plots, weight comparison, and probability measurement are presented in the Results section.

The **bayesvl** R package is employed to perform Bayesian analysis due to its advantages, such as good visualization power, openness, and streamlined operation (La & Vuong, 2019; Vuong, La, et al., 2020). The MCMC setups for all models are 5000 iterations, which contain 2000 warm-up iterations and four chains. Considering the importance of science cost management (Vuong, 2018) and procedure transparency (Vuong, 2020), the data and code snippet of this study are deposited onto the Open Science Framework (OSF) server at: https://osf.io/g8r92 (DOI: 10.17605/OSF.IO/G8R92).

3. Results

Model comparison. The PSIS-LOO approach was employed to compare all the models' weights. The results are presented in Table S1, while the distributions of k-values are illustrated in Figures S1-S4. All the models are deemed to fit the data well as their estimated Pareto k are less than 0.5, and the p_loo statistics are approximately the models' number of parameters. The three different types of weight comparison have been employed, and the results are presented in Table. It is noted that Model 4 outweighs other models as it ranks the best in all categories. Specifically, its weights are 1.0000, 0.9933, and 0.9035 in Pseudo-BMA without Bayesian bootstrap, Pseudo-BMA with Bayesian bootstrap, and Bayesian stacking, respectively. Thus, Model 4 was selected for later result presentation and interpretation in the main text.

Table 2: Model weights comparison and model ranking

Weights	Pseudo-BMA without Bayesian bootstrap	Pseudo-BMA with Bayesian bootstrap	Bayesian stacking
Model 1	0.0000	0.0000	0.0578
Model 2	0.0000	0.0067	0.0043
Model 3	0.0000	0.0000	0.0343
Model 4	1.0000	0.9933	0.9035

Most predictive model	Model 4	Model 4	Model 4

Convergence diagnostics. The two standard diagnostics tests demonstrate good convergence of all four models. Specifically, all values of *n_eff* (effective sample size) pass standard thresholds of 1,000, and all *Rhat* values equal one. The estimated results of Models 1-3 are presented in the Appendix (see Tables S1-S3), while the estimated results of Model 4 are presented in Table 3. All the visualized plots, including the Markov chains' trace plots, the autocorrelation plots, and the Gelman plots also show good convergence in all four models. The diagnostic visualizations of Models 1-3 can be found in the Appendix (see Figures S5-S13), while the visualizations of Model 4 are presented below in the main text.

Table 3: Model 4's simulated posteriors

Parameters	Mean	SD	n_eff	Rhat
Constant	1.97	0.09	6211	1
ExternalInfor	0.20	0.06	3989	1
*ExternalInfor*TransMind*	0.05	0.01	3731	1
InternalInfor	0.14	0.12	3814	1
*InternalInfor*TransMind*	0.01	0.04	3734	1
TimeforEntre	-0.09	0.02	6760	1

The trace plots of Model 4 show that the Markov chains after the warmup period (2,000th iteration) fluctuate around a central equilibrium, signaling good convergence (see Figure 1). The Gelman-Rubin-Brooks plots demonstrate that the shrink factors quickly drop to 1 during the warmup period (see Figure 2). The autocorrelation plots signal the swift decline of autocorrelation levels among iterations after a certain number of lags, indicating the memoryless property of the Markov chains (see Figure 3). Both the Gelman-Rubin-Brooks and autocorrelation plots hint at the good convergence of Model 4's Markov chains.

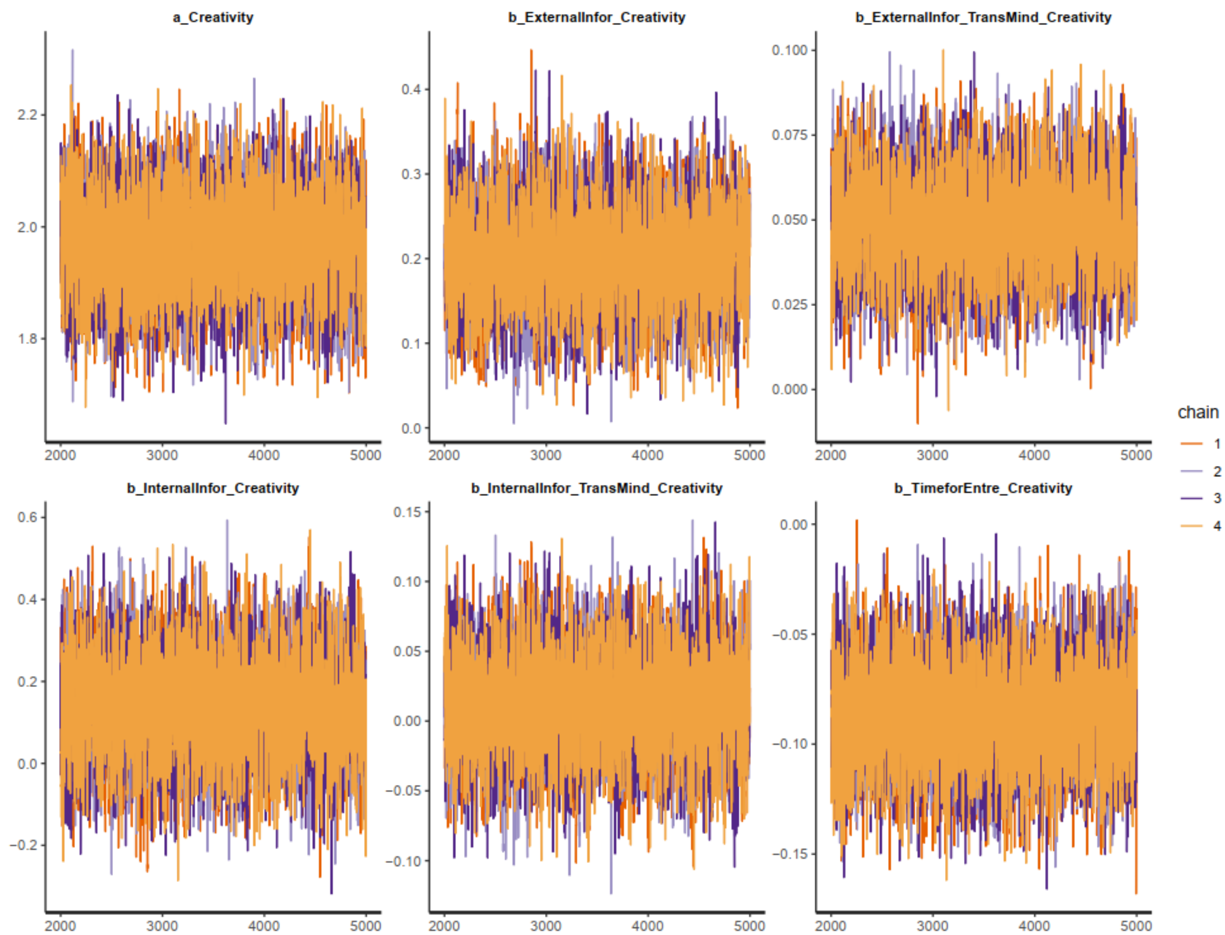

Figure 1: Model 4's trace plots

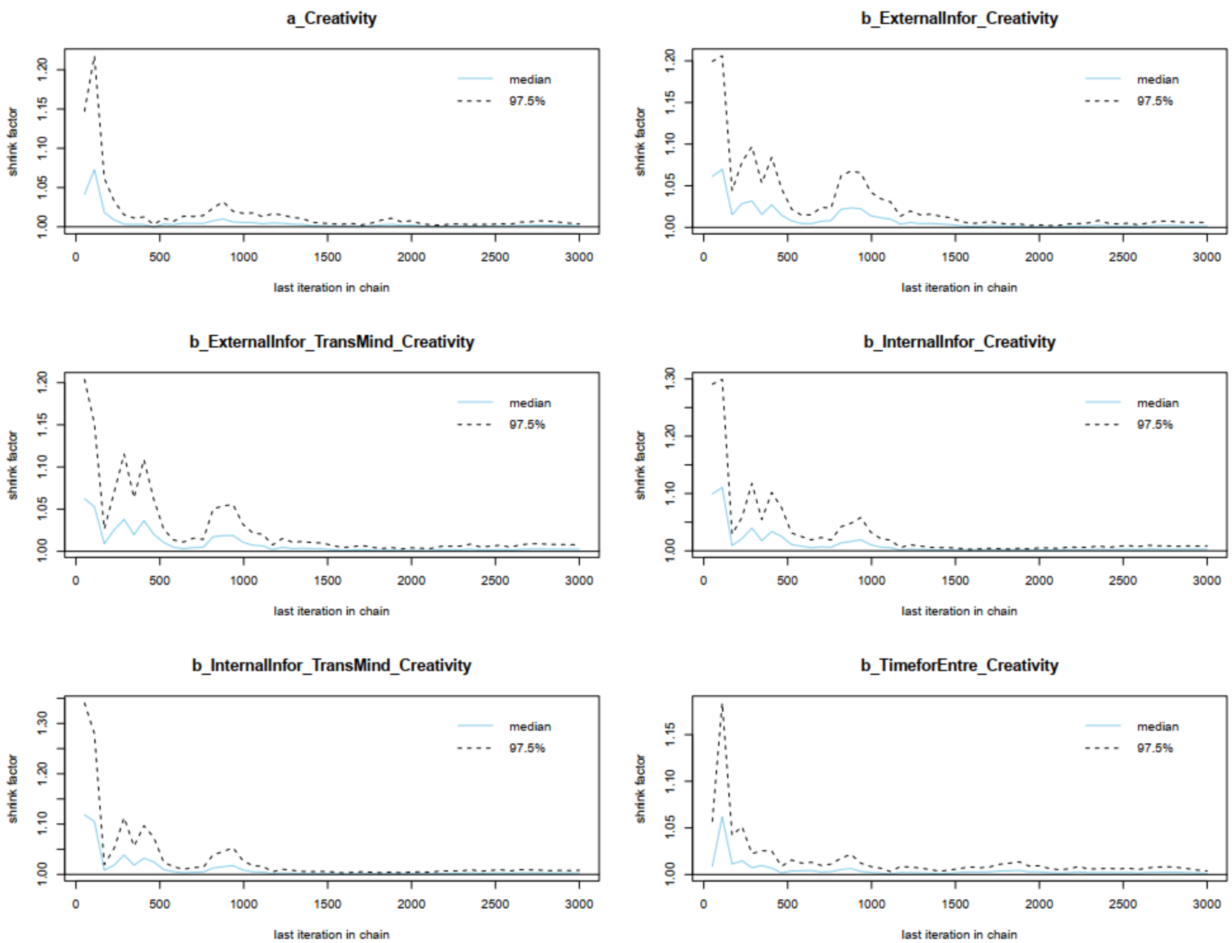

Figure 2: Model 4’s Gelman-Rubin-Brooks plots

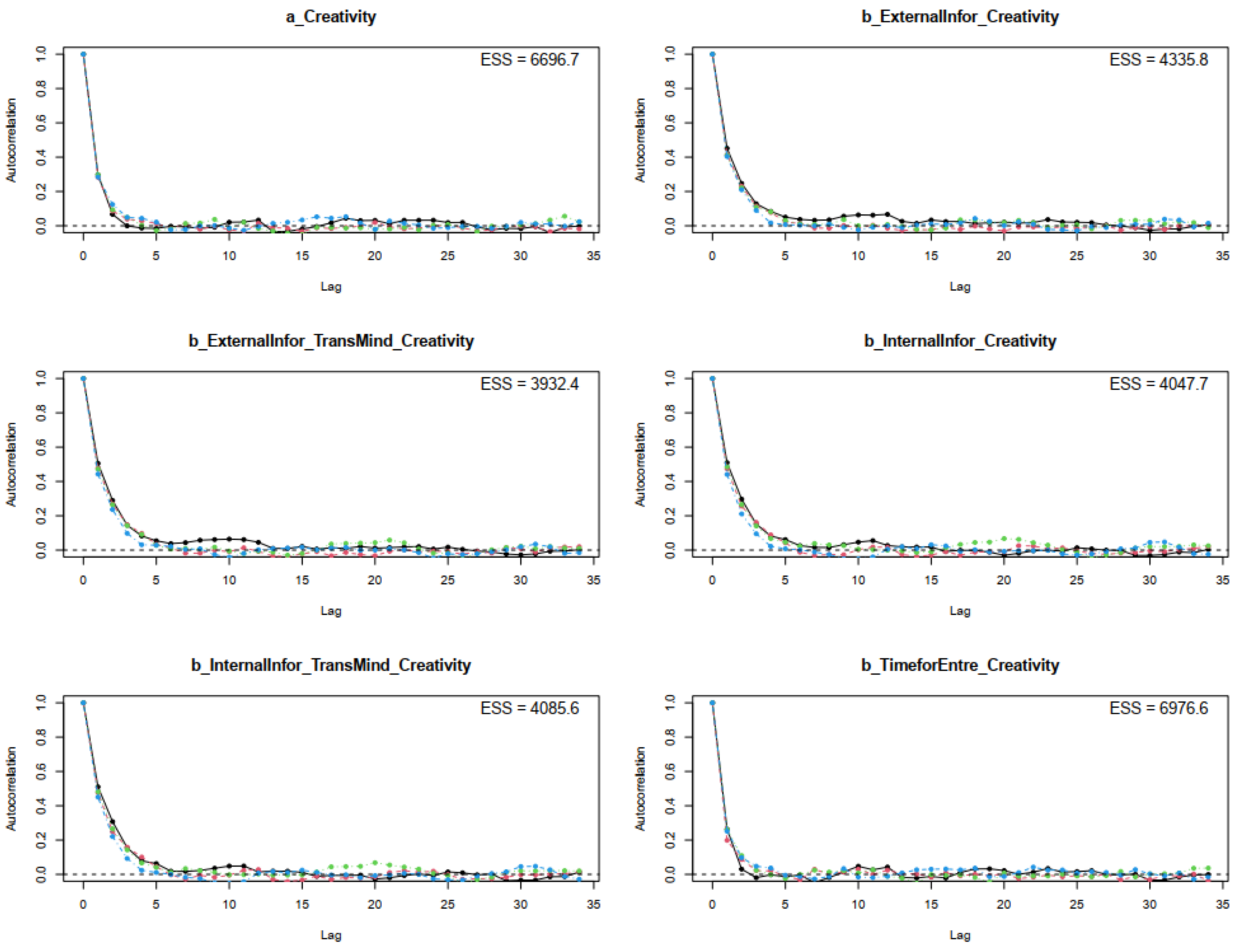

Figure 3. Model 4's autocorrelation plots

Model 4's results show that entrepreneurs who give more time to their startup attempts are less likely to generate creative products, services, or business models ($\mu_{TimeforEntre} = -0.09$ and $\sigma_{TimeforEntre} = 0.02$). Figure 4 shows Model 4's posterior distributions with the Highest Posterior Density Intervals (HPDIs) at 89%.

From the simulated posteriors of Model 4, we also found that entrepreneurs with high knowledge within their discipline are more likely to obtain creative products, services, or business models ($\mu_{InternalInfor} = 0.14$ and $\sigma_{InternalInfor} = 0.12$). However, the moderation effect of having an open-minded mindset is negligible since the posterior is distributed around 0 ($\mu_{InternalInfor*TransMind} = 0.01$ and $\sigma_{InternalInfor*TransMind} = 0.04$).

Entrepreneurs who have a better connection to out-of-discipline knowledge are more likely to obtain creative products, services, or business models, with the coefficients distributed entirely in the positive range ($\mu_{ExternalInfor} = 0.20$ and $\sigma_{ExternalInfor} = 0.06$). Furthermore, if they have an open-minded mindset to transform their thinking, acting, or beliefs, the effect of connection to out-of-discipline knowledge on creativity performance is positively moderated ($\mu_{ExternalInfor*TransMind} = 0.05$ and $\sigma_{ExternalInfor*TransMind} = 0.01$).

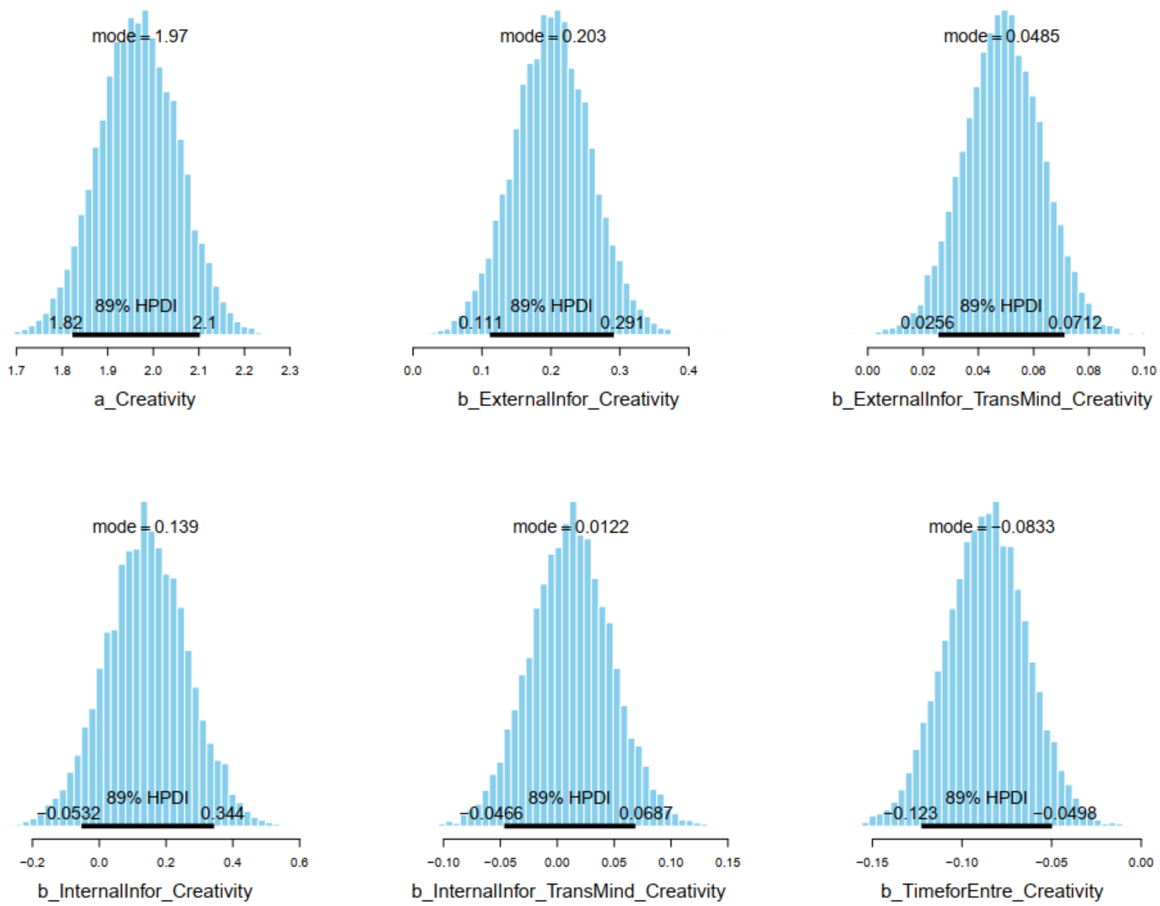

Figure 4: Model 4's posterior distributions with 89% HPDI

4. Discussion

Using reasoning based on the SM3D framework and Bayesian analysis on 3071 data points of entrepreneurs' perceptions in Vietnam, we found that entrepreneurs who give more time to their startup attempts are likely to have lower levels of self-reported creativity. Both factors of higher levels of knowledge within one's discipline and better connections to out-of-discipline knowledge are positively associated with more creativity. While the effect of openmindedness on the relationship between within-discipline knowledge and creativity is unclear, openmindedness was found to have a positive moderating effect on the correlation between out-of-discipline knowledge and creativity.

As it is well discussed, much of the core creativity research and theory are rooted in arts, and not until recently did it stretch beyond its boundary to other areas such as entrepreneurship, business, technology, etc. While there is a vast stream of research embarking on what creativity is and how it works (Kampylis & Valtanen, 2010), our research is grounded on the SM3D creativity management theory, which views creativity as an information process and is in line with other studies such as Pisapia and Rastelli (2022). Therefore, the interpretation of the results will focus on this key notion.

Regarding Hypothesis 1, the negative association between time for startup attempts and creativity, as found in our study, may sound strange at first glance. This is, however, in sync with the new theory on serendipity which argues that survival pressure can boost one's desire to compete for limited resources and thus increases the chance of serendipity attainment (Vuong, 2022b). In this case, the survival aspect can include the existence and well-being of individuals regarding their careers and the competitive power of their firms and products in the market, which mainly belong to the type of social survival (Le, 2022). The finding is also consistent with the study of Marvel and Patel (2018), which suggests that time is likely the scarcest resource for startups and overcoming the time resource constraint usually leads to accelerating innovation for new products. Arguably, time is largely considered to be precious for any human life, while other types of resources, such as money or physical possession, are more dependent on different subjective worldviews. The constraint of time, thus, induces a desire to adapt and overcome through innovation. In other words, one tries to capitalize on the limited resource of time compared to other people. Considering the relationship between time constraints and creative endeavors of entrepreneurs, we suggest that the act of waiting for the "perfect time" or being too lenient with oneself is possibly detrimental to creativity in entrepreneurship. Nonetheless, besides pressure, a well-prepared knowledge background and working environment are crucial in increasing the probability of catching serendipity strikes (Nguyen, 2022).

Our results show that entrepreneurs with better within-discipline knowledge and connections to out-of-discipline knowledge are more likely to generate creative outcomes. These results confirm the first two in the triple-discipline principle of creativity (Vuong & Napier, 2014). They also follow the mindsponge mechanism of information filtering based on information accessibility (Nguyen et al., 2022b; Vuong, La, et al., 2022). Fundamentally, innovation requires a wide range of necessary depth of relevant information as inputs for the corresponding ideation (thought generation). Such inputs require both expertise (whin-discipline knowledge) and high connecting and referencing capacity (out-of-discipline knowledge). This information processing mechanism is in alignment with Sternberg and Lubart's investment theory of creativity (Sternberg & Lubart, 1991), in which the authors state that the ability to acquire knowledge internally and externally is one of the most important elements for making creativity.

Regarding hypotheses 4 and 5, we found evidence supporting the notion that entrepreneurs who are open to new value can utilize out-of-discipline knowledge more effectively for generating creative outcomes. However, the same moderating effect was not found for within-discipline knowledge. Based on the functions of the mindsponge filtering system in an information process, new values that conflict with existing trusted values stored in the mindset will cause cognitive dissonance (Vuong, Le, & Nguyen, 2022; Vuong & Napier, 2015). Openmindedness reflects the ability to incorporate unfamiliar and potentially conflicting values, updating the mindset and reducing current cognitive dissonance, which increases the effectiveness and efficiency of related information processes, including creativity. On a collective level, the phenomenon of cultural additivity is an expression of this information-processing mechanism (Vuong et al., 2018). Intuitively, new within-discipline values are likely more compatible with existing trusted values than new values from other disciplines. Thus, the buffering and integrating effects of openmindedness are stronger and clearer in the case of out-of-discipline knowledge. Indeed, apart from qualities such as fluency, flexibility, and originality, being open to new experiences, curious, willing to take risks, and sensitive to aesthetic characteristics is widely believed to enhance creativity (Runco & Pritzker, 2011). Tolerance for ambiguity, self-discipline, and risk-taking are found to be strongly associated with creativity (Amabile, 2019; Conti et al., 1996).

Vietnamese culture as a collective mindset has a high degree of cultural additivity (Vuong et al., 2018; Vuong, Ho, et al., 2020), which indicates a relatively high tolerance for absorbing and utilizing potentially conflicting new values. In terms of information processing of creativity, this can be considered an advantage for Vietnamese entrepreneurs. Nevertheless, other important conditions for creativity, such as pressure management (constraint-induced motivation), information accessibility (knowledge acquisition), processing capacity (talent), and energy expenditure (efforts), cannot be ignored when one aims to generate innovative products (Vuong, Le, La, et al., 2022). Therefore, our study presents a new perspective for not only Vietnamese entrepreneurs but also every businessperson in their pursuit of creativity on the basis of the human mind's information processing mechanisms.

Appendix

PSIS-LOO inference for model comparison

Table S1. Model comparison using PSIS-LOO analysis

<table>
<tr><th>Model</th><th colspan="3">Summary</th></tr>
<tr><td rowspan="5">Model 1</td><td></td><td>Estimate</td><td>SE</td></tr>
<tr><td>elpd_loo</td><td>-3033.5</td><td>31.9</td></tr>
<tr><td>p_loo</td><td>2.8</td><td>0.1</td></tr>
<tr><td>looic</td><td>6067.0</td><td>63.9</td></tr>
<tr><td>------</td><td></td><td></td></tr>
</table>

	Monte Carlo SE of elpd_loo is 0.0. **Pareto k diagnostic values** All Pareto k estimates are good (k < 0.5).
Model 2	**Estimate** **SE** elpd_loo -2897.0 34.2 p_loo 5.2 0.2 looic 5793.9 68.4 ------ Monte Carlo SE of elpd_loo is 0.0. **Pareto k diagnostic values** All Pareto k estimates are good (k < 0.5).
Model 3	**Estimate** **SE** elpd_loo -2976.1 32.4 p_loo 5.0 0.2 looic 5952.2 64.9 ------ Monte Carlo SE of elpd_loo is 0.1. **Pareto k diagnostic values** All Pareto k estimates are good (k < 0.5).
Model 4	**Estimate** **SE** elpd_loo -2882.5 34.3 p_loo 7.2 0.3 looic 5765.1 68.5 ------ Monte Carlo SE of elpd_loo is 0.1.

	Pareto k diagnostic values
	All Pareto k estimates are good (k < 0.5).

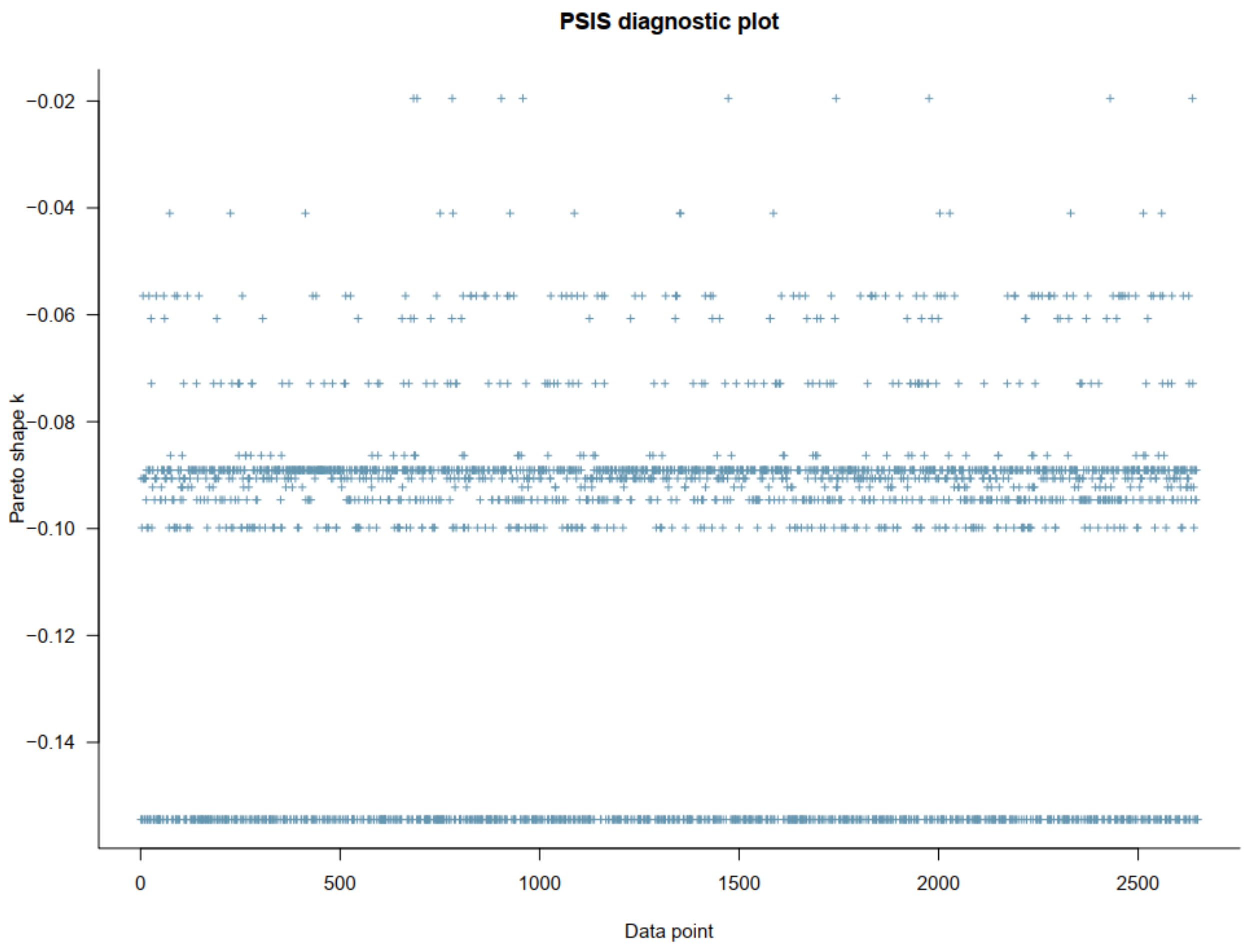

Figure S1: Model 1's PSIS diagnostic plot

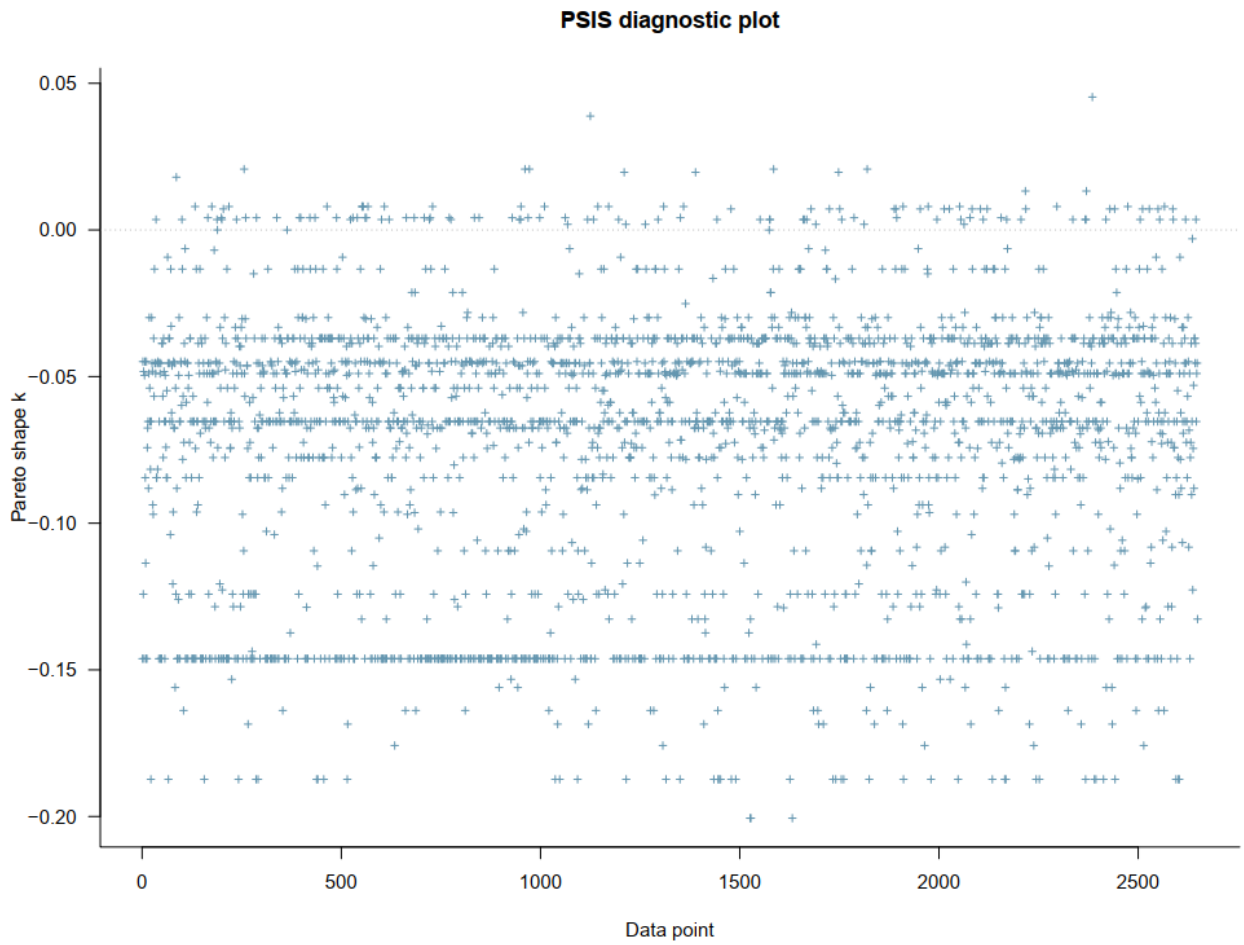

Figure S2: Model 2's PSIS diagnostic plot

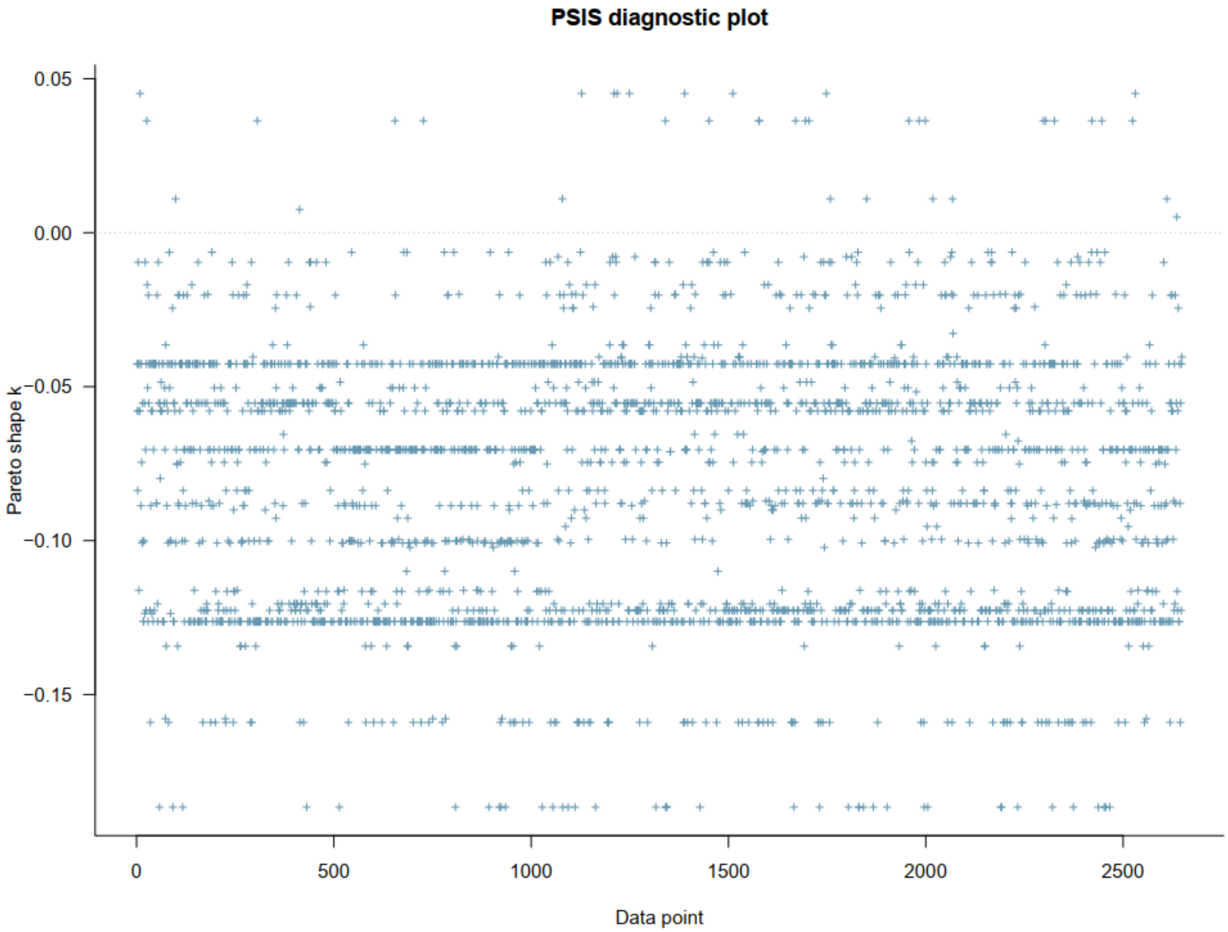

Figure S3: Model 3's PSIS diagnostic plot

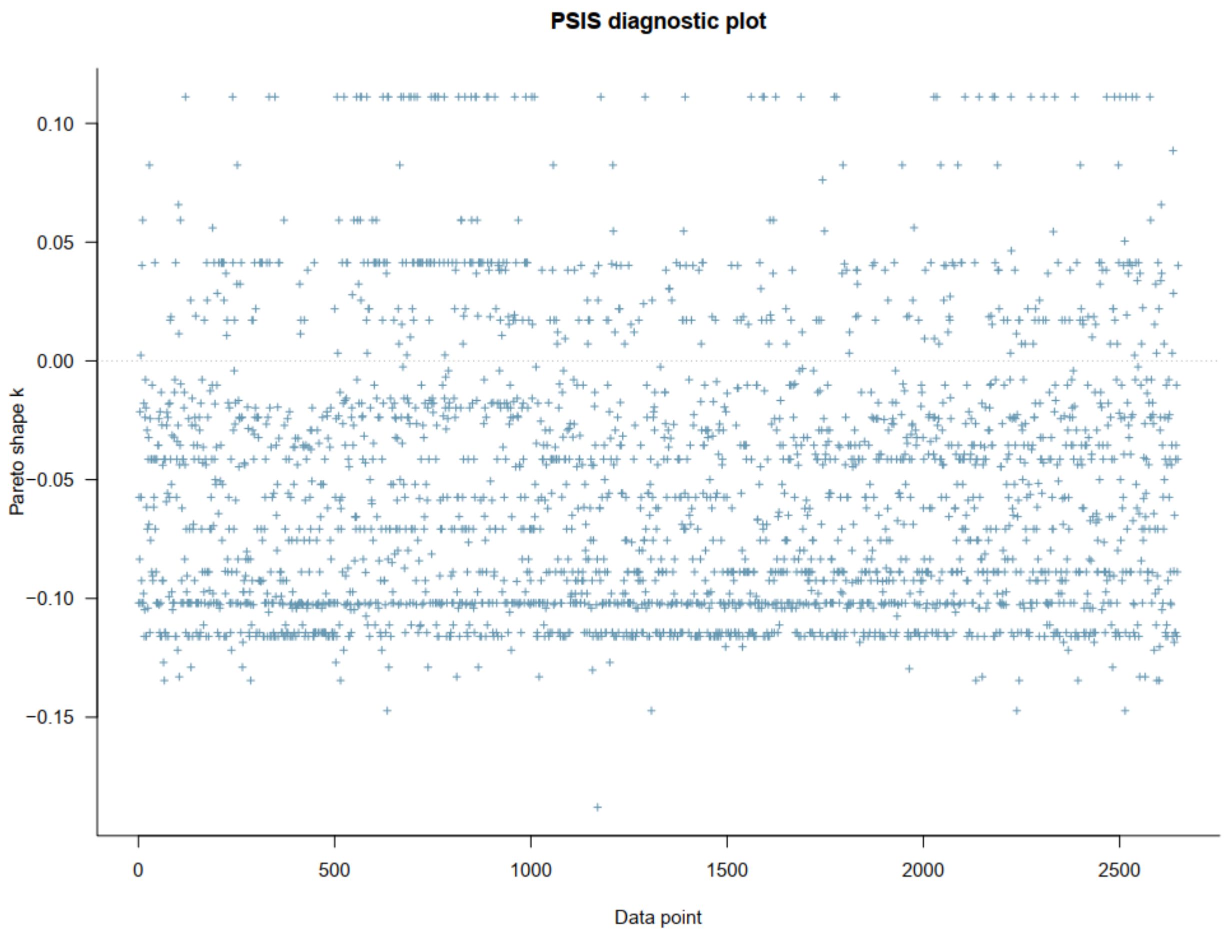

Figure S4: Model 4's PSIS diagnostic plot

Models' summaries

Table S2: Model 1's summary

Parameters	Mean	SD	n_eff	Rhat
Constant	2.93	0.07	3895	1
TimeforEntre	-0.10	0.02	3884	1

Table S3: Model 2's summary

Parameters	Mean	SD	n_eff	Rhat

Constant	2.05	0.09	5125	1
ExternalInfor	0.22	0.04	5821	1
*ExternalInfor*TransMind*	0.05	0.01	6074	1
TimeforEntre	-0.09	0.02	5615	1

Table S4: Model 3's summary

Parameters	Mean	SD	n_eff	Rhat
Constant	2.74	0.07	5753	1
InternalInfor	-0.29	0.08	5840	1
*InternalInfor*TransMind*	0.16	0.02	5999	1
TimeforEntre	-0.10	-0.15	5792	1

Model convergence diagnoses

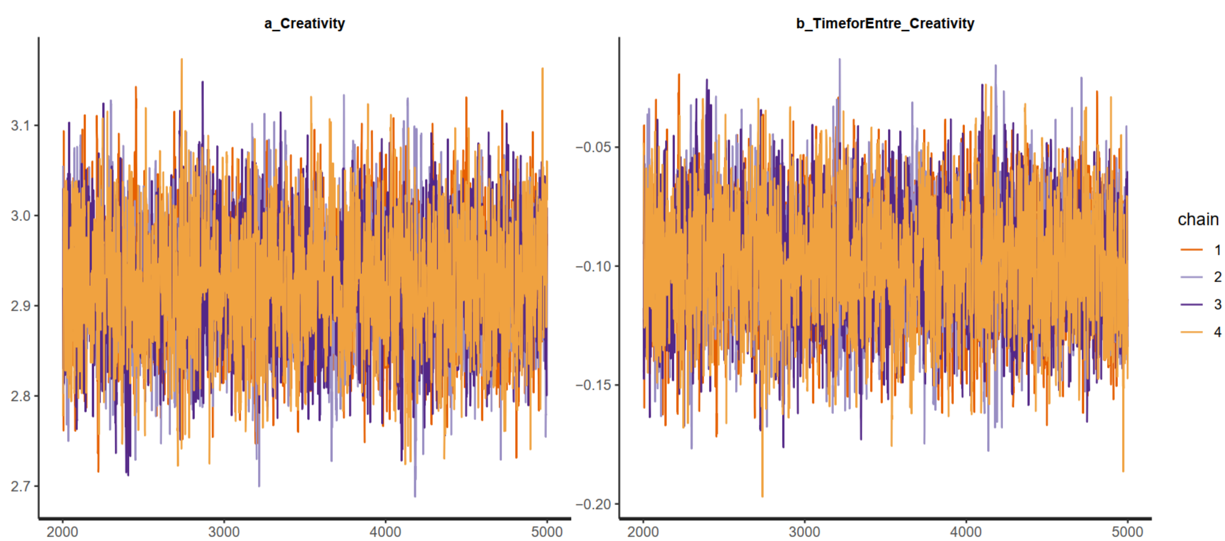

Figure S5: Model 1's trace plots

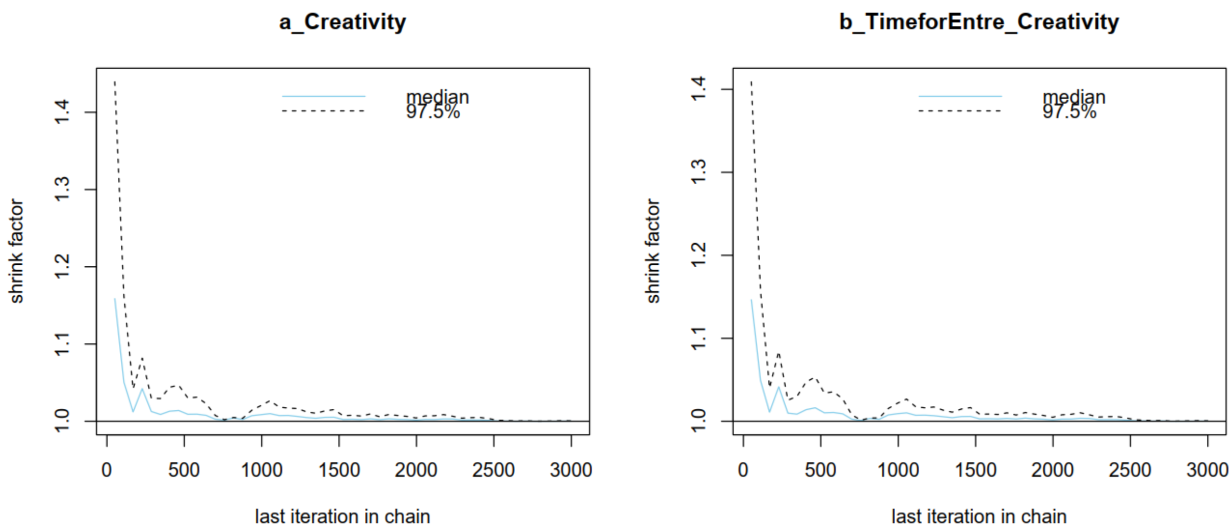

Figure S6: Model 1's Gelman-Rubin-Brooks plots

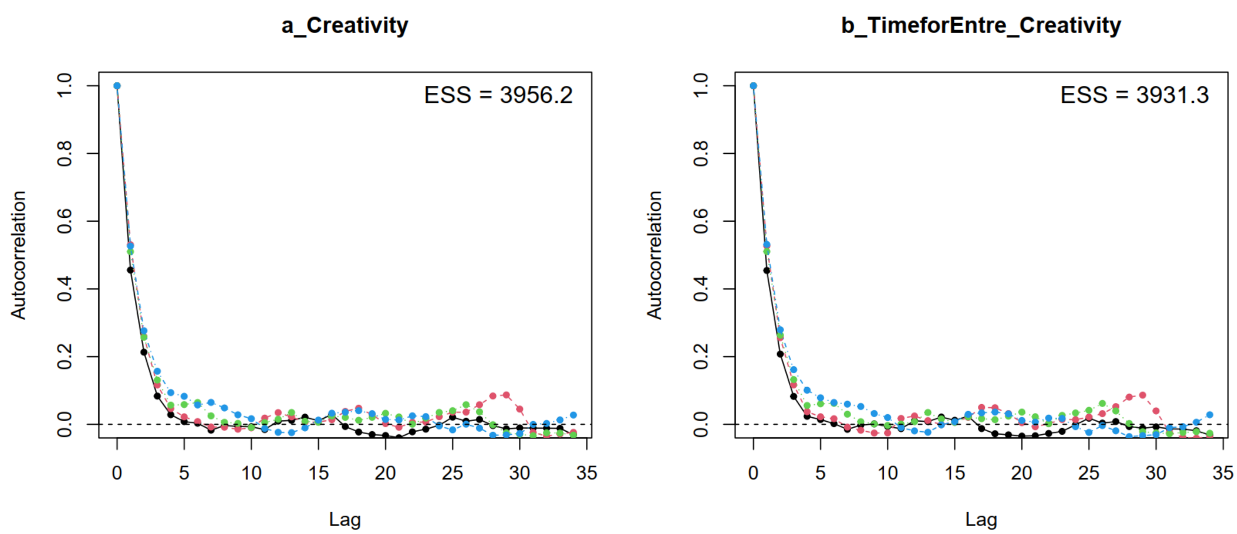

Figure S7: Model 1's autocorrelation plots

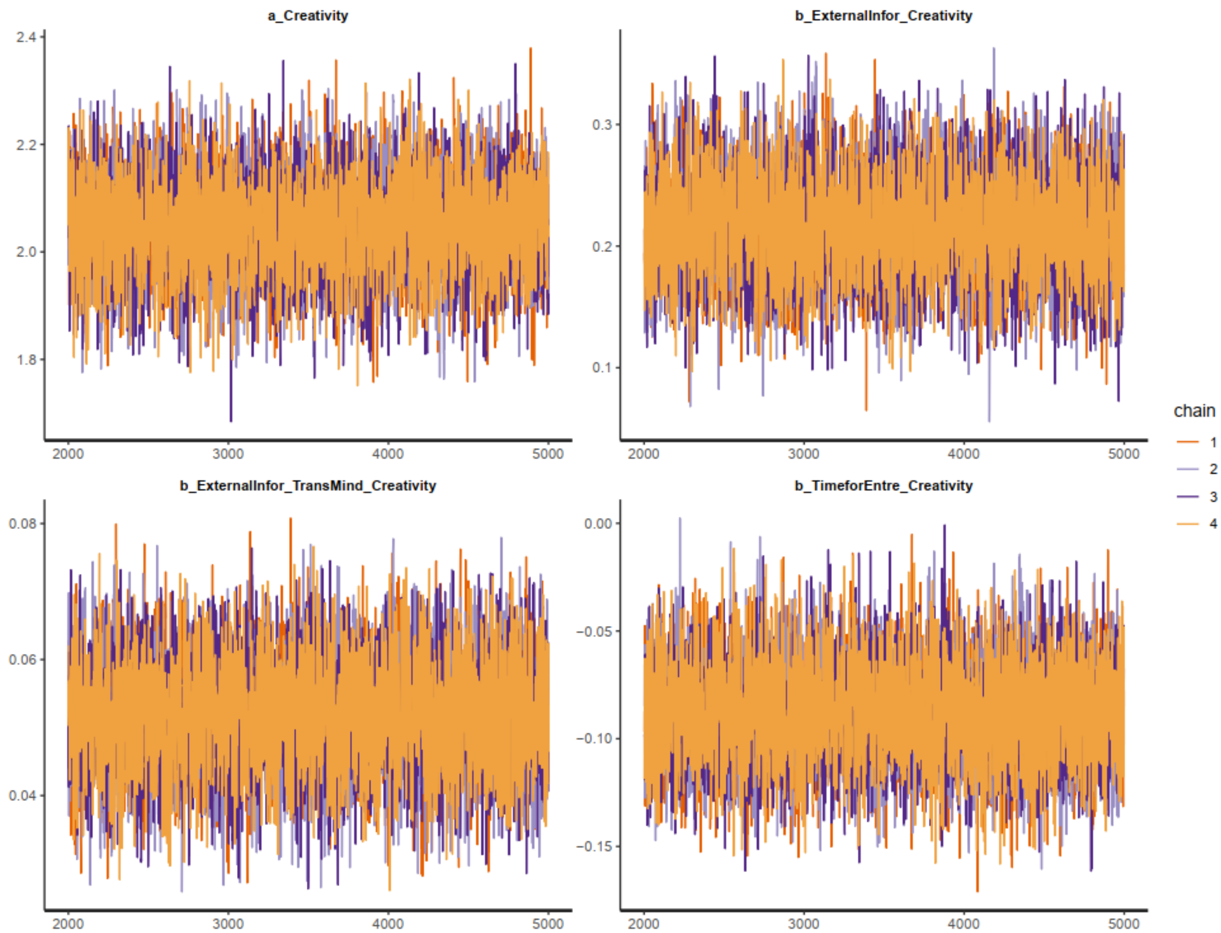

Figure S8: Model 2’s trace plots

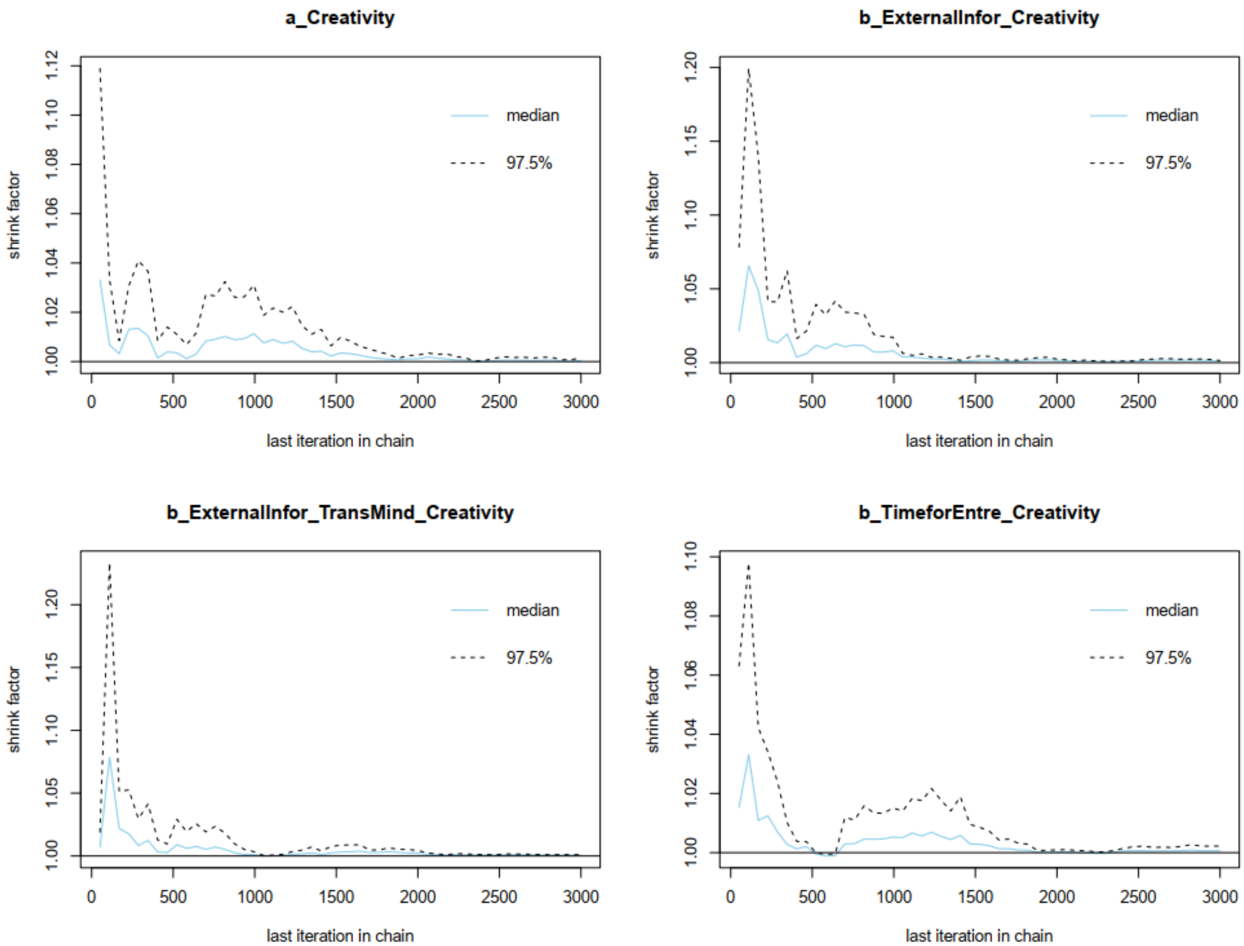

Figure S9: Model 2's Gelman-Rubin-Brooks plots

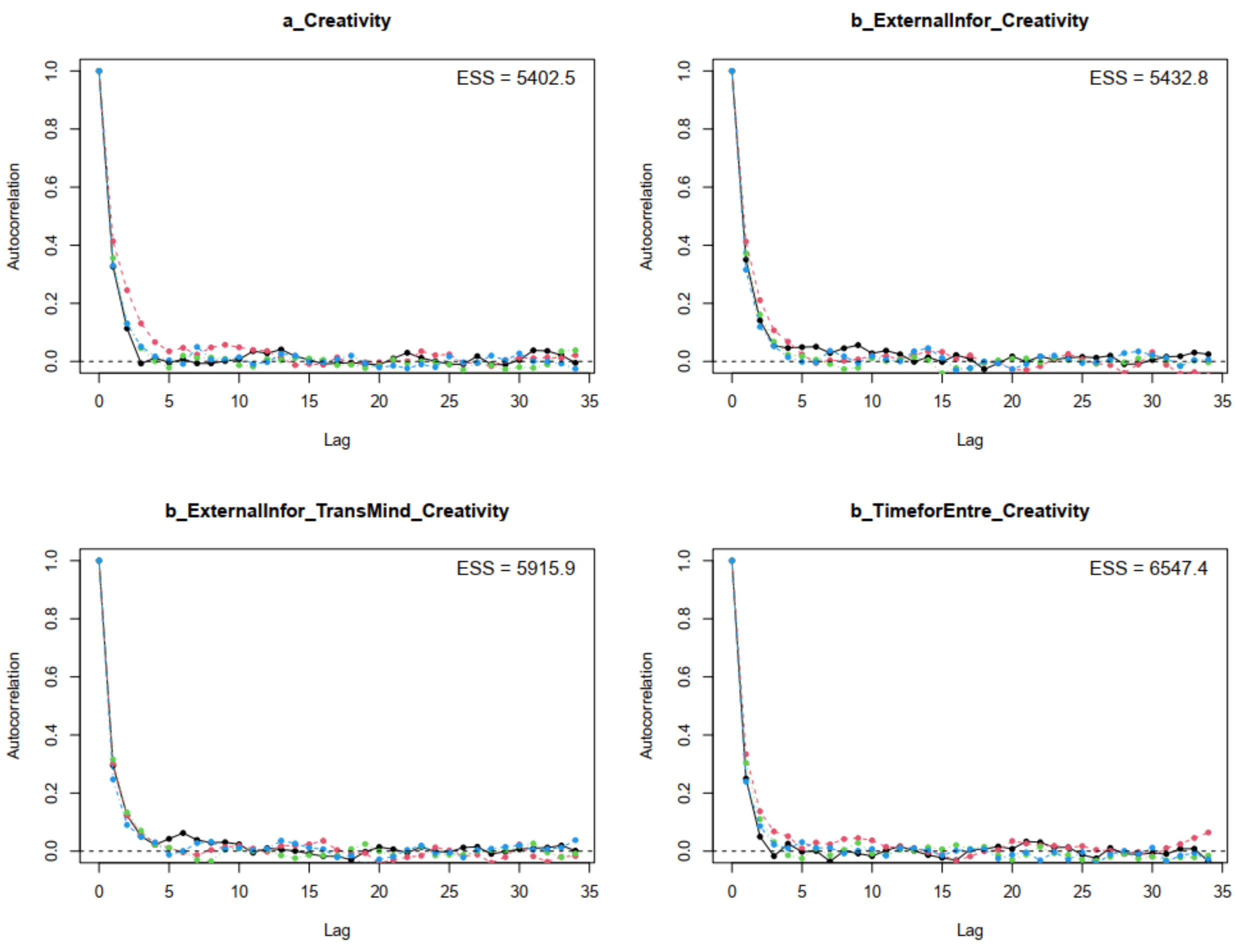

Figure S10: Model 2’s autocorrelation plots

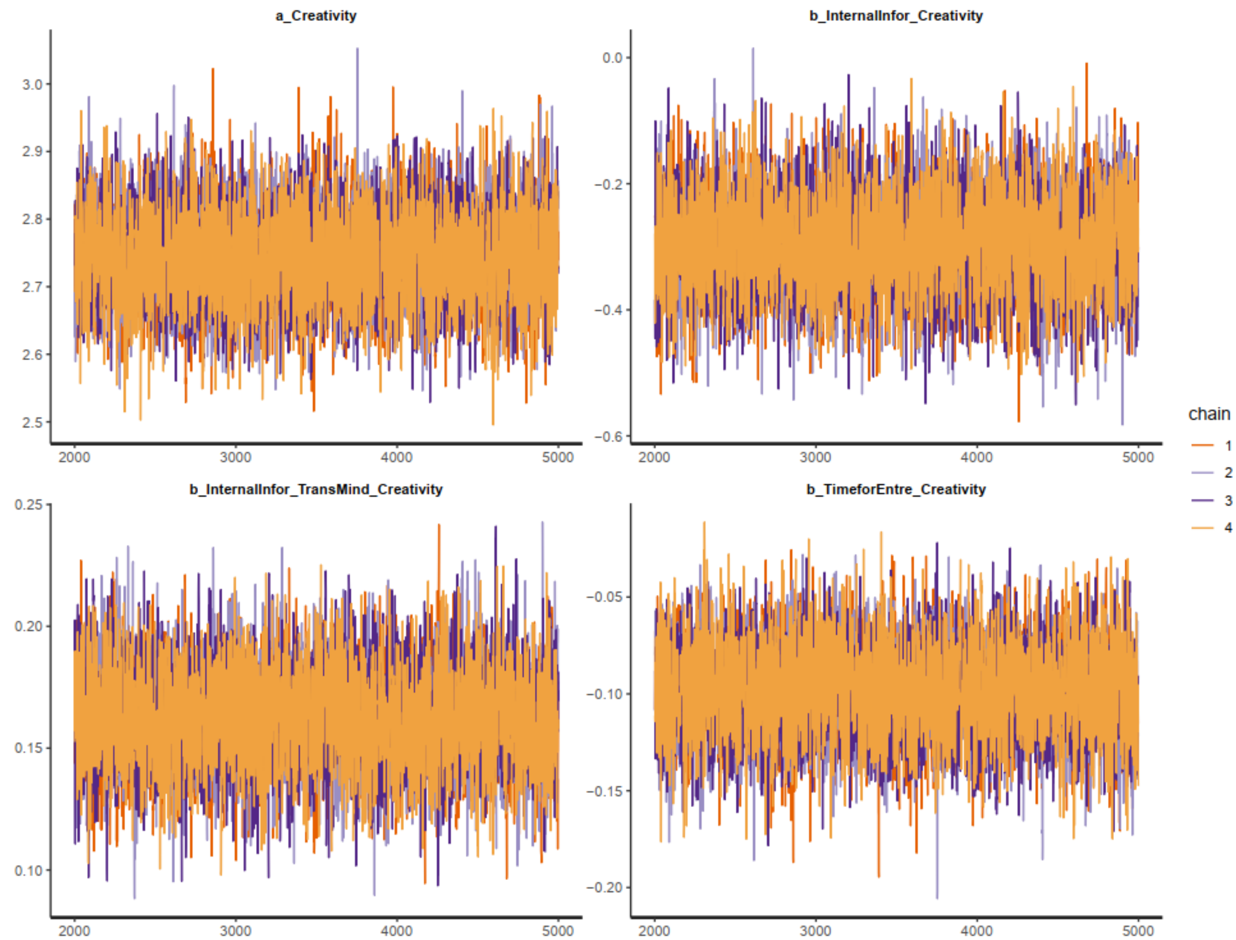

Figure S11: Model 3’s trace plots

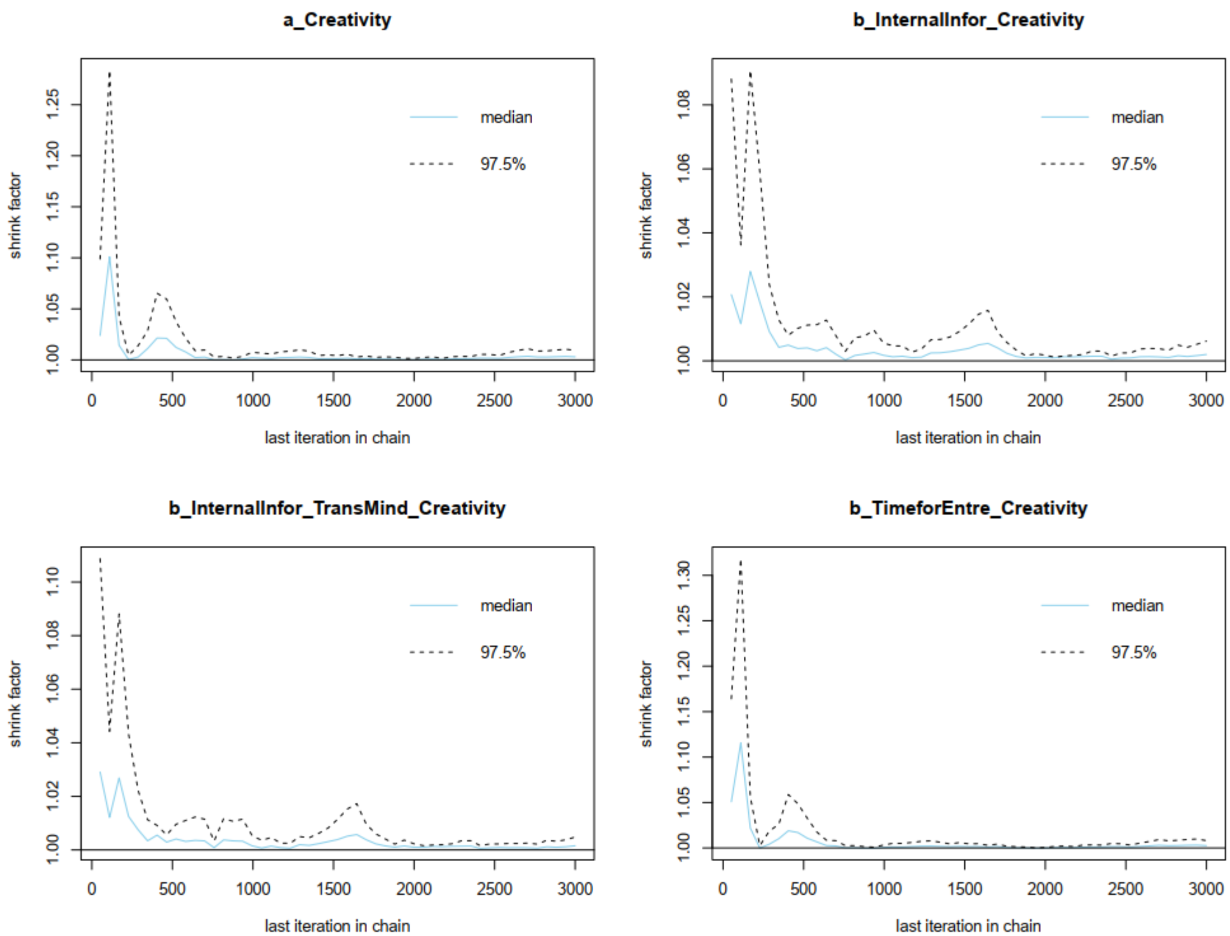

Figure S12: Model 3’s Gelman-Rubin-Brooks plots

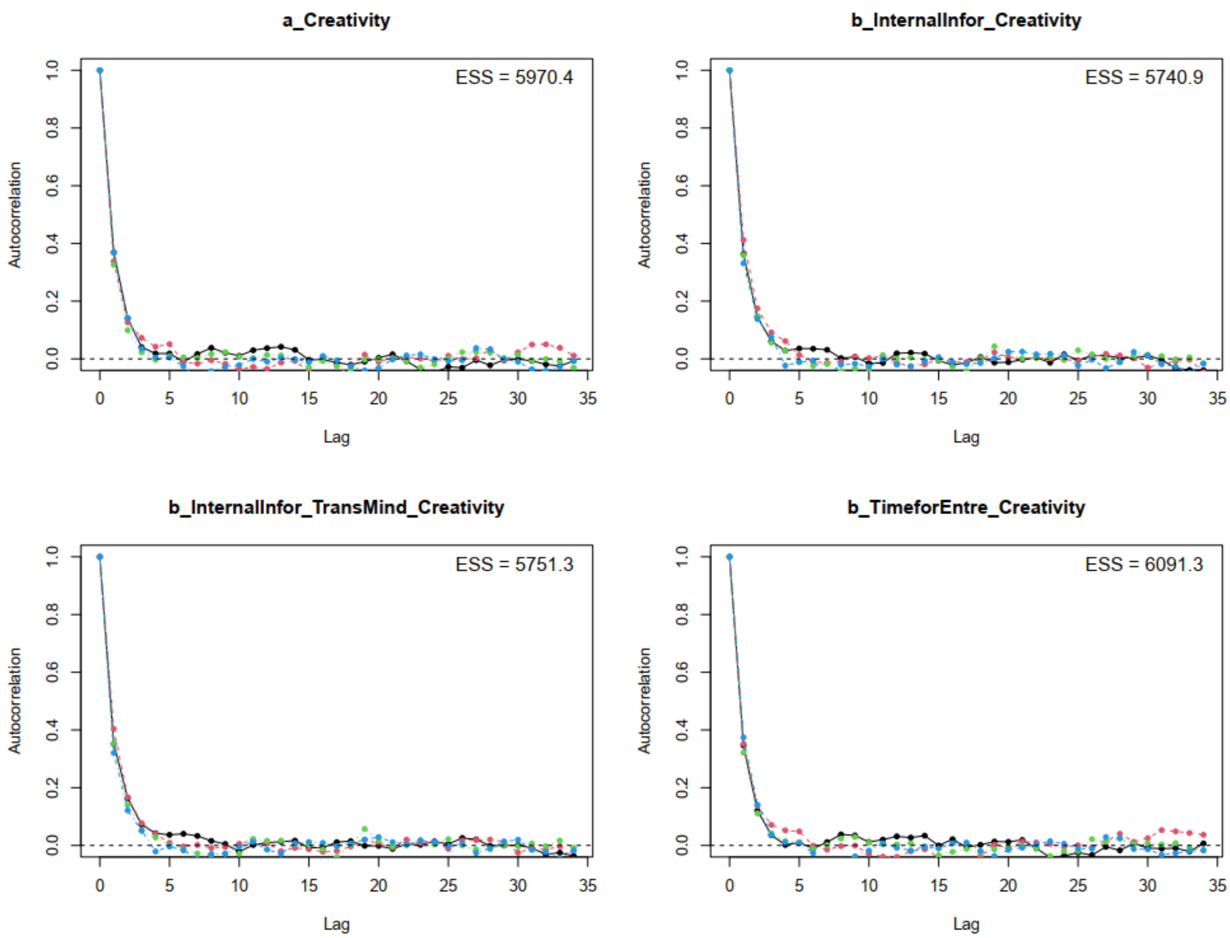

Figure S13: Model 3's autocorrelation plots

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