Chapter 12
Positive and Negative Perceptions of Residents Toward Tourism Development: Formative or Reflective

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Abstract This paper investigates whether residents' positive and negative perceptions of tourism development, in the Asian context, are reflective or formative in nature. This assessment assumes positive perceptions (PP) and negative perceptions (NP) as both unidimensional and multidimensional constructs inclusive of economic, social, cultural, and environmental components. Data for this study was collected from residents of the Lenggong World Heritage Site in Malaysia and analyzed using partial least squares structural equation modeling (PLS-SEM), confirmatory tetrad analysis (CTA), and other recently developed fit models, such as geodesic discrepancy (d_G), unweighted least squares discrepancy (d_ULS), and standardized root mean square residual (SRMR). The results confirm the formative nature of PP and NP. In addition, the findings indicate that the PP and NP measurement model is best conceptualized as a reflective-formative second-order construct. This study makes a significant theoretical and methodological contribution to the resident perception literature, and the quantitative research in tourism. Future quantitative researches in resident perception field should take into consideration the formative nature NP and PP, when the research framework are conceptualized.

Keywords Residents' perception · Negative perceptions · Positive perceptions · Formative · Reflective · Confirmatory tetrad analysis (CTA) · Model fits for PLS

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12.1 Introduction

The past two decades have witnessed the publication of a multitude of international studies focused on the perceptions of residents toward tourism development (Andereck et al. 2005; Ap 1992; Gu and Wong 2006; Hall and Page 2014; Huang and Hsu 2005; Jaafar et al. 2015, 2017; Kayat 2002; Kim et al. 2013; Rasoolimanesh et al. 2015, 2017a, b; Zamani-Farahani and Musa, 2008, 2012). Most of these studies, published in refereed journals, employed quantitative methods with multi-item research instruments used for the measurement of positive and negative perceptions (Jaafar et al. 2015, 2017; Kim et al. 2013; Rasoolimanesh et al. 2015, 2017a; Zamani-Farahani and Musa 2008, 2012). In some studies, researchers use items associated with tourism development to make direct measurements of residents' perceptions, while in other studies, researchers might use multidimensional constructs (inclusive of economic, social, and environmental dimensions) to measure these perceptions (Jaafar et al. 2017; Jurowski et al. 1997). Notwithstanding, each of these approaches involves reflective measures of residents' positive and negative perceptions toward the impacts of tourism development. A reflective construct assumes that the measurement items are similar and interchangeable, sharing a common theme and meaning (Hair et al. 2017). Conversely, a formative construct involves numerous indicators that in combination define the construct (Diamantopoulos et al. 2008). Therefore, in a formative construct, the exclusion or inclusion of one or more indicators affects the meaning and content validity of the construct (Chang et al. 2016; Coltman et al. 2008; Diamantopoulos et al. 2008). Items used to measure formative constructs are not interchangeable with one another as each indicator represents a distinct aspect of the construct (Coltman et al. 2008). After having carefully reviewed numerous uni- and multidimensional measurement item constructs used in previous studies to measure positive and negative resident perceptions, we found that studies often tended to neglect the possibility of formative constructs. Residents' perceptions have economic, social, cultural, and environmental dimensions thus allowing them to be understood from different perspectives. These perspectives facilitate a more comprehensive understanding of residents' positive and negative perceptions toward tourism development. This expanded understanding can similarly be observed when the constructs used to measure residents' perceptions are defined using associative items that are subject to direct observation. Items associated with positive and negative perceptions represent different aspects of the perceived impacts of tourism from the perspective of residents. This analysis of previous studies highlights the value of formative constructs of perception and suggests that the constructs used in some studies to measure residents' positive and negative perceptions of the impacts of tourism development may have been poorly conceptualized. Therefore, this study undertakes to reconsider these positive and negative resident perception constructs from this viewpoint.

This study critically reviews the literature pertaining to reflective and formative concepts, while simultaneously exploring the vast body of literature concerning residents' perceptions toward tourism development, focusing particularly on studies con-

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ducted in Asian countries. This paper subsequently undertakes to discuss the reflective and formative nature of residents' positive and negative perceptions toward tourism development based on the outcomes of the aforementioned review. To empirically test the reflective-formative nature of the positive and negative constructs of residents' perceptions, we rely on data collected from the Lenggong World Heritage Site (WHS) in Malaysia. We analyze this data by way of confirmatory tetrad analysis in partial least squares (CTA-PLS) path modeling and several newly developed fit indices for PLS. Having conceptualized and tested these constructs empirical, we propose a number of recommendations and new directions for future studies to further expand this field of research. The remainder of this chapter is organized as follows. In the next section, we review the literature on residents' perceptions toward tourism development, measuring residents' perceptions, and understanding reflective and formative concepts. Following the literature review, we outline the research methods and describe the results. Then, we discuss the results and findings of this study. We conclude this chapter by identifying some of the contributions and implications of this study and outline the limitations and a number of suggestions for future research.

12.2 Residents' Perceptions Toward Tourism Development

Several previous studies have explored the perceptions of residents toward the impacts of tourism development on local communities (Andereck et al. 2005; Gu and Wong 2006; Kim et al. 2013; Rasoolimanesh et al. 2015, 2017b; Sharpley 1994, 2014; Vareiro et al. 2013). Several of these studies were conducted in Asian countries (Gu and Wong 2006; Huang and Hsu 2005; Jaafar et al. 2015, 2017; Kayat 2002; Rasoolimanesh et al. 2015, 2017a; Zamani-Farahani and Musa 2008, 2012). Communities are directly affected by the development of local tourism industries and infrastructure and by subsequent interactions with tourists (Rasoolimanesh et al. 2015). These impacts influence community values, behavior patterns, lifestyles, and the quality of life of local community members (Huang and Hsu 2005; Jaafar et al. 2015, 2017; Kayat 2002). The development of tourism can exert a number of economic, sociocultural, and environmental effects on host communities, with these effects being both positive and negative (Rasoolimanesh et al. 2015, 2017a). Positive economic effects include increasing family incomes, improved standards of living, and the creation of new jobs and additional employment opportunities (Choi and Sirakaya 2006; Ko and Stewart 2002; Rasoolimanesh et al. 2017a). The negative economic effects of tourism, as identified in the literature, include a rise in the cost of living, as well as spiraling prices for goods, property, and services, relative poverty through low-paying jobs in the tourism industry, and increasing property taxes (Andereck et al. 2005; Látková and Vogt 2012; Rasoolimanesh et al. 2015).

Several previous studies have investigated the positive and negative impacts of tourism development on local communities from the social and cultural perspective (Deery et al. 2012; Jaafar et al. 2017). The development of tourism can result in recreational and entertainment facilities being improved (Tovar and Lockwood

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2008); facilitates an understanding of cultural identity and the preservation and revival of traditional arts, culture, and crafts (Jaafar et al. 2017; Kim 2002; Rasoolimanesh et al. 2017b); and encourages the local community to take pride in their culture (McGehee et al. 2002; Rasoolimanesh et al. 2017b). However, the development of tourism also introduces a number of undesirable social and cultural influences that can adversely affect the value systems of families and family relationships (Jaafar et al. 2017), contribute toward the overcrowding of facilities and traffic congestion on the roads (Ko and Stewart 2002; Látková and Vogt 2012; Rasoolimanesh et al. 2015); result in the increased prevalence of crime, including prostitution (Akama and Kieti 2007; Matarrita-Cascante 2010; Park and Stokowski 2009) and recreational drug use (Deery et al. 2012; Jaafar et al. 2017; Ko and Stewart 2002); and increase both visible litter and public alcoholism (Jaafar et al. 2017; Ko and Stewart 2002; Látková and Vogt 2012). Moreover, from an environmental perspective, the negative impacts of tourism development include damage to the natural environment and ecosystems as well as increased air, water, and other forms of environmental pollution (Ko and Stewart 2002). Therefore, in weighing these negative impacts against the benefits of tourism development, members of affected communities face a critical dilemma (Sharpley and Telfer 2008). While the perceived positive impacts of tourism development might encourage residents to support tourism development, the perceived negative impacts might similarly result in the loss of their support for tourism development (Rasoolimanesh et al. 2015; Sharpley 2014).

12.3 Measuring Residents' Perceptions

Most studies of residents' perceptions, including those conducted in Asian countries, have employed quantitative methods to measure residents' positive and negative perceptions of tourism development using multi-item instruments (Andereck et al. 2005; Gursoy et al. 2002; Jaafar et al. 2015, 2017; Kim et al. 2013; Látková and Vogt 2012; Nunkoo and Ramkissoon 2012; Rasoolimanesh 2017a, 2017b; Vareiro et al. 2013). For this purpose, different types of scales have been used. In some studies, researchers have employed multi-item constructs to measure the perceptions of residents (Ko and Stewart 2002; Látková and Vogt 2012; Rasoolimanesh et al. 2015), whereas in other studies, researchers applied various multi-item constructs to represent the economic, social, cultural, and environmental dimensions of residents' perceptions separately (Jaafar et al. 2017; Jurowski et al. 1997). To the best of our knowledge, all previous quantitative studies have measured residents' positive and negative perceptions as a reflective construct. Moreover, we have not found any studies that have explored the various aspects of residents' perceptions of the impact of tourism development (e.g., economic, social, cultural, and environmental) simultaneously while articulating these positive and negative perceptions as a multidimensional construct. Previous studies have measured residents' positive and negative perceptions either as a reflective multi-item construct or have explored the different aspects of residents' perceptions separately.

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12.4 Understanding Reflective and Formative Concepts

There is a long tradition in the social sciences of assessing latent variables (LVs) (Diamantopoulos et al. 2008), which are a type of variable that cannot be measured directly and that are thus measured based some other observable variable (Coltman et al. 2008). That said, the nature of the observable variable can give rise to a number of different approaches to the measurement of the LV. Therefore, there are different types of measurement specifications (Diamantopoulos et al. 2008). According to classical test theory, the observed items are reflections of the LVs, meaning that the LVs actually cause the observed items and that the observed items share a common variance with the LVs (Bollen and Bauldry 2011). Consequently, type of measurement model is called a *reflective measurement model* (Hair et al. 2017). In a reflective measurement model, each item can be described by linear function of its associated LV plus error (Diamantopoulos et al. 2008). A reflective construct assumes that the measurement items are similar and interchangeable, meaning that the items share a common theme and meaning, and that the direction of causality is from construct to items (Coltman et al. 2008).

However, not all constructs used in the social sciences are necessarily amenable to the use of reflective measurement models (Bollen and Bauldry 2011; Diamantopoulos et al. 2008). In some cases, instead of causing the observed items, LVs may actually be a product of the observed items, either alone or in combination (Bollen and Bauldry 2011; Coltman et al. 2008). In this case the direction of the relationship is from items to LV, because the items cause the LV. This type of LV is referred to as a *formative measurement model* (Diamantopoulos et al. 2008). In a formative construct, the indicators must be combined to define the construct; therefore, the exclusion or inclusion of one or more indicators will impact the meaning and content validity of the construct (Coltman et al. 2008). Consequently, the measurement items in a formative construct are not interchangeable, and each indicator represents a different feature of the construct (Fassott and Henseler 2015). Each LV, therefore, can be described as a linear regression of its associated items plus error (Coltman et al. 2008). Items in a formative construct can be either positively or negatively intercorrelated, or they may not be correlated at all (Coltman et al. 2008; Diamantopoulos et al. 2008). In contrast, the items in a reflective construct should be highly correlated (Coltman et al. 2008).

12.5 Research Methods

This study aims to assess and compare the reflective and formative nature of residents' positive and negative perceptions. The residents who provided the data informing this study were from the Lenggong Valley World Heritage Site in Malaysia, which is a rural tourism destination. Data was collected using a self-administered questionnaire. The questionnaire was adapted from similar instruments used in previous

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resident perception studies, with items describing the positive and negative perceptions of residents toward the economic, social, cultural, and environmental impacts of tourism development (Andereck et al. 2005; Jaafar et al. 2017; Nicholas et al. 2009; Rasoolimanesh et al. 2015, 2017a, b). The final instrument contained 33 items, 14 of which were to measure residents' positive perceptions of various impacts (i.e., 3 economic items, 4 social items, 4 cultural items, and 3 environmental items) and 15 items to measure residents' negative perceptions (i.e., 3 economic items, 4 social items, 4 cultural items, and 4 environmental items). A further four items were used to measure residents' support for tourism development. Question items were answered on a 5-point Likert scale, with 1 indicating *strongly disagree* and 5 indicating *strongly agree*. Data collection was performed over a 1-week period during May of 2017. Respondents were systematically selected from among the residents of several villages within Lenggong Valley. The population of these villages totaled 3,826, spread across 750 houses, 150 of which were selected from data collection purposes.

To identify the reflective or formative nature of residents' perception constructs, the current study has employed partial least squares structural equation modeling (PLS-SEM), with data analysis performed using SmartPLS 3.2.6 (Ringle et al. 2015). The analysis of data using this approach is a two-stage process. In first stage, we analyzed the model assuming residents' positive and negative perceptions were multi-item reflective constructs. We then performed a confirmatory tetrad analysis in PLS (CTA-PLS) to assess the formative nature of the positive and negative perception constructs. CTA-PLS is a method of statistical analysis that facilitates the assessment the formative or reflective nature of a construct (Gudergan et al. 2008; Hair et al. 2018; Rigdon 2015). We then repeated the analysis on the assumption that the resident perception constructs might be formative rather than reflective and assessed the quality of the model based on model fit indices. In the second stage, we assumed that residents' positive and negative perceptions constituted a multidimensional construct inclusive of economic, social, cultural, and environmental dimensions. Therefore, in this stage, we began by establishing residents' positive and negative perceptions as a second-order reflective-reflective construct. Then we performed the CTA-PLS for the model, including second-order constructs, to identify the reflective or formative nature of the constructs. We then changed the reflective second-order constructs to formative constructs and assessed the quality of the model using model fit indices. Therefore, the formative nature of the positive and negative perception constructs was assessed as both multi-item single dimension and multi-item multidimensional constructs, with the results having been compared based on model fit indices.

Using CTA-PLS, we can confirm the inappropriateness of the reflective measurement model and support the use of formative measurements (Gudergan et al. 2008; Hair et al. 2018). To perform CTA-PLS, the pairs of covariances between items should be compared (Hair et al. 2018), which requires the creation of tetrads. A tetrad is the difference between one pair of covariances and another pair. Ideally, all tetrads should be zero to confirm the reflective nature of a construct (Gudergan et al. 2008; Hair et al. 2018). If at least one tetrad in the construct is significantly different from zero, we must reject the assumption of a reflective construct and confirm the formative nature of the measurement model (Hair et al. 2018).

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12.6 Results

As mentioned earlier, we conducted the analysis in two stages. Table 12.1 shows the results of the assessment of the measurement model during the first stage. In this stage, we assumed that positive and negative perceptions were multi-item constructs. Table 12.1 shows the outer loadings, composite reliability (CR), and average variance extracted (AVE) for the three constructs involved in the model, namely, positive perceptions (PP), negative perceptions (NP), and support for tourism development (SUP). To establish the reliability and convergent validity of a reflective construct, the outer loadings should be higher than 0.7, CR higher than 0.7, and AVE higher than 0.5 (Hair et al. 2017). However, a loading between 0.4 and 0.7 is acceptable if the CR and AVE meet the threshold (Hair et al. 2017). Table 12.1 shows that some NP items had an outer loading below 0.4, while most PP and NP items loaded between 0.4 and 0.7. Moreover, the AVE of PP and NP was below 0.5. Therefore, the results of the measurement model assessment do not support an acceptable reliability or convergent validity for PP or NP, thus necessitating the removal of a number of items from these constructs to establish reasonable reliability and convergent validity.

The aim of the current study is to compare the various alternatives using reflective and formative PP and NP constructs, as well as first-order and second-order PP and NP. Therefore, in addition to CTA-PLS, we used various model fit indices to augment this comparison. To estimate these model fit indices, the model-implied correlation matrix should be compared with the empirical correlation matrix (Henseler et al. 2016; van Riel et al. 2017). Therefore, in using these model fit indices to compare the models, the model that best fits the empirical data is deemed to be the most representative model (van Riel et al. 2017). Should none of the models conform with the fit indices to an acceptable degree, then we must conclude that the data is perhaps too rich or contains more information than what any of the compared models can represent (Henseler et al. 2016). The Bollen-Stine bootstrapping procedure is the suitable method of assessing the model fit indices in PLS (Dijkstra and Henseler 2015). This approach is used to estimate the significance of the differences between the empirical and model-implied correlation matrix (Dijkstra and Henseler 2015). The two primary approaches to estimating these differences include the geodesic discrepancy (d_G) and unweighted least squares discrepancy (d_ULS) (Henseler et al. 2016). In addition to these model fit indices, an approximate model fit criteria for PLS—standardized root mean square residual (SRMR)—can be used to assess the differences between the model-implied and the empirical correlation matrix (Henseler et al. 2016). To arrive at an acceptable PLS model fit using bootstrapping, the values for SRMR, d_G, and d_ULS should be lower than the upper value of the 95% confidence interval ($CI_{0.95}$) (Henseler et al. 2016).

Table 12.2 shows the $CI_{0.95}$ for SRMR, d_G, and d_ULS following the inclusion of PP and NP as multi-item first-order constructs in the model, according to which the values were higher than their associated $CI_{0.95}$. Therefore, none of model fit indices can support the model.

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Table 12.1 Assessment of the reflective measurement model

Construct	Items	Loading	CR	AVE
Positive perceptions			0.884	0.355
	1. Tourism development would create more jobs for my community	0.578		
	2. Tourism development would attract more investment to my community	0.561		
	3. Our standard of living would increase considerably because of tourism	0.530		
	4. Tourism development provides more infrastructures and public facilities like, roads, shopping malls, etc.	0.645		
	5. Tourism development enhances the image of local culture, and residents take pride in their culture	0.645		
	6. Tourism development preserves cultural identity of host residents	0.699		
	7. Tourism development promotes cultural exchange	0.659		
	8. Tourism development facilitates meeting visitors and educational experiences	0.684		
	9. Tourism development increases the recreation facilities and opportunities	0.637		
	10. Tourism development improves quality of fire protection	0.454		
	11. Tourism development improves quality of police protection	0.479		
	12. Tourism development helps to preserve the natural environment	0.534		
	13. Tourism development helps to preserve the historical buildings	0.629		
	14. Tourism development improves the area's appearance	0.543		
Negative perceptions			0.904	0.407
	1. Tourism development would increase the price of goods and services	0.230		
	2. Tourism development would increase the price of land and housing	0.366		
	3. Tourism development would increase the cost of living/property taxes	0.329		
	4. Construction of hotels and other tourist facilities would destroy the environment	0.423		
	5. Tourism development would result in traffic congestion	0.610		
	6. Tourism development would cause overcrowding	0.570		
	7. Tourism development would increase noise pollution	0.642		
	8. Tourism development would increase the rate of crime	0.621		

(continued)

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Table 12.1 (continued)

Construct	Items	Loading	CR	AVE
	9. Tourism development increases prostitution	0.757		
	10. Tourism development would increase alcoholism	0.709		
	11. Tourism development increases drug abuse	0.708		
	12. Tourism development would change the lifestyle of local community	0.805		
	13. Tourism development would change the traditional culture, and the Malay culture may disappear slowly	0.834		
	14. Tourism development disturbs the local community routine	0.798		
	15. Tourism development would create phony folk culture	0.757		
Support for tourism development			0.954	0.839
	1. The residents should participate in tourism planning and development	0.872		
	2. I believe that tourism should be actively encouraged in my community	0.922		
	3. I support tourism and would like to see it becomes an important part of my community	0.945		
	4. The local authorities and state government should support the promotion of tourism	0.918		

Table 12.2 Model fit indices for reflective measurement model

	SRMR	5.0%	95.0%	d_ULS	5.0%	95.0%	d_G	5.0%	95.0%
Saturated model	0.164	0.061	0.084	15.156	2.063	3.954	5.176	1.128	2.147
Estimated model	0.164	0.061	0.085	15.156	2.069	4.008	5.176	1.125	2.181

In order to perform CTA, all tetrads should be calculated for the items used to articulate each construct, after which the redundant tetrads are eliminated. In the next step, significance testing is performed using bootstrapping in order to calculate the *p*-value and the bias-corrected confidence interval. This allows us to assess whether the nonredundant tetrads are significantly different from zero (Hair et al. 2017). If the *p*-value is less than 0.05 and zero is not within the bias-corrected $CI_{0.05}$ and $CI_{0.95}$, the tetrad has not vanished (i.e., is significantly different from zero) (Gudergan et al. 2008; Hair et al. 2018). Should even one tetrad has not vanished, we can conclude that the construct is not reflective, but formative (Gudergan et al. 2008; Hair et al. 2018). Appendix A.1 and A.2 show the results of CTA-PLS for the PP and NP constructs. The results reveal that several tetrads failed to vanish for both PP and NP. Therefore, we can conclude that neither PP nor NP first-order constructs can be reflective and that PP and NP must be formative in nature.

As both CTA-PLS and the model fit indices indicated that the PP and NP constructs were in fact formative, we reassessed the measurement model, including the two forma-

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tive constructs (PP and NP) and the reflective construct (SUP). Table 12.3 shows the results of the assessment of the measure model. To assess a formative measurement model, it is necessary to assess the collinearity of the associated items using variance inflation factor (VIF), in which the VIF should be lower than 5 (Hair et al. 2017). Moreover, the outer weight of each item should be significant (Hair et al. 2017). Table 12.3 shows that several items have VIFs greater than 5 and that several PP and NP

Table 12.3 Assessment of formative measurement model

Construct	Items	Weight/loading	*P*-value	VIF
Positive perceptions				
	PP1	0.147	0.041	1.81
	PP2	0.161	0.014	1.92
	PP3	0.031	0.696	2.54
	PP4	0.062	0.377	2.67
	PP5	0.105	0.083	2.13
	PP6	0.093	0.130	2.92
	PP7	0.137	0.017	2.26
	PP8	0.160	0.011	2.15
	PP9	0.209	0.010	1.64
	PP10	0.009	0.906	2.06
	PP11	0.152	0.031	2.07
	PP12	0.099	0.097	2.35
	PP13	0.096	0.149	2.87
	PP14	0.209	0.008	1.61
Negative perceptions				
	NP1	–0.025	0.692	2.46
	NP2	0.091	0.175	6.60
	NP3	0.058	0.345	4.66
	NP4	–0.038	0.632	2.92
	NP5	0.119	0.044	4.51
	NP6	0.044	0.480	4.14
	NP7	0.061	0.306	6.09
	NP8	0.019	0.781	8.14
	NP9	0.087	0.069	7.91
	NP10	0.022	0.733	17.48
	NP11	0.027	0.673	14.41
	NP12	0.301	0.007	2.15
	NP13	0.172	0.002	5.82
	NP14	0.181	0.003	5.42
	NP15	0.251	0.003	4.24
Support for tourism development				
	SUP1	0.858	NA	
	SUP2	0.927	NA	
	SUP3	0.950	NA	
	SUP4	0.923	NA	

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Table 12.4 Model fit indices for formative measurement model

	SRMR	5.0%	95.0%	d_ULS	5.0%	95.0%	d_G	5.0%	95.0%
Saturated model	0.087	0.047	0.072	4.207	1.223	2.917	2.055	1.244	2.472
Estimated model	0.087	0.046	0.072	4.207	1.210	2.933	2.055	1.240	2.468

Table 12.5 Assessment of measurement model of first-order constructs (Before establishing second-order PP and NP)

	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
NP_Cultural	0.890	0.922	0.747
NP_Economic	0.889	0.883	0.724
NP_Environmental	0.895	0.890	0.675
NP_Social	0.964	0.967	0.881
PP_Cultural	0.825	0.882	0.652
PP_Economic	0.740	0.832	0.630
PP_Environmental	0.799	0.869	0.689
PP_Social	0.611	0.746	0.511
SUP	0.935	0.954	0.837

items were weighted nonsignificantly. Moreover, the results of model fit assessment using SRMR, d_ULS, and d_G in Table 12.4 show nonsignificant model fit indices for the model including first-order multi-item formative PP and NP constructs.

To establish PP and NP as second-order constructs, this study used a two-stage approach recommended by several previous studies (Becker et al. 2012; Md Noor et al. 2015; Rasoolimanesh et al. 2016). In first stage, we established economic, social, cultural, and environmental dimensions of positive and negative perceptions of residents toward tourism development (PP_Economic, PP_Social, PP_Cultural, PP_Environmental, NP_Economic, NP_Social, NP_Cultural, and NP_Environmental) as first-order reflective constructs and then assessed the measurement model using these eight reflective constructs as well as SUP. Therefore, the model used in the first stage of assessment included nine reflective first-order constructs. It is necessary to established the reliability, convergent validity, and discriminant validity of these reflective constructs before proceed to the second stage (van Riel et al. 2017). Table 12.5 shows that the CR for all nine reflective constructs exceeded 0.7 and that they had an AVE greater than 0.5. Moreover, the results reveal that the outer loading of associated items of all constructs in this stage were higher than 0.4. Therefore, the results support the acceptable reliability and convergent validity of the nine reflective constructs involved in this stage.

Two criteria were used to establish the discriminant validity of the reflective constructs: the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) ratio (Henseler et al. 2015; Voorhees et al. 2016). To satisfy the Fornell-Larcker criterion, the square root of the AVE of each LV should be higher than its correlation with other LVs (Hair et al. 2017). Table 12.6 demonstrates acceptable discriminant validity based on the Fornell-Larcker criterion. Moreover, the HTMT ratio should be lower than 0.85 or 0.9 to establish discriminant validity (Henseler et al. 2015).

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Table 12.6 Discriminant validity using Fornell-Larcker criterion for first-order constructs (before establishing second-order PP and NP)

	NP_Cultural	NP_Economic	NP_Environmental	NP_Social	PP_Cultural	PP_Economic	PP_Environmental	PP_Social	SUP
NP_Cultural	0.865								
NP_Economic	0.074	0.851							
NP_Environmental	0.399	0.611	0.821						
NP_Social	0.525	0.506	0.789	0.939					
PP_Cultural	0.120	–0.027	0.071	0.086	0.807				
PP_Economic	0.076	0.142	0.227	0.107	0.505	0.794			
PP_Environmental	–0.091	0.161	–0.046	–0.105	0.319	0.176	0.830		
PP_Social	0.114	–0.024	0.057	0.075	0.429	0.222	0.436	0.715	
SUP	0.420	0.147	0.182	0.094	0.217	0.230	0.253	0.200	0.915

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Table 12.7 shows that all the LVs had an $HTMT_{.85}$ below 0.85. Therefore, using both the Fornell-Larcker criterion and $HTMT_{0.85}$, the results support the acceptable discriminant validity for the nine reflective measurement models assessed in the first stage. After establishing the reliability, convergent validity, and discriminant validity of the reflective constructs, the PP_Economic, PP_Social, PP_Cultural, PP_Environmental, NP_Economic, NP_Social, NP_Cultural, and NP_Environmental first-order construct scores were obtained to use as second-order PP and NP indicators in the second stage. Therefore, the model in the second stage includes two second-order constructs (i.e., PP and NP) and SUP as a reflective first-order construct.

PP and NP were established as second-order reflective constructs in the first step of second stage. Table 12.8 shows the results of the assessment of the measurement model for the reflective second-order PP and NP constructs. Table 12.8 demonstrates acceptable reliability and convergent validity for these constructs. The CR of PP and NP was higher than 0.7, the AVE was higher than 0.5, and the outer loadings were acceptable. The next step in this process, therefore, is the assessment of model fit indices and CTA-PLS for the second-order PP and NP constructs, this allowing us to confirm whether PP and NP are reflective or formative measurement models.

Table 12.9 shows the model fit indices for the model, including second-order PP and NP constructs. As mentioned earlier, to arrive at an acceptable fit for PLS modeling using bootstrapping, the values for SRMR, d_G, and d_ULS should be lower than the upper value of 95% confidence interval ($CI_{0.95}$) (Henseler et al. 2016). Table 12.9 shows that SRMR, d_G, and d_ULS had higher values than their associated $CI_{0.95}$. Therefore, none of model fit indices can support this model. As such, it is necessary to perform CTA-PLS on the alternative model to check whether the PP and NP constructs were reflective or formative.

To perform the CTA for the second-order PP and NP constructs, it was first necessary to establish each of the tetrads and then to eliminate those that were redundant. Then, using bootstrapping, the *p*-value and the bias-corrected confidence interval were calculated to assess whether the nonredundant tetrads were significantly different from zero (Hair et al. 2017). Tables 12.10 and 12.11 show the results of CTA-PLS for the second-order PP and NP constructs. The results reveal that none of the nonredundant tetrads for both PP and NP had vanished. Therefore, the results of CTA-PLS strongly support the formative nature of the second-order PP and NP constructs.

According to the results of CTA-PLS for these second-order constructs and for the model fit indices, the second-order PP and NP constructs switched from reflective to formative, thus necessitating the reassessment of the measurement model, including the two second-order formative constructs (i.e., PP and NP) and the one reflective construct (SUP). Table 12.12 shows the results of the assessment of the measurement model. The results show that the VIF of all items associated with PP and NP was lower than 5 and acceptable. Moreover, the outer weights of PP_Economic, PP_Social, PP_Cultural, PP_Environmental, NP_Cultural, and NP_Environmental were significant. The results of the assessment of the measurement model identified only nonsignificant outer weights for NP_Economic and

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Table 12.7 Discriminant validity using $HTMT_{0.85}$ for first-order constructs (before establishing second-order PP and NP)

	NP_Cultural	NP_Economic	NP_Environmental	NP_Social	PP_Cultural	PP_Economic	PP_Environmental	PP_Social	SUP
NP_Cultural									
NP_Economic	0.138								
NP_Environmental	0.374	0.790							
NP_Social	0.520	0.534	0.898						
PP_Cultural	0.138	0.106	0.110	0.102					
PP_Economic	0.135	0.216	0.260	0.122	0.710				
PP_Environmental	0.122	0.230	0.110	0.179	0.430	0.248			
PP_Social	0.130	0.159	0.101	0.108	0.738	0.637	0.657		
SUP	0.427	0.116	0.125	0.071	0.231	0.240	0.253	0.192	

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Table 12.8 Assessment of measurement model of reflective second order

Construct	Items	Loading	CR	AVE
Positive perceptions			0.807	0.568
	PP_ Economic	0.668		
	PP_ Social	0.709		
	PP_ Cultural	0.779		
	PP_ Environmental	0.700		
Negative perceptions			0.836	0.512
	NP_ Economic	0.515		
	NP_ Social	0.816		
	NP_ Cultural	0.849		
	NP_ Environmental	0.787		
Support for Tourism Development			0.953	0.837
	SUP1	0.870		
	SUP2	0.922		
	SUP3	0.946		
	SUP4	0.919		

Table 12.9 Model fit indices for second-order reflective model

	SRMR	5.0%	95.0%	d_ULS	5.0%	95.0%	d_G	5.0%	95.0%
Saturated model	0.114	0.056	0.082	1.011	0.244	0.523	0.510	0.165	0.329
Estimated model	0.114	0.056	0.081	1.011	0.246	0.515	0.510	0.166	0.331

Table 12.10 Results of CTA-PLS for second-order PP

Positive perceptions	Tetrad value	*P*-values	Bias	CI low	CI up	Supported (reflective)
1: PP_Cultural,PP_ Economic,PP_ Environmental,PP_Social	0.149	0.039	–0.004	0.026	0.263	NO
2: PP_Cultural,PP_ Economic,PP_Social,PP_ Environmental	0.145	0.05	–0.005	0.014	0.266	NO

Table 12.11 Results of CTA-PLS for second-order NP

Negative perceptions	Tetrad value	*P*-values	Bias	CI low	CI up	Supported (reflective)
1: NP_Cultural,NP_ Economic,NP_ Environmental,NP_Social	–0.144	0.012	0.004	–0.233	–0.046	NO
2: NP_Cultural,NP_ Economic,NP_Social,NP_ Environmental	–0.262	0.000	0.006	–0.369	–0.143	NO

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Table 12.12 Assessment of measurement model of formative second order

Construct	Items	Weights/loadings	*P*-value	VIF
Positive perceptions				
	PP_ Economic	0.358	0.003	1.343
	PP_ Social	0.312	0.006	1.396
	PP_ Cultural	0.339	0.000	1.593
	PP_ Environmental	0.358	0.000	1.268
Negative perceptions				
	NP_ Economic	0.224	0.127	1.728
	NP_ Social	0.144	0.307	3.154
	NP_ Cultural	0.646	0.000	1.492
	NP_ Environmental	0.279	0.017	3.182
Support for tourism development				
	SUP1	0.865		NA
	SUP2	0.925		NA
	SUP3	0.948		NA
	SUP4	0.920		NA

Table 12.13 Model fit indices for second-order formative measurement model

	SRMR	5.0%	95.0%	d_ULS	5.0%	95.0%	d_G	5.0%	95.0%
Saturated model	0.060	0.036	0.074	0.282	0.103	0.423	0.149	0.112	0.158
Estimated model	0.060	0.037	0.074	0.282	0.105	0.423	0.149	0.113	0.158

NP_Social. As such, we must determine the significance of their outer loadings to decide whether they should be removed (Hair et al. 2017). The results indicate significant outer loadings for these two second-order NP items, and for all the formative PP and NP constructs, thus meaning that they can be retained. The results of the model fit assessment using SRMR, d_ULS, and d_G for this alternative model, including formative second-order PP and NP constructs, are presented in Table 12.13. Table 12.13 shows significant model fit indices for the model, including second-order formative PP and NP constructs. The values of SRMR, d_ULS, and d_G for the model, including second-order PP and NP constructs, were lower than the upper value of 95% confidence interval ($CI_{0.95}$) (Henseler et al. 2016), thus meaning that they were acceptable. Therefore, the results allude not only to the formative nature of PP and NP, but also to the necessity of establishing these constructs as second-order reflective-formative constructs.

12.7 Discussion

The current study aimed to determine whether the positive and negative perceptions of residents living in an Asian context toward tourism development were reflective or formative in nature. Earlier studies published in the tourism literature, including

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studies of Asian countries, articulate residents' positive and negative perceptions as multi-item reflective measurement models (Jaafar et al. 2015, 2017; Kim et al. 2013; Rasoolimanesh et al. 2015, 2017a; Zamani-Farahani and Musa 2008, 2012). Few studies, however, employed measures of residents' perceptions that were inclusive of economic, social, cultural, and environmental dimensions (Jaafar et al. 2017; Jurowski et al. 1997). In this study, we used PLS and CTA to elucidate the formative and/or reflective nature of these constructs. Moreover, this assessment explored two alternatives: (a) that positive and negative perceptions constitute multi-item first-order constructs and (b) that positive and negative perceptions are multidimensional second-order constructs inclusive of economic, social, cultural, and environmental dimensions. In order to compare these alternatives, we used quality criteria to assess the measurement model and model fit indices. For the first alternative, the results of CTA-PLS revealed the formative nature of residents' positive and negative perceptions toward tourism development. Using CTA-PLS, the results indicated that several tetrads were significantly different from zero for the items in the PP and NP constructs, meaning that these results could not support the reflective nature of these constructs. Had at least one tetrad been significantly different from zero after having performed CTA, it would have indicated a low correlation between some items within the construct, indicating that the construct cannot be reflective (i.e., it must be formative) (Gudergan et al. 2008; Hair et al. 2018). In addition, the results of the assessment of the measurement model that assumed a reflective PP and NP showed low loadings for several PP- and NP-related items, as well as low AVE, which might indicate that neither PP nor NP is reflective. Moreover, the values of d_G, d_ULS, and SRMR model fit indices, which were used to assess the differences between the model-implied and the empirical correlation matrix, showed that the data included more information that what the model could represent (Henseler et al. 2016). Then, the direction of arrows were changed from the items to construct in PP and NP, and so PP and NP changed to formative constructs. However, the results of the assessment of the measurement model assuming a formative PP and NP showed high collinearity and VIF for some PP- and NP-related items. One possible reason for this high collinearity among some of the PP and NP items may be their similarity with items used to measure the dimensions of PP and NP. We used these items to measure the economic, social, cultural, and environmental aspects of residents' positive and negative perceptions toward tourism development. Moreover, the results of CTA-PLS showed that only some tetrads differed significantly from zero, which would suggest that not all the PP and NP items were necessarily formative. This finding is consistent with the existing resident perception literature, which suggests that residents might differ, both qualitatively and quantitatively, in their perceptions of the impacts of tourism. For instance, the perception of economic impacts of tourism in a community might be high, while few people might perceive the social or environmental impacts. This would justify going forward with the second alternative and establishing PP and NP as second-order constructs inclusive of perceptions of economic, cultural, social, and environmental tourism impacts.

This study performed CTA-PLS for the second alternative model, assuming PP and NP as multidimensional second-order constructs. The results of CTA-PLS

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showed that all tetrads were significantly different from zero, thus confirming the formative nature of the second-order PP and NP constructs. Moreover, the results for the fit indices for the reflective second-order PP and NP constructs were not acceptable; but when articulated as formative second-order constructs, the results for PP and NP showed SRMR, d_G, and d_ULS values that were lower than the upper value of $CI_{0.95}$ and acceptable (Henseler et al. 2016). Therefore, according to the results of CTA-PLS analysis, the measurement model criteria, and the model fit indices, the best alternative to measure PP and NP in studies of residents' perceptions is to assume a reflective-formative second-order construct inclusive of perceived economic, social, cultural, and environmental impacts.

12.8 Conclusion

To the best of our knowledge, all previous studies in Asian countries of residents' perceptions toward tourism development have assumed that resident's negative and positive perceptions constitute a reflective construct. However, the results of the current study show that the PP and NP are in fact formative nature. In addition, this study identified that the best alternative with which to conceptualize PP and NP is as a reflective-formative multidimensional second-order construct that is inclusive of perceived economic, social, cultural, and environmental impacts, and not as a formative unidimensional construct. These findings amount to a significant theoretical and methodological contribution to the resident perception literature. However, it should be noted that this study was focused entirely on studies of Asian countries and that the data we analyzed was collected from a single case in Malaysia. As such, this study is not without its limitations, and caution should be exercised before generalizing these findings to other geographic locations and communities. More studies are required, in both the Asian and international contexts, to confirm these findings.

The misconceptualization of a measurement model in a study will almost invariably lead to biased and invalid results for the structural model. Therefore, the findings of this study raise a number of concerns about the validity of the results of previous studies of residents' perceptions. Local authorities and correspondence organizations may wish to reconsider the findings of previous studies by correcting the measurement models to arrive at more acceptable and valid structural-level findings. Further research should be undertaken in the future to understand residents' perceptions, with this research assuming formative instead of reflective measures.

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Appendices

Appendix A-1: Results of CTA-PLS for first-order PP

PP	Tetrad value	*P*-values	Bias	CI low	CI up	Supported (reflective)
1: PP1,PP10,PP11,PP12	0.010	0.227	0.000	–0.004	0.024	YES
2: PP1,PP10,PP12,PP11	0.004	0.775	0.000	–0.018	0.025	YES
4: PP1,PP10,PP11,PP13	0.010	0.217	0.000	–0.004	0.023	YES
6: PP1,PP11,PP13,PP10	–0.023	0.042	0.001	–0.040	–0.004	YES
7: PP1,PP10,PP11,PP14	0.006	0.341	0.000	–0.005	0.016	YES
10: PP1,PP10,PP11,PP2	–0.001	0.771	0.000	–0.009	0.006	YES
13: PP1,PP10,PP11,PP3	0.005	0.330	0.000	–0.004	0.014	YES
17: PP1,PP10,PP4,PP11	–0.028	0.154	0.001	–0.060	0.005	YES
20: PP1,PP10,PP5,PP11	–0.043	0.040	0.001	–0.077	–0.007	NO
24: PP1,PP11,PP6,PP10	–0.045	0.048	0.001	–0.082	–0.006	NO
27: PP1,PP11,PP7,PP10	–0.024	0.114	0.001	–0.049	0.002	YES
31: PP1,PP10,PP11,PP9	0.001	0.866	0.000	–0.013	0.016	YES
42: PP1,PP12,PP2,PP10	–0.051	0.040	0.001	–0.091	–0.009	NO
52: PP1,PP10,PP12,PP6	0.003	0.769	0.000	–0.016	0.022	YES
56: PP1,PP10,PP7,PP12	–0.010	0.472	0.000	–0.031	0.012	YES
58: PP1,PP10,PP12,PP8	–0.002	0.808	0.000	–0.012	0.009	YES
59: PP1,PP10,PP8,PP12	–0.035	0.086	0.001	–0.068	–0.001	YES
62: PP1,PP10,PP9,PP12	–0.024	0.169	0.001	–0.053	0.006	YES
66: PP1,PP13,PP14,PP10	–0.002	0.787	0.000	–0.014	0.010	YES
78: PP1,PP13,PP5,PP10	–0.012	0.405	0.000	–0.037	0.013	YES
92: PP1,PP10,PP2,PP14	–0.015	0.575	0.000	–0.058	0.029	YES
98: PP1,PP10,PP4,PP14	0.001	0.967	0.000	–0.026	0.027	YES
100: PP1,PP10,PP14,PP5	0.001	0.898	0.000	–0.013	0.015	YES
104: PP1,PP10,PP6,PP14	–0.004	0.817	0.000	–0.032	0.024	YES
114: PP1,PP14,PP9,PP10	0.010	0.515	0.000	–0.016	0.036	YES
121: PP1,PP10,PP2,PP5	–0.013	0.528	0.000	–0.048	0.021	YES
134: PP1,PP10,PP9,PP2	–0.010	0.468	0.000	–0.033	0.013	YES
144: PP1,PP3,PP6,PP10	0.016	0.417	–0.001	–0.017	0.047	YES
146: PP1,PP10,PP7,PP3	–0.002	0.874	0.000	–0.021	0.017	YES
161: PP1,PP10,PP7,PP4	0.004	0.784	0.000	–0.020	0.026	YES
163: PP1,PP10,PP4,PP8	–0.007	0.524	0.000	–0.024	0.011	YES
166: PP1,PP10,PP4,PP9	–0.030	0.110	0.001	–0.061	0.002	YES
176: PP1,PP10,PP8,PP5	–0.001	0.939	0.000	–0.031	0.027	YES
179: PP1,PP10,PP9,PP5	–0.005	0.699	0.000	–0.024	0.015	YES
181: PP1,PP10,PP6,PP7	–0.001	0.950	0.000	–0.032	0.030	YES
194: PP1,PP10,PP9,PP7	–0.013	0.346	0.000	–0.036	0.010	YES
245: PP1,PP11,PP6,PP13	–0.038	0.062	0.001	–0.071	–0.003	YES

(continued)

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PP	Tetrad value	*P*-values	Bias	CI low	CI up	Supported (reflective)
249: PP1,PP13,PP7,PP11	–0.009	0.572	0.000	–0.034	0.017	YES
278: PP1,PP11,PP9,PP14	–0.020	0.195	0.001	–0.045	0.006	YES
284: PP1,PP11,PP4,PP2	0.004	0.726	0.000	–0.015	0.022	YES
291: PP1,PP2,PP6,PP11	0.019	0.282	–0.001	–0.011	0.048	YES
301: PP1,PP11,PP3,PP4	–0.026	0.193	0.001	–0.058	0.007	YES
307: PP1,PP11,PP3,PP6	–0.010	0.450	0.000	–0.032	0.012	YES
330: PP1,PP4,PP8,PP11	–0.019	0.286	0.000	–0.048	0.011	YES
337: PP1,PP11,PP5,PP7	–0.023	0.158	0.000	–0.049	0.004	YES
365: PP1,PP12,PP14,PP13	–0.018	0.351	0.000	–0.050	0.014	YES
391: PP1,PP12,PP14,PP2	–0.002	0.769	0.000	–0.012	0.009	YES
424: PP1,PP12,PP2,PP6	–0.058	0.067	0.001	–0.109	–0.004	YES
452: PP1,PP12,PP9,PP3	–0.014	0.365	0.000	–0.040	0.012	YES
457: PP1,PP12,PP4,PP6	–0.018	0.391	0.000	–0.053	0.017	YES
467: PP1,PP12,PP9,PP4	–0.028	0.202	0.001	–0.062	0.009	YES
537: PP1,PP2,PP7,PP13	0.044	0.065	–0.001	0.004	0.083	YES
544: PP1,PP13,PP3,PP4	–0.002	0.952	0.000	–0.052	0.049	YES
547: PP1,PP13,PP3,PP5	–0.007	0.752	0.000	–0.043	0.029	YES
551: PP1,PP13,PP6,PP3	0.004	0.848	0.000	–0.027	0.034	YES
553: PP1,PP13,PP3,PP7	–0.012	0.577	0.000	–0.049	0.025	YES
557: PP1,PP13,PP8,PP3	–0.010	0.601	0.000	–0.039	0.021	YES
600: PP1,PP7,PP8,PP13	–0.028	0.076	0.001	–0.054	–0.001	YES
644: PP1,PP14,PP9,PP3	0.009	0.484	0.000	–0.012	0.029	YES
678: PP1,PP6,PP8,PP14	–0.011	0.428	0.000	–0.034	0.012	YES
715: PP1,PP2,PP4,PP7	0.066	0.035	–0.001	0.013	0.117	NO
755: PP1,PP3,PP5,PP4	–0.013	0.603	0.000	–0.055	0.029	YES
766: PP1,PP3,PP4,PP9	0.019	0.176	0.000	–0.005	0.043	YES
800: PP1,PP4,PP6,PP5	–0.029	0.113	0.001	–0.058	0.002	YES
848: PP1,PP6,PP8,PP7	–0.030	0.287	0.000	–0.076	0.016	YES
1021: PP10,PP11,PP8,PP9	0.051	0.036	–0.001	0.010	0.090	NO
1361: PP10,PP2,PP7,PP3	–0.018	0.410	0.000	–0.053	0.018	YES
1377: PP10,PP4,PP7,PP2	–0.016	0.170	0.000	–0.036	0.004	YES
1378: PP10,PP2,PP4,PP8	–0.004	0.823	0.000	–0.036	0.027	YES
1464: PP10,PP5,PP7,PP4	–0.024	0.123	0.001	–0.048	0.002	YES
1478: PP10,PP4,PP9,PP6	–0.053	0.072	0.001	–0.099	–0.003	YES
1656: PP11,PP14,PP2,PP13	0.005	0.744	0.000	–0.022	0.031	YES
1819: PP11,PP14,PP5,PP7	0.018	0.201	0.000	–0.006	0.042	YES
1969: PP11,PP4,PP6,PP8	0.036	0.021	–0.001	0.009	0.061	NO
2077: PP12,PP13,PP4,PP5	0.120	0.003	–0.003	0.051	0.184	NO
2153: PP12,PP14,PP7,PP3	0.059	0.010	–0.001	0.021	0.096	NO
2353: PP12,PP5,PP7,PP8	–0.008	0.637	0.000	–0.037	0.021	YES
2562: PP13,PP7,PP9,PP3	–0.018	0.387	0.000	–0.052	0.016	YES

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Appendix A-2: Results of CTA-PLS for first-order NP

NP	Tetrad value	*P*-values	Bias	CI low	CI up	Supported (reflective)
1: NP1,NP10,NP11,NP12	0.032	0.418	–0.001	–0.034	0.094	YES
2: NP1,NP10,NP12,NP11	0.122	0.361	–0.005	–0.103	0.338	YES
4: NP1,NP10,NP11,NP13	0.061	0.075	–0.002	0.002	0.115	YES
6: NP1,NP11,NP13,NP10	0.238	0.036	–0.006	0.046	0.419	NO
10: NP1,NP10,NP11,NP15	0.020	0.522	–0.001	–0.032	0.069	YES
13: NP1,NP10,NP11,NP2	–0.007	0.763	0.000	–0.044	0.031	YES
17: NP1,NP10,NP3,NP11	–0.932	0.000	0.023	–1.206	–0.611	NO
20: NP1,NP10,NP4,NP11	–0.548	0.000	0.016	–0.765	–0.299	NO
24: NP1,NP11,NP5,NP10	–0.688	0.000	0.018	–0.935	–0.406	NO
25: NP1,NP10,NP11,NP6	0.017	0.649	–0.001	–0.045	0.077	YES
27: NP1,NP11,NP6,NP10	–0.523	0.000	0.014	–0.756	–0.262	NO
31: NP1,NP10,NP11,NP8	0.035	0.479	–0.001	–0.048	0.114	YES
36: NP1,NP11,NP9,NP10	–0.225	0.049	0.007	–0.407	–0.029	NO
38: NP1,NP10,NP13,NP12	0.347	0.001	–0.010	0.172	0.501	NO
41: NP1,NP10,NP14,NP12	0.258	0.023	–0.008	0.063	0.437	NO
43: NP1,NP10,NP12,NP15	0.234	0.011	–0.008	0.075	0.378	NO
47: NP1,NP10,NP2,NP12	–0.580	0.000	0.017	–0.799	–0.325	NO
50: NP1,NP10,NP3,NP12	–0.523	0.000	0.015	–0.724	–0.293	NO
68: NP1,NP10,NP9,NP12	–0.092	0.069	0.003	–0.172	–0.006	YES
73: NP1,NP10,NP13,NP15	0.473	0.000	–0.013	0.263	0.658	NO
76: NP1,NP10,NP13,NP2	0.014	0.817	0.000	–0.084	0.112	YES
80: NP1,NP10,NP3,NP13	–0.524	0.000	0.013	–0.718	–0.304	NO
88: NP1,NP10,NP13,NP6	0.179	0.045	–0.004	0.028	0.322	NO
93: NP1,NP13,NP7,NP10	–0.301	0.022	0.007	–0.510	–0.077	NO
98: NP1,NP10,NP9,NP13	–0.040	0.159	0.001	–0.085	0.008	YES
110: NP1,NP10,NP4,NP14	–0.259	0.004	0.008	–0.397	–0.105	NO
112: NP1,NP10,NP14,NP5	0.133	0.135	–0.004	–0.017	0.276	YES
115: NP1,NP10,NP14,NP6	0.123	0.253	–0.003	–0.057	0.297	YES
123: NP1,NP14,NP8,NP10	–0.154	0.294	0.004	–0.392	0.091	YES
124: NP1,NP10,NP14,NP9	0.204	0.113	–0.006	–0.013	0.410	YES
130: NP1,NP10,NP15,NP3	0.027	0.754	0.000	–0.113	0.166	YES
134: NP1,NP10,NP4,NP15	–0.297	0.002	0.009	–0.449	–0.127	NO
140: NP1,NP10,NP6,NP15	–0.192	0.036	0.004	–0.339	–0.038	NO
152: NP1,NP10,NP3,NP2	0.002	0.984	–0.001	–0.168	0.171	YES
161: NP1,NP10,NP6,NP2	–0.097	0.108	0.003	–0.194	0.005	YES
175: NP1,NP10,NP3,NP5	–0.386	0.001	0.009	–0.565	–0.187	NO
185: NP1,NP10,NP8,NP3	0.046	0.312	–0.001	–0.030	0.120	YES
186: NP1,NP3,NP8,NP10	0.843	0.000	–0.021	0.535	1.109	NO
192: NP1,NP4,NP5,NP10	–0.060	0.671	0.000	–0.294	0.173	YES

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NP	Tetrad value	*P*-values	Bias	CI low	CI up	Supported (reflective)
200: NP1,NP10,NP8,NP4	–0.009	0.876	0.000	–0.099	0.081	YES
202: NP1,NP10,NP4,NP9	–0.477	0.000	0.013	–0.667	–0.261	NO
213: NP1,NP5,NP8,NP10	0.568	0.001	–0.015	0.285	0.822	NO
250: NP1,NP11,NP12,NP4	0.025	0.744	–0.001	–0.102	0.152	YES
270: NP1,NP13,NP14,NP11	–0.032	0.483	0.001	–0.105	0.044	YES
326: NP1,NP11,NP2,NP15	–0.539	0.001	0.014	–0.784	–0.266	NO
333: NP1,NP15,NP4,NP11	–0.485	0.001	0.011	–0.710	–0.238	NO
361: NP1,NP11,NP2,NP7	–0.963	0.000	0.025	–1.263	–0.613	NO
365: NP1,NP11,NP8,NP2	0.027	0.528	0.000	–0.044	0.097	YES
428: NP1,NP11,NP9,NP7	–0.221	0.070	0.007	–0.414	–0.013	YES
433: NP1,NP12,NP13,NP14	0.163	0.082	–0.004	0.005	0.314	YES
470: NP1,NP12,NP3,NP14	–0.589	0.000	0.016	–0.807	–0.339	NO
507: NP1,NP15,NP7,NP12	–0.492	0.000	0.013	–0.709	–0.249	NO
522: NP1,NP2,NP5,NP12	0.179	0.124	–0.006	–0.019	0.364	YES
549: NP1,NP3,NP8,NP12	0.409	0.000	–0.011	0.212	0.584	NO
589: NP1,NP12,NP7,NP8	–0.111	0.444	0.003	–0.348	0.131	YES
636: NP1,NP15,NP5,NP13	–0.909	0.000	0.022	–1.151	–0.624	NO
643: NP1,NP13,NP15,NP8	0.086	0.078	–0.001	0.004	0.165	YES
684: NP1,NP3,NP8,NP13	0.404	0.000	–0.010	0.210	0.579	NO
696: NP1,NP4,NP7,NP13	0.218	0.019	–0.007	0.057	0.364	NO
751: NP1,NP14,NP15,NP8	0.084	0.084	–0.002	0.002	0.161	YES
777: NP1,NP2,NP9,NP14	0.603	0.000	–0.016	0.371	0.803	NO
799: NP1,NP14,NP4,NP6	–0.214	0.070	0.006	–0.403	–0.014	YES
859: NP1,NP15,NP2,NP9	–0.759	0.000	0.018	–0.986	–0.495	NO
861: NP1,NP2,NP9,NP15	0.698	0.000	–0.018	0.447	0.913	NO
867: NP1,NP3,NP5,NP15	0.472	0.000	–0.012	0.266	0.655	NO
921: NP1,NP7,NP9,NP15	0.110	0.173	–0.003	–0.025	0.240	YES
932: NP1,NP2,NP6,NP3	–0.006	0.969	0.000	–0.244	0.233	YES
951: NP1,NP4,NP7,NP2	–0.052	0.455	0.001	–0.166	0.064	YES
960: NP1,NP5,NP6,NP2	–0.090	0.075	0.003	–0.170	–0.004	YES
971: NP1,NP2,NP7,NP6	0.715	0.000	–0.018	0.421	0.973	NO
991: NP1,NP3,NP4,NP6	0.286	0.038	–0.005	0.055	0.507	NO
996: NP1,NP4,NP7,NP3	0.043	0.696	–0.002	–0.142	0.224	YES
1001: NP1,NP3,NP9,NP4	0.257	0.018	–0.005	0.074	0.430	NO
1040: NP1,NP4,NP8,NP5	0.191	0.063	–0.007	0.015	0.354	YES
1055: NP1,NP4,NP8,NP7	0.497	0.001	–0.015	0.232	0.732	NO
1080: NP1,NP8,NP9,NP5	–0.034	0.607	0.001	–0.141	0.076	YES
1086: NP1,NP7,NP9,NP6	–0.092	0.424	0.004	–0.278	0.101	YES
1090: NP1,NP7,NP8,NP9	0.072	0.269	–0.001	–0.037	0.179	YES
1156: NP10,NP11,NP14,NP15	1.349	0.000	–0.033	0.912	1.718	NO
1192: NP10,NP11,NP15,NP5	0.011	0.951	–0.003	–0.289	0.304	YES
1290: NP10,NP8,NP9,NP11	–0.016	0.447	0.001	–0.051	0.020	YES
1576: NP10,NP13,NP6,NP8	0.172	0.014	–0.004	0.053	0.282	NO

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NP	Tetrad value	*P*-values	Bias	CI low	CI up	Supported (reflective)
1838: NP10,NP2,NP8,NP7	–0.022	0.800	–0.001	–0.168	0.121	YES
1870: NP10,NP3,NP5,NP9	0.050	0.318	–0.001	–0.034	0.131	YES
1929: NP10,NP6,NP9,NP5	–0.521	0.001	0.010	–0.765	–0.257	NO
2506: NP11,NP3,NP4,NP5	–0.254	0.062	0.006	–0.471	–0.024	YES
2665: NP12,NP13,NP2,NP4	0.736	0.000	–0.022	0.420	1.008	NO
2827: NP12,NP14,NP5,NP7	0.430	0.000	–0.012	0.223	0.614	NO
3005: NP12,NP3,NP6,NP4	–0.127	0.344	0.004	–0.345	0.097	YES
3544: NP14,NP15,NP7,NP9	1.019	0.000	–0.024	0.684	1.306	NO

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