

Sustainable Clothing Consumption in Uncertain Times: Measuring the Effectiveness of an Extended Theory of Planned Behavior Model during COVID-19 and Post-COVID-19

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Abstract. *The research explores the application and temporal validity of an extended theory of planned behavior model during and after COVID-19 and investigates demographic disparities of consumer behavior evolution concerning sustainable clothing consumption after the COVID-19 pandemic. Although Theory of Planned Behavior is a well-known behavioral theoretical framework, there are few studies investigating its measurement invariance over time, especially comparing its variance across two important moments in the economic evolution, like COVID-19 and post-COVID-19. This study extends the literature on sustainable clothing consumption by addressing the gap and examining COVID-19 and post-COVID-19 shifts in trends and differences across the two groups, particularly within the under-studied Romanian context. Our study used an online questionnaire distributed during and after the COVID-19 pandemic to collect data from 2,331 Romanian consumers. Data analysis was performed to identify differences between the two distinct groups. First, we tested the effectiveness of the model and the reliability of the predictors, followed by the measurement of invariance for the model. Then, we investigated structural path differences among the two groups, and we concluded with non-parametric tests for examining differences among the temporal dimension and main predictors. Our findings contribute to the existing literature on sustainable clothing consumption by exploring the main drivers and underscoring the applicability of the theory of planned behavior to understand changes in consumer behavior during and after a health crisis such as COVID-19 in Romania by pointing out structural path differences for our research framework. Moreover, we shed light on the impact of temporal factor on sustainable attitudes and purchase intention toward sustainable clothing during COVID-19 and post-COVID-19.*

Keywords: Sustainable clothing consumption; Theory of Planned Behavior; COVID-19; Measurement invariance; Consumer behavior.

Introduction

The clothing industry, one of the largest global polluters, has been significantly impacted by the COVID-19 pandemic, with consequences for its workforce and environmental impact (Hwang et

al., 2024). However, this epidemic crisis could provide an opportunity to reform its practices, as there have been disruptions in consumption behaviors at this time. In Romania, consumer expenditure on clothing decreased by approximately 13.78%. At the beginning of the pandemic, people faced uncertainty and despite different predicted key figures, the aftermath of the pandemic brought an increase in consumer expenditure on clothing by nearly 67.29% (Euromonitor, 2025).

The polluting effect has been temporally slowed through the COVID-19 crisis since consumers have shifted their support towards sustainable clothing consumption (Hwang et al., 2024). Changes in consumer behavior initiated by COVID-19 come as a response to significantly increased awareness of sustainability and environmental concerns regarding the fast fashion phenomenon. Unsustainable consumer practices, such as excessive purchase of clothing items, some for single use, encourage excessive consumption and ultimately participate in polluting the environment.

The green literature defines sustainable consumption as *'individual acts of satisfying needs in different areas of life by acquiring, using, and disposing of goods and services that do not compromise the ecological and socioeconomic conditions of all people (currently living or in the future) to satisfy their own needs'* (Geiger et al., 2018, p. 20). A more in-depth adaptation to this definition is *'pro-environmental actions at every stage of the garment's life cycle from pre-purchase to post-purchase comprising its acquisition, storage, usage, and care, as well as discard'* (Rausch & Kopplin, 2021, p. 2). Hence, embracing sustainable clothing consumption includes purchasing fewer items, choosing quality over quantity, opting for second-hand or pre-owned clothes, and renting or swapping outfits rather than always buying new ones. Existing literature approaches sustainable clothing consumption in a pre-during-post-COVID-19 context (Hwang et al., 2024; Rausch & Kopplin, 2021), yet there is a lack of exhaustive research attempting to evaluate the generalizability of the Theory of Planned Behavior measurements and to assess the equivalence across time, especially in the context of COVID-19 pandemic and post-epidemic crisis.

Structured within the Theory of Planned Behavior (TPB) (Ajzen, 1996), this study contributes to the literature with the following key objectives: 1) explore the application of the TPB in two different contexts (an acute crisis and its aftermath) illustrating its relevance within the Romanian setting; 2) empirically investigate the temporal validity of the model in two related contexts that diverge in the number of epidemic cases, imposed safety measures such as lockdowns and social distancing, and key socioeconomic factors, including income rates; 3) uncovering temporal disparities to enhanced understanding of consumer behavior evolution concerning sustainable clothing consumption after the COVID-19 pandemic.

This study provides new empirical findings regarding consumer behavior during two distinct time frames and proposes to explore the following research questions for further verification based on the study's goal and the review of prior research:

RQ1 In what way does the applicability of the TPB differ between the COVID-19 pandemic and its post-COVID-19 aftermath in Romania, and what factors affect its relevance in these contexts?

RQ2 To what extent does TPB maintain temporal measurement invariance in Romania in the contexts of COVID-19 and post-COVID-19 that differ in the intensity of the pandemic, implemented safety regulations and socioeconomic factors?

RQ3 How does the temporal dimension influence the formation of sustainable attitudes and purchase intentions toward sustainable clothing consumption after COVID-19?

We extend the theory of planned behavior model with measurement scales inspired by Rausch & Kopplin (2021) and de Groot & Steg (2008). We applied Confirmatory Factor Analysis

(CFA) to understand the changes in consumer behavior from COVID-19 to the post-COVID-19 pandemic for 2,331 Romanian respondents.

Our findings contribute to the existing literature on sustainable clothing consumption by exploring the main drivers and underscoring the applicability of the TPB to understand changes in consumer behavior during and after a health crisis like COVID-19 in Romania by highlighting structural path differences for our research framework. In addition, we shed light on the impact of demographic factors such as gender and age on sustainable attitudes and purchase intention toward sustainable clothing during COVID-19 and post-COVID-19.

The paper is organized as follows: The following section presents an overview of the literature on sustainable clothing consumption and the relationship between sustainable clothing consumption and consumer behaviors, the third section elaborates on the methodology used, including our data collection and analysis procedures, and the fourth section reports and discusses the main findings. The final section summarizes the key insights, discusses theoretical and practical implications, indicates some limitations, and suggests directions for further research.

Literature review

The fashion industry is one of the biggest global polluters, contributing 10% of the world's total carbon emissions, second only to the oil industry in terms of pollution (Ngo et al., 2024). As the clothing industry has a significant impact on the environment, it is necessary to reduce the production cycle and, consequently, consumption. Therefore, sustainable clothing consumption has become a real concern for governments, producers, and consumers (Hong et al., 2024). Unlike fast fashion, which promotes higher consumption of low-quality clothing, often taking advantage of cheap labor in developing countries, slow fashion aims to protect the climate, workers, natural resources, and the economy.

Sustainable consumer behavior is not a universal phenomenon, and green behavior and consumption are influenced by social attitudes, public self-consciousness, and green consumption values (Aydin, 2024). Consumers who attach importance to self-improvement are more willing to prioritize environmental issues, have a positive attitude towards sustainable consumption, and seek sustainable clothing alternatives that are in line with their personal beliefs and values (Madinga et al., 2025). People pursue a sustainable lifestyle not only because of their environmental awareness and understanding, but also because of the personal benefits or satisfaction derived from the products or services they consume (Hong et al., 2024).

The environmental benefits and impacts of sustainable clothing consumption are important factors for consumers who exhibit green behavior and are more committed to green choices (Aydin, 2024). In addition, one of the strongest drivers to buy sustainable clothing is the awareness of consumers of the negative effects of its production (Carfora et al., 2021). Environmental concern and trust in sustainable clothing brands positively influence sustainable clothing purchases. However, the availability of sustainable clothing in the retail network can be considered as the most important determinant of its purchase (Kumar et al., 2022). The study carried out by Hong et al. (2024) identified that environmental concerns, social norms, and awareness of consequences are the most influential factors in the consumption behavior of sustainable fashion among Chinese adults.

For the average consumer, price is still a determining factor in choosing and buying clothes, and fast fashion is more accessible to everyone. Consumers are increasingly educated about sustainable and ethical ways of production, and they understand and appreciate the aspects that increase the price of sustainable products, such as environmentally friendly materials and

processes. A higher price for sustainable items can be accepted if they offer more satisfaction and intrinsic value (Madinga et al., 2025).-However, consumers for whom it is expensive to buy new sustainable items could turn to second-hand stores.

Sustainable consumption behaviors differ between generations and sexes. In a study investigating the key factors influencing purchase intention among Vietnamese Generation Z consumers regarding sustainable clothing, Ngo et al. (2024) emphasizes the strong mediating role of environmental attitude and product attitude, consumers who have respect for the environment and products are more likely to purchase sustainable clothing. Additionally, the results of a study conducted in educated Indian youth showed that perceived behavioral control has a positive influence on the intention to buy eco-friendly clothing, followed by personal moral norms, attitude, and perceived consumer efficacy (Kumar et al., 2022).). The study by Carfora et al. (2021) contributes to a better understanding of the psychosocial aspects of Italian women's intention to buy sustainable clothing. The findings suggested that the intention of female consumers is driven by personal norms, attitude, subjective norms, biospheric values, and past behavior, which are important factors in increasing the intention to buy sustainable clothing.

Methodology

Sampling Methodology

Data were collected through an online questionnaire distributed on different social networks such as Facebook, WhatsApp and Instagram, as well as institutional email networks. The process took place during two different time frames: during the COVID-19 pandemic from November to December 2020, and after the COVID-19 pandemic from November to December 2023. The respondents were informed of the purpose of this study and gave their consent to participate voluntarily and anonymously. The sampling procedure followed a non-probabilistic snowball technique, consistent with chain-referral sampling, where one participant is recruited through the referral of another (Browne, 2005). Convenience sampling was used to identify the initial participants, with individuals voluntarily choosing to participate, based on their availability, rather than being selected randomly. Respondents were encouraged to share the questionnaire with their social networks, which facilitates the identification of new groups of participants leading to a significant increase in the sample size.

Participants

The sample comprises the valid responses of 2,331 Romanian consumers (1,081 individuals during the COVID-19 pandemic and 1,250 post-COVID-19 pandemic). The average age post-pandemic was 35.73 (SD = 12.44, Range: 14–77), higher than the average age in the sample collected during the pandemic, 33.75 (SD = 11.87, Range: 10–80). There are significantly more male respondents in the post-COVID-19 sample (22.8%), compared to the sample collected during the COVID-19 pandemic (12.76%). In terms of education, the percentage of individuals having higher studies was higher in the post-COVID-19 data sample (77.36%) compared to the sample of data from the COVID-19 pandemic (72.15%). More participants in the post-COVID-19 sample had income more than 5,000 RON (approximately 1,000 EUR) (35.60%) than during COVID-19 (25.34%). All demographic data and statistical comparisons are summarized in Table 1.

Table 1. Descriptive statistics.

Variable	Min.	Mean	Median	Max.	SD
Age (During COVID-19)	10	33.75	32	80	11.87
Age (Post COVID-19)	14	35.73	35	77	12.44
Variable	During COVID-19 (N= 1081)		Post COVID-19 (N = 1250)		
Gender					
Female	87.23%		77.2%		
Male	12.76%		22.8%		
Education					
Elementary	2.4%		2.64%		
Secondary	25.43%		20%		
Higher Studies	72.15%		77.36%		
Income					
< 500 RON	9.73%		7.68%		
500 – 4999 R	64.93%		56.72%		
> 5000 RON	25.34 %		35.60%		

Source: The authors' own research results.

Measurement and Methods

The Theory of Planned Behavior constructs, along with the environmental predictors (Rausch & Kopplin, 2021) and the social values orientations (Roos & Hahn, 2019) were measured on a Likert-scale ranging from 1 (total disagreement) to 7 (total agreement). The items were translated from English to Romanian for cultural appropriation.

Data analysis was performed using the R language v. 4.3.0 to identify the differences between the two distinct groups. First, we explored the invariance of the TPB scale across the two samples, during the COVID-19 pandemic and post-COVID-19 through confirmatory factor analysis (CFA). Measurement invariance involved a sequential testing procedure in which constraints were imposed on the model (Valois et al., 2020). First, we estimated the configural model without invariance for any of its parameters. Then, we tested for metric invariance by constraining factor loadings (equality of loadings). Next, we verified scalar invariance by constraining factor loadings and item intercepts, checking for equality of intercepts among the groups. Finally, we constrained factor loadings, item intercepts, and their uniqueness to determine strict invariance (equality of residuals). Failing to confirm the strict invariance model would imply an assessment of the constructs with divergent levels of measurement error and precision. Then, we compared structural relationships across the two periods of time and employed the Wald test to assess structural path differences between groups. We continued with testing for variances among descriptive statistics using non-parametric tests like the Wilcoxon Rank Sum Test during COVID-19 and post-COVID-19.

Results and Discussions

The section is structured into four subsections. The first one tests the effectiveness of the model and explores the reliability of the predictors, followed by the measurement of invariance for the model. Subsequently, we investigated structural path differences among the two groups: during the COVID-19 pandemic and after COVID-19. We conclude with non-parametric tests for examining temporal differences for our main predictors.

Effectiveness of the TPB model

Table 2 summarizes the reliability of all measures, including McDonald's omega (ω), chosen for a more robust and nuanced reliability assessment. Both Cronbach's Alpha and McDonald's Omega are methods extensively used for estimating reliability (consistency of the measurements). Most variables are above the given threshold of 0.70, demonstrating an acceptable internal consistency, except for attitudes, the only measure that has a value below the limit, during the COVID-19 pandemic. Its reliability results improved in the post-COVID-19 scenario, suggesting that it was measured more reliably in this different context or that there were some transformations in the respondents' mindset.

Table 2. Reliability of the individual measures for the two groups along with the corresponding 95% confidence intervals

Measures	α (*>0.70)		ω (*>0.70)	
	During COVID-19	Post COVID-19	During COVID-19	Post-COVID-19
Purchase Intention	0.874 [0.861, 0.886]	0.879 [0.868, 0.890]	0.877 [0.865, 0.889]	0.882 [0.871, 0.892]
Attitudes	0.686 [0.659, 0.713]	0.727 [0.703, 0.751]	0.699 [0.668, 0.729]	0.738 [0.713, 0.763]
Social Norms	0.935 [0.929, 0.942]	0.949 [0.944, 0.954]	0.937 [0.930, 0.943]	0.950 [0.945, 0.955]
Perceived Environmental Knowledge	0.918 [0.910, 0.926]	0.921 [0.914, 0.928]	0.918 [0.910, 0.926]	0.922 [0.915, 0.929]
Environment Concern	0.909 [0.900, 0.918]	0.921 [0.914, 0.928]	0.908 [0.899, 0.917]	0.924 [0.917, 0.931]
Greenwashing Concern	0.872 [0.859, 0.886]	0.870 [0.857, 0.883]	0.883 [0.871, 0.895]	0.884 [0.873, 0.895]
Altruistic Values	0.867 [0.854, 0.880]	0.876 [0.864, 0.888]	0.880 [0.868, 0.891]	0.892 [0.883, 0.902]
Egoistic Values	0.774 [0.751, 0.797]	0.758 [0.735, 0.780]	0.776 [0.753, 0.799]	0.761 [0.738, 0.784]
Biospheric Values	0.764 [0.741, 0.787]	0.774 [0.753, 0.795]	0.785 [0.763, 0.807]	0.800 [0.782, .0819]

Source: Author's own research.

Measurement Invariance During and Post COVID-19

We further established that the constructs of the model are measured equivalently. Therefore, we ensured that the constructs of the model were comparable by testing different levels of the model. Table 3 reports the levels of invariance: configural invariance that looks at the same factor structure, metric invariance (compares the factor loadings across groups) ensures that respondents interpret items similarly, scalar invariance (tests for equality of intercepts among groups) compares valid means across groups, and strict invariance (compares residual variances) suggests latent means to be equal across groups. The related literature recommends using chi-square and different alternative fit indices such as Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Standardized Root Mean-square Residual (SRMR) etc. for measuring invariance. In addition, in order to compare two models, scholars recommend presenting the difference between fit indices ($\Delta\chi^2$, ΔCFI , $\Delta RMSEA$ etc.). In the absence of a consensus about the best fit indices we decided to assess the model fit by interpreting two indicators: CFI and RMSEA. A CFI between 0.90 and 0.94 is considered an acceptable fit, while values surpassing 0.95 signifies an

excellent fit. For RMSEA, values between 0.08 and 0.061 are labeled as an acceptable fit, with values below 0.06 reflecting an excellent fit (Valois et al., 2020). We see that configural invariance exhibits acceptable fit indices. In terms of metric and scalar models, indices show support for invariance, regardless of small but significant differences.

The results in Table 3 suggest that the metric invariance is statistically significant, thus factor loadings are comparable between the two periods of time. The same goes for scalar invariance, but with some caution, since intercepts may not be fully equivalent. However, means invariance is violated since the results show latent mean differences between groups.

Table 3. Fit indices for invariance across models

Model	χ^2	df	CFI (* > 0.90)	RMSEA (* < 0.06)	$\Delta\chi^2$	Δdf	ΔCFI	$\Delta RMSEA$
Configural	3555.7***	738	0.943	0.057	-	-	-	-
Metric (Loadings)	3650.7***	759	0.942	0.057	75.05	21	0.001	0.000
Scalar (Intercepts)	3705.4***	780	0.941	0.057	74.69	21	0.001	0.000
Strict (Means Invariance)	3822.7***	789	0.939	0.057	117.32	9	0.002	0.001

Source: Author's own research.

Structural Path Equivalence

We continue our analysis with testing for structural path equivalence. Figure 1 shows our first attempt to compare the standardized path coefficients for the relationships in the model, across the group during COVID-19 (red) and after COVID-19 (blue). We see that major predictors like attitude and subjective norms remain consistent over time. Attitude is the most influential driver, while social pressure continues to play an important role in forming sustainable clothing purchase intentions. The results suggest that Greenwashing Concerns have a slightly higher influence post-COVID-19, showing a growing awareness of misleading sustainability after the epidemic crisis.



Figure 1. Comparison of Standardized Path Coefficients

Source: Author's own research.

Furthermore, we consider the Wald test to confirm whether the differences in coefficients observed in Figure 1 are statistically significant. Generally, the null hypothesis of the Wald test states that the means are equal between groups, while rejecting the null concludes that the means are different between groups. Table 4 and Figure 2 summarize the results of the Wald tests for structural path differences. The path from Perceived Environmental Knowledge to Attitude is the only one statistically different (p -value < 0.001), indicating a stronger relationship in one group (during COVID-19).

Table 4. Wald Test Results

Path	χ^2 (p-value)
SN to PI	0.001 (0.97)
GC to PI	0.94 (0.33)
ATT to PI	2.49 (0.11)
PEK to PI	0.0001 (0.99)
EC to PI	1.27 (0.26)
EGO to PI	0.003 (0.95)
BIO to PI	0.008 (0.93)
ALT to PI	0.005 (0.95)
PEK to ATT	11.27 (0.0007) ***
EC to ATT	2.53 (0.11)

Source: Author's own research.

The bar graph in Figure 2 represents the chi-square statistics to test each structural path for invariance between the two groups. The red bar points to paths where there are significant differences ($p < 0.05$), while the blue ones show no such differences.

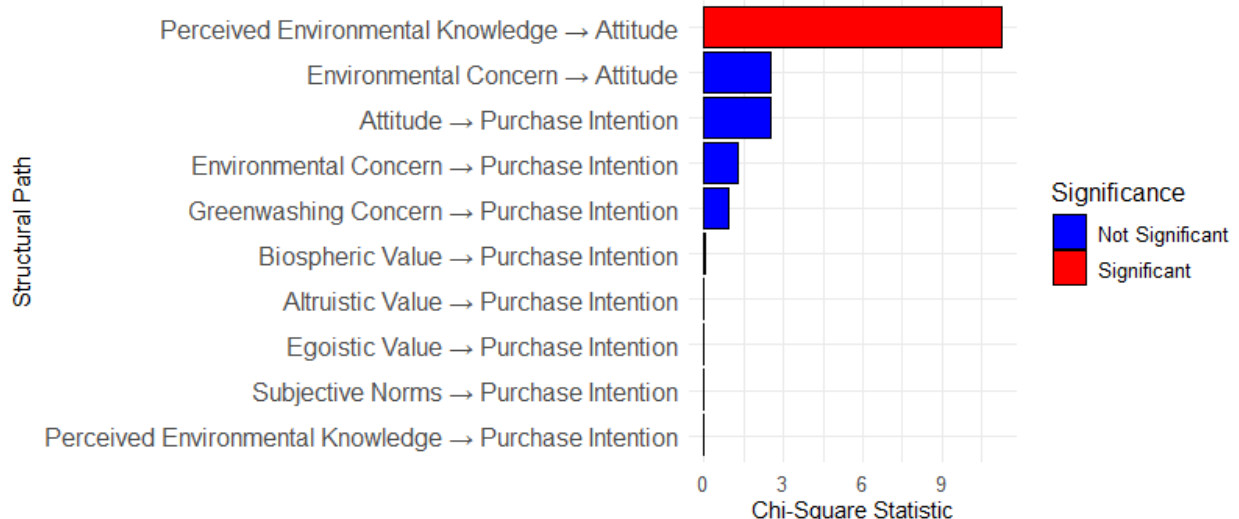


Figure 2. Chi-square statistics for path-invariance tests

Source: Author's own research.

We can observe both in Table 4 and Figure 2 that the path between perceived environmental knowledge and attitude is statistically different ($\chi^2 = 11.74$, p -value = 0.001), suggesting that the impact of the independent variable on attitude differs over time. All other paths do not exhibit significant differences between the two time periods.

Non-parametric tests for identifying differences

We checked whether Purchase Intention and Attitude differed over time using Wilcoxon tests. The null hypothesis (H_0) of this nonparametric test asserts the equality in terms of the distribution of the dispersion measurements. Table 5 summarizes the findings of our analysis, where we verified the differences without distributing the sample in the two distinct groups. Findings show that for Purchase Intention and Attitude there are differences across time. These differences show that interventions could have a more impactful effect during periods of uncertainty.

Table 5. Testing for time differences

Test	Purchase Intention	Attitude
Time differences	W = 792420, p-value = 4.344e-13 r = 0.15 <i>Reject H_0</i>	W = 795435, p-value = 8.744e-14 r = 0.155 <i>Reject H_0</i>

Source: Authors' own research results.

Conclusions

COVID-19 safety measures such as lockdowns and social distancing precipitated substantial changes in daily life of consumers. Many scholars have explored the impact of the pandemic on consumer behavior, especially clothing consumption (Hwang et al., 2024). Despite this, there is limited research exploring the behavioral changes brought by this epidemic crisis in sustainable clothing consumption. Moreover, despite TPB being a well-known behavioral theoretical framework, there are few studies investigating its measurement invariance over time, especially comparing its variance across two important moments in the economic evolution, like COVID-19 and post-COVID-19. This study extends the literature on sustainable clothing consumption by addressing the gap and examining the shifts in COVID-19 and post-COVID-19 trends and differences between the two groups, particularly within the understudied Romanian context.

We explicitly tested the properties of the current TPB instruments in two distinct time frames. Overall, the model fitted well across both samples. The relationships between individual elements and their corresponding constructs were consistent in both groups. Although configural, metric, and scalar invariance were supported, strict invariance was not achieved due to a large chi-square difference. Despite this, further partial invariance testing indicated that the model is robust for structural comparisons. Thus, our measures showed strong construct measurements across the two periods in time and, although there are some residual differences, we found the model reliable for comparing it among groups. Regarding practical implications, we found the measurement properties stable, suggesting that policies and intervention designs regarding sustainable clothing consumption based on our extended TPB model could be implemented across different groups, without employing other models. Our findings suggest that constructs from our research framework are consistently measured, thus cross-group comparisons and behavioral predictions are reliable.

Concerning structural path differences, the Wald test findings highlight the path between perceived environmental knowledge and attitude as statistically significant. This suggests a significantly different effect between the two variables during COVID-19. One potential explanation for this change comes as a result of the epidemic health crisis to improve the environmental awareness of consumers, since during this time people were more attentive to the environment and implicitly practicing sustainability. However, other predictors had consistent

paths between COVID-19 and post-COVID-19, appointing them as stable drivers of purchasing sustainable clothing, regardless of uncertain circumstances such as a health crisis.

The results of our study indicate differences in purchase intention and attitude based on periods (COVID-19 epidemic crisis and post-COVID-19). These findings could help businesses and marketers better design their strategies. These differences show that interventions could have a more impactful effect during periods of uncertainty, and segmentation based on different demographic levels could be effective.

Overall, the presence of statistically significant differences, with strong or weak effect sizes, needs to be approached with caution. Future research should consider exploring more in-depth moderating variables that could better explain variations in purchase intention towards sustainable clothing consumption.

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