"Value" -Based Selection: Assigning Greater Fictitious Value to Small Pears

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Abstract

Alternative options can be represented in a multidimensional space (where each dimension describes different attributes of the options), and accordingly, people may make choices among alternative options based on the "value maximization" principle (Luce, 1959). However, the present study hypothesizes that in real life, decision-makers with fictional storytelling ability will actively transform the space representing options—that is, they will self-generate additional fictional dimensions to represent alternative options. We define the utility (Uv) that decision-makers assign to options on given dimensions as "valuation" (v(x)), and define the utility (Uv) that decision-makers assign to options on self-generated fictional dimensions as "value" (w(xc)). Our series of experimental results demonstrate that options with significantly greater "valuation" on given dimensions are often not selected (violating the "value maximization" principle). This behavior of deliberately choosing the "small pear" (the less valuable option) can be described and explained by a "value" -based choice model: people' s decisions aim to select options with greater "value" , rather than options with greater "valuation" . It is hoped that our findings can not only help understand the intricacies of this type of "taking an extra step" decision-making, but also help us view and prove this ability—further self-generating fictional dimensions, subsequently assigning delayed utility (value) to options on these fictional dimensions, and making value-based choices—as an operational definition capable of measuring the degree of "fictional storytelling ability" proposed by Yuval Noah Harari in his book *Sapiens: A Brief History of Humankind*.

Full Text

Worth-Based Choice: Giving an Offered Smaller Pear an Even Greater Fictional Value

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Suffering a loss is a blessing —Zheng Banqiao (1693–1765)
The human superpower is really based on fiction —Yuval Noah Harari

Alternative options can be represented in a multidimensional space where each dimension describes different attributes of the options. According to the "value maximization" principle (Luce, 1959), people make choices among alternatives based on this representation. However, the present research proposes that in real life, decision-makers with the capacity for fictional storytelling actively transform the space in which options are represented—that is, they self-generate additional fictional dimensions to characterize the alternatives. We define the utility (Uv) that a decision-maker assigns to an option on given dimensions as "value" (v(x)), and the utility (Uw) assigned on self-generated fictional dimensions as "worth" (w(xc)).

Our series of experiments demonstrate that options with obviously greater "value"on given dimensions are often not selected (violating the "value maximization" principle). This behavior of deliberately choosing the "smaller pear" (the less valuable option) can be described and explained by a worth-based choice model: people' s decisions aim to select options with greater "worth" rather than greater "value." We hope our findings will not only help understand the subtleties of this "one-step-further" decision-making but also serve to operationalize and validate the ability to self-generate fictional dimensions, assign delayed utility (worth) to options on these dimensions, and make worth-based choices as a measurable definition of the degree of "fictional storytelling capacity" proposed by Yuval Noah Harari in *Sapiens*.

Keywords: utility on given dimensions; value-based choice; utility on self-generated dimensions; worth-based choice; equate-to-differentiate model

How do people choose among multiple options? The decision mentioned in the *Three Character Classic* may differ from what you imagine:

During the Eastern Han Dynasty, there was a child named Kong Rong who had five older brothers and one younger brother. One day, his father bought some pears and picked out the largest one for Kong Rong. However, Kong Rong shook his head, refused the large pear, and chose the smallest one instead.

Kong Rong' s choice in this anecdote is not an isolated case. Similar choices abound in both Eastern and Western cultures. For instance, an Italian proverb states, "He who eats pears with his master should not choose the best."

Giving up the large pear (i.e., not choosing the option with the greatest "value") can be seen as incurring a personal cost while transferring benefits to others. This generous choice behavior violates the assumptions of economic rationality models (Delton, Krasnow, Tooby, & Cosmides, 2011). In traditional decision

theory, alternatives can be represented in a multidimensional space where each dimension describes different attributes of the options (Méndez, 1974; Birnbaum, 1997; Li, 2004, 2016). Importantly, some decision models, such as the INdividual Differences SCALing model (Carroll & Chang, 1970), consider dimension uniqueness as a key feature—that is, options possess unique dimensions (Carroll & Arabie, 1998). When options are represented on a set of given dimensions, people are assumed to follow the "value maximizing" (VM) principle in making choices (Luce, 1959). Each option x is assigned a "value" v(x), and the decision-maker selects the option with the maximum v(x) based on the given dimensions (Tversky & Shafir, 1992).

From the perspective of these models and their assumptions, Kong Rong' s father and observers would encounter a dilemma: young Kong Rong chose a dominated option. The selected option (the small pear) could not possibly have greater "value" (or other forms of utility such as predicted utility, experienced utility, decision utility, expected utility, etc.) than the unchosen option (the large pear). This conclusion holds as long as the utility of the alternatives is derived solely from the biological dimension given by Kong Rong' s father (representing the options as small or large pears).

However, is choosing a dominated option that violates the value maximization principle a decision bias or a deliberate choice? If selecting a dominated option is not a decision bias or error (e.g., a choice made by someone with cognitive deficits), how can this dilemma be resolved? Similarly, the seemingly "irrational" dilemma of altruism has been explained as "actually a disguised form of selfishness" (e.g., Fisher, 1999; Hamilton, 1964; Hu, Li, Jia, & Xie, 2016; Kaufman, 2016, pp. 151; Li & Xie, 2017; Trivers & Hare, 1976). We argue that traditional decision theory must be missing something that explains why people frequently choose dominated options.

In Kong Rong' s story, although he explained his choice of the small pear over the large one, the dilemma of selecting a dominated option remains unresolved:

Kong Rong' s father was surprised and asked, "Why?" Kong Rong replied, "I am young, so I should eat the small pear, and my older brothers should eat the large pears." His father was pleased and further asked, "What about your younger brother?" Kong Rong answered, "I am older than my brother, so I should give the large pear to my younger brother."

Regardless of age, one should never choose the large pear, which means Kong Rong should always choose the small pear throughout his life. Kong Rong' s own explanation also suggests that the mechanism underlying the failure to choose the option with maximum "value" on given dimensions has not been clarified.

To address this issue, we propose a worth-based choice model, as opposed to value-based choice, to explain and predict choices that result in apparent losses (e.g., Tang, Zhou, Zhao, & Li, 2014; Zhao, Shen, Rao, Zheng, Liu, & Li, 2018). In traditional analyses, preferences can be observed through people' s responses and are assumed to represent the decision-maker' s underlying utility or value

(Tversky, Sattath, & Slovic, 1988). In our proposed model, we define a given set of dimensions x that describe different attributes of options. Importantly, considering that decision-makers possess fictional storytelling capacity, we assume an additional set of dimensions xc that are not passively provided but actively and creatively generated by the decision-maker to weave fictional representations of the given options.

Accordingly, for each option x represented on a set of given dimensions, we assume a general utility function (Uv), where v(x) is the "value" that an individual assigns to different outcomes of the option. For each option xc represented on the additional self-generated fictional dimensions, we also assume a general utility function (Uw), where w(xc) is the "worth" that an individual assigns to different option outcomes to measure their value.

After generating additional dimensions and assigning utility to options on these dimensions, the trade-off between the large and small pears can be viewed as a competition between v(x) and w(xc). Specifically, the final choice may depend on the utility assigned to options (e.g., pears) on given dimensions (v(x)). Likewise, the choice may also depend on the utility assigned to options on additional dimensions (w(xc)). The decision-maker will choose the option with maximum "worth" rather than maximum "value."

The purpose of this research is to examine whether worth-based choice exists and to investigate whether decision-makers' ability to generate additional fictional dimensions to represent given option outcomes is key to their selection of options with smaller "value." Below, we define v(x) and w(xc) as "value" and "worth" associated with options, respectively. To illustrate the relationship between v(x) and w(xc), let us revisit Kong Rong' s choice between the large and small pears (see Figure 1 [Figure 1: see original paper]). In our model, both v(x) and w(xc) represent utilities of the given pear options. The difference is that v(x) is the utility (Uv) Kong Rong assigns to the large and small pears on the biological dimension, while w(xc) is the utility (Uw) he assigns to the pear options on an additional fictional dimension—namely, a socially commendable dimension imagined and created by Kong Rong himself. Thus, the dilemma is resolved: Kong Rong chooses the pear with smaller "value" because although the large pear has greater utility (Uv) on the given biological dimension, the small pear has greater utility (Uw) for him on the newly generated social commendation dimension.

From a utility analysis perspective, our model shares some commonalities with existing decision models: people evaluate the utility of outcomes rather than the outcomes themselves. This interpretation holds if utility is viewed as a general concept of value that individuals assign to different outcomes and if utility resides in the hedonic experience of outcomes or preferences for outcomes (Kahneman, 1994). Despite this commonality, previous research differs from the present study in that we assume, according to our model, that outcome utility can be assigned on dimensions that are not given but actively generated by the decision-maker, whereas in existing decision models, outcome utility is assigned

only on given dimensions. We argue that adaptively featured individuals (a) find it difficult to stop at passive choices based on given dimensions, (b) actively generate additional dimensions by weaving fictional stories, and (c) assign utility from the perspective of "worth" on these generated dimensions. We believe that people willing to "go one step further" do not stop at decisions achieved at the level of "value" maximization (e.g., Li, 1995, 1996) but seek to make choices at the level of "worth" maximization. Therefore, evolutionarily well-adapted individuals make more "one-step-further" choices than maladapted individuals.

In summary, if decision-makers evaluate option outcomes based solely on a given set of dimensions, the utility they assign to options is defined as v(x). However, if decision-makers further evaluate options based on additional dimensions they weave themselves, the utility they assign to options is defined as w(xc). The importance of w(xc) has been difficult for traditional decision theory to address and capture. The essential distinction between v(x) and w(xc) provides a new path for investigating the choice of options with smaller "value" (the small pear). We infer that people practice the value maximization principle if and only if the final decision is based solely on given dimensions. However, this assumption is no longer necessary once decision-makers generate additional dimensions to represent option outcomes. Whether individuals creatively generate additional fictional dimensions to represent outcomes of given options is the key to making worth-based choices. The following studies are our attempts to explore the existence of worth-based choice.

Experiment 1: Is Yielding the Large Pear a Myth or Reality?

The primary purpose of this experiment was to replicate the authenticity of "Kong Rong yielding pears" and the "Italian proverb" —that when faced with an option with greater "value" and one with smaller "value," people may not make value-maximizing choices. Some readers might argue that people do not choose the large pear because they dislike pears, just as people might avoid high-protein burgers or high-calorie chocolate for fear of weight gain. To address this concern, and considering that people generally do not refuse more money (Li, Bi, Su, & Rao, 2011), we used universal currency (money) rather than actual pears as the experimental alternatives.

A total of 62 students (24 male, 37 female) from the School of Transportation at Fujian University of Technology participated in this experiment.

Materials and Procedure

Participants first came to the laboratory to complete two unrelated intertemporal decision-making experiments, each lasting approximately one hour, with a one-week interval between the two sessions. The first two experiments were administered by three students and one teacher from the same school (School of Transportation, Fujian University of Technology). After completing the fi-

nal experiment, a fifth experimenter individually asked each participant: "To thank you and the experimenter (any one of the student experimenters or the teacher experimenter) for completing this time-consuming experiment, here are two red envelopes (one containing 10 yuan and one containing 5 yuan) for you to choose from. The envelope you do not choose will go to one of the teacher experimenters or student experimenters." The first four experimenters were not present during this inquiry. Additionally, half of the banknotes in the red envelopes were exposed so that participants could clearly see the denominations. Participants' choices were recorded.

This experiment was approved by the Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences. Given that the experiment was considered low-risk and data analysis was anonymous, oral informed consent was obtained from participants.

Results and Discussion

Table 1 summarizes participants' choices between the two red envelopes.

Table 1. Most Participants Preferred the 5-Yuan Red Envelope with Smaller Surface "Value" for Themselves

Choice between large and small red envelopes (N = 62)	5 yuan (small)	10 yuan (large)
Student experimenter condition	19 (61%)	12 (39%)
Teacher experimenter condition	21 (68%)	10 (32%)

Most of our participants (64.5%) exhibited the same behavioral pattern described in the *Three Character Classic* anecdote of "Kong Rong yielding pears" and the Italian proverb: among 62 participants, 40 chose the smaller amount of 5 yuan (analogous to the small pear) for themselves ($^{2}(1, 62) = 5.226$, p = .022, phi-squared = 0.290). Although more participants chose the smaller 5-yuan amount for themselves in the "teacher experimenter" condition (68%) than in the "student experimenter" condition (61%), this difference was not statistically significant ($^{2}(1, 62) = .282$, p = .596, phi-squared = .067).

Our results indicate that choosing the option with smaller "value" (giving up the large pear) is not a myth but a genuine reality. The design using real money as alternatives rules out the possibility that "choosing the small pear" results from following a "value minimization" principle (e.g., choosing small, low-calorie chocolate to maintain one' s figure). The subsequent experiments aim to answer: if participants are not maximizing on the given monetary dimension in this experiment, what are they maximizing? Or, in the language of the worth-based choice model, on what non-given dimension are they maximizing?

Experiment 2: Whose Eyes See the Lower-Value Option as Less Attractive—Parents or Children?

To test our hypothesis, Experiment 2 first compared the decision-making behaviors of parents and their children. The alternatives used in the experiment had no hidden meaning in children' s eyes, while their parents could generate potential meaningful dimensions when facing the same options. This study used such options to verify whether there were intergenerational differences in choice —that is, whether parents could generate potential dimensions for choice while children could only choose based on the surface attributes or dimensions of the options.

To test whether children could generate potential dimensions, we designed two child-friendly scenarios: buying a mobile phone number and buying lanterns for the New Year. The mobile phone numbers had 10 different endings (from 510 to 519), and the lanterns had 8 different colors (red, orange, yellow, green, cyan, blue, purple + white). In a Beijing community, we asked 20 children aged 3-6 (11 girls, mean age = 4.70, SD = 0.86) whether they knew what each phone number ending or each lantern color represented (each phone number and lantern was printed as same-sized pictures with light gray backgrounds). If the answer was negative, no further questions were asked; if affirmative, we asked what specific meaning the child referred to.

When asked about phone numbers, all children easily recognized the 10 numbers, but not a single child (0%) indicated knowing any meaning behind the numbers. When asked about buying New Year lanterns, 16 children (80%) said they did not know the meaning of the 8 lantern colors, and only 4 children (20%) said they had seen red or orange lanterns hung during New Year, but they could not explain what hanging such colored lanterns signified.

These results indicate that children aged 3-6 have not yet learned the different meanings of phone numbers or lantern colors from Chinese traditional customs and culture. Considering the influence of Chinese traditional customs and culture on the meanings of different numbers and lantern colors, in the formal experiment we used "red lanterns vs. white lanterns" and "phone endings 514 vs. 518" as options where adults might generate potential dimensions, while using "blue lanterns vs. purple lanterns" and "phone endings 513 vs. 517" as options where potential dimension generation might not occur.

Twenty-nine mother-daughter pairs and thirty-one father-son pairs from a kindergarten in Jinan, Shandong Province participated in this experiment (children aged 3-6; parents aged 27-36). We intentionally selected paired participants as mothers with daughters and fathers with sons; there were no mother-son or father-daughter pairings.

Materials and Procedure

Two scenarios were designed: buying lanterns and buying mobile phone numbers. Each scenario included three pairs of choices (participants were asked to choose one option from two): one option was a relatively cheap lantern or phone number (10 yuan), and the other was a relatively expensive lantern or phone number (20 yuan). The choice questions were as follows:

Mobile Phone Number Scenario: (a) A: Phone number ending in 513 priced at 10 yuan
B: Phone number ending in 517 priced at 20 yuan
(b) A: Phone number ending in 513 priced at 10 yuan
B: Phone number ending in 518 priced at 20 yuan
(c) A: Phone number ending in 514 priced at 10 yuan
B: Phone number ending in 517 priced at 20 yuan

New Year Lantern Scenario: (a) A: Blue lantern priced at 10 yuan
B: Purple lantern priced at 20 yuan
(b) A: Blue lantern priced at 10 yuan
B: Red lantern priced at 20 yuan
(c) A: White lantern priced at 20 yuan
B: Purple lantern priced at 10 yuan

Enlarged pictures were shown to children, with real money attached below each picture. Every 20 father-son or mother-daughter pairs were randomly assigned to one of three pairing conditions to make choices in either the phone number scenario or lantern scenario (60 pairs total, three pairing conditions: phone a & lantern a; phone b & lantern b; phone c & lantern c). Children and parents were tested separately, each being asked about their choice intention in each scenario and the strength of their choice intention (for children: 1 smiley face = somewhat willing to choose this option, 2 smiley faces = moderately willing, 3 smiley faces = very willing). For analysis, the "choice preference" variable was coded as: very willing to choose A = 1; moderately willing to choose A = 2; somewhat willing to choose A = 3; somewhat willing to choose B = 4; moderately willing to choose B = 5; very willing to choose B = 6.

After making their choices, each participant was asked to choose a piece of chocolate as compensation for participation, with one larger piece priced at 6 yuan and one smaller piece priced at 3 yuan. Each participant' s choice was recorded.

Results and Discussion

Table 2 shows the percentage of participants choosing each option, with actual numbers in parentheses. Using a 2 (generation: parents vs. children) × 3 (pairing: phone a & lantern a vs. phone b & lantern b vs. phone c & lantern c) × 2 (scenario: phone vs. lantern) experimental design, ANOVA results showed a significant main effect of generation on choice preference, $F(1, 114) = 113.69$,

p < .001, a significant main effect of pairing condition, F(2, 114) = 32.58, p < .001, and no significant main effect of scenario, F(1, 114) = .23, p = .63. There was no significant interaction between generation and scenario (F(1, 114) = .03, p = .87) or between pairing condition and scenario (F(2, 114) = .08, p = .93). However, there was a significant interaction between generation and pairing condition, F(2, 114) = 22.78, p < .001.

Table 2. Summary of Data (Mean Choice Intention, Percentage of Choices, with Actual Numbers in Parentheses)

Pairing Condition	513-517 Pair (a) (n = 20 pairs)	513-518 Pair (b) (n = 20 pairs)	514-517 Pair (c) (n = 20 pairs)
Children	85.0% choose cheaper (17)	80.0% choose cheaper (16)	80.0% choose cheaper (16)
Parents	15.0% choose cheaper (3)	20.0% choose cheaper (4)	20.0% choose cheaper (4)
Mean (SD)	1.71 (0.91)	1.66 (0.86)	1.93 (0.94)

Pairing Condition	Blue-Purple Pair (a) (n = 20 pairs)	Blue-Red Pair (b) (n = 20 pairs)	White-Purple Pair (c) (n = 20 pairs)
Children	85.0% choose cheaper (17)	75.0% choose cheaper (15)	80.0% choose cheaper (16)
Parents	15.0% choose cheaper (3)	25.0% choose cheaper (5)	20.0% choose cheaper (4)
Mean (SD)	1.54 (0.76)	1.70 (1.06)	1.42 (0.64)

When facing both mobile phone number and lantern scenarios, child participants in this experiment always tended to choose the option with greater "value" (cheaper), regardless of which option was paired with this cheaper alternative (all mean choice tendencies for children were 2.60, with no significant differences across pairing conditions, F(2, 57) = 0.42, p = .66). This strong tendency indicates that for children, the option with greater "value" is the clearly dominant option. When a clearly dominant option exists, it becomes the unquestionably best available option, and decision-makers will not engage in further consideration and analysis (von Winterfeldt & Edwards, 1986). However, parent participants in this experiment showed significant differences across pairing conditions (significant main effect of pairing condition, F(2, 57) = 66.50, p < .001). In the 513-517 phone pairing condition (M = 2.30) and the blue-purple lantern pairing condition (M_blue-purple = 2.10), parent participants tended to choose the option with greater "value" (cheaper). However, when the phone number paired with 513 was changed to 518 (M = 4.95), when

the blue lantern was paired with a red lantern (M_blue-red = 5.75), when the phone number paired with 517 was changed to 514 (M = 5.10), and when the purple lantern was paired with a white lantern (M_white-purple = 5.40), parent participants shifted to preferring the option with smaller "value" (more expensive).

This choice difference between parents and children was so clear and robust that it could be replicated in a real scenario. The chocolate choice task demonstrated this interesting difference: 93.3% of children chose the larger Dove chocolate, whereas only 8.3% of their parents made the same choice (^{2} = 86.72, p < .001, phi-squared = .72).

In summary, Experiment 2 results indicate that it is children, not their parents, who adhere to the value maximization principle in decision-making. This intergenerational difference robustly exists between both real and non-real option trade-offs. Our interpretation is that adults generate fictional dimensions, assign utility (worth) to options on these dimensions, and make choices based on maximizing this utility (worth). We believe the above experimental results (i.e., children cannot articulate the hidden meanings of phone number endings and lantern colors) serve as supporting evidence that children cannot automatically generate fictional dimensions (and therefore can only maximize "value" on the given monetary dimension). Notably, the number of attributes describing the given options (money + color/number) in this experiment was greater than in Experiment 1 (money alone). Some readers might argue that these additional color and number attributes themselves are related to the so-called fictional dimension (superstitious dimension), potentially casting doubt on our claim that "non-monetary dimensions are not given but actively generated by decision-makers." Therefore, the following experiments attempt to provide evidence supporting our conjecture that fictional capacity, rather than the presence of relevant attributes, is the necessary condition for generating fictional dimensions. Specifically, subsequent experiments attempt to answer why the dominant option in children' s eyes becomes non-dominant in adults' eyes—that is, what makes the large pear no longer large enough to be chosen?

Experiment 3a: When Options Contain Unknown/Unrealistic Constructs, What Concepts Do People Represent on Fictional Dimensions?

Different colored lanterns and different mobile phone numbers have different meanings for people from different cultural backgrounds. In Experiment 2, parent participants were more inclined to choose options with smaller "value." The following experiments attempt to explain why adults make such choices and whether their self-generated fictional dimensions influence their decisions.

All participants in this experiment were 148 university students (ages 17-25; 89 females) from a university in Beijing. Participants volunteered and received small gifts worth 5 yuan as compensation upon completion.

Materials and Procedure

This experiment adopted the method of Query Theory, which has been successfully used in cognitive process studies of similar tasks (Hardisty, Johnson, & Weber, 2010; Johnson, Häubl, & Keinan, 2007; Weber et al., 2007). Participants first completed the same choice task as in Experiment 2 (mobile phone and lantern scenarios), then were asked to list reasons for their choices with the instruction: "Please list at least two reasons for your choice above."

Results and Discussion

In Experiment 3a, student participants' choices were similar to those of parent participants in Experiment 2. Based on the order of queries, the statistical variable is called Standardized Median Rank Difference (SMRD; see Johnson et al., 2007). This experiment used the SMRD formula to calculate participants' SMRD scores under different pairing conditions. SMRD = 2(MRi -MRd)/n, where MRd is the median rank of monetary reasons already provided for the listed options; MRi is the median rank of non-monetary reasons not provided for the listed options; and n represents the total number of reasons listed.

SMRD scores range from 1 (all listed non-monetary reasons are ranked before all monetary reasons) to -1 (all listed monetary reasons are ranked before all non-monetary reasons) (see Table 3).

Table 3. Classification Based on Reason Focus and Valence

	Non-Monetary Reasons (Not Provided)	Monetary Reasons (Provided)
Positive Valence	"518" sounds like "I will get rich"	This is cheaper
	Red lanterns are very auspicious	Saving money is important to me
Negative Valence	"514" sounds like "I will die"	This is too expensive
	White lanterns are for funeral use	Expensive doesn' t mean good

Note: The top-left and bottom-right boxes represent non-monetary reasons (not provided on the option surface), while the top-right and bottom-left boxes represent monetary reasons (provided on the option surface).

When participants made choices based on the VM principle (mean choice intention: M = 1.82; M_blue-purple = 2.32), the SMRD mean for the 513-517 pairing condition was -0.63, and for the blue-purple lantern pairing condition was -0.39, indicating that adult decision-makers listed only monetary reasons (refer to content in top-right and bottom-left of Table 2). When participants did not make choices based on the VM principle (mean choice intention: M =

4.44; M = 4.67; M_blue-red = 5.52; M_white-purple = 5.08), the SMRD means for these four pairing conditions were all between 0 and 1 (513-518 pairing SMRD = 0.25; 514-517 pairing SMRD = 0.26; blue-red pairing SMRD = 0.64; white-purple pairing SMRD = 0.46), indicating that adult decision-makers listed only non-monetary reasons (refer to content in top-left and bottom-right of Table 2).

Further tests showed that SMRD means when not following the VM principle were significantly higher than when following value maximization (all $F > 40.70$, $ps < .001$), while difference tests among pairing groups not following value maximization were not significant (513-518 vs. 514-517, $F(1, 96) = 0.01$, $p = .92$; blue-red vs. white-purple, $F(1, 96) = 3.45$, $p = .07$). Logistic regression tests showed that SMRD values explained 83% of variance in the mobile phone scenario (= 6.25, $p < .001$; Nagelkerke $R^2 = .83$) and 67% of variance in the lantern scenario (= 3.99, $p < .001$; Nagelkerke $R^2 = .67$).

These results indicate that when adult decision-makers list reasons for choosing options with smaller "value," the non-monetary reasons (content) they list generate potential dimensions. When adult decision-makers cannot generate or perceive potential dimensions, they make choices based on value maximization. These "query" results, together with Experiment 2 findings, show that providing relevant attributes (e.g., color or number) is not a necessary condition for generating fictional dimensions (e.g., superstition). Rather, the fictional capacity to understand meanings hidden beneath given colors and numbers is the key. It is this fictional storytelling capacity that causes the large pear not to be chosen.

Experiment 3b: When Options Contain Known/Realistic Constructs, What Concepts Do People Represent on Fictional Dimensions?

When people make choices between real, non-superstitious items such as large and small Dove chocolates, our parent participants in Experiment 2 also chose the option with smaller "value." As mentioned in the proverb about giving up the large pear, the cultural context involved may be whether people consider the social relationship where the unchosen option goes to another person (e.g., the experimenter in Experiments 1 and 2, the boss in the Italian proverb, or the brother to whom Kong Rong yielded his pear). Therefore, Experiment 3b attempted to test whether the social relationship of "considering that the unchosen option goes to another person"could lead our participants to choose the option with smaller "value." If this hypothesis holds, we further verify whether the fictionally generated dimension prompts adults to choose the option with smaller "value."

A total of 171 university students (ages 18-24; 62 females) from Beijing Forestry University and University of Chinese Academy of Sciences were recruited through campus advertisements. All participants gave informed consent and received compensation after the experiment. This experiment was approved

by the Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences.

Materials and Procedure

This experiment used two pairs of choice questions. Participants were told they needed to make choices under two experimental conditions. One condition was that the unchosen option did not go to another person, with instructions: "Please choose between the following two options." The other condition was that the unchosen option went to a friend, with instructions: "Please choose between the following two options for you and your friend (i.e., if you choose A, your friend gets B; if you choose B, your friend gets A)."

Each condition included two pairs of choices:

Pencil Choice Question with Variety Superiority: A. Choose 1 pencil from 2 black pencils
B. Choose 1 pencil from 1 white pencil and 1 black pencil

Pencil Choice Question with Quantity Superiority: A. Choose 1 pencil from 2 black pencils
B. Choose 2 pencils from 2 black pencils

Participants first rated their preference for each option under the two experimental conditions (1 = "very willing to choose A" ; 2 = "moderately willing to choose A" ; 3 = "somewhat willing to choose A" ; 4 = "somewhat willing to choose B" ; 5 = "moderately willing to choose B" ; 6 = "very willing to choose B"). Subsequently, under the condition where the unchosen option went to a friend, participants were also asked to write down as many answers as possible to the question "What benefits do you think choosing A has for you yourself?" after making their choice.

Results and Discussion

Under the condition where the unchosen option did not go to another person, participants showed relatively strong willingness to choose Option B, which was superior in variety (Mv = 4.05) or quantity (Mn = 3.76). Under the condition where the unchosen option went to a friend, participants' preference for Option B decreased—that is, their preference for the option superior in variety (Mv = 3.22) or quantity (Mn = 3.26) was reduced (see Figure 2 [Figure 2: see original paper]).

A 2 (unchosen option: not specified for a person vs. specified for a friend) × 2 (option superiority: variety vs. quantity) ANOVA showed a significant main effect of whether the unchosen option went to another person on preference strength [$F(1, 169) = 23.359$, $p < .01$]. No significant main effect of option superiority was found [$F(1, 169) = .793$, $p = .374$]. Similarly, no significant interaction existed between whether the unchosen option went to another person and option superiority [$F(1, 169) = 1.409$, $p = .236$]. These results mean that

considering the social relationship layer of "the unchosen option goes to another person" prompts people to choose options with smaller "value."

Table 4 summarizes participants' answers to "What benefits do you think choosing A has for you yourself?" A total of 433 listed "benefits" were generated, with each participant contributing an average of 2.53 items. The most frequently mentioned "benefits" included "make my friend happy" and "develop and maintain friendship" (accounting for 34.6% and 22.9% respectively in the variety-superior pair, and 36.1% and 25.5% respectively in the quantity-superior pair). Two main conclusions can be drawn from these results, as shown in Table 4. First, people do have the capacity to generate "additional" "benefits," regardless of whether they actually chose Option A. The "benefits" people generated were coded as: (a) leaving Option B for a friend to make the friend happy; (b) convenience and speed; (c) easier choice from 2 black pencils; (d) less is more. Second, those who chose Option A themselves (Mv = 1.64; Mn = 1.51) indeed generated more "benefits" than those who chose Option B (Mv = 1.24; Mn = 0.74), with the difference being significant in the variety-superior condition ($t = 3.376$, $p < .01$) and in the quantity-superior condition ($t = 5.879$, $p < .01$). This result suggests that participants' ability to generate additional fictional dimensions to represent "benefits" likely prompted them to choose options with smaller "value."

Table 4. Number of "Benefits" Listed by Participants for Choosing Option A under "Unchosen Option Goes to Friend" Condition

Benefits of Option A (superior in variety or quantity) N = 171	Variety-Superior	Quantity-Superior
Leave Option B for friend to make friend happy	50 (34.6%)	52 (36.1%)
Convenience and speed	58 (40.4%)	26 (18.1%)
Easier to choose from 2 black pencils	12 (8.3%)	35 (24.3%)
Less is more	33 (22.9%)	19 (13.2%)
Other	12 (8.3%)	5 (9.8%)
Total	1.06 (0.94)	0.86 (0.76)

In summary, these results provide consistent evidence that fictional capacity, rather than the presence of relevant attributes, enables participants to generate fictional dimensions and choose options with smaller "value." What participants maximize are imagined outcomes on non-given, non-monetary dimensions. Experiments 3a and 3b show that for people who choose options with smaller "value," the fictional dimensions they generate are closely related to their cultural context. These sociocultural factors prompt people to choose options with smaller "value." The difference between Experiments 3a and 3b lies in the different fictional dimensions creatively generated by participants: in Experiment 3a, the dimension was unknown/unrealistic constructs (i.e., superstitious beliefs), while in Experiment 3b, it was known/realistic constructs (i.e., friendship).

Experiment 4: How to Stop and Reach a Final Decision? Competition Between Surface "Value"and Potential "Worth"

Previous experiments showed that more economical or cheaper options are not always dominant for adult participants. Sometimes an option is "better" due to its superior monetary attributes, while other times it is "better" due to its superior non-monetary attributes.

When choosing among non-dominant options, a "binary choice" model suggests that decision-makers "equate" differences between conflicting dimensions and use a "weak dominance" principle for decision-making. The weak dominance principle states that if Option A is at least as good as Option B on all dimensions and better than Option B on at least one dimension, then Option A dominates Option B in choice (e.g., Lee, 1971; von Winterfeldt & Edwards, 1986). Considering the limited computational capacity of human decision-makers, the equate-to-differentiate model (Li, 1994, 2001a, 2001b, 2003, 2004, 2005, 2006) and the graphically edited equate-to-differentiate model (Sun, Li, Bonini, & Su, 2012) propose that using intuition or forced-choice principles from weak dominance can enable binary choices between Options A and B in broader contexts. The final decision is based on whether Option A would dominate Option B if a final dimension j exists, such that UAj(xj) -UBj(xj) > 0 is subjectively advantageous compared to all UAj(xj) -UBj(xj) < 0 and UAj(xj) -UBj(xj) $= 0$. Similarly, if the decision-maker judges that Option B would dominate Option A if a final dimension j exists, such that UBj(xj) -UAj(xj) > 0 is subjectively advantageous compared to all UBj(xj) -UAj(xj) < 0 and UBj(xj) -UAj(xj) $= 0$, where xj (j $=$ 1, ···, M) is the objective value of each option on dimension j (see Li, 2001b, for axiomatic analysis). In other words, the decision-maker' s task is to achieve a so-called "equate-to-differentiate" advantage—that is, Option A (B) dominates Option B (A) if differences on which Option B (A) is better than Option A (B) are subjectively "equated" on a smaller dimension difference. Hogarth (1987) and Payne (1976) argue that dimension-based decision processes are easier to operate psychologically and provide a powerful complement to alternative-based decision processes. Using such simplified decision processes requires dimension-based information search patterns, selecting useful information from options, and implementing simple sequential comparisons (Su et al., 2013; Zhou et al., 2016).

Experiment 4 was designed to test whether adult choices can be explained using dominance comparison principles, specifically, whether they can be explained using the equate-to-differentiate model.

Participants were recruited through the campus online announcement system of Central University of Finance and Economics. A total of 148 university students (ages 17-25; 89 females) participated. Participants volunteered and received small gifts worth 10 yuan as compensation. This experiment was approved by the Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences.

Materials and Procedure

Similar to Experiment 2, this experiment used three pairs of mobile phone number options and three pairs of lantern color options. These binary choices could be represented in a fictional representation space composed of monetary and non-monetary dimensions: A was superior to B on the monetary dimension, while B was superior to A on the non-monetary dimension (Figure 3 [Figure 3: see original paper]). Participants first responded on a 6-point scale indicating "which option they were more willing to choose" (1 = definitely choose A, 6 = definitely choose B). Then they completed a "matching task" that paired the outcomes of Options A and B on each dimension (non-monetary dimension labeled C, monetary dimension labeled D), requiring participants to select the pair they perceived as having the greatest difference (see Table 5). For example, C "513 number" vs. "518 number" or D "cost 10 yuan" vs. "cost 20 yuan," meaning participants made subjective difference judgments about ΔUv(x) or ΔUw(xc) in Figure 3.

Results and Discussion

Results from the choice task and judgment task are shown in Table 5. According to the equate-to-differentiate model' s explanation, once the dimension with the greatest utility difference is identified, the decision-maker' s task simplifies to choosing the better outcome on that dimension. That is, if C (D) is identified as having the greatest difference, then B (A) will be chosen, and vice versa.

Point-biserial correlation analysis results confirmed the research hypothesis (point-biserial correlation coefficients between judgment task and choice task ranged from .46 to .87, ps $<$ .01). When the 6-point continuous variable from the choice task was dichotomized, chi-square tests showed that the judgment task explained 29% to 78% of choice variance across all six choice pairs (ps $<$ .001).

Table 5. Contingency Tables of Choice Task and Judgment Task in Mobile Phone Number and Lantern Scenarios

Scenario	Choice Pair	C N1	C N2	C N3	D	^{2}	^{2}	r
Mobile Phone	513-517 (n = 50)	6	1	-	43	22.33	.54	.55
	513-518 (n = 50)	38	-	-	12	14.57	.29	.56
	514-517 (n = 48)	-	-	37	11	32.08	.78	.87
Lantern	Blue-Purple (n = 50)	7	-	-	43	26.90	.61	.68
	Blue-Red (n = 50)	41	-	-	9	23.47	.64	.77

Scenario	Choice Pair	C N1	C N2	C N3	D	^{2}	^{2}	r
	White-Purple (n = 48)	-	-	32	16	13.38	.37	.46

Note: C N1 = greatest difference between "513 number" vs. "517 number" ; C N2 = greatest difference between "513 number" vs. "518 number" ; C N3 = greatest difference between "514 number" vs. "517 number" ; C L1 = greatest difference between "blue lantern" vs. "purple lantern" ; C L2 = greatest difference between "blue lantern" vs. "red lantern" ; C L3 = greatest difference between "white lantern" vs. "purple lantern" ; D = greatest difference between "cost 10 yuan" vs. "cost 20 yuan." "r" represents point-biserial correlation coefficient (ps < .01). Underlined data indicate consistency with equate-to-differentiate model predictions.

Experiment 4 results indicate that judgments of differences between dimensions determine whether the final choice is simply made on the given monetary dimension or on the self-generated non-monetary dimension. "Self-generation" means that if a new non-monetary dimension is not generated to represent the alternatives, there would be no difference on that dimension between options (e.g., no difference would be created between 513 number and 518 number). This result also means that decisions violating value maximization (the majority of choices) and those following value maximization (the minority of choices) are systematic, consistent, and predictable.

Experiment 5: When Utility Assigned on Self-Generated Dimensions Decreases, Do Adult Decisions Change?

Experiment 4 results showed that most adult participants compare differences between options on "given dimensions" while also comparing differences on "self-generated dimensions." If they perceive greater differences between options on "self-generated dimensions" than on "given dimensions," adults are more inclined to choose options with smaller surface value (taking a loss). This raises a question: if the difference between options on "self-generated dimensions" changes—for example, if the difference on "self-generated dimensions" becomes smaller than the difference on "given dimensions" —will this affect our final decision? In other words, adults' choice of the "small pear" occurs when the "value"of the two options (large pear vs. small pear) remains unchanged on given dimensions. Imagine what would happen if the "worth" of the options changed —for instance, if the "worth" of the "small pear" option on the "self-generated dimension" decreased. Experiment 5 attempts to answer this question.

A total of 92 adults (ages 19-34; 59 females) from factories, retail, or service industries in Jinan participated through local supermarket recruitment advertisements. All participants were Chinese. This experiment was approved by the

Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences.

Materials and Procedure

"Wedding banquet" and "friend gathering" scenarios were constructed to manipulate differences on non-monetary dimensions between options: holding wedding banquets and friend gatherings on dates with auspicious number 8. Participants were asked to choose between a relatively more economical or cheaper option (3,000) and a relatively more expensive option (4,000) under each scenario. Example:

Suppose you want to book a wedding banquet (friend gathering). Which of the following options would you prefer?
A: Hold on August 18, price 4,000 per table
B: Hold on September 5, price 3,000 per table

First, to obtain more direct evidence that the "worth" of options on "self-generated dimensions" would change, based on the idea that "the meaning of wedding banquets (Block & Kramer, 2009) differs from that of friend gatherings," we pre-tested a batch of participants by asking them to imagine they were hotel managers and set prices for holding friend gatherings or wedding banquets on "September 5"and "August 18"(fill-in-the-blank questions) (see Figure 4 [Figure 4: see original paper]). Results showed that participants' price setting for wedding banquets (M = 1,137.89 yuan) was significantly higher than for friend gatherings (M = 450.70 yuan), $F(1, 32) = 9.60$, $p < .01$; price setting for events on August 18 (M = 927.70 yuan) was significantly higher than for September 5 (M = 660.89 yuan), $F(1, 32) = 5.93$, $p = .02$, and the interaction between date and scenario was significant, $F(1, 32) = 4.32$, $p = .046$. Further analysis showed that the price for auspicious dates in the wedding banquet scenario was higher than for inauspicious dates ($p = .03$), while the price difference between auspicious and inauspicious dates in the friend gathering scenario was not significant ($p = .16$). This price difference across scenarios indicates that the utility difference on self-generated non-monetary dimensions decreased in the friend gathering scenario.

Results and Discussion

Participants' choices are shown in Table 6 . Similar to choosing numbers containing 8 in the mobile phone scenario, most participants (73.9%) chose to hold the banquet on the more expensive date in the "wedding banquet" scenario, while most participants (88.0%) chose the cheaper date in the "friend gathering" scenario (see Table 6). Meanwhile, most participants (80.4%) indicated that date differences needed to be considered for wedding banquets but not for friend gatherings.

In summary, Experiment 5 results show that choices between two identical options reversed across different scenarios: most adults' choices violated value maximization in the wedding banquet scenario but followed value maximization

in the friend gathering scenario. This means that when the "worth" of options on "self-generated dimensions" decreases (e.g., when the scenario changes from "wedding banquet" to "friend gathering," the potential value generated by auspicious dates decreases accordingly), people make value-based choices rather than worth-based choices.

Table 6. Percentage of Participants Choosing Each Option (Higher Price vs. Lower Price) in Wedding Banquet or Friend Gathering Scenarios

Scenario	A (4,000/Aug 18)	B (3,000/Sep 5)
Wedding Banquet (N = 92)	73.9%	26.1%
Friend Gathering (N = 92)	12.0%	88.0%

McNemar' s test, $p < .001$

Experiment 6: Do Older People Make More Worth-Based Choices Than Younger People?

When decision outcomes are smaller "pears" or obvious losses, the most commonly used "self-defense"in daily life is: "It's worth the money."As in Experiment 3, when the more expensive option was chosen, one of the most frequently listed reasons was "worth it" —implicitly indicating value beyond what money represents. Notably, social reinforcement (Skinner, 1958; 1971), future or delayed rewards (Green, Fry, & Myerson, 1994; Rao & Li, 2011), cooperative behavior (Chen & Li, 2005), mutual benefits at all life levels (Trivers, 2004), superstitious value (Ng, Chong, & Du, 2010), and many other factors all use "worth" as an unspoken benefit.

Experiment 3 showed that self-generated dimensions are fictional dimensions. When participants choose options with smaller surface "value," they construct this socially based "fictional dimension" through their cultural environment for decision-making. Considering that participants' degree of socialization is related to their age, we wanted to explore differences between older and younger people in "worth"choices—that is, whether older people are more willing to make "worth" choices.

Fifty students (ages 47-70, 21 females) from a senior university and fifty university students (ages 19-21, 33 females) from a regular university were selected as participants. Each participant received a small gift worth 5 yuan as compensation after the experiment.

Materials and Procedure

This study included five scenario questions. Questions 1 and 2 used the mobile phone number and lantern scenarios from Experiment 1, while the other three

questions were designed social scenarios concerning social value dimensions and belief value dimensions, as follows:

Career Choice Scenario: Suppose you are a government-sponsored international student facing a choice after graduation:
Option A: Stay abroad to work, annual salary $50,000 (approximately ¥300,000 RMB)
Option B: Return to China to work, annual salary ¥200,000 RMB

Eco-Friendly Lunch Box Scenario: You want to buy 500 disposable lunch boxes. Would you:
Option A: Buy non-degradable boxes at ¥0.4 each
Option B: Buy degradable boxes at ¥0.5 each

Red Envelope Scenario: Suppose a colleague gave you a ¥600 red envelope when you got married. Now this colleague is getting married, would you:
Option A: Give a ¥600 red envelope
Option B: Give a ¥800 red envelope

For each scenario, participants first answered: "Which option do you want to choose?" (1 = definitely choose A; 2 = moderately choose A; 3 = somewhat choose A; 4 = somewhat choose B; 5 = moderately choose B; 6 = definitely choose B). Then participants judged the two options on the "value" dimension (1 = strongly agree that choosing A results in more monetary loss than choosing B; 7 = strongly agree that choosing B results in more monetary loss than choosing A; 4 = equal monetary loss between choosing A and B). Finally, participants judged the two options on the "worth" dimension (1 = strongly agree that choosing A is more worthwhile than choosing B; 7 = strongly agree that choosing B is more worthwhile than choosing A; 4 = equal worth between choosing A and B).

Results and Discussion

As observed in Experiments 2-4 with mobile phone number and lantern scenarios, in the newly added scenarios most participants also chose the lower-price option (68% chose the lower-salary job; 88% chose the more expensive eco-friendly lunch boxes; 62% chose to give more red envelope money), all violating the value maximization principle.

Experiment 6 used regression analysis with choice tendency as the dependent variable and "value" judgment and "worth" judgment as independent variables entered into the regression equation (see Table 7).

Table 7. Regression Analysis for Regular University Students and Senior "University Students" Across Five Scenarios

Scenario	Regular University Students (N=50) M (SD)	Senior "University Students" (N=50) M (SD)
514-517 Phone Scenario		
Choice tendency (DV)	3.74 (2.12)	5.28 (1.50)
"Value" judgment (IV)	6.04 (1.23)	5.98 (1.13)
"Worth" judgment (IV)	3.98 (2.51)	5.78 (1.90)
Blue-Red Lantern Scenario		
Choice tendency (DV)	5.28 (1.63)	5.34 (1.51)
"Value" judgment (IV)	5.94 (1.06)	5.92 (1.05)
"Worth" judgment (IV)	5.76 (2.00)	6.00 (1.74)
Career Choice Scenario		

Scenario	Regular University Students (N=50) M (SD)	Senior "University Students" (N=50) M (SD)
Choice tendency (DV)	3.66 (1.80)	5.10 (1.61)
"Value" judgment (IV)	4.76 (1.57)	5.82 (1.40)
"Worth" judgment (IV)	4.32 (2.26)	5.40 (2.05)
Eco-Friendly Lunch Box Scenario		
Choice tendency (DV)	5.14 (1.34)	5.26 (1.44)
"Value" judgment (IV)	5.22 (1.64)	5.96 (1.29)
"Worth" judgment (IV)	5.94 (1.77)	5.94 (1.68)
Red Envelope Scenario		
Choice tendency (DV)	3.62 (1.88)	4.88 (1.75)

Scenario	Regular University Students (N=50) M (SD)	Senior "University Students" (N=50) M (SD)
"Value" judgment (IV)	5.40 (1.32)	5.62 (1.26)
"Worth" judgment (IV)	4.14 (2.01)	4.98 (1.94)

Experimental results showed that differences in "value" between options could not predict final choices ("value" judgments as independent variables were not significant, ps $>$ .08), but differences in "worth" between options could predict final choices ("worth" judgments explained 56% to 85% of choice variance, ps $<$ .001). This means that the options participants chose could be perceived as having higher or lower "value," but were always perceived as having higher "worth." As expected, the highest choice tendency in each scenario was for the most expensive option (the smallest "value" option) (M_older+younger = 4.67, SD = 1.04), and older participants made higher "worth" judgments (M = 5.10, SD = 0.94) than younger participants (M = 4.25, SD = 0.97), F(1, 99) = 19.78, p $<$ .001. This indicates that older people seem less willing to make choices based on value maximization. Combined with Experiment 2 findings (that children, not their parents, make decisions based on value maximization in actual choices), this supports our speculation that there is an age effect in choosing the "smaller pear" in Chinese culture. People make value-maximizing choices based on instinct to seek benefits and avoid harm in early childhood, but as they grow older and become socialized under cultural influence, they learn to make worth-based choices. As people age and become more socialized and culturally integrated, they learn other values in the culture, making it easier to generate fictional dimensions. The ability to make worth-based decisions can thus be seen as fundamental to adaptively surviving the process of social integration.

In early life, people are smart enough to distinguish the "value" of given options and make value-maximizing choices. Children's technical abilities are sometimes surprisingly accurate (Cook, Goodman, & Schulz, 2011). As people grow older and become wiser and more socialized, they can foresee more possibilities in causal relationships. Then they can transform the principle of when to stop the decision process, and as revealed in this research, go further to explore potential benefits related to options but not obviously revealed by the given dimensions. To achieve this, decision-makers may creatively generate a new dimension and assign delayed subjective value—such as "worth" —to options on

this new dimension. When decisions are strictly limited to a given representation space, the equate-to-differentiate model shows that our decisions are simple choices comparing option values on one or another given dimension (Li, 1994, 1995, 1996, 2001a, 2004, 2016). However, when new dimensions are generated, many of our choices become simple comparisons of options' "value" on given dimensions or options' "worth" on additional fictional dimensions.

To test our choice model, we explored two forms that can assign greater worth to the given "small pear" : one very realistic construct (e.g., friendship) and one very unrealistic construct (e.g., superstitious beliefs). In the superstitious form, the imagined "worth" is associated with lucky numbers in phone numbers (banquet dates) or lantern colors. The role of these superstitious beliefs is similar to the "name letter effect" (Nuttin, 1987; Nelson & Simmons, 2007; Chandler, Griffin, & Sorensen, 2008).

In the realistic form, the imagined "worth"is something that can be reciprocated. This "worth"is assumed to arise from stable constructs such as the experimenter or friend involved in red envelopes, chocolate, pencil choice problems, hometown issues in job searching, and colleague issues in gift-giving scenarios. These choice problems, together with mobile phone number (banquet) and lantern color scenarios, suggest that even in very common situations (e.g., in Kong Rong' s example), "worth" is represented on generated fictional dimensions and endowed with potential future benefits.

Notably, Yuval Noah Harari in *Sapiens* identifies "fictional storytelling capacity" as the key that enables large-scale human cooperation and humanity' s rise to the top of the food chain. Fictional stories create superhumans (see Bloom, 2017). The worth-based choice introduced in this paper is essentially a process of weaving fictional stories. Without the ability to imagine non-existent things, decision-makers cannot generate unprovided dimensions nor assign delayed utility (worth) to options on self-generated dimensions (e.g., the praise Kong Rong received and future prosperity). From the perspective of fictional dimensions, the concept of "worth" illustrated in this research should be future or delayed utility. Using a Chinese proverb as an example, "In books there are golden houses" —the future benefit of golden houses requires time to accumulate and realize for the individual. The gist, as Yuval Noah Harari says, is that "values" exist in people' s collective imagination because we act as if they truly have value (e.g., the existence of money).

Although Yuval Noah Harari proposed the concept of "fictional storytelling capacity" in *Sapiens*, the lack of an operational definition has hindered our true understanding of it. We hope to view and validate the ability to self-generate fictional dimensions, assign delayed utility (worth) to options on these dimensions, and make worth-based choices as an operational definition that can measure the degree of "fictional storytelling capacity" proposed by Yuval Noah Harari in *Sapiens*.

We are pleased to see that our research on fictional dimensions is not alone;

recently, many studies on choosing the "small pear" can be gathered under this umbrella. Hu et al. (2016) attempted to answer whether the potential future benefits obtained by altruists are positive internal benefits. From our model' s perspective, so-called positive internal benefits can be represented on non-given, fictional dimensions. Recently, O' Brien and Kassirer (2018) found that the joy of giving lasts longer than the joy of receiving. They argue that when receiving, people easily compare on outcome dimensions, so each identical receiving experience reduces happiness; but when people focus attention on an action, such as donating to charity, they may compare less and treat each donation as a unique happiness-inducing event. Similarly, in our model' s language, the so-called "experience of each giving act as a unique happiness-inducing event" can be redescribed as follows: giving behavior (e.g., yielding a pear) is represented on the given (monetary) dimension, where "giving behavior" is not endowed with any utility such as happiness unless the donor self-generates an additional fictional dimension (e.g., social reinforcement) to represent the "giving behavior."

More relevantly, in Tang et al. (2014), worth-based choice through exploratory factor analysis yielded four factors/dimensions: favor, virtuous, righteousness, and law, and confirmatory factor analysis confirmed the stability and validity of this four-factor structure. Zhao et al. (2018) showed that people more inclined to suffer losses (e.g., unpaid overtime, giving up inheritance) were more likely to have high levels of subjective well-being and higher socioeconomic status indices, and these benefits would increase over time. The material and spiritual benefits revealed in Zhao et al. (2018) support our proposed view that "there exist extra dimensions that are not given but self-generated." The reason is that real but delayed benefits (whether material or spiritual), which can be approximated as the later success achieved in young Kong Rong' s story, can all be fictionally represented on non-given/self-generated extra dimensions (e.g., social desirability).

Fictional dimensions have also attracted attention in neuroeconomics. In a review article exploring the common neural basis of social and monetary rewards, Saxe and Haushofer (2008) point out that some rewards in life are more valuable than money. However, to explain that love is more valuable than money, a third measurement is needed—a universal "currency" that can be used to measure and compare physical and social rewards. In a recent fMRI study exploring the physiological basis of superstition, Rao, Zheng, Zhou, and Li (2014) found that superstitious beliefs indeed have a neural basis: luck-based choices showed stronger negative activation in the right middle/superior frontal gyrus than economy-based choices.

Our research results indicate that young children have difficulty choosing options with smaller "value" because they cannot generate additional dimensions and assign value to given options. Conversely, for older people, regardless of whether options have greater "value," they tend to choose options with greater "worth." This result aligns with the dynamics of knowledge accumulation: forming a culturally meaningful fictional entity requires time to immerse in, and believing

in such a fictional entity also requires time to polish. As time passes, fictional reality becomes increasingly powerful (Harari, 2014).

Further analysis of worth-based choice shows that the association between potential benefits and "worth" maximization decisions is unstable and slow. Not everyone is born able to imagine the "ugly duckling" (the small "value" option) as a "white swan." We quickly develop value-based strategies in early life, but developing worth-based strategies lags behind. The "age effect" found in our research also supports this speculation. Throughout human evolution from hunting to agriculture, only when humans were brave enough to make the intertemporal decision of "planting seeds that could be eaten immediately to 换取 perhaps greater harvest later" —a "lose first, gain later" decision—could we bid farewell to hunting civilization and transition to agricultural civilization. This intertemporal decision is both an important characteristic involving human survival capability and a major decision related to national economy and people' s livelihood. Perhaps it is the awareness of this "fragility of causality" that leads our judicial system and public opinion to treat value-based and worth-based choices differently. Behaviors of "gain now, no gain or big loss later" (e.g., drug use, academic fraud, or borrowing from loan sharks) are punished by law, while behaviors of "loss now, big gain later" (e.g., education investment or charitable donation) are protected.

In summary, this research elucidates the mechanism of making loss choices and provides an explanation for why people do not choose options with obviously greater "value." The important implication of this study is that in real life, a considerable number of people are not "content" and are willing to "go one step further" than ordinary people. In this research, "going one step further" means generating one more additional dimension than others, assigning one more utility to options, and thus making different worth-based choices from ordinary people. If "choice shapes our lives"(Bezos, 2010), this "one-step-further" choice might become a potential behavioral marker distinguishing "qualified" from "unqualified" Homo sapiens behavior (沈丝楚, 陈熹, 郭慧芳, & 李纾, 2018), and might also serve to keep humanity firmly at the top of the food chain.

Two questions deserve further exploration in future research. First, it is unknown to what extent our results can be generalized to other cultural contexts. Given that our research has certain "Chinese characteristics"in sampling, scenarios, and other aspects, validating the cross-validity of our findings is meaningful. From a collective action perspective, this concern is also justified: we generate various Chinese-characteristic fictional dimensions, and these fictional entities (e.g., lucky numbers) only work when all of us believe in the same fictional story (Harari, 2014). Second, it remains to be verified to what extent we can improve our methods to explore extra fictional dimensions and measure dimensional differences on given and generated dimensions. In this research, we concisely revealed extra fictional dimensions between options using the Query Theory method. Using some neuroscience measurement methods, such as fMRI, might help us further explore whether this fictional dimension has a neural basis (e.g.,

Rao, Zheng, Zhou, & Li, 2014).

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Note: Figure translations are in progress. See original paper for figures.