Examining the influence of generalized trust on life satisfaction across different education levels and socioeconomic conditions using the Bayesian Mindsponge Framework

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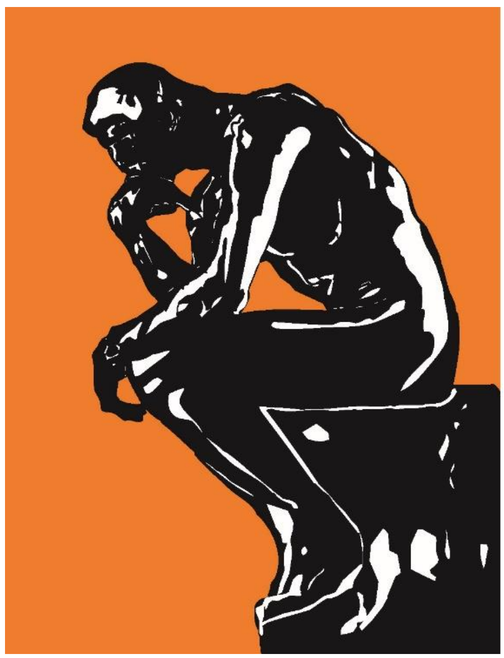

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Abstract

Extant literature suggests a positive correlation between social trust (also called generalized trust) and life satisfaction. However, the psychological pathways underlying this relationship can be complex. Using the Bayesian Mindsponge Framework (BMF), we examined the influence of social trust in a high-violence environment. Employing Bayesian analysis on a sample of 1237 adults in Cali, Colombia, we found that in a linear relationship, generalized trust is positively associated with life satisfaction. However, in a model including the interactions between trust and education level as well as between trust and socioeconomic status, generalized trust is found to be negatively associated with life satisfaction. In this non-linear relationship, both education level and socioeconomic status have moderating effects against the negative association between generalized trust and life satisfaction. In other words, less educated people living in worse socioeconomic conditions are more likely to have lower life satisfaction when they have higher levels of social trust. In contrast, highly educated people living in better socioeconomic conditions are more likely to have higher life satisfaction when they have higher levels of social trust. Due to the facilitating function of trust in information processing, lowering the rigor of the filtering system in a high-violence social environment will likely put an individual at risk. Based on our findings, we suggest that policymakers should consider the impacts of social contexts when advocating for increasing social trust. We also recommend that researchers carefully examine the psychological mechanism underlying an observed association before making suggestions for policymaking.

Keywords: social trust, life satisfaction, education level, socioeconomic status, Bayesian Mindsponge Framework

> "Trembling up a high branch after nearly dying by Kitty's mouth, Kingfisher stealthily looks down; beneath him stands Kitty—drooling with saliva, dazed, and clearly disappointed."
>
> from "Brotherhood" in the *Kingfisher Story Collection* (2022)

1. Introduction

1.1. Social trust and life satisfaction

Trust refers to the trustor's willingness to accept vulnerabilities under the assumption that the trustee will act in the trustor's best interests (Mayer et al., 1995; Schilke et al., 2021). In social science studies, trust is a critical component that would facilitate a range of dynamic social processes, including organizational effectiveness, economic development, and so on (Roth, 2022; Rousseau et al., 1998; Tabellini, 2010). Some believe that trust is one of the most essential components of modern civilizations and that social conflict and chaos are too commonplace in the absence of it (Gambetta, 2011; Harraka, 2002; Muraskin, 1974; Q.-H. Vuong, 2022).

Social trust (also called generalized trust) is trust toward other people in society in general. It is an important form of trust in modern society that involves a large number of social interactions among strangers (Algan & Cahuc, 2013; Intravia et al., 2016). Social trust is the bedrock of interactions between individuals in a society, and without trust in the acts of others, individuals may need to contemplate too many contingencies and uncertainties before acting, which would ruin the foundation of community and civilization (Kwon, 2019). As a result, the level of social trust would have an impact on individuals' life satisfaction.

Defined as one's self-evaluation of one's own quality of life based on one's own rules (Shin & Johnson, 1978), life satisfaction refers to the cognitive component of subjective well-being (Pavot & Diener, 1993). According to Pavot and Diener (1993), life satisfaction is an important indicator that represents an individual's life situation as well as their mental state. Many studies have concluded that increased social trust would lead to better life satisfaction (Graafland & Lous, 2019; Shao et al., 2021; Vyrost et al., 2007). Social trust was also found to be positively associated with individual happiness (Kuroki, 2011). In addition, when life satisfaction and social trust in society are both low, individuals are more likely to suffer from mental illness due to health distress (L. M. Martínez et al., 2019). Therefore, researchers often suggest policymakers aim for increasing social trust.

However, the relationship between social trust and life satisfaction is not simple or straightforward. For example, Bi et al. (2021)'s study found inconsistency in the commonly stated positive correlation between social trust and life satisfaction. Specifically, in probing the moderating role of social trust on the life satisfaction of adolescents, Bi et al. (2021) argued that in countries with higher levels of social trust, adolescents were reported to have lower levels of life satisfaction because with a higher level of trust would anticipate more social cooperation and mutual respect from others, particularly those who are not compelled to assist them. Consequently, their life satisfaction would be diminished if their expectations were not satisfied. To investigate deeper into the psychological pathways in the relationship between social trust and life satisfaction, the approach of information processing can be advantageous.

The mindsponge mechanism of the human mind's information processing was originally conceptualized by Vuong and Napier (2015) to describe how a person absorbs and incorporates new values into their mindset. Throughout the mindsponge process, trust plays a crucial role as a facilitator for filtering newly received information (M.-H. Nguyen et al., 2021; Q.-H. Vuong, Le, La, & Nguyen, 2022). Trust can influence the cost-benefit judgment by adding preconceived positive or negative values, which helps accelerate the evaluation process. Normally, trust (or distrust) is attached to a source of information or a collection of information with similar features (Q.-H. Vuong, Le, La, Nguyen, et al., 2022). Thus, the mind can save time and energy by quickly accepting or rejecting information from the same source or group without going through a thorough evaluation process (Le et al., 2022; Vuong, 2022). Due to the function of trust in terms of information processing, the psychological pathways to life satisfaction may be different in a high-violence sociopolitical context.

1.2. The high-violence social infosphere in Columbia

According to United Nations Office on Drug and Crime (UNODC), Colombia is one of the countries that has the highest homicide rates in the world (UNODC, 2006). Although the number of intentional homicide cases dropped in the past 30 years from 73 per 100,000 inhabitants in 1990 to 23 per 100,000 inhabitants in 2020, the ratio is still striking when compared to that of the average countries (6 per 100,000) (World Bank, 2022). In addition, crimes other than homicide also persisted in Columbia due to the existence of illegal armed organizations and criminal groups' involvement in drug trading and serious crimes, including kidnapping, money laundering, and running extortion and prostitution rackets. Consequently, Verisk Maplecroft, a risk analysis firm based in United Kingdom, in its global risk report, listed Columbia's Medellín as a nucleus of transnational crime networks and tagged Colombia's capital Bogotá as one of the top three riskiest among the world's 30 largest cities (Parkes & Blanco, 2022). In the context of rampant violent crimes, exposing one's vulnerabilities to others poses relatively higher risks of physical, mental, or financial harm.

While many studies have been conducted about social trust and life satisfaction in developed countries, few have been conducted regarding social trust in a highly violent sociopolitical context, namely, in this case, Columbia. Moreover, it is imperative to probe the information processing mechanism in this relationship, as to how trust/distrust of strangers would affect one's overall life satisfaction at a personal-societal level under specific conditions. Possible significant moderating factors in this process include education level and socioeconomic status, which determine the immediate infosphere that an individual interacts with (e.g. living environment and social circles). Thus, using the Bayesian Mindsponge Framework (M.-H. Nguyen et al., 2022b; Q.-H. Vuong, La, & Nguyen, 2022) – an effective tool for sociopsychological research – as the basis for theoretical conceptualization and statistical analysis, our study aims to examine the following research questions (RQ):

RQ1: How does social trust affect life satisfaction?

RQ2: How do education level and socioeconomic status moderate the association between social trust and life satisfaction?

2. Materials and methods

2.1. Materials, variables, and models

This study employs secondary data, with the dataset from the article "Trust, life satisfaction and health: Population data in a mid-size city in the Global South" (L. Martínez, 2019). Data collection was conducted in 2017 by the Observatory of Public Policy of ICESI University using face-to-face interviews. Respondents were explained about the purpose of the study and assured confidentiality There was a total of 1237 responses from adults in the city of Cali. The male/female ratio is approximately 1:1. The average age of the respondents is 39.

The outcome variable in the present study is life satisfaction, and the independent variables are generalized trust, education level, and socioeconomic status (see descriptions in Table 1). Life satisfaction is measured with the following question: "On a scale of zero to ten (zero means you have no satisfaction and ten means you have complete satisfaction), in general, how satisfied are you with your life?" The average score of life satisfaction for this sample is 8.4. The measurement of trust followed the OECD guidelines, which measures generalized trust using the following question: "On a scale from zero to ten, where zero is 'not at all', and ten is 'completely', in general, how much do you trust most people?" (OECD, 2017). The average score of generalized trust for the sample is 4.5. For socioeconomic status, the stratification system in Colombia classifies households into six categories numbered 1 to 6, where 1 means worst conditions and 6 means best conditions. For education level, in this study, we use a 4-level classification, where 1 is uneducated or primary education, 2 is secondary education, 3 is undergraduate degrees or equivalent, and 4 is Master or Doctorate. The average education length of respondents in the sample is 11.8 years.

Table 1: Variable description

Variable	Description	Type of variable	Value
Satisfaction	The degree of respondents' life satisfaction in general	Numeric	Ranging from 0 to 10
GenTrust	The degree of respondents' generalized trust	Numeric	Ranging from 0 to 10
Edulevel	The level of respondents' education	Numeric	Ranging from 1 to 4
Socioeconomic	The respondents' socioeconomic status	Numeric	Ranging from 1 to 6

Following the research questions stated, two models are constructed. In order to increase predictability, we adhere to the principle of parsimonious model construction for Bayesian analytics (M.-H. Nguyen et al., 2022a). Parsimonious models have high predictive power, and they allow us to focus on examining specific factors and relationships. While such parsimonious models mean there are many unknown parameters, the properties of Bayesian inference and validating techniques in analysis help increase the prediction's accuracy (see the subsection below for more detail). Model 1 examines the linear relationship between *Satisfaction* and *GenTrust*. In Model 2, the moderation of *Edulevel* and *Socioeconomic* are added through their interactions with *GenTrust*.

$$Satisfaction \sim GenTrust \tag{1}$$

$$Satisfaction \sim GenTrust + Edulevel * GenTrust + Socioeconomic * GenTrust \quad (2)$$

2.2. Statistical analysis

The Bayesian analysis method was used because it is compatible with mindsponge-based reasoning, among other advantages (M.-H. Nguyen et al., 2022b). While parsimonious models have high predictability, there are also many unknown parameters. The advantage of Bayesian inference for this problem is that it treats all parameters probabilistically, including unknown ones (Gill, 2015). Moreover, prediction accuracy in fitting complex models containing interaction terms is increased thanks to the Markov Chain Monte Carlo (MCMC) algorithms, which iteratively generate a large number of samples from the joint posterior distribution of the parameters (Cowles, 2013; Dunson, 2001; Wagenmakers et al., 2018). Another major advantage of using Bayesian analysis in psychological research is that it does not make binary judgments based on *p*-values to evaluate statistical results but rather makes interpretations with estimated and visualized credible intervals. The current reproducibility crisis in social sciences, especially psychology, is partly attributed to the over-reliance on *p*-value as a dichotomous threshold for rejecting null hypotheses (Camerer et al., 2018; Open Science Collaboration, 2015). Visualizing estimated coefficients in the Bayesian approach is a reliable alternative for evaluating statistical results instead of *p*-values (Halsey et al., 2015).

Both models were fitted using the following MCMC setups: 5,000 iterations, 2,000 warm-up iterations, and four Markov chains. Due to the exploratory nature of the study, we used uninformative priors to provide the least amount of prior information possible to the model estimation (Diaconis & Ylvisaker, 1985). To test the models' goodness-of-fit, Pareto smoothed importance-sampling leave-one-out cross-validation (PSIS-LOO) test was employed (Vehtari et al., 2017). To validate the simulated posteriors, we used diagnostic statistics of effective sample size (*n_eff*) and Gelman-Rubin shrink factor (*Rhat*) to check Markov's chains' convergence. The model's Markov chains are generally considered to be convergent if *n_eff* is greater than 1,000 and *Rhat* is equal to 1. Graphical representations such as trace plots, Gelman-Rubin-Brooks plots, and autocorrelation plots were also used for convergence diagnosis. Due to the following advantages, the present study's Bayesian analysis was carried out using the **bayesvl** R package (Q.-H. Vuong et al., 2020). The package's effective visualization features support the presentation and interpretation of results. The package also supports replication studies or related follow-up research because it is free, open, and simple to use.

Considering the importance of transparency in research procedures and cost management (Q.-H. Vuong, 2018, 2020), the study's data files and code snippets were deposited at the Open Science Framework (OSF) server (DOI: 10.17605/OSF.IO/H8GQ7).

3. Results

3.1. Model 1

PSIS diagnostic for Model 1 shows that the Pareto *k*-values are less than 0.5 (see Figure 1), indicating that the model fits the actual data well. In other words, the model has an acceptable goodness-of-fit.

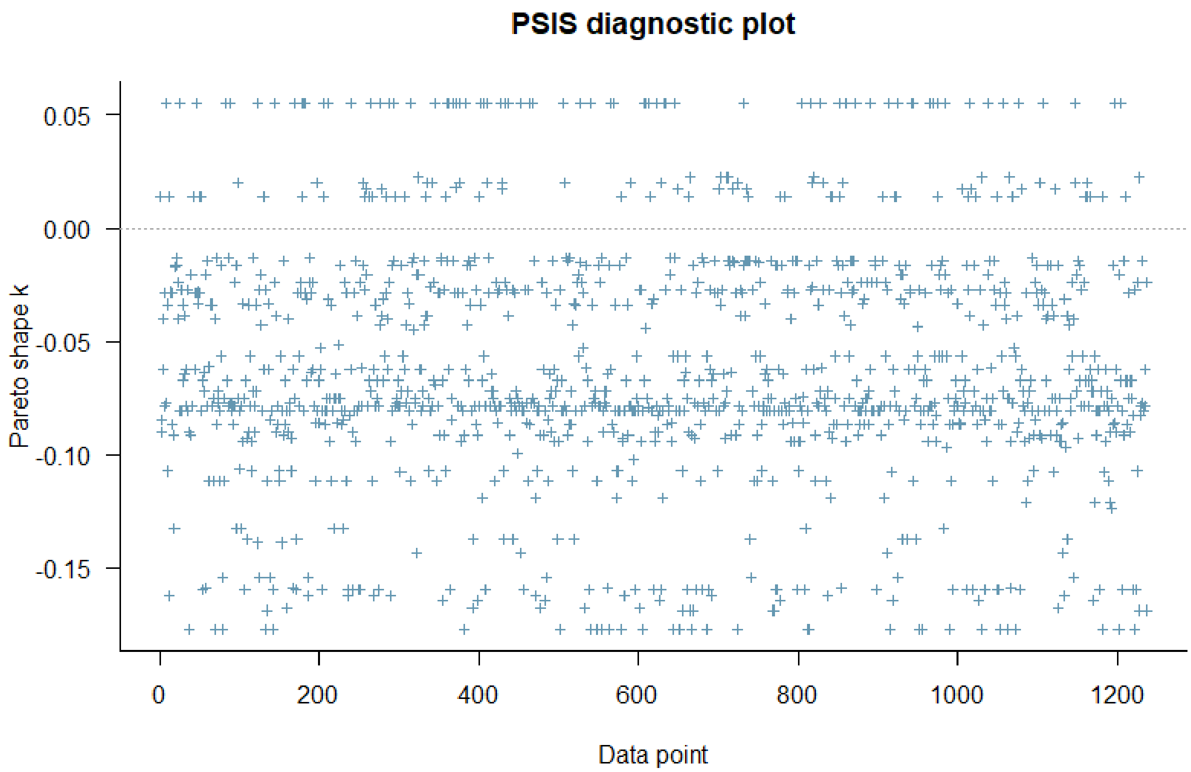

Figure 1: Model 1's PSIS diagnostic plot

Table 2: Model 1's simulated posterior coefficients

Parameters	Mean	SD	*n_eff*	*Rhat*
Constant	7.50	0.18	4899	1
GenTrust	0.09	0.03	5005	1

In Table 2, we see that the *n_eff* values are greater than 1,000, and *Rhat* values are equal to 1, generally considered to be signals of good convergence of the Markov chains. The trace plots for Model 1 (see Figure 2) show fluctuations around a central equilibrium, meaning that there are no divergent chains after warmup iterations. This indicates that the Markov chains converge to the same posteriors and the results are reliable.

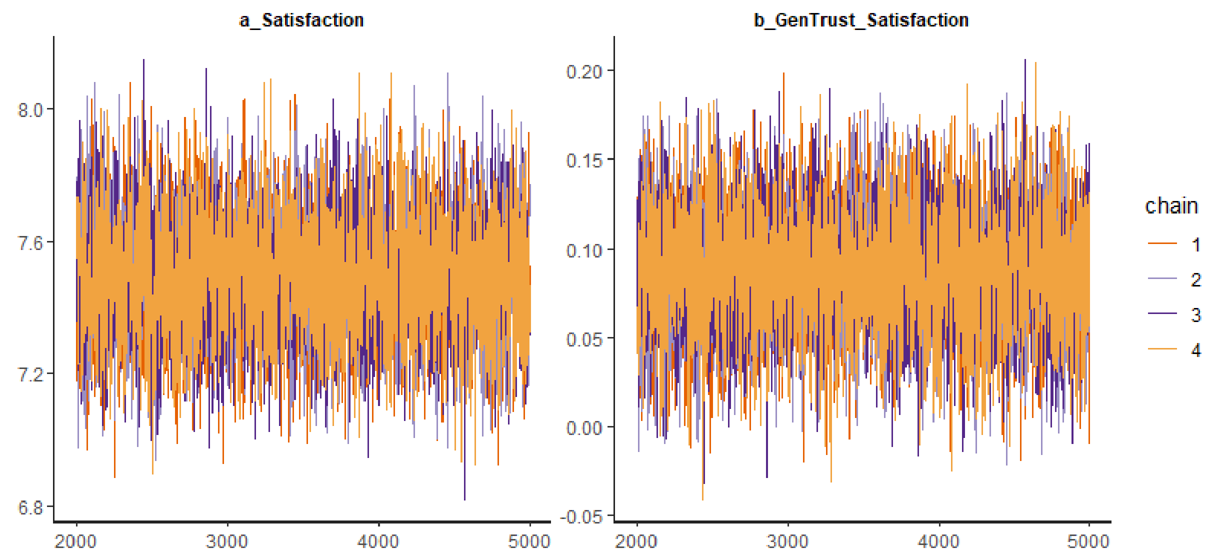

Figure 2: Model 1's trace plots

The Gelman plots (see Figure 3) support the healthy convergence by showing that the shrink factors reduce to one after warmup iterations, meaning that there is almost no difference between variance between chains and variance within chains.

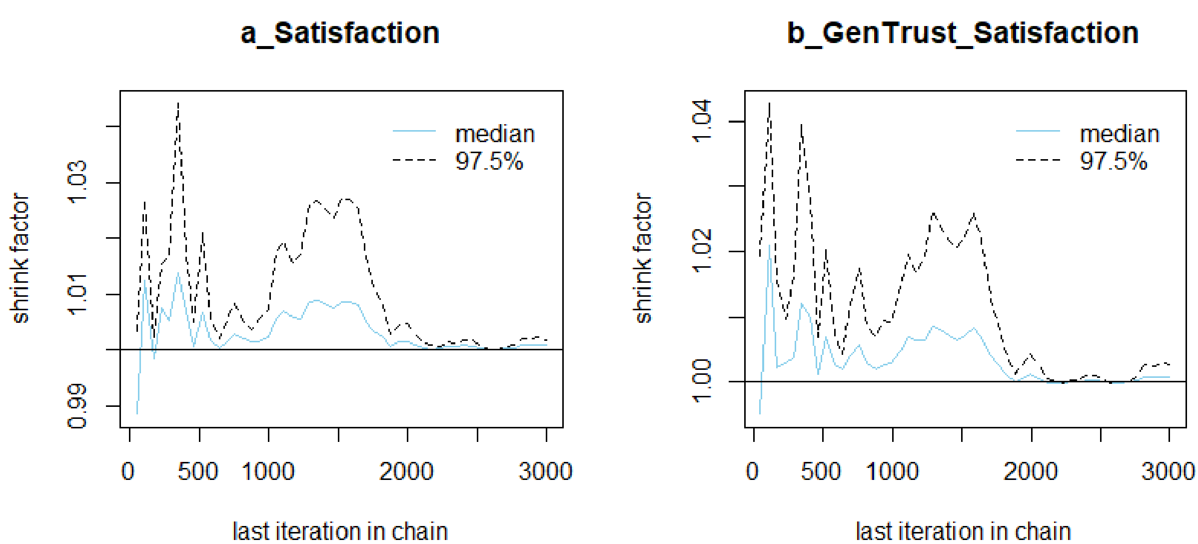

Figure 3: Model 1's Gelman plots

The autocorrelation plots (see Figure 4) also indicate that the Markov property is held by showing autocorrelations being eliminated rapidly, meaning that MCMC-simulated samples are memoryless during the stochastic simulation process.

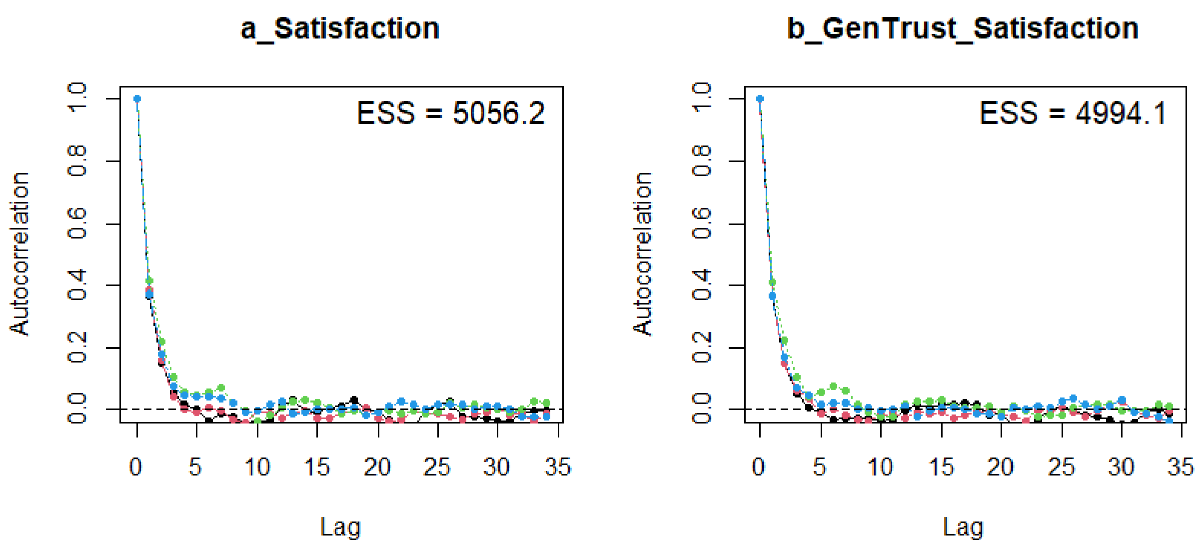

Figure 4: Model 1's autocorrelation plots

Analysis results show that generalized trust is positively associated with life satisfaction ($\mu_{GenTrust}$= 0.09 and $\sigma_{GenTrust}$= 0.03). The posterior distribution of *GenTrust* at 95% Highest Posterior Distribution Intervals (HPDI) lies completely on the positive side (greater than 0.0195), which indicates that the result has high reliability (see Figure 5).

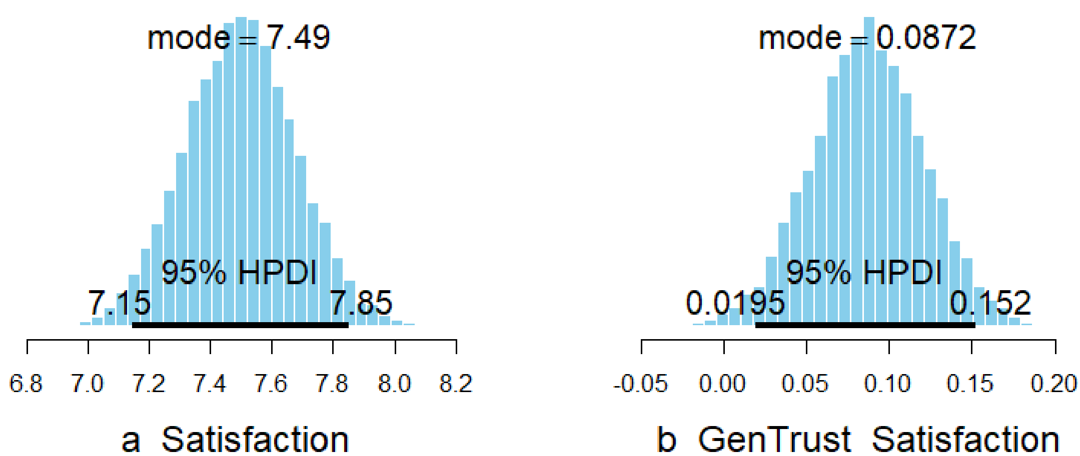

Figure 5: Model 1's posterior distribution plots with HPDI at 95%

3.2. Model 2

The relationship tree for the parameters in Model 2 is shown in Figure 6. *GenTrust* affects *Satisfaction* in a linear relationship and through two interacting pathways with *Edulevel* and *Socioeconomic*.

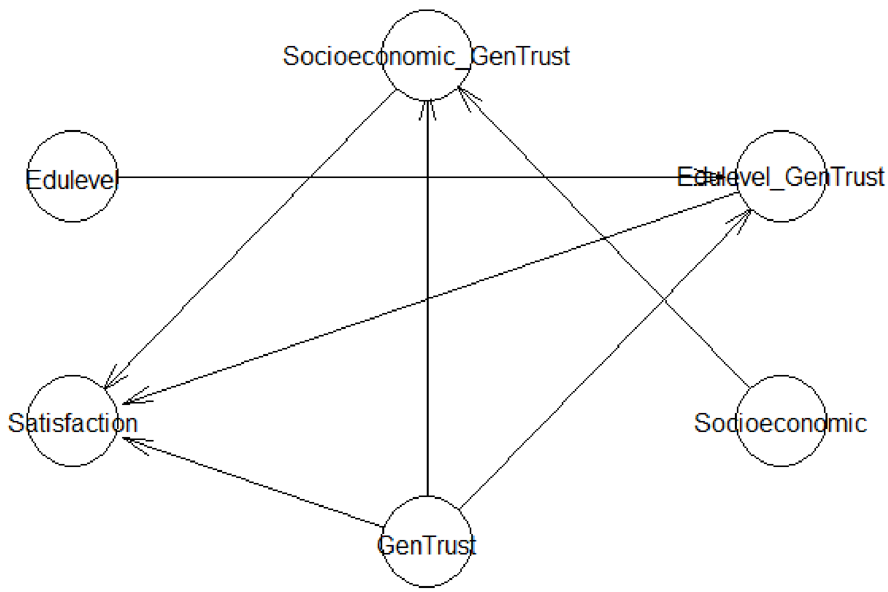

Figure 6: Relationship tree of Model 2

The *k* values of the PSIS diagnostic plot for Model 2 are less than 0.5 (see Figure 7), indicating that the model is well-specified.

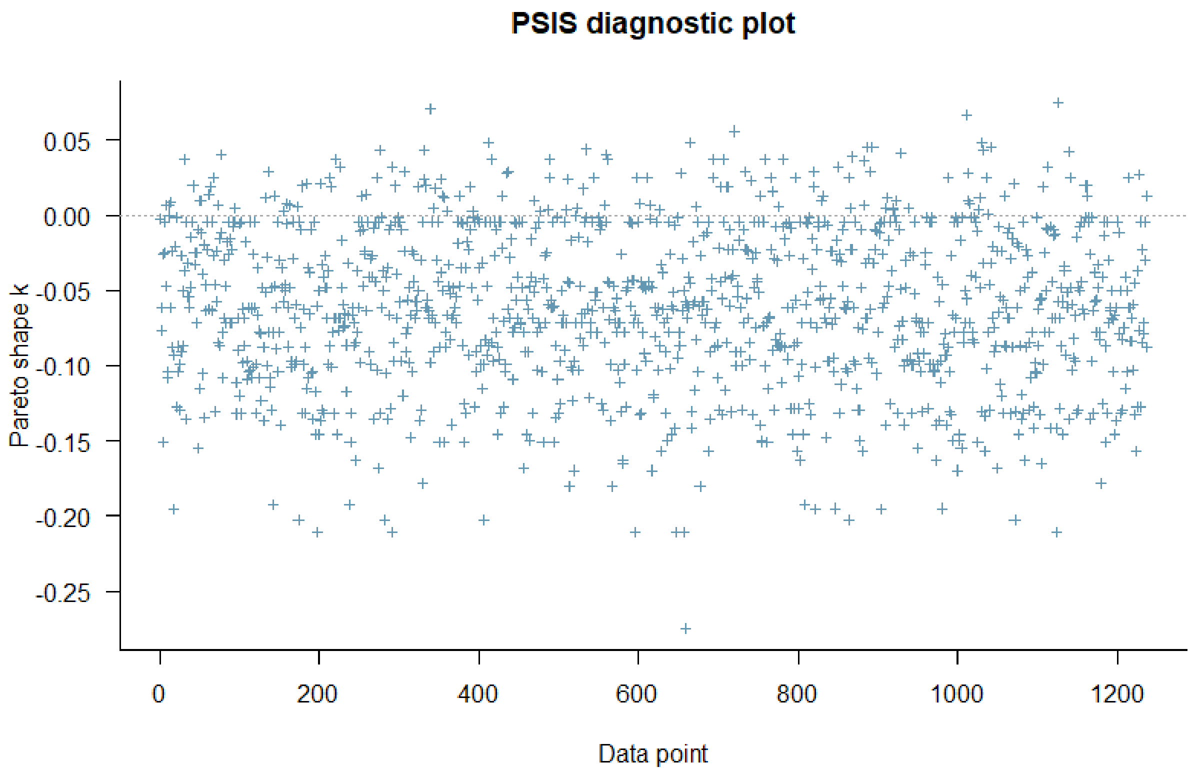

Figure 7: Model 2's PSIS diagnostic plot

Similar to the explanation of statistical validation in Model 1, Model 2 also shows good convergence of the Markov chains, as seen through the n_eff and Rhat values (see Table 3) as well as the trace plots (Figure 8), the Gelman plots (Figure 9), and the autocorrelation plots (Figure 10).

Table 3: Model 2's simulated posterior coefficients

Parameters	Mean	SD	*n_eff*	*Rhat*
Constant	7.53	0.18	9176	1
GenTrust	-0.34	0.07	7201	1
*Gentrust*Edulevel*	0.16	0.03	7231	1
*GenTrust*Socioeconomic*	0.02	0.01	9351	1

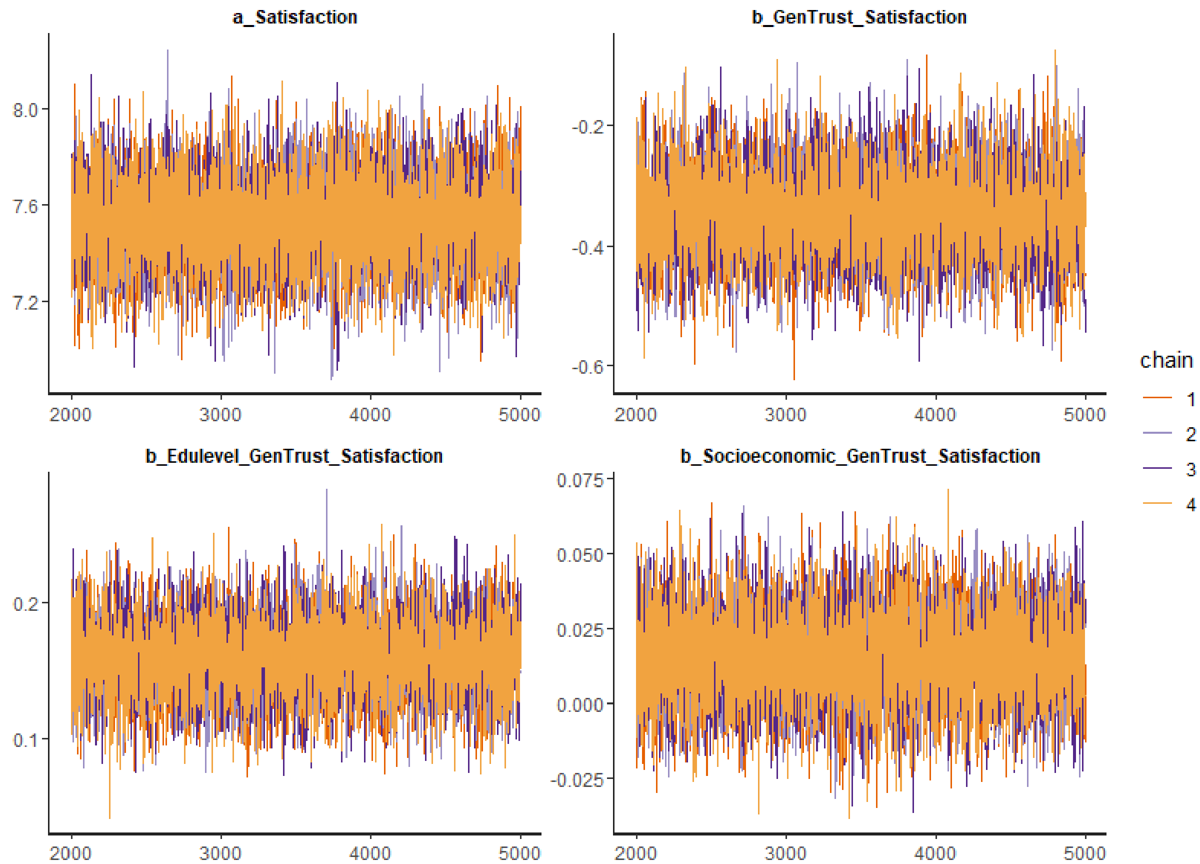

Figure 8: Model 2's trace plots

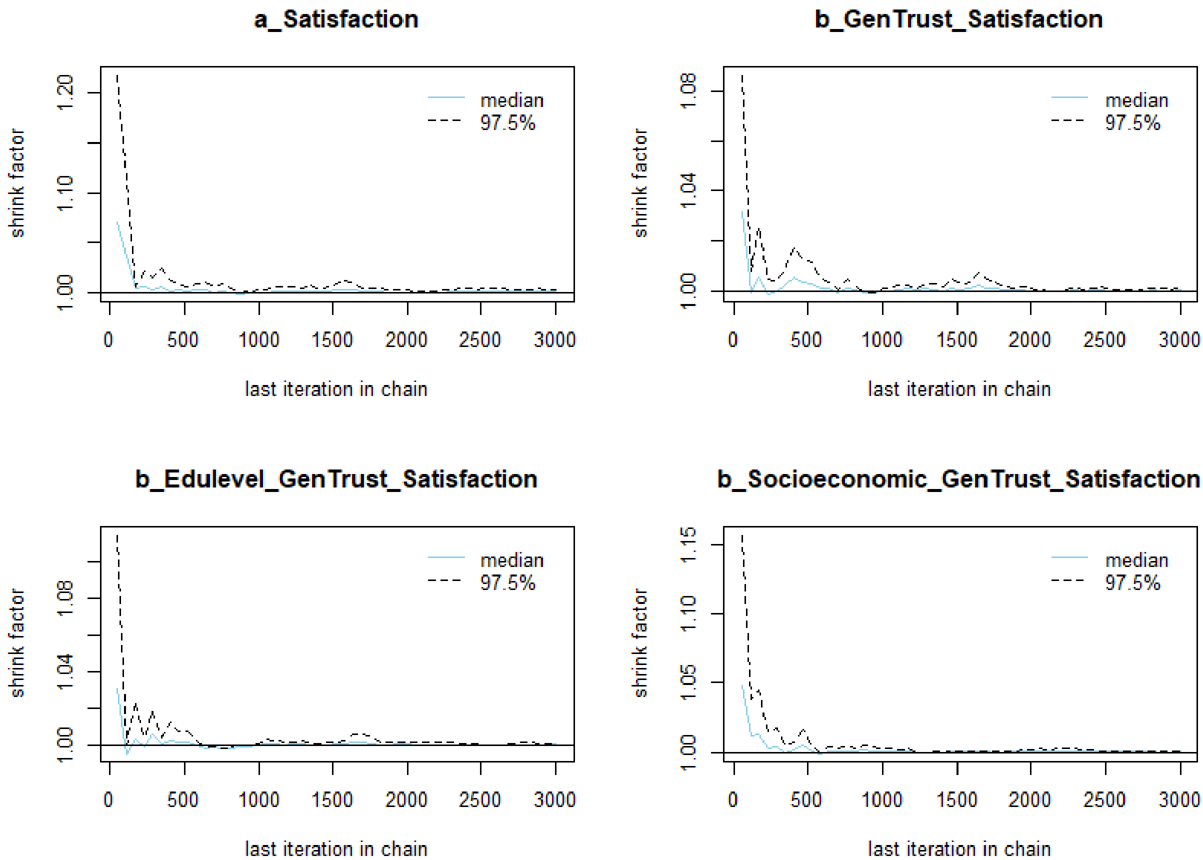

Figure 9: Model 2's Gelman plots

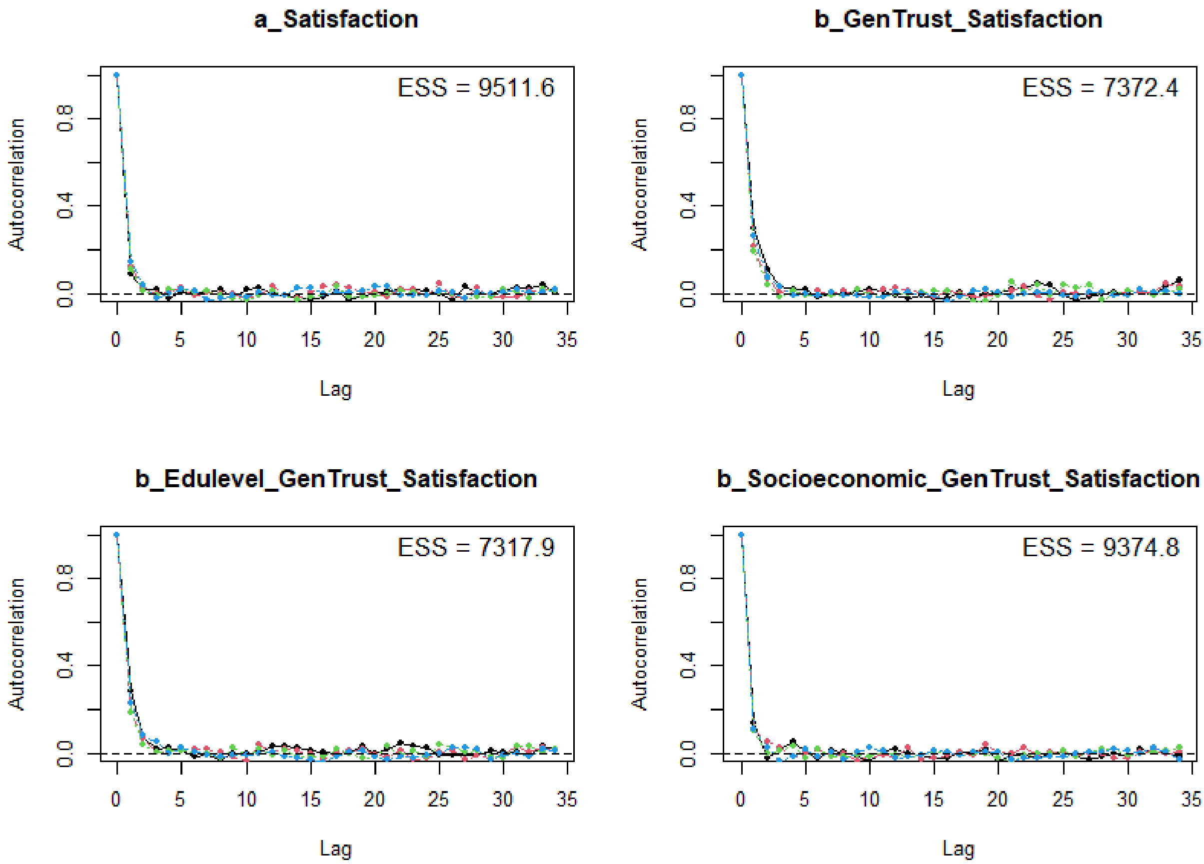

Figure 10: Model 2's autocorrelation plots

When considering the interactions with education level and socioeconomic status in the model, generalized trust is negatively associated with life satisfaction ($\mu_{GenTrust}$= -0.34 and $\sigma_{GenTrust}$= 0.07). However, both *Edulevel*Gentrust* and *Socioeconomic*GenTrust* moderate the relationship between *GenTrust* and *Satisfaction* in the opposite direction ($\mu_{Edulevel*GenTrust}$= 0.16, $\sigma_{Edulevel*GenTrust}$= 0.03, $\mu_{Socioeconomic*GenTrust}$= 0.02 and $\sigma_{Soioeconomic*GenTrust}$= 0.01). In model 2, the coefficient for *GenTrust* has a negative sign (compared to Model 1's coefficient being positive). This is because, in Model 2, the influence of *GenTrust* on *Satisfaction* is considered together with its interactions with *Edulevel* and *Socioeconomic* simultaneously (see the *Satisfaction* value estimation across different scenarios below). It is also worth noting that although the coefficients are rather small, they are significant. Regarding the meaning of life satisfaction for a human, the degrees of changes here are considerable.

The visualization of the posterior distributions are presented in the interval plots (see Figure 11) and the two-dimensional density plots (see Figure 12). The distributions of *GenTrust* lie completely on the negative; the distributions of *Edulevel*GenTrust* lie completely on the positive; the distributions of *Socioeconomic*GenTrust* lie mostly on the positive.

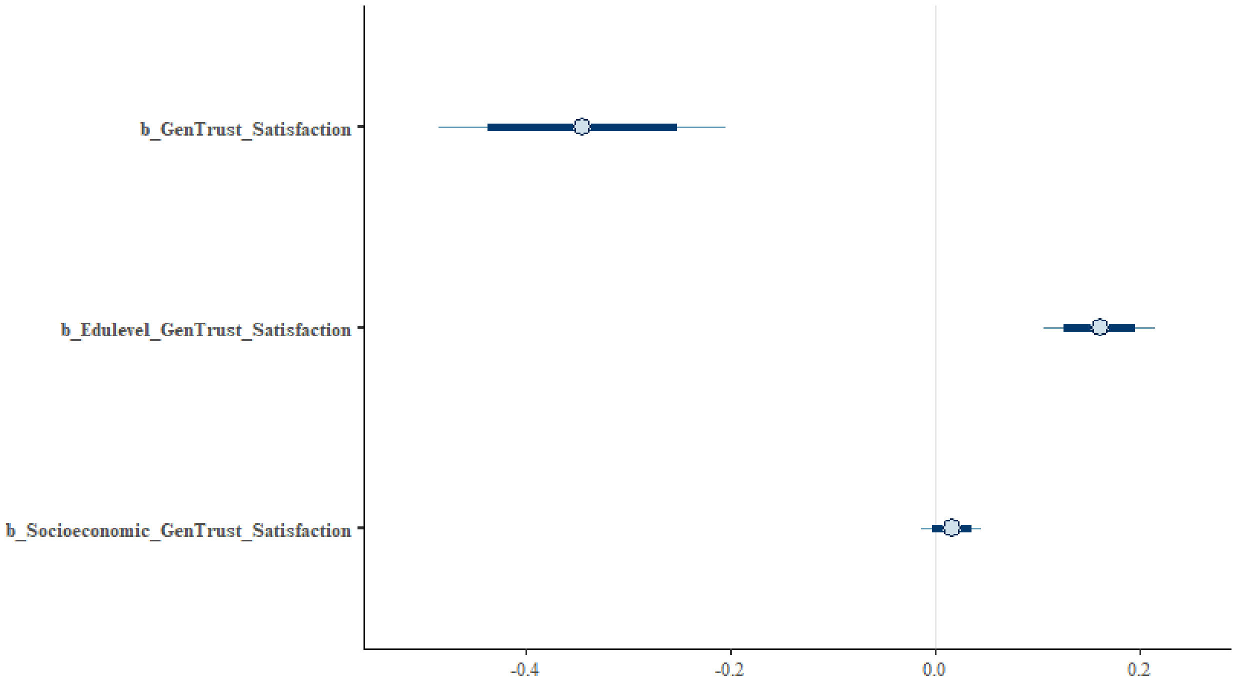

Figure 11: Posterior distributions of Model 2's parameters

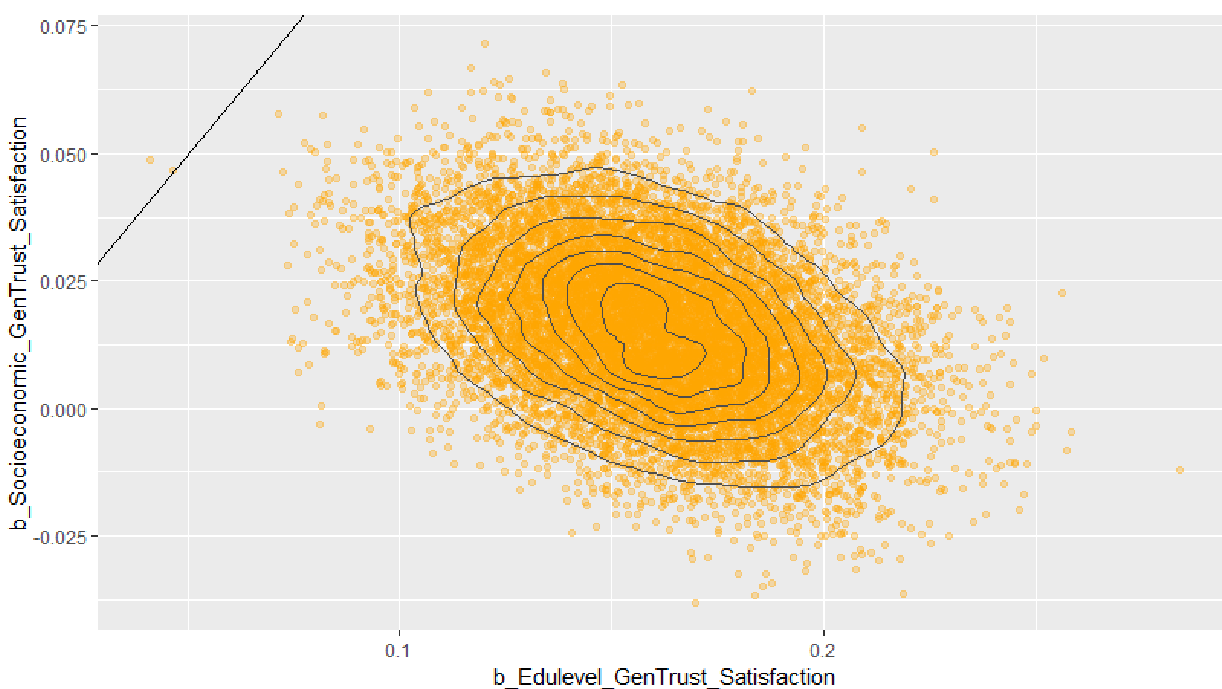

Figure 12: Model 2's two-dimensional density plot of *Edulevel*GenTrust* and *Socioeconomic*GenTrust*

To aid in interpreting the results of Model 2, the estimation of life satisfaction values based on the posterior coefficients is presented below. The mean values are used because they have the highest probabilities of occurrence. For example, the estimated *Satisfaction* value of a person having a *GenTrust* value of 5, *Edulevel* value of 3 (undergraduate degrees or equivalent), and *Socioeconomic* value of 4 (slightly above average) is as follows:

$$y_{Satisfaction} = 7.53 - 0.34 * 5 + 0.16 * 3 * 5 + 0.02 * 4 * 5 = 8.63$$

Similarly, the estimated *Satisfaction* values for *Edulevel* of 1 (uneducated or primary education) and *Edulevel* of 2 (secondary education) are visualized in Figure 13 and Figure 14, respectively. The *x*-axis represents the degree of generalized trust, the *y*-axis represents the degree of life satisfaction, and the line color represents socioeconomic status. Figure 13 shows a downward trend as the degree of trust increases, whereas Figure 14 shows an upward trend instead. *Edulevel* of 3 and 4 continue further in this upward tendency.

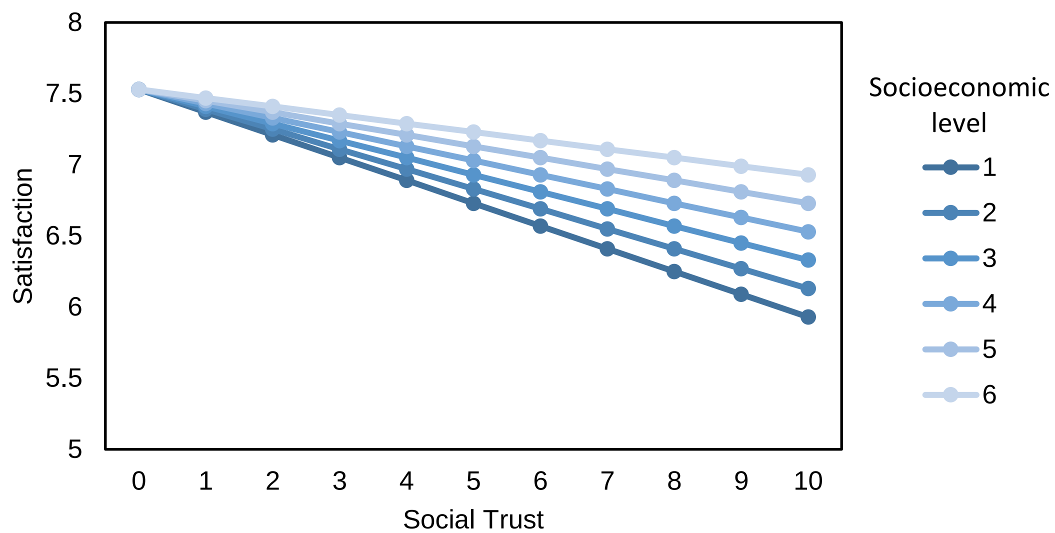

Figure 13: Estimated life satisfaction in those with no educated or primary education level

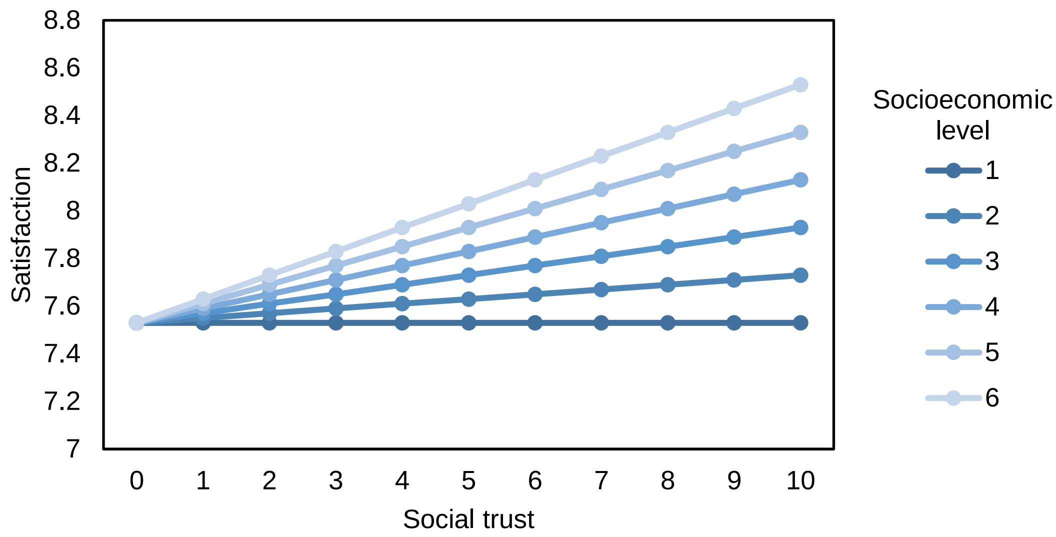

Figure 14: Estimated life satisfaction in those with secondary education level

4. Discussion

Employing Bayesian analysis aided by the MCMC technique on 1237 urban people in Colombia, we found that generalized trust is positively associated with life satisfaction. This result aligns with the findings in other studies (Graafland & Lous, 2019; Kuroki, 2011; Shao et al., 2021; Vyrost et al., 2007). However, in a model including the interactions between trust and education level as well as between trust and socioeconomic status, generalized trust is found to be negatively associated with life satisfaction. In this non-linear relationship, both education level and socioeconomic status have moderating effects against the negative association between generalized trust and life satisfaction. In other words, less educated people living in worse socioeconomic conditions are more likely to have lower life satisfaction when they have higher levels of social trust, whereas highly educated people living in better socioeconomic conditions are more likely to have higher life satisfaction when they have higher levels of social trust. Our findings also suggest that education level has a bigger impact compared to socioeconomic status. Uneducated people or those with only primary education tend to have worse life satisfaction as social trust increases, regardless of socioeconomic status (poor people have a stronger negative association). For those with secondary education levels or above, life satisfaction tends to increase as social trust increases, regardless of socioeconomic status (wealthy people have a stronger positive association).

From the mindsponge standpoint, trust acts as the "gatekeeper" of an information absorption channel (Le et al., 2022; Q.-H. Vuong, Le, La, & Nguyen, 2022). The more people trust a certain piece of information (meaning that its carried value was integrated into the mindset), the more likely and quickly they will accept related information carrying similar values. Likewise, when a source of information (including other people – as in interpersonal trust) is trusted, new information coming from that source is filtered more quickly and favorably. On the other hand, under the influence of distrust, related information carrying similar values will likely be rejected quickly. In a high-violence social environment (treated as an infosphere), a high level of generalized trust means that one is more open and susceptible to information coming from other people in society, including strangers. Less educated and poor people surround themselves with "bad" social circles where deception and hostility are more prevalent, which will create more risks if they lower the rigor of the information filtering system. Intuitively, it is commonly considered an unwise idea to trust strangers in a "bad neighborhood".

A higher level of generalized trust does not mean naiveness. The impact of the received information is largely determined by the processing capacity of a system. This also involves the quality of stored information in memory used as references in information filtering. In other words, knowledge and thinking skills are very important for effectively utilizing the function of trust in an information process (to speed up evaluation). Information processing capacity is enhanced by education (Clouston et al., 2012; Mather, 2020), and our results show that those with higher education levels likely are not negatively affected by high levels of social trust. In fact, from secondary to undergraduate and graduate levels, the higher the education levels are, the stronger the positive correlation between generalized trust and life satisfaction is. Overall, the relationship between social trust and life satisfaction has complex underlying psychological pathways. Social trust heavily depends on social contexts (Boyadjieva & Ilieva-Trichkova, 2015; Q.-H. Vuong et al., 2021), and complex information processes can sometimes produce a negative correlation in specific cases (Bi et al., 2021).

Based on our findings, there are some implications for policymakers and researchers on the issue of social trust. While it is beneficial to advocate for increasing social trust in communities with high education levels and relatively good socioeconomic conditions, promoting the same thing in communities with low education levels, poor living conditions, and a high prevalence of crime may have negative consequences for the people there. This matters even more in countries and regions with high social inequality or social unrest. Human psychology is multiplex and often context-dependent. Researchers need to carefully examine the psychological mechanism of an association before making suggestions for policymaking. Failure to investigate deeply or understand the underlying mechanisms of observed phenomena and patterns can result in studies that provide statistical descriptions but lack insightful interpretations. Regarding future research direction, further qualitative studies on the relationship between social trust and life satisfaction may help shed more light on possible psychological pathways in specific social contexts.

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