Empirical Evaluation of Third-Generation Prospect Theory

Michael H. Birnbaum

Department of Psychology, California State University, Fullerton, CA 92834, USA

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Contact Info: Mailing address:

Prof. Michael H. Birnbaum,
Department of Psychology, CSUF H-830M,
P.O. Box 6846,
Fullerton, CA 92834-6846

Email address: mbirnbaum@fullerton.edu

Phone: 657-278-2102

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Abstract

Third generation prospect theory (Schmidt, Starmer, & Sugden, 2008) is a theory of choices and of judgments of buying and selling prices of risky prospects. Buying and selling prices are also called willingness to pay (WTP) and willingness to accept (WTA), and the gap between them is sometimes called the "endowment effect" and it was previously called the "point of view" effect. Third generation prospect theory combines cumulative prospect theory for risky prospects with the theory that judged values are based on the integration of price paid or price received with the consequences of gambles. TGPT was developed independently of earlier, similar developments by Birnbaum and Zimmermann (1998) and by Luce (2000). This paper reviews theoretical and empirical findings, some previously unpublished, to show that third-generation prospect theory fails as a descriptive model of both choices and judgments. The data refute two theories of loss aversion, but they are consistent with configural weight models that had been published before the term "endowment effect" was coined (Birnbaum & Stegner, 1979).

Schmidt, Starmer, & Sugden (2008) proposed third-generation prospect theory (TGPT) as a unified theory to account for judgments of value of risky prospects as well as choices between such prospects. This theory was intended to account for the discrepancy between willingness to pay (WTP) and willingness to accept (WTA) and for preference reversals between choices and judgments of value.

Original prospect theory (Kahneman & Tversky, 1979) made use of a subjectively weighted utility formulation similar to that of Edwards (1953). Second generation, cumulative prospect theory (Tversky & Kahneman, 1992) adapted a rank-and sign-dependent utility representation similar to that of Luce and Fishbein (1991).

Birnbaum and Stegner (1979) presented a configural weight model to account for the discrepancy between buying and selling prices. The highest buying price is also known as the willingness to pay (WTP) value, and the lowest selling price is also called the willingness to accept (WTA). Birnbaum and Stegner referred to the differences as the effects of the "judge's point of view," and presented a configural weight averaging model to account for the phenomena. Thaler (1980) did not cite the earlier work and coined the term "endowment effect" for a subset of such effects, and stated that the phenomena might relate to "loss aversion." The phenomenon is sometimes viewed as a special case of a "status quo" bias (Samuelson & Zeckhauser, 1988). Tversky and Kahneman (1991) used their notion of loss aversion to explain the discrepancy between buying and selling prices of riskless goods, but their theory was not applicable to judgments of risky gambles or choices between them.

To deal with risky gambles, Schmidt, et al. (2008) proposed TGPT, which used cumulative prospect theory, combined with the assumption that prices paid or accepted are integrated into the consequences of a prospect. In TGPT, buying or selling prices of risky prospects are theorized as decisions among mixed gambles that are affected by loss aversion, even though all of the consequences are strictly positive.

These main ideas of TGPT had already been proposed and evaluated by Birnbaum and Zimmermann (1998), along with other theories of the so-called endowment effect. They rejected this model as a descriptive account of price judgments. The theories of Tversky and Kahneman (1991) and an anchoring and adjustment model can also be rejected.

In response to findings by Birnbaum and Yeary (1998), Luce (2000) developed a more elaborate theory in which prices and consequences are integrated via a joint receipt operation; this theory was improved upon by Birnbaum, Yeary, Luce, & Zhao (2002). The main difference between TGPT and Luce's approach is that prices are integrated with consequences via a joint receipt operation rather than by simple addition or subtraction as in Birnbaum and Zimmermann (1998) and by Schmidt, et al. (2005).

The present article presents new analyses of previously published and unpublished data to evaluate the empirical status of TGPT. Empirical results show that TGPT is not an accurate empirical description of either judgments of value (WTP and WTA) or of choices between prospects. The rest of this paper is organized as follows: Section 1 presents the key ideas of TGPT and presents theorems of TGPT that can be evaluated empirically; Section 2 presents evidence that theorems of TGPT are violated systematically by empirical findings. It is noted that the configural weight model (Birnbaum and Stegner, 1979) provides a better fit to the data. Section 3 reviews arguments against the loss aversion theory of Tversky and Kahneman (1991) for the endowment effect; Section 4 briefly summarizes the case against cumulative prospect theory as a model of choices between risky prospects; Section 5 discusses related theories; it concludes that configural weighted models based on the model in Birnbaum and Stegner (1979) provide the most accurate account of a variety of choice and judgment data and are also more parsimonious than other models proposed.

1. Third-Generation Prospect Theory

Let $G = (y, p; x)$ represent a binary gamble to win y with probability p and otherwise to receive x, where $y > x$. Cumulative prospect theory (Tversky & Kahneman, 1992) can be written for such gambles as follows:

(1) $$\mathrm{CPT}(y, p; x) = u(y)W(p) + u(x)[1 - W(p)] \text{ if } y \geq x \geq 0$$

$$\mathrm{CPT}(y, p; x) = u(y)W(p) + u(x)W^{-}(1 - p)] \text{ if } y \geq 0 \geq x$$

$$\mathrm{CPT}(y, p; x) = u(x)W^{-}(p) + u(y)[1 - W^{-}(p)] \text{ if } 0 \geq y \geq x$$

Where $\mathrm{CPT}(y, p; x)$ is the value of the gamble; $u(x)$ and $u(y)$ are the utilities of the consequences; $W(p)$ and $W^{-}(p)$ are weighting functions of probabilities to win or lose, respectively. It is assumed that a person would choose G over F if and only if $\mathrm{CPT}(G) > \mathrm{CPT}(F)$.

Utility is assumed to be a power function of cash value:

(2) $$u(x) = x^{\beta}$$

In addition, it is assumed that losses "loom larger" than gains according to the following:

(3) $$u(-x) = -\lambda u(x),\ \ x \geq 0$$

where λ is a constant, sometimes called the "loss aversion" parameter, where $\lambda > 1$.

Equations 1, 2, and 3 are called "second-generation" prospect theory (Schmidt, et al., 2008). In third-generation prospect theory (TGPT), it is further assumed that the decision maker integrates the price of a prospect with the prizes. In willingness to pay, it is assumed that the subject considers that if he/she pays B and wins y, then the gain will be y – B, but if the gamble yields only x, then the loss will be x – B. Similarly, in willingness to accept, it is assumed that the subject considers a sale for S to be a gain when x occurs, since the profit is S – x; but the seller considers it a loss if the higher outcome *y* occurs, because the seller would have been better off to have kept the gamble, so seller experiences a loss of S – *y*. Thus, buying and selling positive valued prospects involve the evaluation of mixed gambles, where psychological losses invoke "loss aversion."

These assumptions of TGPT can be written as follows:

(4) Buy if $\mathrm{CPT}(y - B, p; x - B) \geq 0$

(5) Sell if $\mathrm{CPT}(S - y, p; S - x) \geq 0$

1.1 Complementary Symmetry

Birnbaum and Zimmermann (1998) showed that Equations 4 and 5 combined with CPT imply a property called *complementary symmetry* for binary gambles. The maximal buying price, B (WTP) for gamble $(y, p; x)$ plus the minimal selling price, S (WTA) for the complementary gamble $(y, 1 - p; x)$ should be $x + y$. This property should be satisfied according to third-generation prospect theory.

Proof: From Expression 4, the highest buying price is

$$W(p)u(y - \mathrm{B}) + W^{-}(1 - p)u(x - \mathrm{B}) = 0$$

Substituting from Equation 3,

$$u(y - \mathrm{B}) = \lambda W^{-}(1 - p)u(\mathrm{B} - x)$$

$$u(y - \mathrm{B}) = [\lambda W^{-}(1 - p)\mathrm{u}(\mathrm{B} - x)]/\, W(p)$$

$$y - \mathrm{B} = u^{-1}\{[\lambda W^{-}(1 - p)u(\mathrm{B} - x)]/\, W(p)\}$$

Assume Equation 2, $u(x) = x^{\beta}$, and define $T(p) = [\lambda W^{-}(1 - p)] / W(p)]^{(1/\beta)}$.

$$y - \mathrm{B} = T(p)(\mathrm{B} - x)$$

$$\mathrm{B} = [y + T(p)x]/[1 + T(p)] \quad (6)$$

From Equation 5, the lowest selling price, S, of the complement $(y, 1 - p; x)$ satisfies:

$$W(p)u(\mathrm{S} - x) + W^{-}(1 - p)u(\mathrm{S} - y) = 0$$

$$W(p)u(\mathrm{S} - x) = \lambda W^{-}(1 - p)u(y - \mathrm{S})$$

with the same definition of $T(p)$, it follows that:

(7) $$\mathrm{S} = [x + T(p)y]/[1 + T(p)]$$

Adding Expressions 6 and 7, we have

(8) $$\mathrm{S} + \mathrm{B} = x + y.$$

Complementary symmetry (Equation 8) thus follows from TGPT with any weighting functions; however, it is predicted to fail in systematic fashion, according to the configural weight models of Birnbaum and Stegner (1979). In particular, given parameters of Birnbaum and Stegner (1979), S + B should be a decreasing function of $|x - y|$, with $x + y$ held constant. In Section 2 below, data of Birnbaum and Sutton (1992) are re-analyzed to show that the property is systematically violated.

1.2 First Order Stochastic Dominance in Judgments

According to configural weight models, first order stochastic dominance can be violated in specially constructed choice problems. Birnbaum (1997) devised a recipe that was tested in choice by Birnbaum and Navarrete (1998) who found that about 70% of undergraduates chose *G* = ($96, .85; $90, .05; $12, .10) over *F* = ($96, ,90; $14, .05; $12, .05) even though *F* dominates *G*. Birnbaum (2005) explored variations of the recipe to compare descriptive models that violate dominance. Because CPT must satisfy stochastic dominance, evidence that people systematically violate dominance shows that CPT is not an accurate descriptive model of risky decision making.

Stochastic dominance also follows in third-generation prospect theory: judgments of buying or selling prices should also satisfy first order stochastic dominance in this recipe; that is, the WTP of *F* should exceed that of *G* and the WTA of *F* should exceed that of *G*. Proof for WTP: CPT satisfies coalescing, consequence monotonicity, and transitivity (Birnbaum & Navarrete, 1998); therefore, CPT($96 – B, .85; $90 – B, .05; $12 – B, .10) ~ CPT($96 – B, .85; $90 – B, .05; $12 – B, .05; $12 – B, .05) < CPT($96 – B, .85; $96 – B, .05; $14 – B, .05; $12 – B, .05) ~ CPT($96 – B, .90; $14 – B, .05; $12 – B, .05). The proof for WTA works in the same way. Section 2 notes that violations of first order stochastic dominance are observed in buying prices, selling prices, and choices.

1.3 Violations of Restricted Branch Independence

Consider three branch gambles with a fixed probability distribution. Let (x, y, z) represent a prospect to win x with probability p; y with probability q, and otherwise win z. Let $B(x, y, z)$ and $S(x, y, z)$ represent the judged value of buying and selling prices. Restricted branch independence can be expressed for such three branch gambles as follows:

$$S(x, y, z) > S(x', y', z) \text{ if and only if } S(x, y, z') > S(x', y', z') \quad (9a)$$

$$B(x, y, z) > B(x', y', z) \text{ if and only if } B(x, y, z') > B(x', y', z') \quad (9b)$$

This property can be violated by TGPT when the weighting functions are not linear. The manner of violation, however, depends on the weighting function. According to third-generation prospect theory, it should be possible to predict the types of violations of this property in judgments from the shape of the weighting function estimated from choices (Birnbaum, 2008; Birnbaum & Zimmermann, 1998). The weighting function of CPT required to reproduce standard findings in the literature must have an inverse-S form (Tversky & Kahneman, 1992; Birnbaum, 2008; Wakker, 2011); as noted below in Section 2, this shape function predicts the wrong pattern of violation of restricted branch independence from what is observed in both choice and judgment.

2. Judged Prices (WTP and WTA) violate TGPT

2.1 Complementary Symmetry

According to TGPT, the sum of buying and selling price of complementary binary gambles should equal the sum of the outcomes. This sum should be independent of other factors, such as the range, $|x - y|$, holding $x + y$ constant. Note that this conclusion follows for any weighting functions, W and W-. In contrast, configural weight theory (Birnbaum & Stegner, 1979) implies that S + B (for complements) will in general vary systematically with the range. With parameters estimated from Birnbaum and Stegner (1979), that theory predicts that the sum should decrease systematically with increasing range.

Figure 1 shows a new figure constructed from the Birnbaum and Sutton (1992) data to test complementary symmetry. At the time of Birnbaum and Sutton (1992), TGPT had not yet been developed, and this figure has not been published. The figure shows the sum of median judgments of buying and selling prices of gambles of the form (x, .5; y); that is S + B. These are plotted as a function of $|x - y|$ with a separate curve for each value of $x + y$. According to third-generation prospect theory, the curves should be horizontal and have constant value of $x + y$.

Insert Figure 1 about here.

Instead, Figure 1 shows that S + B decreases systematically with the range. For example, the median buying and selling prices of ($48, .5; $60) are $50 and $54, respectively, for a total of $104. However, the median buying and selling prices of ($12, .5; $96) are $25 and $50, respectively, for a total of only $75. TGPT implies that both totals should have been $108. For all 28 gambles with positive outcomes studied by Birnbaum and Sutton (1992), median B + S = $x + y$, in every case where $x = y$ and median B + S < $x + y$ in every other case. Every curve decreases as a function of range ($|x - y|$), so these data systematically violate complementary symmetry, as predicted by the model and configural weights of Birnbaum and Stegner (1979).

In sum, empirical evidence systematically violates complementary symmetry, contrary to TGPT.

2.2 First Order Stochastic Dominance

According to TGPT, WTP and WTA should satisfy first order stochastic dominance.

Birnbaum & Yeary (1998) asked 66 undergraduates to evaluate 166 risky gambles from the viewpoints of both buyer and seller. Interspersed among those trials were 8 trials that provided four tests of first order stochastic dominance in each point of view. These four tests of first order stochastic dominance should result in violations, according to configural weight models. Table 1 shows the median judgments of WTP and WTA for these 8 gambles.

Insert Table 1 about here.

In all eight comparisons (four tests by two viewpoints), the dominated gamble (denoted *G*- in Table 1) received higher median judgments than the dominant gamble (*G*+). The mean judgment was $63.31 for the dominated gambles, compared to $55.11 for the dominant gamble, averaged over all tests and viewpoints. This difference was significant, $F(1,65) = 20.56$. The difference was greater in the buyer's point of view (WTP), where the means were $53.02 and $41.18, than it was in the seller's viewpoint (WTA), where the means were $73.61 and $69.05, respectively. This interaction between viewpoint and dominance was significant, $F(1,65) = 11.62$.

Birnbaum and Yeary (1998) analyzed each participant’s data separately and found that 51 of the 66 judges tested (77%) assigned higher mean judgments to dominated gambles than to the dominant gambles, averaged over the four tests. Only 15 judges assigned higher mean judgments to the dominant gambles. Significantly more individuals violated than satisfied stochastic dominance in this recipe.

The largest violation was observed for the pair *G*+ = ($12, .05; $14, .05; $96, .90) vs. *G*- = ($12, .10; $90, .05; $96, .85). Although the former (*G*+) dominates the latter, the dominated gamble received a mean judgment of $53.52 in the buyer's viewpoint, compared to a mean judgment of only $34.52 for the dominant gamble. Different gamble pairs showed significantly different magnitudes of violation, $F(3, 195) = 5.73$; but the three-way interaction of Gambles by Dominance by Viewpoint was not significant, $F(3, 195) = 2.31$.

These judgment results agree with direct choices between the same gambles; Birnbaum and Navarrete (1998) found that 73, 61, 73, and 73 judges (out of 100) chose the dominated gamble *G*– over the dominant gamble, *G*+, in direct choices of Tests 1 though 4 (of Table 1), respectively. In sum, violations of first order stochastic dominance are observed in buying prices, selling prices, and in choices--all systematic violations of TGPT.

2.3 Violations of Restricted Branch Independence

Because TGPT assumes that the same *W*-(*p*) and *W*(*p*) functions apply to judgments as to choices, this theory implies that we should be able to predict violations of restricted branch independence from the shape of the probability weighting functions estimated from choice experiments. It is well-known that to describe standard results of empirical choice studies, including the Allais paradoxes, CPT requires inverse-S probability weighting functions in which intermediate branches receive lower weight than lowest or highest valued branches (Tversky & Kahneman, 1992; Birnbaum, 2008; Wakker, 2011). See Birnbaum and Chavez (1997) for an analysis of how the CPT weighting function relates to violations of restricted branch independence.

It turns out that the observed pattern of violation of restricted branch independence in both WTP and WTA judgments is not in agreement with the inverse-S weighting function postulated in TGPT (Birnbaum & Beeghley, 1998; Birnbaum & Zimmermann, 1998; Birnbaum & Veira, 1998).

For example, Table 3 shows mean judgments of 12 of the prospects studied by Birnbaum and Beeghley (1992), who asked 46 participants to judge both WTP and WTA for 166 gambles, each of which had three, equally likely outcomes: (*x, y, z*). The mean judgments violate restricted branch independence in both viewpoints; in addition, mean judgments are not monotonically related between viewpoints.

The predicted judgments are calculated from TGPT using the parameters estimated by Tversky and Kahneman (1992). The observed violations of restricted branch independence are opposite of predictions. Note that in the WTA viewpoint, S($2, $45, $51) = $34.1 > S($2, $12, $96) = $28.5 and that S($12, $96, $148) = $75.2 > S($45, $51, $148) = $62.0. However, using TGPT, predictions have the opposite relations. Similarly, in the WTP viewpoint, B($2, $33, $39) = $19.1 > B($2, $12, $96) = $14.4 and B($12, $96, $148) = $47.8 > B($45, $51, $148) = $39.8, and the predictions are again exactly backwards for TGPT. The problem for TGPT is basically the same as for CPT; the inverse-S shaped weighting function implies the opposite pattern of violations from what is observed empirically. For another, more detailed analysis of restricted branch independence and the weighting functions and parameters of CPT, see Birnbaum (2008, p. 486).

The changes in rank order between buying and selling prices and of violations of restricted branch independence within each viewpoint for the full set of gambles were analyzed in Birnbaum and Beeghley (1997), who showed that configural weight models provide good fits to both aspects of the data.

Johnson and Busemeyer (2005) developed a model of attention that can be interpreted as a cognitive theory to account for Birnbaum and Beeghley's configural weights. Their model fits as well as the model of Birnbaum and Beeghley, and these authors agree with Birnbaum and Zimmermann's (1998) conclusion that configural weight, attention models fit much better than the model of Tversky and Kahneman (1981) based on loss aversion.

Violations of restricted branch independence in choice also show the opposite pattern from that predicted by the inverse-S weighting function needed by that theory. This pattern of violations has been replicated in dozens of empirical studies using different formats for presentation of choices (Birnbaum, 2004, 2008; Birnbaum & Bahra, 2012; Birnbaum & Navarrete, 1998). Therefore, one cannot retain both CPT and the inverse-S decumulative weighting function, if one wants to explain either judgment or choice.

2.4 Model Fitting

The TGPT models of WTP and WTA (Equations 6 and 7) were fit to judgments of 63 binary gambles of the form, $(x, p; y)$ by Birnbaum, Yeary, Luce & Zhao (2002). The data, from Birnbaum and Yeary (1998), used 9 levels of probability, so 9 parameters were estimated for the 9 values of $T(p)$. [Recall that $T(p) = [\lambda W^{-}(1 - p)] / W(p)]^{(1/\beta)}$. Estimating $T(p)$ for each p allows complete flexibility to the weighting functions, W and W- (they are completely free to follow any positive valued functions, whether inverse-S, S-shaped, or any other shape), and this approach allows any value of λ and any power function exponent for $u(x)$.

Despite the flexibility allowed by so many free parameters, TGPT does not fit the data as well as either TAX or RAM, two configural weight models that use fewer parameters. The sum of squared deviations between predicted and obtained judgments (126 predicted values for 63 gambles in WTP and WTA) was 20,242 for TGPT (9 parameters) compared to 1,051 for the TAX model that used 6 parameters and 1,097 for the TAX model with 5 free parameters (with $u(x) = x$). The RAM model (6 parameters) achieved a fit of 1,129, almost the same as TAX in this study. Other comparisons of RAM and TAX can be found in Birnbaum (2005). [The mean values fit and best-fit predictions of TGPT are included in the Appendix. Every test of complementary symmetry in these data shows violation as well, for $x + y$ constant and p varying.]

To account for the Birnbaum and Yeary (1998) data, Luce (2000) developed a model of buying and selling prices that is more general than TGPT, and which avoids one of the problems that had been identified in Birnbaum and Zimmermann (1998). Although Luce's (2000) model need not satisfy complementary symmetry and fits data better than TGPT, it still implies first order stochastic dominance and even when it uses twice as many parameters as configural weight models, it does not fit as well. A more complete discussion of that theory is in Birnbaum, et al. (2002). Because of such problems and the important results for choice that violate the family of rank and sign dependent utility models, including CPT, Luce, Marley, Ng, & Aczél (2008a, 2008b) turned their attention to models that can violate coalescing and stochastic dominance.

3. Riskless Loss Aversion Theory of Tversky and Kahneman (1991)

Tversky and Kahneman (1991) proposed a model of the endowment effect for riskless goods. As shown in Birnbaum and Zimmermann (1998), that model implies that the ratio of selling prices to buying prices should be a constant. Birnbaum and Stegner (1979) had already shown that this ratio is not a constant, and in fact, buying and selling prices are not monotonically related to each other, so this theory had already been disproved before it was published.

Although they did not cite the earlier evidence against their theory nor acknowledge earlier theories that could describe the evidence, Tversky and Kahneman (1991) did acknowledged that their model was implausible because it implies that the ratio of the selling price of a $5 bill to the buying price of the same bill should be about 4:1. To avoid this obvious flaw, they postulated an exception for goods held for exchange, like cash or gold. But this "exception" is just the tip of an iceberg of cases that violate the loss aversion model.

This exception for cash is not required by the model of Birnbaum and Stegner (1979), who had already shown that the ratio of selling to buying prices varies systematically for different "riskless" entities to be evaluated. The "exception" required by the model of Tversky and Kahneman (1991) is not a problem for the configural weight models, which imply that the ratio of selling to buying price will be 1 for the $5 bill and will show systematically greater ratios as a function of the amount of uncertainty or ambiguity of the goods or prospects in question. For a fuller discussion of this point, see Birnbaum, Coffey, Mellers, & Weiss (1992).

Plott and Zeiler (2005) criticized the experimental methods used in the isolated "endowment effect" literature, echoing certain criticisms previously made by Birnbaum and Zimmermann (1998) and by Birnbaum (1999) regarding short-term, between-subject studies that do not utilize proper experimental designs to establish a context in which judgments can be interpreted with respect to proper theory.

To these criticisms of experimental procedure, one can add a criticism of scholarship: many investigators in the endowment literature refused to acknowledge or even cite rival theories or data regarding the phenomena of WTA and WTP besides those used in the studies of mugs—the subset of literature criticized by Plott and Zeiler. A recent *Annual Review of Economics* article (Ericson & Fuster, 2014), for example, cites none of the articles or evidence arguing for configural weighting as opposed to loss aversion as a theory of the "endowment" effect.

4. Cumulative Prospect Theory Refuted for Choice

Both original prospect theory and cumulative prospect theory have been refuted as descriptive models of choice between risky prospects. Although these models could account for those phenomena that had already been published that they were designed to fit, they failed to correctly predict new tests of their implications. Both versions of prospect theory can now be rejected by empirical findings in what Birnbaum (2008) calls the "new paradoxes." These new paradoxes refute prospect theories in the same way that the Allais paradoxes violated EU. Six of the "new paradoxes" refute all forms of RSDU, including CPT and EU (Birnbaum, 2008): violations of first order stochastic dominance, of coalescing, of gain-loss separability, of lower and upper cumulative independence, and of upper tail independence. Despite flexibility of choosing any weighting functions and any utility functions for gains and losses, there is no way to use CPT to account for these phenomena.

For example, cumulative prospect theory implies that people should always satisfy first order stochastic dominance in choice, so the fact that more than 40 studies have been published showing systematic violations of stochastic dominance in choice (using more than a dozen different formats for presenting choice problems) is strong evidence against cumulative prospect theory as a descriptive model. Most of these studies are reviewed in Birnbaum (2008) and Birnbaum and Bahra (2012).

In addition, tests of restricted branch independence, dissection of the Allais paradoxes, and several tests of distribution independence lead to inconsistent or contradictory weighting functions if one assumes CPT. Violations of branch independence disprove the stripped version of original prospect theory, with or without its editing assumption of cancellation. Therefore, if TGPT relies on either CPT or original prospect theory as its model of choices among risky prospects, it can be rejected by the overwhelming empirical evidence against both versions of prospect theory as a model of choice.

5. Conclusions

TGPT fails as a descriptive model of the endowment effect and of preference reversals because it implies properties of buying prices, selling prices, and choices that are systematically violated by empirical data. These violations are large, robust, and have been replicated in many experiments.

Configural weight models (Birnbaum & Stegner, 1979), which are rarely (if ever) cited in the isolated "endowment" literature, remain compatible with major properties of empirical data that refute both the loss aversion theory of Tversky and Kahneman (1991) and the TGPT (Schmidt, et al., 2008) in which prices paid or received are integrated into the consequences of the gamble.

Birnbaum and Stegner's (1979) model can explain their finding that the ratio of WTA to WTP is not a constant and that these two judgments are not even monotonically related to each other. It correctly predicted the violations of complementary symmetry in Figure 1, it correctly describes violations of restricted branch independence, and it fits data better than either the model of Tversky and Kahneman (1991) or of Schmidt, et al. (2005).

It seems reasonable to ask those who would continue to work with the concept of loss aversion in connection with the endowment effect to show that their theory provides a better fit to the data than earlier models that had been proposed to account for the effect and to show that these loss aversion theories can handle the empirical results of experiments testing formal properties of buying and selling prices. Those working with the concept of loss aversion should respond to the challenge to demonstrate that it provides a better description of data than the earlier configural weight models.

Configural weighting models correctly predicted violations of complementary symmetry, which violates TGPT of Schmidt, et al. Configural weight models were used to design the gambles that violate stochastic dominance in WTP, WTA, and choice. Those models correctly predicted violations of restricted branch independence, which are in the opposite direction from what is predicted by TGPT, and configural weighting models provide a better quantitative fit to data. They also account for the fact that the ratio of selling to buying prices is not a constant and that these two kinds of judgments are not monotonically related to each other, contrary to the theory of Tversky and Kahneman (1991).

In configural weight models, the utility of a gamble is a weighted average of the utilities of the consequences on the branches of the gambles. Those models need only two basic ideas regarding configural weights to account for the phenomena described here, besides the properties of an averaging model.

The first idea is that absolute weight of a branch in a gamble (apart from configural effects) is a nonlinear function of its probability, which is usually approximated by a power function, $t(p) = p^{\gamma}$, where $\gamma < 1$. A branch of a gamble is a probability-consequence component of a gamble that is distinct in the presentation to the participant. Thus, the prospect *A* = ($100, .1; $100, .1; $0, .8) is different from the prospect *B* = ($100, .2; $0, .8). Original prospect theory assumed that *A* and *B* are equivalent by the editing rule of combination, but in second and third-generation prospect theory, the representation requires *A* and *B* to be equivalent. In configural weight theory, the sum of the weights of the two branches to win $100 exceeds the weight of the single branch to win $100 in *B*, even though the probabilities are equivalent, if $t(p)$ is negatively accelerated. In these models, splitting a branch leading to a certain consequence tends to increase the weight of that consequence.

The second idea is that weight of a branch is affected by the rank of the consequence on the branch compared to other branch consequences. In the TAX model, weight is transferred among branches in proportion to the probability weight of the branch losing weight. As in

Birnbaum and Stegner (1979), weight is transferred from branches leading to higher valued consequences to lower ones in the case of buying prices (WTP) and transferred from lower to higher branches in selling prices. That is, buyers put more weight on the lower valued aspects or possibilities of an object or gamble and sellers place greater weight on higher valued aspects or possible outcomes of an object or gamble.

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Figure 1. Sum of median WTP and WTA (buying plus selling prices) for gambles of the form (x, ½; y) as a function of |x – y| with a separate curve for each level of x + y. According to third-generation prospect theory, all curves should be horizontal and aligned with the points for |x – y| = 0. Instead, all curves decrease as a function of the range. Data from Birnbaum and Sutton (1992).

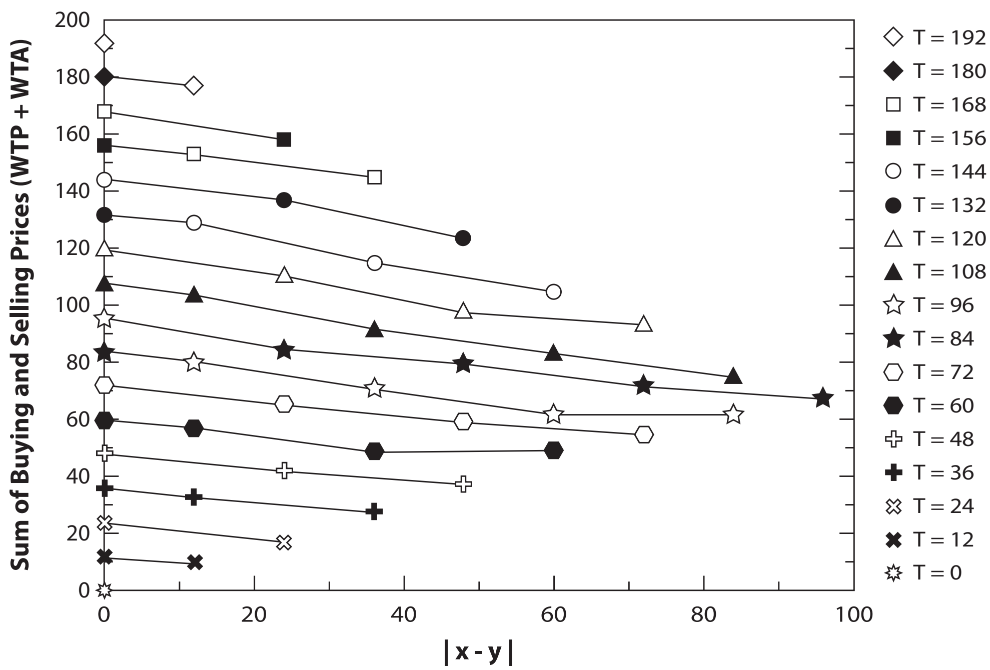

TABLE 1. Median Judgments in the Tests of Stochastic Dominance (Birnbaum & Yeary, 1998).

Buying Prices

Test	*G+*	Median WTP	*G–*	Median WTP
1	.05 .05 .90 / $12 $14 $96	30	.10 .05 .85 / $12 $90 $96	60.0
2	.06 .06 .88 / $3 $5 $97	22.5	.12 .04 .84 / $3 $92 $97	50.0
3	.02 .03 .95 / $6 $8 $99	40.0	.05 .03 .92 / $6 $91 $99	54.0
4	.01 .01 .98 / $4 $7 $97	50.0	.02 .02 .96 / $4 $89 $97	62.5

Selling Prices

Test	*G+*	Median WTA	*G–*	Median WTA
1	.05 .05 .90 / $12 $14 $96	73.5	.10 .05 .85 / $12 $90 $96	81.5
2	.06 .06 .88 / $3 $5 $97	68.0	.12 .04 .84 / $3 $92 $97	80.0
3	.02 .03 .95 / $6 $8 $99	82.5	.05 .03 .92 / $6 $91 $99	83.5
4	.01 .01 .98 / $4 $7 $97	81.0	.02 .02 .96 / $4 $89 $97	87.5

Table 2. Reanalysis of Data from Birnbaum and Beeghley (1997). Predicted WTP and WTA are based on third-generation prospect theory using parameters of Tversky and Kahneman (1992).

Lottery	WTP	WTA	Pred WTP	Pred WTA	EV
($2, $27, $33)	15.4	23.0	6.7	27.0	20.7
($2, $33 $39)	19.1	26.6	7.7	33.0	24.7
($2, $39, 453)	19.6	30.0	8.6	38.9	28.7
($2, $45, $51)	21.9	34.2	9.6	44.9	32.7
($2, $51, $57)	27.7	37.1	10.5	50.9	36.7
($2, $12, $96)	14.4	28.5	11.9	61.5	36.7
($27, $33, $148)	35.5	51.9	38.6	102.7	69.3
($33, $39, $148)	39.8	50.2	44.1	105.0	73.3
($39, $45, $148)	45.2	58.5	49.6	107.3	77.3
($45, $51, $148)	49.9	62.0	55.0	109.6	81.3
($51, $57, $148)	56.5	68.5	60.5	111.8	85.3
($12, $96, $148)	47.8	75.2	30.7	108.0	85.3

Appendix. Data for Binary gambles from Birnbaum and Yeary (1998). Mean Buying Prices (WTP). Pre = predictions of third-generation prospect theory, obs = observed mean judgments.

	(100,0)		(72,0)		(48,0)		(24,0)		(100,48)		(100,24)		(100,6)	
P	Pre	obs	pre	obs	pre	obs	pre	obs	pre	obs	pre	obs	pre	obs
0.01	12.1	2.3	8.7	2.8	5.8	2.2	2.9	2.3	54.3	42.3	33.2	22.7	17.3	7.4
0.05	15.7	4.2	11.3	5.0	7.5	3.6	3.8	3.6	56.2	44.0	35.9	25.0	20.8	9.6
0.10	18.5	7.1	13.4	5.1	8.9	4.9	4.5	3.6	57.6	45.1	38.1	25.1	23.4	11.1
0.25	26.1	10.9	18.8	11.3	12.5	7.9	6.3	4.8	61.5	45.7	43.8	27.8	30.5	12.6
0.50	35.7	25.1	25.7	19.2	17.1	14.2	8.6	8.2	66.6	51.3	51.1	35.5	39.6	21.4
0.75	51.0	33.7	36.7	26.7	24.5	17.4	12.2	11.1	74.5	52.2	62.8	37.9	54.0	35.4
0.90	60.2	47.1	43.3	34.9	28.9	21.3	14.4	12.2	79.3	58.6	69.7	49.4	62.5	40.4
0.95	64.7	51.4	46.6	35.9	31.0	25.1	15.5	13.2	81.6	63.7	73.1	48.0	66.8	50.7
0.99	71.1	61.9	51.2	47.8	34.1	29.0	17.1	14.5	85.0	65.2	78.0	59.2	72.8	55.1

Mean Selling Prices (WTA)

	(100,0)		(72,0)		(48,0)		(24,0)		(100,48)		(100,24)		(100,6)	
P	pre	obs	pre	obs	pre	obs	pre	obs	pre	obs	pre	obs	pre	obs
0.01	28.9	12.8	20.8	12.0	13.9	10.1	6.9	6.8	63.0	49.6	46.0	30.3	33.2	19.5
0.05	35.3	17.0	25.4	15.7	17.0	13.3	8.5	7.6	66.4	51.9	50.9	31.7	39.2	19.4
0.10	39.8	19.8	28.7	18.0	19.1	15.4	9.6	8.3	68.7	53.3	54.3	34.6	43.5	24.9
0.25	49.0	29.6	35.3	26.7	23.5	19.3	11.8	11.2	73.5	53.7	61.2	40.6	52.0	28.0
0.50	64.3	53.8	46.3	39.0	30.9	26.4	15.4	14.4	81.4	62.0	72.9	58.2	66.4	51.2
0.75	73.9	62.5	53.2	44.4	35.5	28.1	17.7	16.5	86.5	66.0	80.2	62.5	75.5	60.2
0.90	81.5	72.8	58.6	51.1	39.1	34.4	19.5	18.3	90.4	74.7	85.9	68.8	82.6	72.2
0.95	84.3	79.0	60.7	53.3	40.5	33.4	20.2	18.1	91.8	76.0	88.1	73.0	85.2	75.6
0.99	87.9	81.6	63.3	59.5	42.2	36.3	21.1	18.1	93.7	80.4	90.8	76.1	88.7	79.3