An Assessment of Prospect Theory in Tourism Decision-Making Research

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Accepted for publication in the **Journal of Travel Research**.

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Abstract

Prospect theory has been an essential theoretical foundation for behavioral economics, as recognized with the Nobel Prize in economic sciences in 2002. The growing interest in behavioral economics among tourism researchers necessitates a systematic assessment of prospect theory and its application in tourism research to critically examine the current status of tourism decision-making studies. This study therefore clarifies the theoretical background of prospect theory and analyzes 93 published studies to examine how prospect theory has performed in explaining tourism decision-making. The study also evaluates the application of prospect theory in tourism research and provides future research directions with respect to under-researched dimensions, reference points, dynamic decision-making processes and the logical continuity and systemization of prospect theory.

Keywords: Prospect theory, Decision making, Tourist behavior, Behavioral economics

1. Introduction

Understanding human behavior is crucial for both tourism researchers and practitioners. Intensive business activities involve decision making throughout the entire process of production and consumption. Both suppliers and consumers must make decisions under risk and uncertainty given the intangibility, inseparability, heterogeneity and perishability of the tourism products as well as various objective forces that may deter consumption such as natural/economic crises, cultural conflicts and political issues.

By integrating psychological factors with economic principles, behavioral economics (BE) aims to explain decision making primarily arising from the bounded rationality of economic agents due to cognitive biases and environmental influences (Simon, 1956). As a keystone of BE, prospect theory (PT) has been used to study individual decision-making patterns in risky and uncertain situations and how these decisions diverge from those made by the perfectly rational actors of classical economic theories. Since its first publication by Daniel Kahneman and Amos Tversky (1979), PT has been adopted in various economic contexts, such as finance, insurance and savings (Barberis, 2013) and has become a fundamental theoretical framework in which numerous BE concepts are rooted. Kahneman received the Nobel Prize in economic sciences in 2002 for his contribution to PT.

In general, PT centers on the concept of reference dependence, which posits that the individual decision-making process hinges on the potential losses or gains relative to a reference point rather than an absolute value. Furthermore, loss aversion and diminishing sensitivity respectively dictate that individuals react more to losses than gains and that sensitivities toward potential losses/gains tend to decline as losses/gains grow. These three main principles set the foundation

for behavioral economic research in various disciplines. PT remains widely considered the most effective description of people's risk attitudes and decisions in experimental settings (Pan, 2019).

PT has been used for years in tourism research to analyze decision making and more realistically describe tourists' and firms' choices or preferences. Applying PT to the study of tourism decision-making is important for many reasons. First, many market decisions are made in risky and uncertain circumstances, particularly for tourists, who normally confront advance purchases with limited information about the destination and future conditions. Second, certain prevalent business practices in the tourism industry enhance the relevance of the core tenets of PT, such as the tenet of reference dependence supporting dynamic pricing and the tenet of loss aversion supporting message framing. Third, with behavioral economics theories gaining prominence among tourism studies, researchers must increasingly have in-depth knowledge of PT as a key foundation of behavioral economics to ensure the academic rigor of their research.

In many cases, however, the theory has been fragmented into discrete principles and applied with a lack of comprehensive understanding. For example, some researchers have used the concept of loss aversion without proper contextualization of gains and losses, which may undermine the theoretical contribution of their research. Erroneous conclusions have also been made because of researchers' unfamiliarity with and unawareness of the certainty/possibility effect (as another major element of PT) as an important aspect of the research framework. Therefore, clarifications of the theoretical background of PT are important for correcting previous assertions as well as for guiding future studies.

An assessment of the empirical applications of PT could also advance its further improvement. For one thing, PT was originally established through laboratory experiments using numerical prospect games without reference to commercial goods such that the exact probability of each

possible outcome was known. These settings differ considerably from real-life decision-making contexts. Questions thus remain regarding its validity in specific production/consumption decisions where gains/losses are not absolutely numerical and event probabilities are unforeseeable. In addition, tourism research could enrich and expand PT in view of the characteristics of the service industry. In particular, tourism products are normally intangible, experiential and diverse, involving not just monetary decisions but also the pursuits of non-monetary goals. Tourists' behavior may consequently reveal unique characteristics that differ from consumption decisions on utilitarian goods, which would necessitate a systematic review of the tourism literature to outline potential behavioral patterns and to inspire corresponding theorization.

This study therefore provides a holistic overview of PT and its theoretical background, frames the current state of PT in tourism decision-making analysis and suggests future directions for tourism researchers to incorporate and improve the application of PT to better explain decisions. Based on previous studies that have applied PT to study tourism consumers' or suppliers' decision-making, the present study aims to answer three main research questions: 1) how has PT been adopted in tourism research and been used to describe what types of decisions; 2) what particular behavioral patterns in the tourism industry can be identified that may complement the general principles of PT; and 3) what issues obstruct the application of PT and how can future research be conducted to better utilize PT and remedy these issues to enhance our understanding of tourism decision-making.

2. Theoretical background

Prior to the advent of PT, expected utility theory (EUT) dominated the study of consumer behavior under risk and uncertainty as a normative model of rational choice (Keeney & Raiffa, 1976). Established by von Neumann and Morgenstern (1944), the underlying model proposes that consumers compare the utility values of risky prospects and choose the prospect with the highest utility according to three tenets: 1) the utility value of a prospect is the expected value of all possible outcomes; 2) a prospect is evaluated based on final states defined as the integration of the prospects with one's current wealth/welfare position; and 3) consumers are risk-averse and so prefer certainty over risk when making choices. Individuals thus mathematically evaluate the overall utility (U) of a given prospect as

$$U = \sum_{i=1}^{n} v(W + x_i)p_i,$$

where W denotes current wealth/welfare, x_i is the possible outcome that the prospect yields, p_i indicates the associated probability, and $v(\cdot)$ is the increasing concave value function of utility (Barberis, 2013). However, EUT does not adequately describe actual behavior, as decision-makers systematically violate the underlying tenets. In 1979, Daniel Kahneman and Amos Tversky first proposed PT to explain these key violations and provide a descriptive model of choice, written as

$$U = \sum_{i=1}^{n} v(x_i)w(p_i),$$

where $w(\cdot)$ is a probability weighting function that transforms outcome probabilities into decision weights. The model demonstrates two elements of PT that depart from the axioms of EUT: 1) the utility value of each outcome is weighted by the subjective probability (i.e., decision

weight) rather than the objective or explicit probability and 2) the value function considers not the final states but the relative changes in the decision-makers' wealth/welfare.

The critical difference between EUT and PT can be demonstrated by a hypothetical gamble with a 50% chance to win or lose $100 ($100, 50%; -$100, 50%). If one's current asset is $200, the utility of the gamble under EUT is $v(\$200 + \$100) \times 50\% + v(\$200 - \$100) \times 50\%$, where $v(\cdot)$ is concave. In contrast, the utility evaluation under PT follows $v(\$100)w(50\%) + v(-\$100)w(50\%)$, where $v(\cdot)$ is not concave, and which does not account for the absolute value of the asset and reevaluates the outcome probabilities. The particular shapes of the value function $v(\cdot)$ and the probability weighting function $w(\cdot)$ display the core principles of PT and ultimately portray risk attitudes in decision making.

2.1. Value function

The value function under PT is asymmetric and S-shaped and passes through the axis of the reference point (Figure 1). Incorporating three properties underlying the three main principles of PT, the function markedly contrasts with the concave function adopted in EUT.

Reference dependence. The argument of the value function is the deviation from a certain reference point with the potential outcomes designated as either gains or losses. In the assessment of the monetary outcomes, the reference point normally matches one's current wealth position, while gains and losses coincide with changes in wealth. Nevertheless, the reference point remains susceptible to the construct of the choice problem (Tversky & Kahneman, 1981), the expectation or experience of the decision-maker, social norms and the market environment, and it fails to have a certain location when evaluating nonmonetary outcomes or even monetary outcomes. For example, a consumer holds in mind a reference price before booking a hotel. Any

market prices lower/higher than the reference price would be considered as a potential gain/loss (e.g., Liang & Chen, 2012; Smith, 2016). The reference price can change over time and vary across individuals, and may affect their willingness to pay (Smith, 2016). In this regard, PT provides limited insights into the determination of the reference point.

Loss aversion. People code potential outcomes relative to the reference point and react to gains and losses differently, as shown by the steepness of the value function in the loss domain relative to the gain domain ($v'(x) < v'(-x)$), indicating a higher sensitivity of utility valuations to losses. This is supported by decision-makers' pronounced reluctance to accept fair bets ($x, 0.5; -x, 0.5$), which grows with the value of the bet (Kahneman & Tversky, 1979). To continue the hotel booking example above, loss aversion suggests that a market price \$10 higher than the reference price would hurt more than a market price \$10 lower than the reference price would compensate in terms of the consumer's consumption decision. Empirical studies have found that both consumers (e.g., Grazzini et al., 2018) and managers (e.g., Raue et al., 2015) differently perceive loss and gain scenarios despite identical absolute amounts.

Diminishing sensitivity. The marginal utility value, or one's sensitivity to changes in outcomes, decreases as gains or losses increase, resulting in a concave gain domain ($v''(x) < 0$) and a convex loss domain ($v''(-x) > 0$). For instance, a shift of gain or loss from 100 to 200 has a greater impact on utility than a shift of equal magnitude from 1100 to 1200 (Kahneman & Tversky, 1979). In the hotel booking process, a consumer's decision could similarly be less deterred by a one-time fixed-amount charge than by multiple small-amount charges over time (Yu et al., 2019). The functional curvature entails that people tend to be risk-averse when presented with potential gains because of fear of disappointment but risk-seeking when presented with potential losses in the hope of avoiding them.

[Insert Figure 1.]

However, the value function alone does not adequately reflect individual risk attitudes in decision making because of the transformation of probabilities into decision weights, which jointly shape decisions under risk. In the original proposal of PT, Kahneman and Tversky (1979) deduced that low probabilities are overweighted, whereas moderate to high probabilities are underweighted. Importantly, overweighting/underweighting differs from overestimation/underestimation, as the former measures the magnitude of the impact an outcome has on the final utility evaluation, whereas the latter describes the perceived likelihood that an uncertain outcome will occur. Yet the exact functional forms of $v(\cdot)$ and $w(\cdot)$ were not offered, restricting the applicability of PT as a descriptive model. This, together with other limitations discussed in the next section, motivated the development of a modified version of PT called cumulative prospect theory (CPT).

2.2. Cumulative prospect theory and probability weighting function

Informed by the later rank-dependent or cumulative model for decision under risk (Quiggin, 1982) and uncertainty (Schmeidler, 1989), Tversky and Kahneman (1992) proposed the CPT to resolve two major problems within the original weighting scheme of PT: the possible violations of stochastic dominance and the small number of manageable outcomes. These changes give CPT several advantages over PT. First, its applications extend to include not only risky prospects (known probabilities) but also uncertain prospects (unknown probabilities). Second, the cumulative probability weighting function transforms the entire distribution rather than each probability discretely. Third, the model can accommodate prospects with unlimited outcomes. Finally, CPT allows independent weighting schemes for gains and losses.

CPT provides the specific value function and probability weighting function, both of which exhibit diminishing sensitivity toward their endpoints (i.e., 0 and 1), leading to an inverse S-shaped configuration (Figure 2). Therefore, the probability weighting function is concave at low probabilities and convex at moderate to high probabilities, as represented by the following fitted functional form:

$$w(p) = \frac{p^{\gamma}}{(p^{\gamma}+(1-p)^{\gamma})^{1/\gamma}},$$

where γ denotes the estimated parameter that varies for gains and losses. Tversky and Kahneman (1992) found that the probability weighting function for gains distorts slightly more than that for losses ($\gamma^{+} < \gamma^{-}$), particularly in moderate and high probabilities. In both positive and negative prospects, the magnitude of underweighting is greater than that of overweighting ($w(p) + w(1-p) < 1$).

[Insert Figure 2.]

Furthermore, the value function is fitted using a two-part power function written as

$$v(x) = \begin{cases} -\lambda(-x)^{\beta}, x < 0 \\ x^{\alpha}, x \geq 0 \end{cases}.$$

Integrating the value and probability weighting functions reveal the complete picture of individual risk attitudes under risk and uncertainty, referred to as the "fourfold pattern of risk attitudes" (Table 1). This pattern introduces the other two key principles within PT: the *certainty effect* and the *possibility effect*. The former considers high-probability situations where probabilities of gains and losses are underweighted, ensuring risk aversion for gains due to fear of disappointment but risk-seeking for losses because of the hope of avoiding them. This may provide an explanation for gambling addiction and aggressive strategies when gamblers are

losing money. Conversely, when the possibility effect activates in low-probability situations, risk-seeking occurs in the gain domain due to the hope of larger gains and risk aversion in the loss domain because of the fear of larger losses, as people overweight the probabilities of gains and losses (Kahneman, 2011). For example, the possibility effect can be shown by the great travel deterrence that a terrorist attack generates on potential tourists as a result of their overweighting the probability of such an incident.

[Insert Table 1.]

The formulation of PT was a prominent milestone in the study of human decision-making. Although developed from risk prospects with explicit probabilities through laboratory experiments, PT has demonstrated great generalizability and power to explain behavior under risky, uncertain and riskless situations within finance (e.g., Barberis & Huang, 2008), insurance (e.g., Sydnor, 2010) and savings/consumption (e.g., Köszegi & Rabin, 2009). With its solid theoretical combination of economics and psychology, PT has become a keystone of BE that underpins many well-known principles and concepts.

2.3. Other relevant principles

PT distinguishes two phases in decision making: the editing phase, wherein organization and reformulation of prospect options occurs, and the evaluation phase, wherein edited prospects are evaluated and the option of highest utility is chosen (Kahneman & Tversky, 1979). The *framing effect*, likely the most notable principle related to PT, depicts a particular behavioral pattern in the editing phase such that different ways to frame the acts, contingencies and outcomes in one decision problem can predictably influence the editing phase and subsequently alter final

decisions (Tversky & Kahneman, 1981). However, PT is primarily a descriptive model of risky choice that stresses the evaluation phase and provides superior explanations of human decisions than EUT (as a normative model) does. The framing effect reflects the manipulability of preference beyond the decision-makers themselves that empirically violates the theory of rational choice, whereas PT acts as an explanatory framework to axiomatize the consequential decision-making pattern (Tversky & Kahneman, 1986).

As mentioned above, the analysis of risky choice to riskless choice importantly extends PT, primarily by including consumption and trades/transactions. Inspired by the arguments from Thaler (1980) about the relationship between *mental accounting* and consumption behavior, Kahneman and Tversky (1984) proposed that a mental account is formed to specify the advantages and disadvantages associated with accepting a consumption offer or transaction. The formulation of this mental account as minimal, topical, or comprehensive leads to different choices. Moreover, by assuming that the status quo is the reference point, people tend to be biased against accepting a new option because loss aversion magnifies disadvantages. This retention of the status quo is termed *status quo bias* (Samuelson & Zeckhauser, 1988). Conversely, the *endowment effect* asserts that people are also reluctant to sacrifice the value of their initial endowment (Thaler, 1980), as indicated by the gaps between willingness to accept (WTA) and willingness to pay (WTP). Status quo bias and the endowment effect are essentially manifestations of loss aversion in riskless situation. Tversky and Kahneman (1991) formalized riskless choice behavior using the reference-dependent model, in which indifference curves are reshaped according to reference points to display loss aversion and diminishing sensitivity.

The principle of *negativity bias* suggests that negative entities generate stronger psychological effects on decision-makers than neutral and positive entities (Rozin & Royzman, 2001).

Although its similarity to loss aversion has caused confusion among researchers, negativity bias has broader applications than loss aversion and has been studied in various domains, including cognition (e.g., Taylor, 1991), impression formation (e.g., Hamilton & Zanna, 1972) and decision making (e.g., Costantini & Hoving, 1973). More narrowly, loss aversion in PT is the investigation and theorization of negativity bias within the domain of risk decisions.

2.4. Advancements and limitations of prospect theory

PT has exerted a profound impact on the study of decision making. Most importantly, it advances the understanding and modeling of the systematic patterns of people's decisions under risk and uncertainty that fail to be depicted and explained by traditional decision-making axioms that presume rational choices based on optimal expected utility. PT utilizes the two-stage decision processes of editing (the coding of losses and gains) and evaluation (the calculation of utility values) and reveals the roles of cognitive factors in distorting the utility from gains/losses and their probabilities. Therefore, PT depicts more real decisions compared to EUT, which essentially models the decisions of perfectly rational agents. Moreover, the modified CPT establishes a comprehensive quantitative framework that formalizes decision-making behavior into continuous functions, which transforms choice behavior into estimable scientific models.

Nonetheless, PT was developed in laboratory settings using numerical prospects with predictable results, and its relevance to real-world behaviors involving various forms of utility (e.g., well-being, satisfaction, fairness) is debatable. This issue might be particularly salient in tourism decision-making, as utilities are not easily observable or quantifiable. PT focuses on the interpretation of risk attitudes but does not include other important influential decision-making factors, such as emotions, heuristics, information sources, and individual differences.

Furthermore, some challenges remain regarding the application of PT to empirical studies, particularly with respect to determining reference points and defining gains and losses. An in-depth review and assessment of past tourism studies on PT and its applications may provide insights for these pending discussions and lead to a better understanding of tourism decision-making.

3. Methodology

To systematically review research progress on the application of PT in tourism decision-making, the authors collected documents in Scopus and Web of Science using the following search terms to identify titles, abstracts and keywords: {"prospect theory," "reference dependence," "loss aversion," "diminishing sensitivity," "certainty effect," OR "possibility effect"} AND {touris*, hospitality, hotel, restaurant, airline, wine, casino, OR cruise}. The first bracket included PT and its five core principles, and the second bracket outlined the field of tourism and hospitality. Without limits on publication year, all of the retrieved English journal articles were exported for further screening, which initially yielded 302 articles. Though other article types such as book reviews, editorial notes, or commentaries would have been excluded, all of the articles were research papers. After removing duplicates, 201 articles were included in the first round of full-text review to assess their relevance according to the following three-tier filtering conditions:

Tier 1 – The study was in tourism context.

Tier 2 – The study applied PT to conduct research.

Tier 3 – The study investigated decision making.

Tier 1 outlined the tourism context according to four main sectors: travel and tourism (e.g., tourism demand, tourist flow, transportation, travel agencies), lodging (e.g., hotels, resorts, sharing accommodation), food and beverage (e.g., restaurants, wine), and recreation (e.g., tourist attractions, sports, casino gambling); these do not include people's daily mobility within their usual environment. In Tier 2, studies were considered to apply PT if it was involved in the establishment of their conceptual framework by either deriving research questions or underpinning research hypotheses. Studies that mentioned PT only to justify their results were

excluded. “Decision making” in Tier 3 referred to the behavioral decisions made by consumers and suppliers, including choices, purchase intentions, managerial decisions, transactions, and policymaking. This tier filtered out the studies that limited their discussions to people’s emotional responses, such as satisfaction and perceptions, without touching on their final decisions. After cross-checking the results and discussing any inconsistencies, the authors removed 23 articles in Tier 1, 67 articles in Tier 2 and 18 articles in Tier 3, resulting in 93 relevant articles for the main review (Figure 3).

[Insert Figure 3.]

The authors agreed to create a worksheet that recorded all the elements to be reviewed. The reviewed elements were determined in view of the key focus of this study (i.e., the application of PT in tourism decision-making) and consisted of three aspects: research design (i.e., research context, target market side, type of decisions, and methods of data collection and data analysis), theoretical application (i.e., applied PT principles, way of applying PT, degree of depth in applying PT, and other incorporated theories/concepts), and summary and assessment (i.e., conceptual framework, findings, and inconsistencies against PT if any). Each author conducted a double-blinded coding process through intensive examination of all the selected articles. The authors performed coding independently and followed an intercoder reliability method. This method can reveal significant and nuanced meanings within qualitative data while also increasing consensus among multiple researchers (O’Connor & Joffe, 2020). The intercoder reliability for each reviewed element that had predetermined coding was 99% (research context), 99% (target market side), 94% (applied PT principles), and 90% (degree of depth in applying PT), respectively, which were above the acceptable threshold of 85% (O’Connor & Joffe, 2020).

The elements without any predetermined coding, particularly the type of decision and way of applying PT, were coded by each author independently. The coding results were aggregated to enable a detailed discussion among the authors to develop a codebook and revise the codes accordingly. Besides, the summarized conceptual framework, findings, and inconsistencies against PT from each author were cross-checked to ensure the accuracy and integrity of the final records. A unified review worksheet was then confirmed.

4. Findings

The selected articles were systematically reviewed and discussed through a preliminary analysis of basic publication information, a deconstruction of their research designs and an in-depth investigation of the theoretical application of PT.

4.1. Preliminary analysis

Since 2000, the number of studies applying PT to tourism decision-making has grown exponentially. Despite an initially slow rate of publication, this topic began drawing attention from researchers in 2011, and its popularity peaked between 2018 and 2022. We also calculated the proportion of PT articles relative to all of the tourism studies published each year to better describe the prevalence of PT in tourism research. The number of tourism studies was counted by summing the annual published articles in all of the journals under the tourism, leisure, and hospitality management categories on Scopus. Despite fluctuating wildly over the years, the proportion of PT articles exhibited a generally increasing trend similar to that of the absolute number of articles (see Figure 4).

To compare the pervasiveness of PT with that of EUT, the articles that applied EUT to analyze tourism decision-making were searched and screened with the same methodology as in Section 3, but the keywords to represent EUT were {“expected utility theory” OR “expected utility”}. In contrast to the growing applications of PT in tourism research, only 14 relevant articles using EUT and published between 2005 and 2022 were identified out of 29 database records (see Appendix 2). The majority have focused on airline management (e.g., Courty & Ozel, 2019; Kim & Hansen, 2015; Zheng et al., 2020) and applied EUT to theoretically assess or simulate certain decision-making processes (e.g., Huang et al., 2019; Mattila et al., 2012; Schwartz, 2006; Wang

et al., 2017). Some studies have also discussed the violations of EUT (De Lapparent, 2010; Delquié, 2008; Schwartz & Chen, 2012), among which the mental process has been proven to distort the theoretically ideal outcome evaluation based merely on economic consequences. These results corroborate the superiority of PT as a descriptive model in tourism research, portraying a clear theoretical trend in decision-making analysis away from the traditional perspective of rational economic agents and toward the boundedly rational humans propounded by BE.

The selected PT articles have been published across 48 journals. More than one third of the journals are tourism, leisure and hospitality management journals where 58 articles (62%) have been published, with particular volume in *Tourism Management*. Journals in the fields of revenue management, transportation, consumer/organizational behavior, marketing, psychology and information systems have also published sampled articles (see Table 2). The search also revealed particularly active scholars in this topic, including Juan Luis Nicolau (14 articles), Egon Smeral (6 articles), Lorenzo Masiero and Yushinori Suzuki (3 articles each).

[Insert Figure 4.]

[Insert Table 2.]

4.2. Research design

Research on tourism decision-making using PT has been conducted around the globe but has centered in North America (29 articles, primarily in the US), Asia (23 articles, primarily in the Greater China area) and Europe (19 articles, primarily in Spain), as shown in Table 3. More than half of the studies are related to travel and tourism (48 articles), followed by lodging (25

articles), with 2 articles in both sectors. In contrast, research related to food and beverage (12 articles) and recreation (10 articles) has been less common.

[Insert Table 3.]

Table 4 summarizes the particular decision-making behaviors examined in the selected articles from two angles: 1) classification of decisions into demand side and supply side depending on whether the applied PT principles explain consumer or supplier behavior and 2) the risky/uncertain or riskless situation where the decision is made. The vast majority of articles (84, 90%) utilized PT to model consumer decision-making, predominantly choice/purchase decisions, but few studies (8, 9%) investigated supplier decision-making. In addition, PT aided in solving evaluation/optimization problems in fuzzy environments confronted by consumers and suppliers. Only 1 article simultaneously targeted both demand and supply sides to dissect their transactions. A relatively smaller proportion of articles (40%) utilized the original PT framework to model decision making under risk and uncertainty, whereas the remainder extended the application of PT to riskless circumstances to study decisions on consumption, acceptance of offers, or particular behaviors. Conversely, studies of the supply side emphasized risk-taking behavior.

[Insert Table 4.]

The selected articles cover a wide variety of methodological approaches (Figure 5). Both empirical and conceptual studies were identified, although the latter comprised only 4% of the sample. Most empirical studies were quantitative, among which most data collection occurred through experiments, secondary data and surveys, and the dominant data analysis method was regression modeling. There were also a small number of qualitative and mixed-method studies.

Excluding the 10 articles in which no data were collected through empirical studies (4 articles using simulation, 2 review articles and 4 conceptual articles), 48 articles (52%) collected data to measure stated behavior, whereas 30 articles (32%) analyze revealed behavior and 5 articles (5%) integrated both stated and revealed behaviors.

[Insert Figure 5.]

4.3. Theoretical application

Within the framework of PT, all five major principles illustrated in Section 2 were applied in the selected articles, and their respective frequencies are shown in Figure 6. In addition, several studies directly utilized the value function and/or probability weighting function of PT as a mathematical vehicle for research. Loss aversion was the most well-known and commonly applied PT principle, appearing in almost 67% of the articles, followed by reference dependence (42%). The other principles were rarely applied, especially the certainty effect and possibility effect. The probability weighting function also drew less attention than the value function. These observations likely illustrate a general lack of complete understanding of PT as an analytical model for decision making under risk and uncertainty and as a predictive structure for risk attitudes when applied to tourism decision-making.

[Insert Figure 6.]

Moreover, a three-stage structure was developed based on the progressively increased depths in theoretical application and knowledge generation and was used to assess the quality of applying PT among the selected articles. The first stage, applying, referred to the direct applications of the theory into various research contexts, and included 18% of the articles (n = 17). In this stage,

certain PT principles/functions were simply employed to solve research problems without any changes or adjustments (e.g., Cui & Ma, 2022; Hernandez-Maskivker et al., 2019). A similar number of articles (21 articles, 23%) were classified into the second stage, exploring, in which the studies aimed to enrich or complement PT principles, for example, to investigate the possible moderators that regulate the patterns of reference dependence (e.g., Sellers & Nicolau, 2021), loss aversion (e.g., Xu & Zeng, 2022), diminishing sensitivity (e.g., Nicolau et al., 2022), and so on. The remaining majority (55 articles, 59%) were all in the stage of developing, which refined and extended PT beyond its original research setting to underpin arguments and help build knowledge in new research fields and topics, including but not limited to sunk cost (e.g., Su et al., 2022), sales promotion (e.g., Lim & Ok, 2022), inventory management (e.g., Li & Yin, 2020), environmental behavior (e.g., Huang et al., 2021), and value of time (e.g., Chen et al., 2020).

To examine how PT has been applied, the conceptual frameworks of the selected articles were reviewed in detail. Theoretical applications fell into three different categories, conforming to the following logical order:

1) Testing significance – to verify if the PT principles remained valid in the applied research contexts (25 articles, 27%);
2) Identifying influencing factors or behavioral impacts – to explore the potential factors affecting the relationships depicted by PT or how the PT-implied behavioral patterns affected other behaviors (10 articles, 11%);
3) Used as a theoretical framework – to presume the PT principles held and adopted them to underpin the development of research questions, hypotheses, or statements (58 articles, 62%).

The remainder of this section expounds the review findings based on the above classifications. See Appendix 1 for a comprehensive summary of all 93 selected articles.

4.3.1. Testing significance

One third of the articles in this category confirmed the validity of PT principles for explaining various tourism decision-making behaviors. The other research outcomes produced several inconclusive results.

First, the PT-implied behavioral patterns are context dependent and vary across individuals. Research has found individual differences in the sensitivity to gains and losses when choosing destinations (Nicolau, 2008) and that the magnitude of asymmetry between gains and losses differed across hotel attributes in hotel choice decisions (Masiero et al., 2016; Román & Martín, 2016). The manifestations of loss aversion and diminishing sensitivity have also been shown to be dissimilar between airline price sensitivities for economy and business classes (Nicolau et al., 2022). In addition, loss aversion does not exist constantly, as insignificant relationships have been obtained between service failure and consumers' subsequent airline choices (Suzuki, 2004) and between the results of large sporting events and the market value of low-risk tourism firms (Nicolau, 2012b). The nature of goods can also reshape consumer decision-making such that they tend to be more risk-seeking for experiential options but more risk-averse for material options, which weakens or even reverses the expected PT pattern of risk attitudes in the choice of experiential goods (Mittal et al., 2019). In realizing these variations, van de Kaa (2008) revised some of the assumptions to construct an extended PT (EPT) framework that incorporates interpersonal heterogeneity and allows for an updated rather than static reference point. EPT better describes choice in the following meta-analysis on a large body of travel behavior

literature (van de Kaa, 2010). However, no additional applications related to EPT in tourism decision-making were identified.

Second, loss aversion can be violated by reverse asymmetries, which have been discovered in visitors' willingness to donate to a national museum (Chang & Mahadevan, 2018), tourists' intentions to revisit a destination (Park & Nicolau, 2019) and various managerial decisions by tourism firms/organizations (Raue et al., 2015). Perhaps these results reflect a behavioral pattern in tourism that remains unidentified, but they may also arise from the framing of the gains and losses in these studies where the presumed reference point may not truly be what is referred to by decision-makers. The determination of reference points can greatly alter the research outcomes. For instance, Sellers and Nicolau (2021) tested the pattern of reference dependence between satisfaction and expenditure in wineries by stipulating the group average of wine tourists' expected satisfaction as the reference point. They found that the behavior conformed to loss aversion and diminishing sensitivity if groups were defined by psychographics, while reverse loss aversion and insignificant diminishing sensitivity were observed when demographic groups were used for analysis. Discrepancies in reference states likely exist between evaluating personal interests and collective interests, so the perceived gains or losses for public goods are not necessarily equivalent to those for individual consumer goods. In addition, as previously stated, the examination of any behavioral pattern or principle should be based on within-context comparisons; between-context comparison embraces diverse evaluation systems and may produce misleading conclusions.

Third, diminishing sensitivity is sometimes violated in paradoxical ways. For example, the positive effect of discounts on hotel room rates (Smith, 2016) and airline fares (Nicolau, 2011b) vanishes or even backfires when discounts exceed a certain level, possibly because consumers

tend to link price with quality, particularly when evaluating hedonic goods. Alternatively, reverse diminishing sensitivity has been discovered among consumers' online reviews that assess hotel location, which produced a linear utility curve for gains but a concave curve for losses (Mellinas et al., 2019). In other words, the positive marginal effect never diminished, but the punishment for undesirable location became increasingly severe. This indicates that location is among consumers' highest priorities for hotel choice and may also suggest a unique evaluation mechanism of electronic word-of-mouth (eWOM) behavior that differs from that of physical consumption.

4.3.2. Identifying influencing factors or behavioral impacts

Eight articles were designed to elucidate the influencing factors underlying PT principles, with particular focus on reference dependence and loss aversion. Research has explored the influencing factors of the choice and adjustment of reference points. For organizational behavior, Short and Palmer (2003) concluded that CEOs normally use internal (external) referents to assess financial performance (production effectiveness), but external referents are more widely used in larger, younger and highly performing firms. For individual consumers, reference prices can be shifted by advertising but are more subject to risk preferences (Song & Jiang, 2019).

Concerning loss aversion, high cultural interest in a destination (Nicolau, 2011a), booking tourism packages through an intermediary (Nicolau, 2013) and bundling purchases (Nicolau & Sellers, 2020) has been shown to mitigate the negative effect of being in a loss domain with an actual price higher than the reference price, with age, household size and marital status also affecting the degree of loss aversion when choosing a destination (Nicolau, 2012a). Fundamentally, Tang et al. (2016) asserted that the summed anticipatory affect intensity (i.e., an additive logic) better explains the formation of loss aversion than the offset of positive emotions

by greater negative emotions (i.e., a subtractive logic). This has been partially supported by the argument that loss aversion arises from increased vigilance and attention (Chark & King, 2022).

One article explored the behavioral impact of loss aversion and found that together with present bias, it positively affected outbound tourists' overspending behavior, which was somewhat alleviated by decision making in groups (Nguyen, 2016). Nonetheless, no systematic conclusions can be made because of the small number of studies in this category. Xu and Zeng (2022) studied tourists' local foods consumption to examine both the factors that influence loss aversion and its behavioral impact in this decision mechanism and concluded that tourists' familiarity with local foods inversely influenced their levels of loss aversion, which in turn stimulated consumption.

4.3.3. Used as a theoretical framework

The vast majority of the selected articles established their research frameworks on the grounds of PT principles and/or functions to study extensive decision-making problems. This subsection subsequently explicates the behavioral patterns and strategies of each underlying principle.

Reference dependence is mainly utilized as the foundation for scenario framing to manipulate decision-makers' reference points and evaluation domains and consequently influence decision making across topics including menu design (Shoemaker et al., 2005), the effectiveness of promotion tools such as bonus versus discount (Byun & Jang, 2015) and percentage-off discount versus free-fee discount (Lim & Ok, 2022), and nudging environmental behavior (Grazzini et al., 2018; Huang et al., 2021). This principle has also been used to explain unplanned visits because on-site stimuli elicit changes in reference points (Hwang & Fesenmaier, 2011).

Loss aversion, as a theoretical basis, is commonly associated with the endowment effect, which can be triggered even without actual endowment of goods (Azar, 2011) and leads downgrade

framing to effectively facilitate upselling tourism services (Mayer et al., 2020). Studies have provided evidence that the endowment effect can outweigh loss aversion among providers of shared accommodations since providers do not adjust the WTA in view of the costs (Teixeira et al., 2020), but the veracity of this statement remains unproven, as cost and loss are not necessarily equivalent. Loss aversion has also been applied to analyze and explain risk-taking behavior in the contexts of auctions (Ashta, 2006), financial investments (Seo & Sharma, 2008), early booking (Rahman et al., 2018), gambling (Flepp et al., 2021) and reactions to sunk costs (Su et al., 2022). In uncertain situations where online reviews and locations greatly inform decisions, risk-taking behavior varies regarding resort and restaurant choices. For example, the locational superiority (inferiority) of a resort can be offset (overcome) by negative (positive) reviews (Tanford & Kim, 2019), whereas positive reviews can dominate consumers' preferences in spite of a restaurant's distance from consumers (Kim & Tanford, 2019). Moreover, several sequential studies have corroborated that loss aversion serves as a critical cause of asymmetric income elasticities through business cycles (Smeral, 2012, 2014, 2017, 2018, 2019; Smeral & Song, 2015), but the effect of loss aversion is not consistently pronounced across all tourism source markets and is sometimes superseded by other economic factors. Finally, a number of studies have aspired to improve strategy formulation by incorporating the loss aversion attitudes of consumers (Mathies et al., 2013; Reese & Kerr, 2013; Sheu, 2014) and policymakers (Benner, 2020).

Diminishing sensitivity informs the study of pricing strategy to enhance consumption through means such as combined-currency pricing (Drèze & Nunes, 2004), collaborative pricing (Kuokkanen, 2016) and left-digit pricing (Zou & Petrick, 2021). While extra charges are unfavorable to utility evaluation compared with one-off charges, their presence has been shown

to indicate quality for sharing accommodations of unsure quality (Dogru et al., 2021). Diminishing sensitivity has also been applied to provide theoretical support for the roles of relative and referent thinking in bidding behavior (Liang & Chen, 2012; Yu et al., 2019).

The *certainty/possibility effect* is instrumental in exploring decision making in risky or uncertain situations. The former helps explain risk-averse behavior with sure gains (e.g., reluctance to cancel booking; Riasi et al., 2018) and risk-seeking behavior with sure losses (e.g., desire for medical tourism; Zolfagharian et al., 2018), while the latter manifests in the profound travel deterrence caused by terrorism, as people dramatically overweigh the likelihood of such events and thus become risk-averse for fear of large losses (Gray & Wilson, 2009). Recent articles have closely examined the impacts of COVID-19 on decision making (e.g., Belarmino et al., 2021; Li et al., 2021). Some have improperly argued that the revealed risk-averse behavior amid the pandemic contradicts the risk-seeking behavior in the loss domain expected by PT because they overlooked the possibility effect. This illustrates that a greater familiarity with certainty/possibility effects as a crucial aspect of PT in analyzing risk attitudes is required for future decision-making research.

Value and *probability weighting functions* in PT have been directly used by several studies either to model choice behavior, such as travel arrangements with flight delays (Wen et al., 2019), online hotel bookings (Masiero et al., 2020) and airline demand (Li & Yin, 2020), or to quantify subjective utilities in fuzzy environments to solve evaluation/optimization problems regarding scenic spots (Cheng et al., 2019), tourism development plans (Abrishamchi et al., 2021), aircraft rerouting (Hu et al., 2021) and tour route design (Cui & Ma, 2022). In addition, the value function of PT has been integrated into the development of new choice models to better describe choice behavior in transportation (Peeters, 2013) as well as the demand for online tourism (Chen

et al., 2021). These applications return to the essence of PT as a descriptive model of choice and decision.

5. Future research directions

Tourism researchers have actively used the principles derived from PT for decision-making analysis. As an advanced descriptive model of decision making, PT has been widely demonstrated to be superior to and to outperform EUT in explaining behaviors (van de Kaa, 2010). Thanks to the prevalence and robustness of reference dependence and loss aversion in utility valuations, PT models choice behavior strategies more realistically than EUT, which considers only a sign-independent utility function. The non-linear probability weighting function in PT accurately incorporates psychological effects on decisions and therefore provides a better description of choices under risk and uncertainty than does the direct integration of event probabilities by EUT to weight choice utilities. In view of these factors, PT has been more popularly studied in tourism literature, which must address risk and uncertainty in both business and consumer decision-making processes.

Nonetheless, the application of PT remains at its initial stage of development with scattered research topics. Many studies have been mutually independent and have lacked the logical connections necessary to systematically explore the unique behavioral characteristics of tourism suppliers/consumers. Furthermore, research contexts targeting decision-making behavior and applied principles have been heavily skewed such that many areas remain under-researched. While some PT principles have been widely confirmed, theoretical inconsistencies in certain circumstances remain to be validated. Some studies have also failed to build their arguments with an in-depth understanding of what PT entails as a behavioral mechanism but instead discussed only partial concepts. This has generated incomplete comprehensions or misapprehensions about PT as other researchers have referred to these studies. Considering these

issues, the present study remedies several prevalent misconceptions and suggests research directions for future studies on PT in tourism decision-making.

5.1. Misconceptions

PT contends that evaluations of utility are reference dependent, concerning either gains or losses. Among the applications of this principle in which gain and loss domains should be framed into scenarios, it is sometimes questionable whether the domains devised by researchers are consistent with those perceived by people when evaluating choices and making decisions (Barberis, 2013; Kahneman & Tversky, 1984). For example, a framed gain/loss of some public benefits was regarded as the consumers' personal gain/loss in the data analysis. However, there might be a marked gap between public benefits and personal benefits, and people's perceptions of their relationship can vary greatly (e.g., Baekgaard, 2017). Misrepresenting the gain and loss domains in the research design likely influences the modeling results and leads to unreliable conclusions. Therefore, we advise future research to thoroughly deliberate on the framing of gains and losses and conduct pre-tests to verify that the chosen gain and loss domains conform to decision-makers' real evaluations.

Unawareness of the certainty/possibility effect involved in the research framework is also a relatively common problem, which partially contributes to the extremely low application frequency of these principles. Among the articles stating that they only applied loss aversion, the actual research questions were associated with not just gains and losses but also the event probabilities, wherein the fourfold pattern of risk attitudes (implying the certainty and possibility effects) should underpin the interpretation of results. Yet some studies have failed to recognize this issue and still used loss aversion to explain behavior. Taking the stance that people should

always be risk seeking in the loss domain because of loss aversion, some studies have concluded that the identified risk-averse behaviors indicated a reversed loss aversion that contradicted PT. However, if the target losses are in low-probability situations, PT predicts a risk-averse attitude toward loss. In this case, the conclusion should not be a reversed loss aversion but rather a confirmed possibility effect (Tversky & Kahneman, 1992). We therefore urge researchers interested in PT to equip themselves with comprehensive knowledge of the theoretical framework, which should not only be limited to the three principles regarding the value function but should also include the probability weighting function and the certainty/possibility effect.

Furthermore, some studies have confounded loss aversion with risk aversion and applied them interchangeably when establishing their research frameworks. This pattern warrants a reiteration of the distinction between the two concepts. Loss aversion is the evaluation pattern whereby a unit loss would reduce a greater amount of utility than a unit gain would increase, as manifested by a steeper value function in the loss domain than in the gain domain (Kahneman & Tversky, 1979). Dismissing the influence of probabilities, loss aversion stimulates a risk-seeking (risk-averse) decision-making attitude for losses (gains) because the marginal benefit of reducing losses (increasing gains) is relatively large (small). Alternatively, risk aversion is a risk attitude characterized by the tendency to sacrifice optimal utility to secure predictable outcomes, and it has no direct correlation with loss aversion (Werner, 2008). A loss-averse agent can subsequently hold opposite risk attitudes under different circumstances, as summarized by the fourfold pattern of risk attitudes (Tversky & Kahneman, 1992). From a quantitative perspective, loss aversion is a property of the value function, whereas risk aversion is a consequence of the integration of the value function and the probability weighting function. Future studies should clearly differentiate these two concepts to avoid using them interchangeably.

5.2. Under-researched dimensions

The majority of the literature has applied PT in the travel and tourism sector, while other sectors such as recreation, food and beverage and event sectors remain understudied. Future research should therefore investigate these fields to understand whether typical behavioral patterns exist in a certain field or across fields to achieve more robust and generalizable results. This would be particularly valuable for markets where tourism is the pillar industry or one sector dominates the provided products/services (e.g., casinos in Macao).

In economics, PT has mostly been used to explain risky/uncertain choices related to individual risk preferences regarding losses and gains. In contrast, tourism literature has concentrated on studying riskless choices on the demand side. Concepts such as anchoring, framing, mental accounting, status quo bias and the endowment effect have been widely incorporated with PT principles for decision-making analysis (e.g., Azar, 2011; Byun & Jang, 2015; Mayer et al., 2020; Shoemaker et al., 2005). However, this type of application may restrict the potential implications of PT, given that risk and uncertainty are not only the core theoretical contexts of PT but also the common decision-making contexts for tourism practitioners given the lack of information and risks from natural, financial and health crises. The foremost crisis in recent years has been the COVID-19 pandemic, which has greatly impacted the tourism industry. However, among the 30 selected articles published since 2020, only 4 have applied PT to examine the changes in people's decision-making amid COVID-19 (Leung & Cai, 2021; Li et al., 2021), market recovery strategies (Pan et al., 2021) and post-pandemic behavior (Belarmino et al., 2021). There remains extensive scope to use PT to explore decision making under these high-risk circumstances. Research questions may include evaluations of the health risk, the potential shifts in evaluation patterns before/during/after COVID-19 and the effectiveness of interventions to

facilitate industry revival. Apart from crises that would cause travel deterrence, decisions involving advanced bookings and gambling also qualify as risky/uncertain situations. Future researchers should further examine risky/uncertain decisions to comprehensively explore the behavioral mechanism shaped by risk preferences, which would require greater knowledge and adoption of the certainty/possibility effect and the probability weighting function under PT.

Besides, few studies have investigated tourism suppliers' managerial decisions and risk-related behaviors. As managers and policymakers can exert great influence on industry development, their choice preferences are worth understanding. In particular, decisions such as financial investment, inventory management, reputation management, employment and business/public strategy evaluation deserve greater attention. Targeting both the supply and demand sides would also yield valuable information regarding to what extent their risk preferences and decisions influence each other and how this interaction can affect final transactional outcomes (e.g., Teixeira et al., 2020).

5.3. Reference points and the dynamic decision-making process

Studies that incorporate reference dependence into their research design have utilized various measures of reference points, including internal reference points such as past/current experience (e.g., Masiero et al., 2016; Masiero & Qiu, 2018; Nicolau, 2008), expectations (e.g., Hernandez-Maskivker et al., 2019) and direct statements (e.g., Smith, 2016) as well as external reference points such as market average (e.g., Mellinas & Nicolau, 2020), major competitors (e.g., Grigolon et al., 2012) and initial endowment (e.g., Lucas & Nemati, 2020; Seo & Sharma, 2018). However, understanding whether the predetermined reference point is the actual reference point in the decision-making process cannot be easily assessed. This remains a major challenge of

applying PT to empirical investigations (Barberis, 2013) and perhaps causes the diverse research outcomes. For example, some of the reverse patterns of loss aversion in the literature may have resulted from the ineffective use of reference points and the inappropriate definition of loss and gain domains. Future research should therefore consider using and comparing multiple measures to find the most appropriate reference point in a given decision-making context (e.g., Suzuki et al., 2001).

In addition, individuals' reference points are likely unstable. On the demand side, many tourism decisions, particularly those made on-site, occur in high frequencies, so normal behavioral patterns may be disturbed by unexpected temporary elements. Pre-trip and post-trip decisions are also susceptible to objective influences, including advertising (Song & Jiang, 2019), word of mouth (Chang & Chen, 2019) and fulfillment of expectations (Park & Nicolau, 2019). On the supply side, managers' reference points are normally subject to the features of their organizations (Short & Palmer, 2003) and the business environment (Hua et al., 2016). Therefore, understanding how reference points adjust as well as their underlying motivators would be particularly useful.

Apart from the adjustment of reference points, future studies should more broadly focus on the dynamic decision-making process. Researchers have favored static decision-making processes by incorporating choice modeling (e.g., Masiero et al., 2020; Wen et al., 2019) and cross-sectional secondary data analysis (e.g., Lucas et al., 2022; Mellinas et al., 2019); however, given the correlations between temporal decisions and experiences, further investigation is needed to capture the long-term evolution of decision-making patterns and the potential causal effects of both intrinsic and extrinsic factors (see, e.g., Smeral, 2012; Smeral & Song, 2015). This could be accomplished by modeling time series data or conducting longitudinal studies.

5.4. Logical continuity and systemization

Future research should consider the logical continuity of research questions when applying PT, particularly as many of the propositions and hypotheses proposed by previous conceptual studies (e.g., Reese & Kerr, 2013; Riasi et al., 2018) remain unverified. In addition, some studies have found contextual inconsistencies against PT principles, which should be further investigated to determine whether they reflect unique behavioral patterns in tourism decision-making processes that challenge the generalizability of PT or arise from problems in research design.

Variations in research conclusions regarding the consistency with PT may have resulted from a variety of measurements across the selected articles. For instance, as an essential variable to specify decisions, WTP has been variously quantified using monetary units (e.g., Román & Martín, 2016), Likert scales (e.g., Smith, 2016) and choice alternatives (e.g., Chen et al., 2020), which could lead to divergent statistical results. Similarly, discrepancies between subjects' stated and revealed preferences may produce disparate conclusions. Furthermore, some studies have confused risk aversion and loss aversion, subsequently utilizing them for the same theoretical arguments. Loss aversion describes the particular asymmetric S-shape of the value function, whereas risk aversion is part of the derived risk preferences that are jointly affected by the value function and probability weighting function. Improper substitution of one for the other can generate spurious behavioral patterns.

Nonetheless, studies have supported that the decision-making processes in tourism have peculiar characteristics. Most tourism products are more experiential than utilitarian and are regarded as luxury goods, so tourists may hold a distinct set of risk preferences compared to those adopted for material purchases (Mittal et al., 2019). Tourism suppliers are subsequently likely to adjust their strategies to account for tourists' behavioral propensities. Behavioral patterns can also shift

across decision-making contexts and individual factors. For example, behavior toward eWOM and environmental behaviors differ from that toward consumer goods, while differences such as age, gender and personality further diversify behavioral patterns (e.g., Masiero & Qiu, 2018). Therefore, future studies should continue to improve PT by exploring the uniqueness and inconsistencies of tourism decision-making that have not been sufficiently explained by PT and by systemizing the heterogeneity of behavioral patterns across individuals and decision-making contexts.

6. Implications and limitations

With growing interest in BE, this study serves as the first systematic review of the application of PT in the context of tourism and highlights the current research outlook, research gaps in the literature and future research directions while illuminating fundamental misconceptions. Future studies can utilize this review to clarify theory and systematically apply PT, as its application entails not merely using the proven conclusions from BE but also exploring the characteristic behavioral patterns of tourism subjects based on the core issues in this field.

Moreover, this study can inspire industry practitioners and policymakers by providing a holistic view of the decision-making processes in the tourism industry. On the one hand, findings associated with consumers' utility valuations, risk preferences and choice propensities can help business managers establish effective business and marketing strategies. Although PT has been shown to effectively explain tourism decision-making, business managers should consider the influences of consumption contexts and consumers' individual differences on the PT-implied behavioral patterns before formulating strategies. In addition, the development of efficient business strategies depends upon accurately locating reference points, which are subject to the evaluation of targets, decision-makers' characteristics and external factors. Besides, the use of price discounts in tourism products needs to be more discreet, as their positive effects can vanish or even backfire at a certain level. Furthermore, consumers' eWOM behavior can diverge from their consumption behavior. For instance, given the increasing marginal effect of undesirable product/service attributes and the nondecreasing marginal effect of desirable attributes shown in online reviews, tourism businesses should attach more importance to customer satisfaction and service failure recovery to improve customer relationship management. On the other hand, supply-side risk-taking behaviors, such as inconsistent reference points, overconfidence and

status quo bias, highlight the potential management biases that must be controlled. The applications of PT value functions for fuzzy decision-making research provide market suppliers and policymakers with practical solutions to evaluate performance and determine optimal planning schemes. And the findings from both the demand and supply sides of tourism offer exceptional opportunities for policymakers to formulate cost-efficient public policies to nudge market participants' behavior and facilitate market transactions.

As in all literature reviews, this study was limited in terms of publication identification and selection. Although the authors only selected English journal articles within two databases (i.e., Scopus and Web of Science), an independent and double-blind coding categorization process ensured the reliability of the findings. Some articles incorporated other theories or concepts together with PT to develop their theoretical arguments (e.g., Grazzini et al., 2018; Mao & Lyu, 2017; Seo & Sharma, 2018), but given the purpose and scope of this study, the review and discussion devoted less attention to the application of those additional theories.

Appendix 1. Summary of the selected PT articles

Author (year) per theoretical application	Research context[1]	Target market side	Type of decision	Decision-making context	Major applied principles
Testing significance					
Suzuki (2000)	T	Demand	Market share/value	Risky/uncertain	Reference dependence, loss aversion
Suzuki et al. (2001)	T	Demand	Market share/value	Riskless	Reference dependence, loss aversion
Suzuki (2004)	T	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Nicolau (2008)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion, diminishing sensitivity
van de Kaa (2010)	T	Demand	Choice/purchase	Risky/uncertain	Reference dependence, loss aversion, diminishing sensitivity, probability weighting function
Nicolau (2011b)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion, diminishing sensitivity
Grigolon et al. (2012)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Nicolau (2012b)	T	Demand	Market share/value	Riskless	Loss aversion

Raue et al. (2015)	L	Supply	Managerial decision	Risky/uncertain	Reference dependence, loss aversion
Masiero et al. (2016)	L	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Román & Martín (2016)	L	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Smith (2016)	L	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Nicolau & Santa-María (2017)	T	Demand	Market share/value	Riskless	Loss aversion
Masiero & Qiu (2018)	T	Demand	Choice/purchase	Riskless	Reference dependence
Rahman et al. (2018)	T	Demand	Choice/purchase	Risky/uncertain	Loss aversion, certainty effect
Chang & Mahadevan (2018)	R	Demand	Choice/purchase	Riskless	Loss aversion
Mittal et al. (2019)	L	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Park & Nicolau (2019)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Mellinas et al. (2019)	L	Demand	eWOM behavior	Riskless	Loss aversion, diminishing sensitivity
Hernandez-Maskivker et al. (2019)	R	Demand	Choice/purchase	Risky/uncertain	Reference dependence, loss aversion

Lucas & Nemati (2020)	R	Demand	Gambling	Risky/uncertain	Loss aversion
Mellinas & Nicolau (2020)	L	Demand	eWOM behavior	Riskless	Reference dependence
Sellers & Nicolau (2021)	F	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion, diminishing sensitivity
Lucas et al. (2022)	R	Demand	Gambling	Risky/uncertain	Loss aversion
Nicolau et al. (2022)	T	Demand	Choice/purchase	Riskless	Loss aversion, diminishing sensitivity
Identifying influencing factors or behavioral impacts					
Short & Palmer (2003)	F	Supply	Managerial decision	Riskless	Reference dependence
Nicolau (2011a)	T	Demand	Choice/purchase	Riskless	Loss aversion
Nicolau (2012a)	T	Demand	Choice/purchase	Riskless	Loss aversion
Nicolau (2013)	T	Demand	Choice/purchase	Riskless	Loss aversion
Nguyen (2016)	T	Demand	Choice/purchase	Riskless	Loss aversion
Tang et al. (2016)	R	Demand	Gambling	Risky/uncertain	Loss aversion
Song & Jiang (2019)	T	Demand	Choice/purchase	Risky/uncertain	Reference dependence
Nicolau & Sellers (2020)	T	Demand	Choice/purchase	Riskless	Loss aversion

Chark & King (2022)	L	Demand	Choice/purchase	Riskless	Loss aversion
Xu & Zeng (2022)	F	Demand	Choice/purchase	Riskless	Loss aversion
Applying as the theoretical basis					
Drèze & Nunes (2004)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion, diminishing sensitivity
Shoemaker et al. (2005)	F	Demand	Choice/purchase	Riskless	Reference dependence
Ashta (2006)	F	Demand	Bidding	Risky/uncertain	Loss aversion
Gray & Wilson (2009)	T	Demand	Choice/purchase	Risky/uncertain	Possibility effect
Azar (2011)	L & T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Hwang & Fesenmaier (2011)	R	Demand	Choice/purchase	Riskless	Reference dependence
Smeral (2012)	T	Demand	Choice/purchase	Riskless	Loss aversion
Liang & Chen (2012)	L	Demand	Bidding	Riskless	Reference dependence, loss aversion, diminishing sensitivity
Reese & Kerr (2013)	R	Demand	Choice/purchase	Riskless	Loss aversion
Peeters (2013)	T	Demand	Choice/purchase	Riskless	Value function
Mathies et al. (2013)	L & T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion

Zhang & Xu (2014)	T	Demand	Evaluation/optimization	Risky/uncertain	Value function
Smeral (2014)	T	Demand	Choice/purchase	Riskless	Loss aversion
Sheu (2014)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Byun & Jang (2015)	R	Demand	Choice/purchase	Riskless	Reference dependence
Tseng et al. (2015)	L	Demand	Evaluation/optimization	Risky/uncertain	Value function
Smeral & Song (2015)	T	Demand	Choice/purchase	Riskless	Loss aversion
Kuokkanen (2016)	T	Demand	Choice/purchase	Riskless	Diminishing sensitivity
Hua et al. (2016)	F	Supply	Managerial decision	Risky/uncertain	Reference dependence
Pavesi et al. (2016)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Mao & Lyu (2017)	L	Demand	Choice/purchase	Risky/uncertain	Reference dependence
Smeral (2017)	T	Demand	Choice/purchase	Riskless	Loss aversion
Riasi et al. (2018)	L	Demand	Choice/purchase	Risky/uncertain	Certainty effect
Seo & Sharma (2018)	F	Supply	Managerial decision	Risky/uncertain	Reference dependence, loss aversion
Zolfagharian et al. (2018)	T	Demand	Choice/purchase	Riskless	Certainty effect
Grazzini et al. (2018)	L	Demand	Environmental behavior	Riskless	Reference dependence

Rahman et al. (2018)	T	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Wang et al. (2018)	L	Supply	Evaluation/optimization	Risky/uncertain	Value function
Smeral (2018)	T	Demand	Choice/purchase	Riskless	Loss aversion
Wen et al. (2019)	T	Demand	Choice/purchase	Risky/uncertain	Value function, probability weighting function
Tanford & Kim (2019)	L	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Kim & Tanford (2019)	F	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Yu et al. (2019)	L	Demand	Bidding	Riskless	Reference dependence, loss aversion, diminishing sensitivity
Cheng et al. (2019)	R	Demand	Evaluation/optimization	Risky/uncertain	Value function
Smeral (2019)	T	Demand	Choice/purchase	Riskless	Loss aversion
Chang & Chen (2019)	L	Demand	eWOM behavior	Riskless	Reference dependence
Teixeira et al. (2020)	L	Both	Transaction	Riskless	Loss aversion
Chen et al. (2020)	T	Demand	Choice/purchase	Risky/uncertain	Reference dependence, loss aversion, diminishing sensitivity
Benner (2020)	T	Supply	Policymaking	Riskless	Reference dependence, loss aversion

Mehraliyev et al. (2020)	F	Demand	eWOM behavior	Riskless	Loss aversion
Masiero et al. (2020)	L	Demand	Choice/purchase	Risky/uncertain	Probability weighting function
Li & Yin (2020)	T	Demand	Choice/purchase	Risky/uncertain	Value function, probability weighting function
Mayer et al. (2020)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion
Zou & Petrick (2021)	L	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion, diminishing sensitivity
Flepp et al. (2021)	R	Demand	Gambling	Risky/uncertain	Loss aversion
Hu et al. (2021)	T	Demand	Evaluation/optimization	Risky/uncertain	Value function
Abrishamchi et al. (2021)	T	Supply	Evaluation/optimization	Risky/uncertain	Value function
Huang et al. (2021)	F	Demand	Environmental behavior	Riskless	Reference dependence
Pan et al. (2021)	T	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Li et al. (2021)	T	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Leung & Cai (2021)	F	Demand	Choice/purchase	Risky/uncertain	Loss aversion
Belarmino et al. (2021)	F	Demand	Choice/purchase	Risky/uncertain	Loss aversion

Chen et al. (2021)	T	Demand	Choice/purchase	Riskless	Value function
Dogru et al. (2021)	L	Demand	Choice/purchase	Riskless	Diminishing sensitivity
Bi et al. (2022)	L	Demand	Evaluation/optimization	Risky/uncertain	Value function
Cui & Ma (2022)	T	Supply	Evaluation/optimization	Risky/uncertain	Value function
Lim & Ok (2022)	L	Demand	Choice/purchase	Riskless	Reference dependence, diminishing sensitivity
Su et al. (2022)	T	Demand	Choice/purchase	Riskless	Reference dependence, loss aversion

[1] T = travel and tourism; L = lodging; R = recreation; F = food and beverage.

Appendix 2. Summary of relevant EUT articles

Author (year)	Research context[1]	Target market side	Type of decision	Relationship to EUT
Squalli (2005)	T	Demand	Choice/purchase	Theoretical assessment
Schwartz (2006)	L	Demand	Choice/purchase	Theoretical assessment
Delquié (2008)	T	Demand	Choice/purchase	Violations of EUT
De Lapparent (2010)	T	Demand	Choice/purchase	Violations of EUT
Mattila et al. (2012)	L	Demand	Choice/purchase	Simulation
Schwartz & Chen (2012)	F	Demand	Choice/purchase	Violations of EUT
Ayra et al. (2014)	T	Supply	Managerial decision	Simulation
Kim & Hansen (2015)	T	Supply	Managerial decision	Empirical application
Wang et al. (2017)	F	Demand	Choice/purchase	Theoretical assessment
Courty & Ozel (2019)	T	Demand	Choice/purchase	Empirical application
Huang et al. (2019)	T	Demand	Choice/purchase	Simulation
Kubo et al. (2019)	T	Demand	Choice/purchase	Empirical application
Zheng et al. (2020)	T	Supply	Managerial decision	Empirical application
Ojo et al. (2022)	T	Demand	Choice/purchase	Empirical application

[1] T = travel and tourism; L = lodging; F = food and beverage.

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Tables

Table 1. Fourfold pattern of risk attitudes.

	Gains	**Losses**
High probability *(Certainty effect)*	Risk-averse Fear of disappointment.	Risk-seeking Hope to avoid losses.
Low probability *(Possibility effect)*	Risk-seeking Hope of larger gains.	Risk-averse Fear of larger losses.

Table 2. Article distribution by journal.

Journal	**No. of articles**
Tourism, leisure and hospitality management[1]	
Tourism Management	14
Journal of Travel Research	7
Annals of Tourism Research	6
International Journal of Contemporary Hospitality Management	6
Tourism Economics	5
Journal of Hospitality and Tourism Research	4
Journal of Sustainable Tourism	3
International Journal of Hospitality Management	2
International Journal of Tourism Research	2
Journal of Hospitality and Tourism Management	2
Others	7
Other subject areas	
International Journal of Revenue Management	3
Journal of Air Transport Management	2
Organizational Behavior and Human Decision Processes	2
Others	28

[1] According to the source categorization in Scopus.

Table 3. Article distribution by geographic region.

Region		**No. of articles**
North America (31%)	USA	28
	Others	1
Asia (25%)	Mainland China	7
	Taiwan	6
	Singapore	3
	Hong Kong SAR	2
	Macao SAR	2
	Others	3
Europe (20%)	Spain	11
	UK	2
	Others	6
Oceania (3%)	Australia	3
South America (1%)	Brazil	1
Multi-continental (10%)		9
Not applicable[1] (10%)		9

[1] Referring to articles where no data were collected through empirical studies.

Table 4. Article distribution by target decision-making behavior.

Type of decision	**Risky/uncertain decision-making**	**Riskless decision-making**	**Total no. of articles**
Demand side			
Choice/purchase	20	42	62
Evaluation/optimization	5	0	5
eWOM[1] behavior	0	4	4
Gambling	4	0	4
Market share/value	1	3	4
Bidding	1	2	3
Environmental behavior	0	2	2
Supply side			
Managerial decision	3	1	4
Evaluation/optimization	3	0	3
Policymaking	0	1	1
Both sides			
Transaction	0	1	1
Total no. of articles	**37**	**56**	**93**

[1] eWOM stands for electronic word of mouth.

Figures

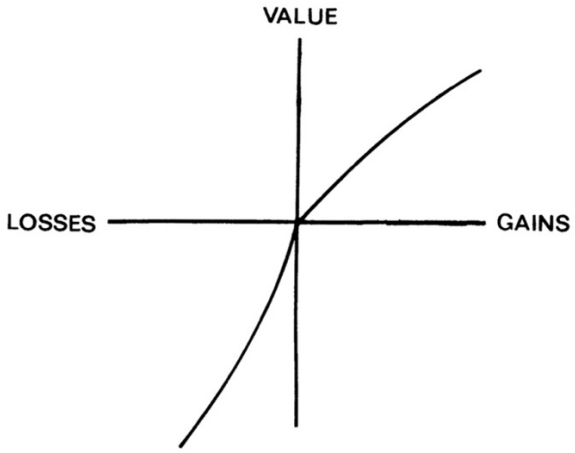

Figure 1. Value function (Kahneman & Tversky, 1979, p. 279).

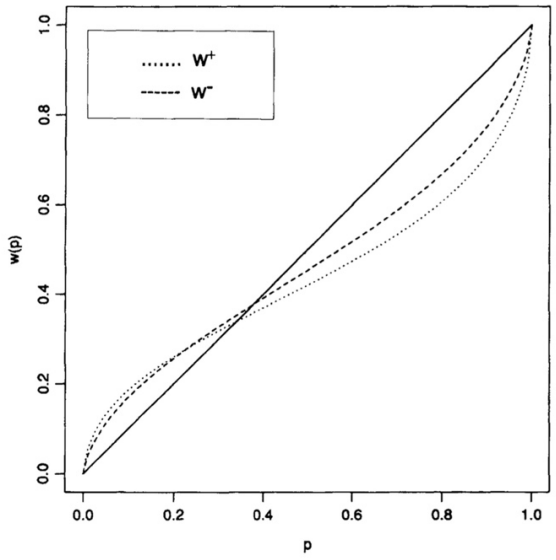

Figure 2. Probability weighting functions for gains (w^+) and losses (w^-) (Tversky & Kahneman, 1992, p. 313).

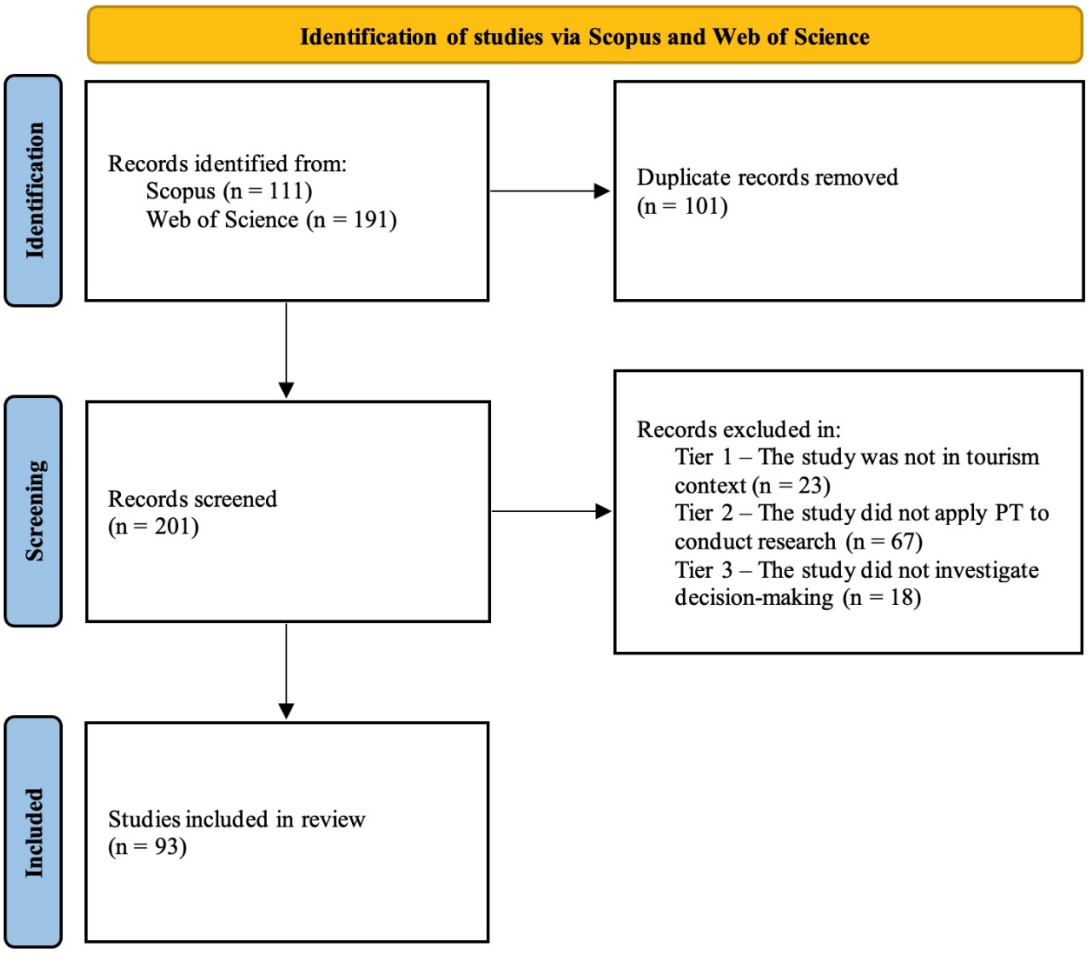

Figure 3. Article screening process.

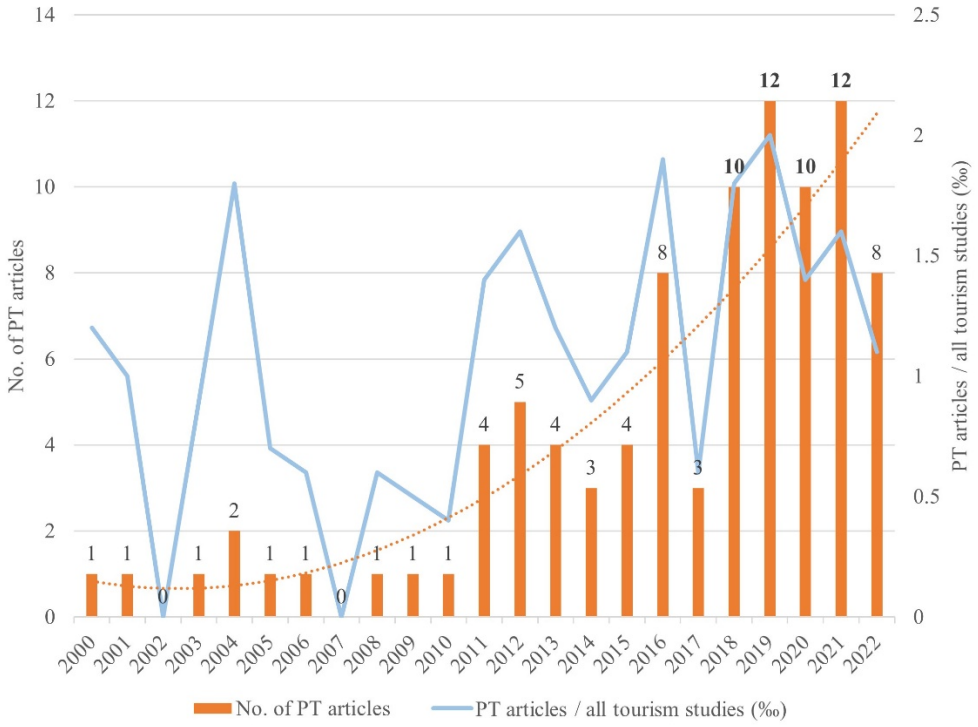

Figure 4. Number of PT articles and proportion of PT articles composing total tourism studies by publication year.

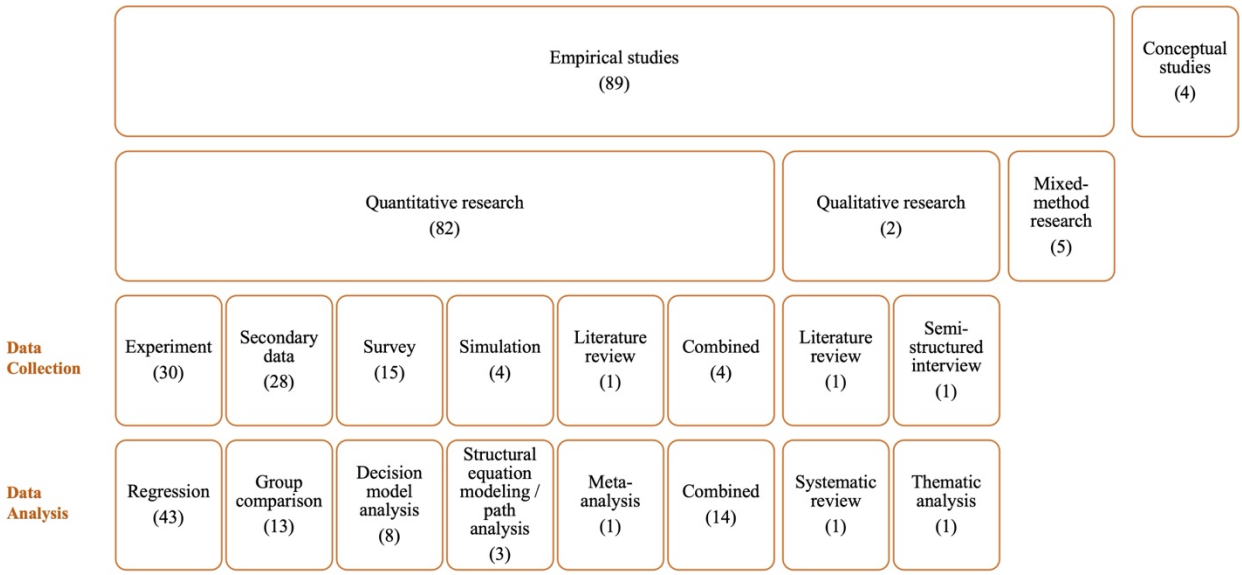

Figure 5. Article distribution by research methodology.

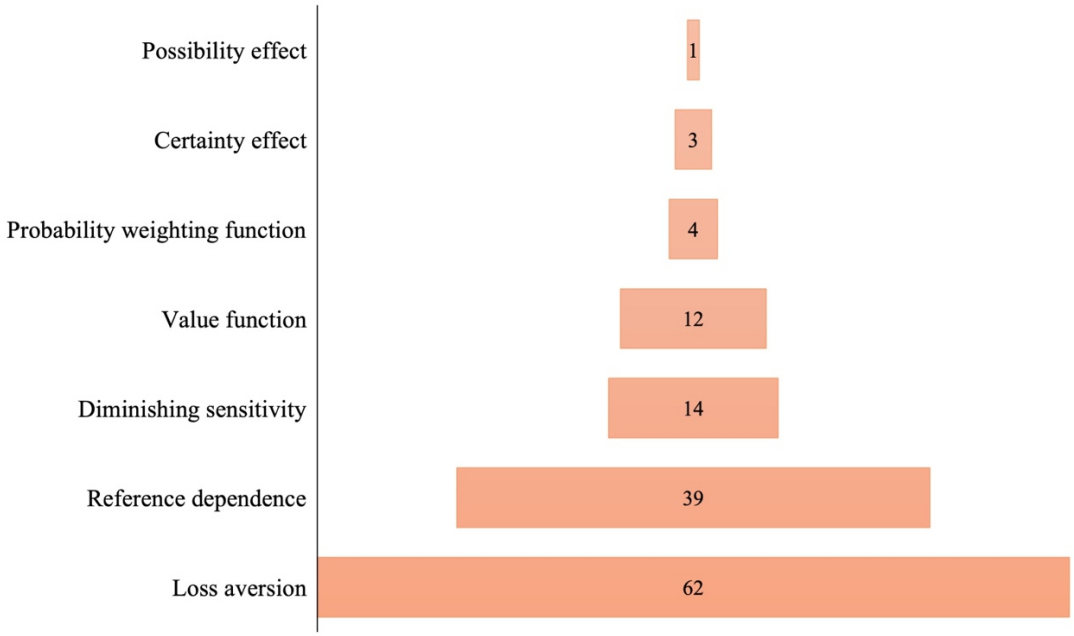

Figure 6. Application frequencies of PT principles among selected articles.