# Measuring Habit Formation

Jiannan Zhou*

December 10, 2025

**Abstract**

For millennia, habit formation has been recognized as essential across numerous disciplines, yet insufficient economic measurements have led to controversies over its existence, parameterization, and implications. This paper introduces a novel approach that provides direct micro-level evidence on habit formation while overcoming identification challenges inherent in existing approaches. We specify total consumption variations that separately identify habit's internal and external formation, decay speed, and welfare impacts relative to consumption and peer effects. Implementing the variations through survey experiments, we find that habit forms internally, decays by two-thirds annually, and exerts a welfare impact equivalent to 63% of that from consumption and three times that from peer effects. The measurements shed new light on the modeling of habit formation and indicate that, contrary to common belief, habit formation alone (or peer effects alone) cannot resolve the Easterlin paradox, although combining them could.

*Keywords:* Habit formation, consumption, micro evidence, Easterlin paradox, measurement
*JEL codes:* D12, D15, E21, I31, C81

*School of Economics, Shandong University (email: jiannan.zhou@icloud.com). I am indebted to Miles Kimball, Alessandro Peri, Martin Boileau, and Xingtan Zhang for their advice and support during this paper's development. I thank Daniel Benjamin, Andrew Caplin, Michael Woodford, John Cochrane, Kelsey O'Connor, Adam Szeidl, Colin Camerer, Tong Wang, Jian Li, Claudia Sahm, Hanming Fang, Richard Mansfield, Carlos Martins-Filho, Adam McCloskey, Matthew Rognlie, Sanjai Bhagat, Sergey Nigai, Scott Savage, Terra McKinnish, Vincent Mastantuno, Tony Cookson, Nathalie Moyen, Scott Schuh, Edward Van Wesep, Jin-Hyuk Kim, Nicholas Flores, Charles de Bartolomé, Brendan Epstein, and Shuang Zhang, and many seminar and conference participants for their helpful comments. Financial support from Miles Kimball is gratefully acknowledged. This work utilized the Summit supercomputer and the Alpine high-performance computing resource at the University of Colorado Boulder. The author received IRB approval from the relevant institutions (Protocol No. 180012) and has no material financial interests that relate to the research described in this paper.

"The difficulty [in composing *The General Theory*] lies, not in the new ideas, but in escaping from the old ones[—'habitual modes of thought and expression'], which ramify, for those brought up as most of us have been, into every corner of our minds."

John Maynard Keynes, 1936

# 1 Introduction

For more than two thousand years, habit formation has been recognized as a fundamental determinant of human behavior. Aristotle observed that "moral virtue comes about as a result of habit" (*Nicomachean Ethics* 2.1), and Confucius noted, "What nature put together, habit separates" (*The Analects* 17.2). Habit formation has been studied across numerous disciplines, such as philosophy, psychology, biology, medicine, marketing, and education. In economics, prominent figures such as Adam Smith and John Maynard Keynes have highlighted its profound impact on character development and consumption patterns. In *The Wealth of Nations* (1776), Smith observed that "the difference between the most dissimilar characters, between a philosopher and a common street porter, seems to arise not so much from nature, as from habit, custom, and education." Keynes argued in *The General Theory* (1936) that "a man's habitual standard of life usually has the first claim on his income ... when employment falls to a low level, aggregate consumption will decline by a smaller amount than that by which real income has declined, by reason both of the habitual behavior of individuals and also of the probable policy of governments," emphasizing the important role of habit formation in determining both individual-level and aggregate-level spending. Habit formation has also been incorporated into modern economic theory, with early contributions by Duesenberry (1949), Pollak (1970), and Spinnewyn (1981) in microeconomics; Ryder and Heal (1973), Carroll et al. (2000), and Fuhrer (2000) in macroeconomics; and Abel (1990), Constantinides (1990), and Campbell and Cochrane (1999) in finance.

Despite its enduring significance across time and disciplines and its theoretical prominence in economics, empirical work on habit formation in economics has struggled to provide clear and consistent evidence at the micro level. As a result, economists have yet to reach a consensus on fundamental questions about habit formation, such as whether it exists at all. Cochrane (2017), in a review of the literature, asks: "Is habit persistence really habit persistence, or does it pick up something else?" Moreover, limited evidence for the parameters in habit formation models raises concerns about their potential to overfit data, posing a significant challenge to model credibility (Breeden et al., 2015). The scarcity of micro-level evidence on habit formation also undermines the further development of habit-based models and their broader applicability in understanding macroeconomic and financial outcomes, as robust micro-level measurement serves as a foundation for macroeconomic predictions and policymaking (Stiglitz, 2018; Lucas, 1976).

Measuring habit formation in economics poses significant challenges. Unlike other disciplines, whose measurements of habit formation often focus on the automaticity of cue-action associations (Wood and Rünger, 2016), economic theories of habit formation emphasize past (total) consumption's influence on current utility—a latent construct—and on intertemporal choices, both shaped by many external factors.[1] This distinct emphasis underscores the need for robust, economics-specific measurement approaches. Existing economic measurements of habit formation exhibit limited scope, focusing on the existence and intensity of habit formation, while effectively neglecting critical dimensions such as habit's decay speed and welfare impacts. The limited dimensions under examination are typically inferred from observable choices, which rely on tenuous identifying assumptions, such as imposing restrictive parametric structures or proxying total spending with partial spending. Measurement via laboratory or field experiments is practically infeasible, as generating sufficient variation in total spending over extended periods to assess habit formation's existence, persistence, and welfare impacts is prohibitively costly. Consequently, despite three decades of research, economic measurements of habit formation remain limited and inconsistent, with substantial variation across contexts.

The main contribution of this paper is to introduce a novel approach that can directly measure habit formation, overcoming the identification challenges inherent in existing methods. We specify key parameters governing habit formation's existence, decay speed, and welfare impacts in a general model, and formally derive their separate identification through total consumption variations. In principle, the identifying variations are implementable through any approach that can isolate the variations. We implement the variations through hypothetical choice survey experiments in order to circumvent the restrictive assumptions often required to isolate habit formation through observational data and feasibly achieve identification that remains elusive in laboratory or field experiments, while broadening the scope of evidence on habit formation in the literature.

Although hypothetical choices tend to raise validity concerns, this type of data is well-grounded in economics (see, e.g., Barsky et al., 1997; Manski, 2004; Ameriks et al., 2020; Stantcheva, 2023) and, when carefully designed, is supported by evidence of significant alignment with real-world decisions (Hainmueller et al., 2015; Matousek et al., 2022; Kumar et al., 2023; Gneezy et al., 2024), particularly in spending contexts (Coibion et al., 2022). Unlike traditional real-world data, which often suffer from identification issues, our implementation adopts the "data

[1]The impact of habit formation on utility—characterized by reduced response or "getting used to" repeated stimulation—aligns with habituation, which is distinct yet related to cue-action automation (Liu et al., 2025; Pinsker et al., 1970). This study focuses on total consumption habit formation, the type of habit formation that drives the theoretical significance of habit formation in economics. Accordingly, models with habits linked to specific consumption categories (Ravn et al., 2006) and models that have not been used to explain total consumption dynamics, such as Matyskova et al. (2020) and Camerer et al. (2024), are not considered here. Consistent with the literature, this study refers to total consumption habit formation and habituation simply as "habit formation."

engineering" strategy—generating new forms of data closely linked to model constructs—as advocated by Caplin (2025, 2024), Almås et al. (2024), and others. This strategy has been successfully applied in studies of inflation and unemployment expectations (Coibion et al., 2022; Andre et al., 2022), earnings (Weidmann and Deming, 2021), consumer spending (Ameriks et al., 2007; Coibion et al., 2024), and firm decisions (Kumar et al., 2023). Despite potential validity concerns, hypothetical choices offer two key advantages. First, they allow us to identify habit parameters that remain elusive under traditional methods. Second, they provide complementary evidence for parameters that traditional methods can also address. This complementarity arises because the limitation of hypothetical choices—hypothetical bias—tends to be orthogonal to the aforementioned identification challenges that limit traditional methods. To enhance validity, we employ spending variations anchored in empirical realities, a two-wave design to mitigate response error, and experimental controls that isolate habit formation from confounding factors like durable goods. Our findings are corroborated by respondents' own explanations and related behaviors in an independent dataset and in the literature, exhibiting convergent and predictive validity.

Using this innovative approach, we document a new set of micro evidence on habit formation, covering its existence, decay speed, and welfare implications. First, habit forms internally, based on an individual's own past consumption, but not externally, based on the past consumption of others. This finding provides direct evidence for the dominant preference-based approach to modeling habit formation, especially for those internal-habit-based formulations. Second, habit decays at a rate of two-thirds per year—a speed that could significantly impact the performance of habit formation models. Third, habit formation has a welfare impact equivalent to 63% of that from consumption and three times that from peer effects, indicating a substantial hedonic effect. Lastly, contrary to common belief, habit formation alone—or peer effects alone—cannot explain the Easterlin paradox, but their combination provides a plausible explanation. These results enhance our understanding of habit formation and demonstrate the broader value of direct, controlled measurement approaches in economic research.

To generate these results, we use a general model that is agnostic about the existence and specification of habit formation, while still nesting existing habit formation models that are heterogeneous along multiple dimensions. This generality is essential because rejecting a specialized version of habit formation only refutes that specific version, whereas testing the general idea of habit formation requires a more general formulation (Cochrane, 2017). To extract useful information within such a general framework, we specify preference parameters that govern the existence, decay speed, and welfare implications of habit formation (Section 2.1). We then identify these parameters using total consumption variations, implement the variations through survey experiments, and conduct two waves of the survey on Prolific, yielding a representative

U.S. sample of approximately 2,100 responses across both waves.

Following detailed instructions and comprehension checks, the survey presented respondents with a series of binary choice questions asking about the (utility) ranking of spending profiles. The profiles differ in spending time horizon and levels, with both dimensions anchored to ensure familiarity. Such hypothetical variations are routinely used to identify preference parameters in the literature (e.g., Ameriks et al., 2020; Barsky et al., 1997). Leveraging humans' natural capacity for counterfactual thinking about both past and future variations (Epstude and Roese, 2008), the differing spending profiles induce variations in habitual spending levels, thereby influencing the utilities of the profiles. The ranking of the utilities is thus a function of the spending difference and the preference parameters. Given the spending difference specified in our questions, inverting the utility ranking indicated in the survey responses enables uncovering the preference parameters, a procedure we formalize in Section 3. This identification logic parallels decision-theoretic approaches where latent parameters are separately identified through structured variations in choice objects (e.g., Siniscalchi, 2009). Section 2.2 details the design of our survey experiments, such as the visual presentation of the spending profiles and the hypothetical scenario for reducing cognitive load and controlling for confounding factors. Section 2.3 discusses our strategies to enhance the validity of our hypothetical choices and presents evidence of their effectiveness. Section 2.4 summarizes the demographics of our respondents. Section 2.5 presents the statistical model used to extract reliable responses from the two survey waves while controlling for response errors not addressed by the survey experimental design.

Building on this framework, Section 3 details the measurement of the preference parameters of interest, starting with the existence of habit formation (Section 3.1). Depending on its source, habit formation can be categorized into internal habit formation and external habit formation, with about half of the literature assuming each type. These two types of habit formation can have dramatically different implications for optimal tax policy and welfare analysis (Carroll et al., 1997; Ljungqvist and Uhlig, 2000). Since habit formation reflects response decrement to repetitive stimulation, the most natural way to identify its existence is to vary past spending while holding future spending constant, as in our survey question eliciting the existence of internal habit formation. Choosing an option with lower past spending for a more satisfying future experience thus directly indicates the existence of internal habit formation. Two-thirds of respondents consistently chose this option across the two waves, indicating the presence of internal habit formation. Estimation accounting for response errors and respondents' open-ended explanations of their choices both confirm the existence of internal habit formation. A similar survey question on external habit formation, varying only other people's past spending, provided no evidence supporting its existence.

Given the existence of habit formation, we then investigate the speed of habit decay in Section 3.2. Most specifications of habit formation depend on two parameters: habit decay rate and habit intensity. The extant literature has predominantly focused on estimating the habit intensity parameter (see Havranek et al., 2017, for a review), while largely overlooking the habit decay rate, despite its potential to substantially influence the performance of habit formation models (see the section for an example). Because the habit decay rate governs the persistence of habit, the natural way to identify it is by varying the persistence of past spending. Responses indicating that sustained past spending exerts less influence on habit compared to transitory past spending thus imply that habit decays faster than a certain threshold, as formalized in Proposition 1. The estimated speed of habit decay is about two-thirds per year and exhibits a narrow confidence interval, suggesting that, contrary to prevailing practice, it should not be treated as a free parameter. We further show that faster habit adjustment, as measured by our approach, predicts faster real-world hedonic adaptation in an independent dataset collected two months later than ours.

Section 3.3 details the measurement of two preference parameters that govern the welfare impacts of habit formation. In particular, the slope of the indifference curve, $-\frac{u_H}{u_C}$, measures the welfare impact of habit formation ($H$) relative to that of one's own consumption ($C$). The ratio $\frac{u_{C_{\text{others}}}}{u_H}$ assesses the relative welfare impacts of habit formation and peer effects from others' contemporaneous consumption ($C_{\text{others}}$). Both parameters offer insights into the resolution of the Easterlin paradox. As ratios, the identification of these parameters naturally depends on trade-offs: habit versus consumption (for $-\frac{u_H}{u_C}$), and peer effects versus habit (for $\frac{u_{C_{\text{others}}}}{u_H}$). Leveraging these tailored identifying variations, our findings imply a habit intensity of approximately 0.6, providing micro-level evidence for common macroeconomic calibrations of this parameter. Furthermore, habit formation's welfare effect is found to be three times that of peer effects.

To illustrate how novel measurement can lead to novel insights, Section 4 investigates the potential of habit formation to explain the half-century-old Easterlin paradox. Easterlin (1973, 1974) highlighted the tension between the positive cross-sectional correlation and the zero time-series correlation of happiness and income and proposed peer effects as an explanation in light of their impact on averaging happiness across individuals. As happiness data accumulated over time, the literature discovered that the zero time-series correlation tends to hold only in the long run, whereas the short-run correlation is generally positive (Stevenson and Wolfers, 2008; Easterlin, 2017). Habit formation has been suggested as a potential explanation for the original version of the paradox (Easterlin, 1995) and, specifically, for the more recently discovered temporal heterogeneity of the correlation (Clark et al., 2008). To the best of our knowledge, evidence on whether habit formation can actually explain the paradox is absent from the literature. Utilizing this paper's extensive evidence on habit formation, we find that, contrary to the proposed explanations, neither

habit formation nor peer effects alone can fully account for the happiness–income dynamics highlighted by the Easterlin paradox. However, combining habit formation and peer effects can generate the observed happiness–income pattern across all dimensions: cross-section, short run, and long run. Individuals eventually habituate to income and observe others' similar income adjustments, explaining the negligible long-run happiness–income gradient. Before full habituation or awareness of others' income changes, happiness tracks income, driving the positive short-run gradient. Wealthier individuals and countries accumulate more short-term happiness, accounting for the positive cross-sectional gradient. Assessing scale-use tendency à la Benjamin et al. (2023) shows that the explanation remains robust when individuals' reporting scales exhibit little variation. This explanation implies that, despite the negligible long-run happiness–income gradient, sustained economic growth remains critical for maintaining the stabilized level of happiness.

**Related literature.** The primary contribution of this paper is a methodology for directly measuring habit formation. It adds to four main strands of literature: micro evidence on habit formation, the Easterlin paradox, reference dependence, and structural preference elicitation.

Over the past three decades, the study of micro evidence on habit formation has emerged as an active field in economics. This literature, primarily leveraging observational data, focuses on the existence of internal habit formation and yields divergent findings. Studies such as Dynan (2000), Meghir and Weber (1996), and Brunnermeier and Nagel (2008) find no evidence of internal habit formation, whereas Crawford (2010), Naik and Moore (1996), and Khanal et al. (2018) provide supporting evidence. Other studies, such as Browning and Collado (2007), report mixed results. The limited exploration of external habit formation also reveals conflicting evidence: Dynan and Ravina (2007) support its presence, while Brunnermeier and Nagel (2008) do not. Moreover, estimates of the intensity of habit formation often fall short of the levels required to account for macroeconomic data (see Havranek et al., 2017, for a review).

Experimental research in economics consistently finds evidence of habit formation, though it often focuses on non-consumption behaviors. Field experiments by Charness and Gneezy (2009), Royer et al. (2015), and Hussam et al. (2022) show habit formation in gym attendance and handwashing, while Camerer et al. (2024) find it in social media posting and tuna purchases. Matyskova et al. (2020) document habit formation in binary state-recognition tasks within a laboratory setting. Additionally, Kapteyn and Teppa (2003) show superior performance of a multiplicative habit model over a non-habit model in explaining survey experimental data on time preference and intertemporal substitution.

This paper contributes to the literature by developing identifying variations that can directly measure habit formation. Utilizing the recently termed "data engineering approach" (Caplin, 2025, 2024; Almås et al., 2024), our implementation of the variations through survey experiments en-

ables isolating habit formation from confounding factors in observational data and overcomes the prohibitive costs associated with investigating total consumption habit formation in laboratory and field settings, addressing concerns due to heterogeneity of habit formation across behaviors (Wood and Rünger, 2016; Buyalskaya et al., 2023). The validity of these identifying variations rests on standard economic assumptions (see Section 2.1) and is independent of the survey experimental implementation. We provide direct micro-level evidence on the impact of total consumption habit formation on preference, offering key support for the dominant preference-based approach to modeling habit formation while addressing concerns inherent in the existing literature, such as the reliance on partial spending data, the challenges posed by parametric assumptions susceptible to alternative explanations, and the focus on comparative model fit over direct examination of habit's effect on preference structure. Utilizing a hypothetical scenario with minimal adjustment costs, our approach provides evidence on habit formation that complements Chetty and Szeidl's (2016) work that attributes similar consumption dynamics to consumption commitments. Furthermore, our approach relaxes key parametric assumptions, such as the multiplicative habit specification, thereby enhancing the robustness of the evidence. By tailoring identifying variation for each of the habit-related parameters, this paper broadens the scope of micro evidence on habit formation, enabling investigation of habit's decay speed and welfare impacts relative to consumption and peer effects, unconstrained by specification and data availability.

A more focused literature has sought to test habit formation models while relaxing important parametric assumptions. Chen and Ludvigson (2009) allow habit to evolve nonparametrically while maintaining additive habit and power utility specifications. Crawford (2010) extends this by relaxing the parametric assumptions on both the utility function and habit evolution. This paper advances the literature by adopting a more general approach, employing a nonparametric utility function that relaxes joint concavity in consumption and habit, thereby encompassing the common multiplicative habit specification. It further accommodates an infinite number of lags in habit evolution and leverages data specifically designed to measure total consumption habit formation.

In the five decades since the Easterlin paradox was introduced (Easterlin, 1973, 1974), many explanations have been proposed to resolve it, but how to validate these conjectured explanations—especially those based on unobservable cognitive constructs such as habit formation (Easterlin, 1995; Clark et al., 2008)—remains an open question. This paper offers a unique perspective for tackling this issue: measuring the cognitive constructs with minimal restrictions and conducting calibrated quantitative investigations to assess the extent to which each explanation can contribute to resolving the paradox. Drawing on its measurements of habit formation, this paper corroborates the literature's recognition of habit formation's key role in explaining the paradox, but challenges the view that habit formation alone is sufficient to fully account for it. This study further advances

the literature by controlling for and assessing changes in reporting scales à la Benjamin et al. (2023), thereby differentiating the explanation through habit formation and peer effects from the rescaling explanation (Deaton, 2008; Prati and Senik, 2024). The essentially zero long-run happiness–income gradient highlighted by the paradox has been used to critique growth-centric economic policies, notably by degrowth proponents advocating for reduced economic growth in affluent nations (e.g., Alexander, 2012). This paper's explanation of the paradox suggests, however, that although sustained economic growth may not be sufficient to elevate long-run happiness, it is necessary to maintain long-run happiness, as slower growth would precipitate declines in happiness due to habit formation and peer effects.

This paper also relates to the extensive literature on reference dependence, originally introduced into economics by Markowitz (1952) and popularized by Kahneman and Tversky (1979). The dominant assumption in this literature is that reference points are shaped by the status quo (e.g., Masatlioglu and Ok, 2014) or by expectations (e.g., Kőszegi and Rabin, 2006). This literature has linked habit formation with reference dependence, leading to the introduction of backward-looking reference points (e.g., Bowman et al., 1999; Post et al., 2008; DellaVigna et al., 2017). Consistent with field evidence (e.g., Kahneman et al., 1991), this paper provides further support for habit formation as a mechanism driving backward-looking reference points and offers insights into the speed at which the reference points evolve over time.

Finally, this paper contributes to the literature on structural preference elicitation. Previous studies have predominantly estimated structural preference parameters under fully parametric specifications (e.g., Barsky et al., 1997; Kimball et al., 2008, 2009, 2024b). To mitigate specification errors, some researchers have relaxed certain parametric assumptions and employed first-order approximations in eliciting semiparametric and nonparametric preferences (e.g., Benjamin et al., 2014b, 2019). This paper advances the literature by employing higher-order approximations, up to infinite order (see Section 3.2). This methodological enhancement improves the precision of preference elicitation and enables the elicitation of previously intractable preference parameters.

# 2 Methodology

## 2.1 Model and Preference Parameters

To address the gaps in the existing evidence, this paper utilizes a general model that is agnostic regarding the existence and specification of habit formation, while retaining widely accepted economic assumptions to ensure relevance to existing models. Specifically, the agent maximizes

$$\mathbb{E}_0 \int_0^\infty e^{-\rho t} u(C_t, H_t) dt,$$

where $C_t$ is the agent's total spending, $H_t$ is their habitual level of spending (henceforth, habit), and $\rho$ is the time discount rate. Unless otherwise specified, the time index is omitted hereafter for brevity. We follow the literature in maintaining expected utility and exponential time discounting. The utility function is analytic, strictly increasing in consumption ($u_C > 0$), and exhibits diminishing marginal utility of consumption ($u_{CC} < 0$), as is standard in economic models. These assumptions facilitate identification while leaving open whether and how habit affects utility.[2] The utility function may depend on additional variables, such as leisure. However, since these variables remain constant in the identifying variations, omitting them from the explicit utility function results in no loss of generality. When examining changes in variables beyond own consumption and habit—such as others' consumption—these additional variables will be explicitly incorporated into the utility function.

Habit evolves according to

$$\dot{H} = \theta(C - H), \tag{1}$$

where $\theta$ is the habit decay rate. This habit evolution equation implies that habit depends on the agent's entire spending history, with the influence of each period's consumption weighted by $\theta$ and the elapsed time. This specification is chosen for four reasons. First, it is the most widely used habit evolution equation in the literature, with the discrete-time expression $H_t = \left(1 - e^{-\theta}\right) C_t + e^{-\theta} H_{t-1}$. Researchers have used different formulations of the habit evolution equation; however, their differences either amount to a simple rescaling of the unit of habit (e.g., the habit evolution equation of Constantinides, 1990) or vanish in the steady state (e.g., the habit evolution equation of Campbell and Cochrane, 1999). Second, the habit evolution equation can be extended to incorporate a mixture of internal and external habits (e.g., Grishchenko, 2010), with negligible impact on the results presented in this paper. For habit evolution equations that are potentially nonlinear (even in the steady state),[3] we show in Appendix A that they are observationally equivalent to this linear habit evolution equation under the general preference above. The main idea of the proof is that any nonlinear habit evolution equation can be represented equivalently by the linear habit evolution equation with a different functional form for $u$. Third, this habit evolution equation provides an intuitive unit for habit, identical to that of consumption, consistent with $H$'s definition as the habitual level of spending. For example, a person who has spent \$5,000 per month for as long as they can remember has a habitual spending level of \$5,000 per month. Fourth, the exogeneity of this habit evolution equation is supported by extensive evidence from the biology literature showing habituation across

[2] To preserve the generality of the utility function under infinite-order approximation with habit formation, this paper assumes that any positive $\partial^n u / \partial H^n$ is bounded above (see Lemma 3 in Appendix C for details). Common additive and multiplicative habits with power utility satisfy these bounds under typical parameter values.

[3] This includes, but is not limited to, habit evolution equations with lagged spending, such as $H_t = \left(1 - e^{-\theta}\right) C_{t-1} + e^{-\theta} H_{t-1}$.

diverse species, including single-celled organisms without neural systems (Boisseau et al., 2016).

These assumptions complete the model's specification. The model is intentionally parsimonious, allowing it to nest more specialized models with additional structures that are held constant in the experiments. Furthermore, we do not explicitly model budgetary constraints, as the respondents choose among complete, budget-feasible spending profiles (see Section 2.2 for details).

To provide micro evidence on habit formation, it is essential to determine whether and how habit influences utility. Accordingly, we measure six relevant preference parameters: the existence of internal habit formation, the existence of external habit formation, the habit decay rate ($\theta$), the time discount rate ($\rho$), and two ratios of utility derivatives ($-\frac{u_H}{u_C}$ and $\frac{u_{C_{\text{others}}}}{u_H}$).[4] The habit decay rate ($\theta$) determines how rapidly habit adjusts to changes in consumption, while $-\frac{u_H}{u_C}$ captures the welfare impact of habit formation relative to consumption. $\frac{u_{C_{\text{others}}}}{u_H}$ quantifies the relative welfare impact of peer effects versus habit formation. By concentrating on these parameters, this paper evaluates the major aspects of habit formation while maintaining clarity and focus.

## 2.2 Survey Experimental Design

Our survey is structured as follows: (i) consent form; (ii) demographic questions; (iii) calibration questions;[5] (iv) instructions on spending graphs with comprehension checks; (v) instructions on the hypothetical situation with comprehension checks; (vi) four modules on internal habit formation, habit decay rate, slope of indifference curve, and time discount rate; (vii) instructions on spending graphs under uncertainty; (viii) three modules on higher-order habit parameters;[6] (ix) instructions on spending graphs with other people's spending; (x) three modules on external habit formation, external habit mixture coefficient, and $\frac{u_{C_{others}}}{u_H}$; (xi) comprehension checks on the hypothetical situation (repeated); (xii) calibration questions (repeated); and (xiii) exit questions on respondents' approach to the survey and willingness to participate in a follow-up wave. Appendix G presents screenshots of the full survey.

Past spending shapes habit, which in turn may influence well-being, suggesting that varied spending profiles can produce distinct welfare outcomes, with preference parameters modulating the process. Our core identification strategy thus involves recovering preference parameters from respondents' welfare rankings of different spending profiles.[7] Correspondingly, our main survey questions

[4] Estimating certain preference parameters requires knowledge of the time discount rate, $\rho$, the elicitation of which is detailed in Appendix F.1 due to this indirect relevance.

[5] Calibration questions are survey questions designed to have the same objective state across all respondents, enabling the identification and measurement of scale-use heterogeneity across individuals (Benjamin et al., 2023).

[6] Modules (vii) and (viii) are designed to address distinct research questions. To maintain the paper's focus, they are not analyzed here. Module (x) includes questions to measure an external habit mixture coefficient, which is omitted from this paper given evidence on the absence of external habit formation (Section 3.1).

[7] Because income affects utility through spending, the experiments do not specify the income process except to inform respondents that they can afford the spending profiles in the survey.

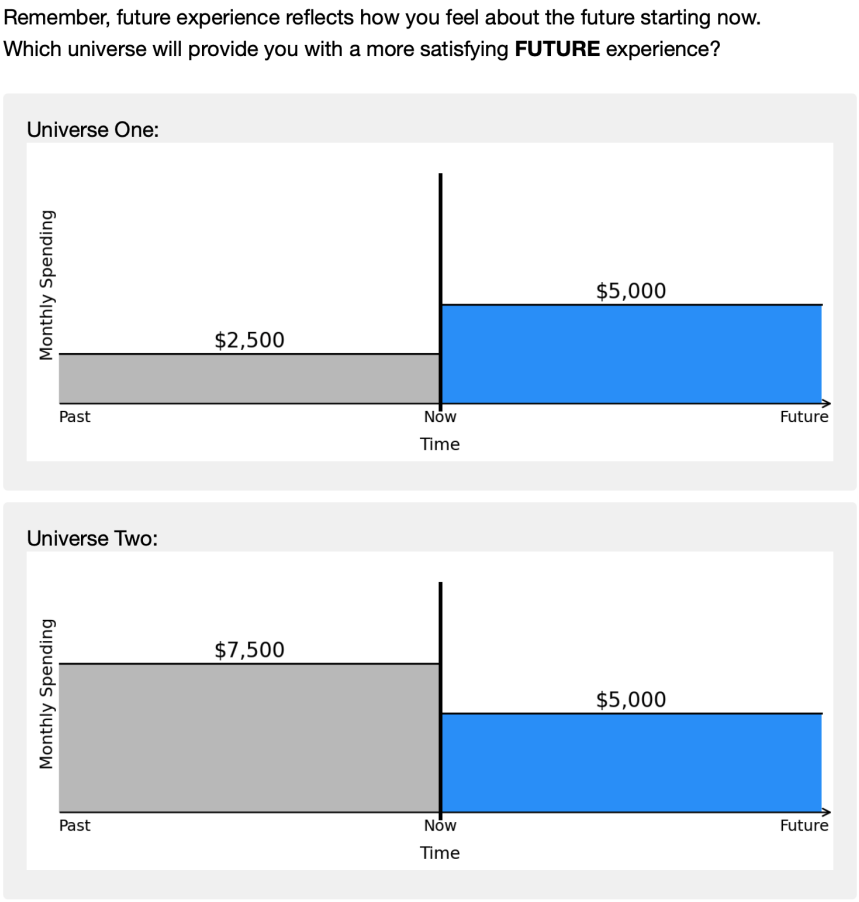



Figure 1: A Typical Survey Question

ask respondents for their binary rankings of spending profiles designed to identify parameters of interest. The identifying variations are parameter-specific and will be elaborated upon in Section 3, where the contextual richness facilitates a clearer discussion of the specific identification strategies.

To enhance respondents' intuitive comprehension and facilitate comparisons between spending profiles, visual representations of these profiles were employed (see Figure 1 for two examples). In these graphs, the horizontal axis represents time, with the past on the left, now in the center, and the future on the right. Monthly spending is depicted as bars above the time axis, scaled proportionally to the spending amounts and color-coded to distinguish between different temporal periods. For instance, the first spending profile in Figure 1 illustrates monthly spending of $2,500 in the past up to now, followed by an increase to $5,000 per month in the future starting now. To ensure accurate interpretation, respondents were provided with detailed instructions and underwent comprehension assessments regarding these graphical representations.

The baseline level of household spending is set to $5,000 per month to align with average

household spending reported by the Bureau of Labor Statistics, ensuring familiarity among our respondents, whose average household spending was $4,362 and $4,265 in the two survey waves, respectively. To investigate how deviations of the hypothetical spending profiles from respondents' actual spending might affect our responses, we conduct several robustness checks. First, half of the respondents with monthly spending below $4,000 were randomly assigned a baseline spending of $3,000 per month. The estimates showed no significant differences between this group and the control group with the default baseline spending level (see Column 1 of Table A.4), indicating that the baseline spending levels do not bias responses. Second, regression analyses reveal that neither current nor anticipated spending exerts a statistically significant impact on the estimates of the preference parameters, and an indicator for the $3,000 baseline spending also lacks influence (see Appendix Table A.3)—a result that remains robust across a variety of specifications. Furthermore, restricting the analysis to respondents whose actual spending levels closely align with the baseline spending produced robust results (see Column 2 of Table A.4).

The spending profiles presented in our survey involve variations in both the level and timing of spending, designed to mimic common, real-world household spending fluctuations—approximately 50% of U.S. households reported changes in monthly spending from the prior year in 2024 (Larrimore et al., 2025), and checking account data show that over 60% of U.S. households experience average monthly spending fluctuations exceeding 30 percent (Farrell and Greig, 2015). In our experiments, the monthly spending varies no faster than the annual frequency, with the average variation kept within 35% of the baseline spending level. To simplify the variations while preserving identification, spending deviates from the baseline only across two stylized time frame categories: (1) all past or all future years and (2) the last or next year. When questions involve other people's spending, we exclusively use the simpler variation type (1). The levels of spending deviations were chosen to represent meaningful economic changes and were refined through pilot studies. The specific combinations of spending time frames and levels were guided by the identification propositions (e.g., Proposition 1-3), ensuring that the elicitation accurately covers an informative part of the domain for each parameter of interest. Finally, comprehension checks (in module iv) confirm that respondents effectively engaged with the spending variations: 58% of respondents passed the checks on their initial attempt, and the remaining 42% passed on their second attempt.

Hypothetical scenarios involving future spending are routinely used to elicit preferences (e.g., Barsky et al., 1997; Ameriks et al., 2020). Since habit is shaped by the past, the identification of its parameters necessitates the introduction of variations in past spending. Our experimental approach of constructing hypothetical scenarios involving past spending, while novel in this context, is firmly grounded in counterfactual thinking—a fundamental cognitive process ubiquitous across human reasoning, such as learning, problem-solving, and causal inference (Epstude and Roese, 2008).

This approach is exemplified by intuitive reflections such as, "If I had spent less back then, I would be in a better place now," illustrating how people readily contemplate historical variations. Evidence from respondents' explanations of their choices confirms their capacity to effectively evaluate these counterfactual past variations (see Section 3.1 for details). To help distinguish the spending profiles specified in the questions from the respondents' own spending history, the survey employs a parallel-universe analogy, in which all factors remain identical except for the respective spending profiles. Respondents demonstrated a strong grasp of this analogy, with 93% passing the relevant comprehension check on their first attempt. Respondents are then prompted to indicate which universe's spending profile would yield a more satisfying past or future experience—that is, how they feel about the past up to now or the future starting now. Figure 1 illustrates a typical survey question.

To reduce cognitive load and control for potential confounding factors, while preserving identification, respondents' choices are situated within the following hypothetical scenario (with emphasis as in the survey):

*To simplify the comparison of your experience under various spending patterns, please evaluate your experience in the following hypothetical situation:*

- *There is* ***no inflation****, and prices of everything stay the same over time.*
- *You* ***rent the durable goods*** *you use, including residence, furniture, car, etc.*
- *Your* ***preferences do not change*** *over time.*
- ***People not mentioned in the questions always spend $5,000 per month****, regardless of their income or wealth.*
- ***Any other factors not specified in the questions are identical between the universes and remain identical over time.***

The hypothetical situation alleviates respondents' concerns regarding changes in the purchasing power of money, the acquisition of durable goods, and potential shifts in preferences. It is standard practice to exclude inflationary dynamics from hypothetical spending scenarios when inflation is not the primary focus of investigation (e.g., Kapteyn and Teppa, 2003). The acquisition of durable goods can be seen as antithetical to habit formation, as the former tends to diminish the marginal utility of consumption, whereas the latter increases it. Renting durable goods mitigates this dampening effect. Consistent with the scenario, the literature finds that people typically operate under the assumption of preference stability (e.g., Loewenstein et al., 2003). Because the spending of others may influence individual well-being, the hypothetical situation controls for this factor when its variation is not of interest but could be confounding. To preclude the influence of extraneous variables not explicitly addressed in the experimental design, the scenario stipulates that such factors remain constant across all choice alternatives and temporal dimensions. To reinforce this point, the instruc-

tions clarify that "*The last point means that factors, including but not limited to your income, savings, wealth, control over finances, and the state of the economy, are the same between the universes and remain the same over time.* ***Only your spending mentioned in the questions varies between the universes****, so please focus solely on those spending differences when making your evaluations.*"[8] The instructions explicitly define "you" as your household and "others" as other households. Both entities are described as being able to afford the spending specified in the survey questions.

The seemingly abstract nature of our hypothetical scenarios is, in fact, strategically designed to reduce hypothetical bias and enhance identification. Complicating the scenarios (e.g., by introducing inflation dynamics) would increase the cognitive burden and reduce respondent engagement, which tends to amplify, rather than reduce, hypothetical bias (Haghani et al., 2021b). Furthermore, not controlling for potential confounding factors risks conflating the true effect of habit formation with those factors (e.g., durable goods ownership). Our design mitigates this by varying only the relevant variable (total consumption) while holding irrelevant variables (such as inflation and durable goods) constant. This approach is consistent with the process of counterfactual thinking, where individuals naturally tend to vary only the key variable of interest.

To ensure comprehension, key aspects of the hypothetical situation are emphasized in bold in the survey (as above), and respondents are required to pass all the comprehension tests on the hypothetical scenario (and the monthly spending graphs) to proceed to the core survey modules on preference parameters. Comprehension checks focused on the hypothetical situation (module v) demonstrated high understanding: 93% of the participants passed on their first attempt, with the remaining 7% passing on their second attempt. To assess sustained understanding of the situation, participants were reassessed toward the survey's conclusion (in module xi) using the same set of comprehension questions. The results indicate that 92% of the participants provided correct responses to all six questions, 5% answered one question incorrectly, and 3% answered two or three questions incorrectly.

Respondents were not informed that the survey aimed to study habit formation, but rather that it examined spending behavior, for three reasons. The first reason was to mitigate potential biases; priming respondents with habit formation could undermine the validity of the test for its existence. The second reason was to prevent confusion; it is likely that the average respondent is unfamiliar

[8]To address potential confusion regarding the relationship between income, saving, and spending, the survey instructions include a clarifying note: "*Even though your income, saving, and wealth are the same across universes, your spending doesn't have to be identical. For the purposes of this survey, you can imagine a hypothetical external financial system that automatically adjusts your savings at no cost to you, allowing your spending to vary while keeping everything else unchanged.*" This is a deliberate design choice to isolate effects from consumption, free from confounding wealth effects or savings optimization. While this might be confusing for some respondents, we can detect such misunderstandings using open-ended explanations of respondents' choices, and our results are robust to removing confused respondents.

with the concept of habit formation as modeled in economics. The third reason was to minimize selection based on the survey topic.

The main survey questions utilize a binary-choice format to reduce cognitive load for participants. To enhance the precision of the estimates for point-identified parameters, an adaptive unfolding bracket methodology is implemented.[9] This approach entails an initial ranking of two spending profiles, followed by a subsequent ranking of the preferred profile against a third profile that is dynamically adjusted based on the respondent's prior selection. An illustration of this technique is provided in Section 3.2. Furthermore, the binary-choice format deliberately excludes an option for indifference, thereby reducing the propensity for satisficing behavior (Caplin et al., 2011) and fostering more thorough engagement with the presented scenarios.[10] In instances where respondents perceive the options as equivalent, their selections are presumed to be stochastic, consistent with stochastic choice theory (Block and Marschak, 1960). To enhance reliability and address potential order effects, the study conducts two waves of the survey with reversed option orderings.

In the survey questions, response options were crafted to reflect respondent preferences rather than to elicit objectively correct or incorrect answers, which inherently precluded the use of direct incentivization. To counteract potential biases arising from question misinterpretation, inattention, or protest responses, the survey instrument was meticulously structured to minimize cognitive load. This was achieved through several integrated features: spending profiles were visually depicted to enhance comprehension; repeated emphasis was placed on the fact that the only variation between response options lay in their spending profiles; explicit descriptions clarified the time horizon of spending differences; and follow-up questions incorporated dynamic explanations regarding changes in the spending graphs. Additionally, to facilitate the distinction between past and future experiences, survey questions solicited responses for both, with definitions reiterated and the words "past" and "future" highlighted in each question. Furthermore, to minimize erroneous selections, spending graphs were embedded within interactive options that provided visual feedback, such as gradual darkening when hovered over or selected.

To ensure sustained participant attention throughout the survey, a multifaceted approach incorporating both explicit and implicit attention checks was implemented. Explicit checks consisted of comprehension questions administered at the survey's outset and targeted questions designed to elicit specific responses, thereby verifying engagement. Implicit checks included the time participants spent on each question, exit comprehension checks, and response consistency across

[9]This design diverged from Ameriks et al.'s (2020) strategic survey question format, as the identifying variations encompass both spending levels and time horizons. This multifaceted structure significantly increases the cognitive burden of eliciting indifference points, rendering their approach impractical for typical respondents.

[10]The sole exception pertains to the time discount rate question regarding past experiences, where the spending profiles across options were objectively identical, and participants were offered the opportunity to indicate indifference.

waves. Participants were informed of the inclusion of these attention checks, though details regarding their specific nature and placement within the survey were deliberately withheld to maintain their efficacy. To further incentivize diligent participation, respondents were offered entry into a lottery with a 1 in 100 probability of winning $5, contingent upon the provision of high-quality responses.[11] Additionally, the survey design incorporated self-assessment mechanisms, whereby participants evaluated their attention levels at the midpoint and their overall effort upon completion. The results of these self-assessments revealed that over 99% of participants reported maintaining full attention midway through the survey. At the survey's conclusion, 82% indicated exerting maximum effort, 16% reported substantial effort, and only 1% acknowledged minimal effort.

To further enhance reliability, the survey was conducted in two waves, with the first wave fielded in August 2024 and the second wave administered two weeks later in September 2024. In the second wave, the core modules were reordered, and the order of response options was reversed to mitigate potential response biases. Additionally, to reduce survey time and minimize respondent burden, the demographics module and the two modules of calibration questions were omitted from the second wave. The baseline spending level from the first wave was retained in the second wave. The test-retest correlations for the core module responses averaged 0.45 (see Appendix Table A.1 for parameter-specific correlations across the waves),[12] which falls within the typical reliability range for preference measurements through choice experiments (Chuang and Schechter, 2015).

It is worth emphasizing that comparisons of the spending profiles do not amplify the significance of habit formation. Comparative evaluations do not intrinsically result in estimates indicative of habit formation ($u_H < 0$); these evaluations are equally compatible with $u_H > 0$, a scenario in which habit formation is not present. Importantly, neither the experimental design nor the estimation procedure imposes constraints on the sign of $u_H$, thereby allowing the data to reveal the genuine effect of habit formation without introducing bias. Moreover, whereas real-world behavior is frequently subject to numerous intersecting factors that obscure the influence of habit formation, the controlled experimental environment is deliberately structured to isolate consumption patterns needed to identify key habit parameters, thus providing insights that are challenging to obtain from complex real-world contexts.

## 2.3 Validity of Hypothetical Choices

To provide evidence on the habit parameters of interest without being constrained by the confounding factors inherent in observational data or the practical infeasibility of traditional experiments, we

[11] From the 2,097 valid responses, 21 respondents were randomly selected for this award.

[12] The test-retest correlation for the responses on external habit formation was excluded from this calculation as the absence of evidence on external habit formation (Section 3.1) suggests that their responses are random and thus naturally have low cross-wave correlation.

implement our approach using hypothetical choices. Systematic deviations between hypothetical and real-world choices are typically categorized as hypothetical bias (Haghani et al., 2021a). Our research design, therefore, is constructed with the explicit goal of minimizing the most likely sources of hypothetical bias in the context of eliciting preferences over total consumption profiles.

The literature identifies multiple sources of hypothetical bias (Haghani et al., 2021a; Johnston et al., 2017). In our specific context of measuring habit formation, we assess the primary threats to be cognitive biases and lack of consequentiality. The challenge from cognitive biases (e.g., hot-cold empathy gap) is arguably the most significant. Respondents in an unemotional "cold" state may struggle to accurately predict their utility under different consumption profiles.

To mitigate this concern, our experimental design anchors the hypothetical scenarios to empirical realities, a strategy shown to enhance the validity of elicited responses (Manski, 2004; Haghani et al., 2021b). Specifically, the baseline monthly household spending level of $5,000 closely approximates average U.S. household expenditures reported by the Bureau of Labor Statistics, with 79.3% of the respondents' household spending falling within one standard deviation from this baseline. For respondents with lower actual spending, we randomized half of them into a version of the experiments with a $3,000 baseline spending and find that the estimates from this group were statistically indistinguishable from those of the main sample, indicating that the default baseline spending level does not bias responses. Furthermore, our variations in consumption profiles mirror the typical life experiences of U.S. residents (Section 2.2). Because consumption decisions are ubiquitous, respondents possess crystallized preference structures derived from extensive past behavior—a familiarity known to reduce hypothetical bias (List, 2001). Finally, our scenarios leverage humans' innate capacity for counterfactual thinking (Epstude and Roese, 2008), which our participants effectively utilized as evidenced by their open-ended responses (Section 3.2).

Crucially, our approach does not require respondents to report absolute utility levels. Our method remains valid provided that cognitive biases do not alter the ranking of options—an assumption that holds if biases affect all predictions symmetrically. This distinction is well supported by the literature, which suggests that hypothetical bias tends to distort absolute levels while preserving the reliability of relative trade-offs (see Haghani et al., 2021a, for a review). Since choices are not financially binding, respondents may exert insufficient cognitive effort. We address this through several mechanisms detailed below, including comprehension checks and incentivizing response quality.

Other common sources of hypothetical bias, such as social desirability or strategic behaviors, are less pertinent here. Unlike surveys on prosocial or environmental goods, preferences for total consumption profiles are not laden with strong normative motivations. The risk of respondents trying to "appear good" is therefore minimal. The academic nature of our survey, which was not framed as a commercial or policy pricing study, makes it unlikely that respondents would

strategically misrepresent their preferences to influence a market or policy outcome.

To counter these potential biases, we implemented a suite of ex-ante mitigation strategies integrated into the survey instrument to enhance response validity and reliability, focusing on contextual realism, cognitive load reduction, and mitigation of inattention and indifference. By incorporating clear visual representations of spending profiles, a "parallel-universe" analogy, and anchoring to average consumer expenditures, we mitigate the "hot-cold empathy gap" and limited familiarity, creating a tangible decision-making environment to strengthen internal and external validity. To minimize reliance on simplifying heuristics, we employed a streamlined binary-choice format, provided detailed instructions with comprehension checks, and controlled for complicating factors such as inflation, thereby reducing cognitive burden and fostering deliberate responses. Additionally, we ensured high-quality data by incorporating explicit and implicit attention checks, offering a lottery-based incentive for diligent engagement, and excluding an indifference option to encourage more thorough engagement and reduce satisficing behavior. To enhance the reliability of our findings, we conduct the survey twice and extract reliable responses from the two survey waves, while accounting for response errors. We also perform various checks to show the robustness of our estimates to demographics, baseline spending levels, time horizons, additional attention checks, and response biases and errors with nonzero and wave-varying means (Appendix E).

Given the lack of readily observable counterparts for these structural habit parameters in conventional data, we assess the validity of our hypothetical choices by demonstrating their convergent and predictive validity (Strauss and Smith, 2009). To establish convergent validity, we compare our estimates to findings on related behaviors in the literature and show consistency: our estimated rate of habit decay closely aligns with prior estimates of income adaptation speed (Section 3.2), and our derived welfare impacts of habit formation and peer effects effectively match established estimates for income adaptation and peer effects, respectively (Section 3.3). This validity is further supported by qualitative evidence, as approximately 80% of respondents who chose in accordance with internal habit formation articulated reasons directly tied to habituation (Section 3.1). Finally, to demonstrate predictive validity, we show that the habit decay rate measured in our survey predicts real-world happiness responses: respondents reporting faster habit adjustment in our hypothetical scenarios exhibited faster hedonic adaptation to the 2024 U.S. presidential election outcome, which occurred two months subsequent to our survey (Section 3.2).

## 2.4 Data Summary

The survey was administered via Prolific, an online platform designed for human intelligence tasks. To mitigate cultural bias, the sample was restricted to residents of the United States. While online samples may not achieve the representativeness of census-based samples, they offer greater representativeness than in-person convenience samples (Berinsky et al., 2012). These samples

are commonly employed in economic research (e.g., Kuziemko et al., 2015; Bordalo et al., 2016; Kumar et al., 2023; Sergeyev et al., 2024). Furthermore, research indicates that Prolific yields higher response quality relative to other online platforms (Peer et al., 2022; Douglas et al., 2023). Median participants spent about 31 and 23 minutes on the two-wave surveys, earning $4.70 and $2.70, respectively, for an effective hourly rate of approximately $8.00.

This study utilized Prolific's representative-sample feature to recruit a sample of U.S. residents. Among the 1,243 first-wave respondents willing to participate in follow-ups, 730 completed the second wave. The analysis includes 1,367 valid responses from the first wave and all responses from the second wave. Appendix Table A.2 presents the sample's demographic distributions alongside those of the 2020 U.S. Census. As is common in online samples, older individuals (65+), those with less than some college education, and those with incomes exceeding $120,000 are represented differently in the sample compared to the Census. Overall, the sample closely aligns with Census distributions for age, gender, education, income, race, household size, and region.

## 2.5 Statistical Model

This study employs a statistical model to extract consistent variations across the two waves of responses and to mitigate response errors not addressed by the survey experimental design or the elimination of low-quality responses. Potential remaining response biases and errors are addressed through robustness checks in Appendix E.

The observed response for preference parameter $x$ can vary across respondents, indexed by $i$, and waves, indexed by $w$, and is generated by $X_{i,w} \equiv \sum_k k \cdot 1(T_{k,\tilde{x}} < \tilde{x}_{i,w} \leq T_{k+1,\tilde{x}})$, where $k$ indexes response options and $1(\cdot)$ is the indicator function. The latent variable $\tilde{x}_{i,w} = x_i + \varepsilon_{i,x,w}$, and $T_{\{k\},\tilde{x}}$ denotes the sequence of known thresholds determined by the identifying propositions and the experimental variations (see Section 3 for details). The true parameter value for individual $i$, $x_i$, is drawn from $\mathcal{N}(\mu_x, \sigma_x^2)$. The response error, $\varepsilon_{i,x,w}$, can vary across respondents, parameters, and waves, and is drawn from $\mathcal{N}(0, \sigma_{\varepsilon_x}^2)$ independently of the true parameter value for each wave. A robustness check allows the means of the response errors to be nonzero and to vary across waves (Appendix E.3), finding that the estimated means are indistinguishable from zero and that the estimates of the preference parameters are not significantly different from those under the specification here. For aggregation and computation, the parameters are assumed to be independent within a respondent. Because the respondents are geographically dispersed across the United States and are unlikely to be acquainted, the responses are assumed to be independent across respondents. Thus, the joint distribution of respondent $i$'s parameter $x$ in the two waves of the survey is

$$\begin{bmatrix} \tilde{x}_{i,1} \\ \tilde{x}_{i,2} \end{bmatrix} \sim \mathcal{N}\left( \begin{bmatrix} \mu_x \\ \mu_x \end{bmatrix}, \begin{bmatrix} \sigma_x^2 + \sigma_{\varepsilon_x}^2 & \sigma_x^2 \\ \sigma_x^2 & \sigma_x^2 + \sigma_{\varepsilon_x}^2 \end{bmatrix} \right),$$

whose cumulative distribution function is denoted by $\Phi$.

Given the predominance of representative-agent frameworks in contemporary habit formation models, this study examines the implications of parameter estimates within such models. In Appendix B, we establish that individual agents' parameter values aggregate to their population mean for the representative agent. Formally, let $x_R$ denote the representative agent's value for parameter $x$, and let $x_i$ represent the corresponding parameter value for individual $i$. We show that $x_R = \frac{1}{N}\sum_{i=1}^{N} x_i$, where $N$ is the number of individuals. Since $\frac{1}{N}\sum_{i=1}^{N} x_i \xrightarrow{p} \mu_x$, the parameter of interest in estimation is $\mu_x$, the mean of the individual parameter values.

Estimates are derived from joint maximum likelihood estimation, with the likelihood function

$$\prod_{i,x}\left[\Phi\left(\begin{bmatrix} T_{X_{i,1}+1,\tilde{x}} \\ T_{X_{i,2}+1,\tilde{x}} \end{bmatrix}\right) - \Phi\left(\begin{bmatrix} T_{X_{i,1}+1,\tilde{x}} \\ T_{X_{i,2},\tilde{x}} \end{bmatrix}\right) - \Phi\left(\begin{bmatrix} T_{X_{i,1},\tilde{x}} \\ T_{X_{i,2}+1,\tilde{x}} \end{bmatrix}\right) + \Phi\left(\begin{bmatrix} T_{X_{i,1},\tilde{x}} \\ T_{X_{i,2},\tilde{x}} \end{bmatrix}\right)\right].$$

To address the computational challenges posed by joint estimation, we adopt a Bayesian approach, thereby circumventing the need for direct maximization of the likelihood function. Specifically, we employ Hamiltonian Monte Carlo, a Markov Chain Monte Carlo method renowned for its superior sampling efficiency, together with uniform priors for the main parameters of interest to ensure equivalence between posterior modes and maximum likelihood estimates.

# 3 Measurement

This section details the measurement of the preference parameters of interest, including the identifying variations, survey questions, and resulting estimates.

## 3.1 Existence of Habit Formation

**Existence of internal habit formation.** The defining characteristic of habit formation is response decrement to repetitive stimulation. In the case of internal habit formation, elevated past consumption (the stimulus) results in diminished future utility (the response). As a measure of the intensity and persistence of prior stimulation, habit increases with past consumption. Consequently, internal habit formation is consistent with the utility differential $Q_{HI} \equiv u(C,H+\Delta h) - u(C,H)$ being negative for $\Delta h > 0$ stemming from higher past own consumption, but is inconsistent with a non-negative differential.[13]

To identify the sign of $Q_{HI}$, it is thus intuitive to vary the respondent's past spending while controlling for future spending, ensuring that variation in future experience is induced only by variation in habit. Figure 1 shows a screenshot of the resulting survey question eliciting the sign

[13]The evidence for internal habit formation does not require specifying the exact relationship between $H$ and $C$. Identification holds as long as $H$ increases with $C$, as is satisfied in all existing models with internal habit formation.

Table 1: Response Distributions

| | First wave | | | | Second wave | | | |
|---|---|---|---|---|---|---|---|---|
| **Panel A**: Sign-identified parameters | U1 | | U2 | | U1 | | U2 | |
| Existence of internal habit formation | 64.3% | | 35.7% | | 65.3% | | 34.7% | |
| Existence of external habit formation | 51.1 | | 48.9 | | 53.2 | | 46.8 | |
| **Panel B**: Point-identified parameters | U1U1 | U1U2 | U2U1 | U2U2 | U1U1 | U1U2 | U2U1 | U2U2 |
| Habit decay rate | 34.7% | 19.5% | 18.5% | 27.4% | 39.0% | 18.5% | 16.0% | 26.4% |
| $-u_H/u_C$ | 34.1 | 8.6 | 16.9 | 40.5 | 33.4 | 7.3 | 18.6 | 40.7 |
| $u_{C_{\text{others}}}/u_H$ | 48.1 | 14.0 | 6.8 | 31.0 | 47.5 | 14.5 | 10.0 | 27.9 |

*Notes:* This table presents the response distributions for each preference parameter of interest from both waves of the study, with 2,097 observations. All numbers are percentages. UX stands for Universe X. U1U2 denotes the response sequence of choosing Universe One in the first question and Universe Two in the follow-up question. Similar notations are used to denote other response sequences.

of $Q_{HI}$.[14] In this question, preferring a spending profile with low past spending (low $H$) over one with high past spending (high $H$) for a better future experience implies $Q_{HI}<0$. In other words, choosing Universe One in the question shown in Figure 1 is consistent with internal habit formation, while choosing Universe Two is not. It is worth emphasizing again that the survey does not prime respondents with habit formation and that no assumption is made about the sign of $Q_{HI}$. Additionally, comparison (over time) does not necessarily imply $Q_{HI}<0$, because the comparison could also be consistent with $Q_{HI}\geq 0$, in which case internal habit formation would not exist.

Response distributions to this question show that two-thirds of respondents chose lower past spending for a better future experience—Universe One—in both waves of the survey (Panel A of Table 1), consistent with the existence of internal habit formation. After accounting for response errors, the estimate of $\text{sgn}(Q_{HI})$ corroborates this finding (Table 2).

At the conclusion of the survey, respondents provided open-ended explanations of how they arrived at their answers to the question regarding the existence of internal habit formation.[15] The full question and their choices were displayed. Using machine learning, we categorize the explanations and rank them by frequency. Table 3 presents the most common explanations.

Since the precise concept of habit formation typically lies outside conscious awareness (Wood and Rünger, 2016), respondents might not accurately attribute their choices to it. Therefore, we interpret responses such as "increased (future) spending (relative to past) leads to (more) satisfaction" as evidence that habit formation influenced their decisions. For instance, one respondent noted, "It's the same amount of money, but because I spent way more in the past in Universe

[14] In Figure 1, past spending deviates by $2,500 below or above the baseline spending of $5,000. In the survey version with the baseline spending of $3,000, past spending varies by $1,000 below or above the baseline.

[15] To maintain a reasonable survey duration, respondents were not asked to explain their responses to other questions.

Table 2: Parameter Estimates

| | Estimate | 95% CI |
|---|---|---|
| sgn($Q_{HI}$) | -1.00 | [-1.00, -1.00] |
| sgn($Q_{HE}$) | 1.00 | [-1.00, 1.00] |
| Habit decay rate | 1.03 | [0.86, 1.17] |
| Habit decay factor (annual) | 0.64 | [0.58, 0.69] |
| $-u_H/u_C$ | 0.63 | [0.57, 0.71] |
| $u_{C_{\text{others}}}/u_H$ | 0.30 | [0.13, 0.47] |
| $u_{C_{\text{others}}}/u_C$ | -0.19 | [-0.30, -0.08] |
| $u_H/u_C + u_{C_{\text{others}}}/u_C$ | -0.82 | [-0.96, -0.69] |

*Notes:* This table presents the estimates for preference parameters of interest. The annual habit decay factor is calculated based on the habit decay rate: Habit decay factor $= 1 - e^{-\text{Habit decay rate}}$. $u_{C_{\text{others}}}/u_C$ and $u_H/u_C + u_{C_{\text{others}}}/u_C$ are calculated based on $-u_H/u_C$ and $u_{C_{\text{others}}}/u_H$.

Two than One, the amount in One would FEEL like more than it's in Two. Spending more is never a problem; it's having to cut down from spending that's hard" (respondent's emphasis). Another stated, "Because I'm accustomed to spending less ($2,000) a month, if I have more money to spend, my future will be happier and more satisfying." As shown in Table 3, about 80% of respondents who selected Universe One ($Q_{HI} < 0$) cited habit formation as their reason, while the remaining 20% indicated misunderstanding of the hypothetical scenario (e.g., incorrectly assuming higher income or savings in Universe One) or general errors.

The reasoning of respondents who selected the option inconsistent with habit formation (Universe Two, $Q_{HI} > 0$) also provides insight. Approximately two-thirds of these respondents cited a preference for "decreased (future) spending (relative to past)," often associating it with frugality, better financial control, or greater efficiency. While these reasons suggest an implicit misunderstanding of the hypothetical scenario—in which unspecified factors such as frugality, financial control, and efficiency remain constant across time and response options—they do not contradict habit formation. Other respondents chose Universe Two due to more explicit misunderstandings, such as ignoring the survey instruction to rent durable goods, misinterpreting the constancy of income and savings, or making general errors or random choices. These responses indicate the delicate balance between comprehensive scenario specifications and clear, concise instructions, while also affirming that the reasoning underlying responses inconsistent with internal habit formation does not contradict the existence of habit formation.

Chetty and Szeidl (2016) propose that consumption commitments, arising from the costly adjustment of illiquid durable goods such as residences and vehicles, provide an alternative explanation for consumption patterns typically ascribed to habit formation. To distinguish between

Table 3: Rationale and Proportion of Respondents' Choices

| | Proportion | | |
|---|---|---|---|
| Rationale | First wave | Second wave | Overall |
| Choose U1 ($Q_{HI}<0$) because | | | |
| Increased spending leads to satisfaction | 76.0% | 81.5% | 50.3% |
| More saving | 8.0 | 5.0 | 4.5 |
| More income in the future | 5.5 | 7.8 | 4.1 |
| Other reasons | 10.6 | 5.7 | 5.7 |
| Total | 100.0 | 100.0 | 64.6 |
| Choose U2 ($Q_{HI}>0$) because | | | |
| Reduced spending leads to satisfaction | 63.9 | 71.5 | 23.5 |
| Durable spending | 18.5 | 13.4 | 5.9 |
| Increased saving in the future | 10.9 | 6.7 | 3.3 |
| Other reasons | 6.8 | 8.3 | 2.6 |
| Total | 100.0 | 100.0 | 35.3 |

*Notes:* This table presents the primary rationales and their associated proportions for respondents' choices in the question concerning the existence of internal habit formation. All numbers are percentages.

these concepts, this study employs a hypothetical scenario in which respondents rent durable goods to minimize adjustment costs. It includes only responses from participants who demonstrate a clear understanding of the scenario in the comprehension checks, with approximately 95% of them also confirming their understanding through the open-ended feedback discussed above. The survey question ensures symmetric deviations between past and future spending, thereby excluding residual psychological or non-psychological factors, captured by symmetric (e.g., quadratic) adjustment costs, as drivers of the observed responses. The open-ended feedback also indicates that the vast majority of respondents' choices are not driven by costs related to adjusting consumption commitments. These findings suggest that habit formation can influence behavior independently of consumption commitments in scenarios that minimize adjustment costs.

**Existence of external habit formation.** External habit formation is consistent with lower future utility resulting from higher past spending by others. Allowing $H$ to increase with others' past consumption,[16] external habit formation predicts that the utility differential $Q_{HE} \equiv u(C,H+\Delta h)-u(C,H)$ is negative for $\Delta h>0$ arising from higher past spending by others, but is inconsistent with a non-negative differential.

To identify the sign of $Q_{HE}$, it is natural to vary other people's past spending while holding

[16]The evidence for external habit formation does not require specifying $H$'s exact relationship with others' consumption. Identification holds as long as $H$ rises with others' consumption, as is satisfied in all existing models with external habit formation.

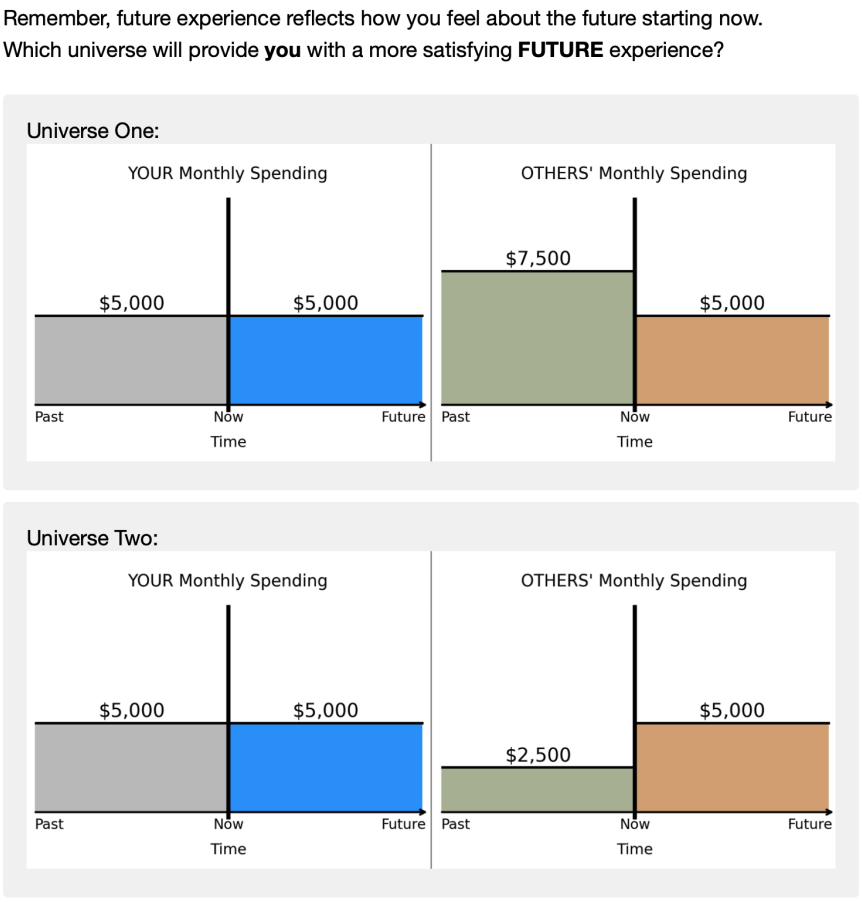



Figure 2: Survey Question on Existence of External Habit Formation

constant both their future spending and the individual's own past and future spending. This ensures that variation in future experience is driven solely by changes in habit due to other people's past spending. To visually represent these variations, the spending graphs were augmented with others' spending profiles. To facilitate comparisons over time and across people, one's own spending graph is compressed horizontally so that both one's own and others' spending graphs fit on a single line (see Figure 2). Different colors distinguish between the spending of oneself and others. Respondents received a brief instruction about these changes and were informed that the compressed graphs encompassed the same time frames as the uncompressed graphs.

In this context, preferring a spending profile with low past spending by others (low $H$) over one with high past spending by others (high $H$) implies $Q_{HE} < 0$. In other words, choosing Universe Two in the question is consistent with external habit formation, while choosing Universe One is inconsistent with external habit formation. Since the survey does not prime respondents with habit formation and no assumptions are made about the signs of derivatives of the utility

function with respect to habit, comparison (over time and across people) does not necessarily imply $Q_{HE} < 0$ (that external habit formation exists), because the comparison could also be consistent with $Q_{HE} \geq 0$, in which case external habit formation does not exist.

The distribution of responses (Panel A of Table 1) suggests that respondents essentially choose randomly between the two universes in the question shown in Figure 2, indicating that others' consumption lacks a systematic influence on one's habit. After accounting for response errors, the estimate of $\text{sgn}(Q_{HE})$ includes 0 in its 95% confidence interval (Table 2), indicating no evidence for external habit formation.

As discussed in Section 2.2, the survey questions exclude an indifference response option. The essentially uniform distribution of responses to this question supports this design choice, confirming that indifferent respondents tend to choose randomly in the absence of such an option. The finding of no external habit formation aligns with the evidence from Brunnermeier and Nagel (2008) and, combined with our evidence on internal habit formation, supports models featuring exclusively internal habit formation while challenging those relying solely on external habit formation.

## 3.2 Speed of Habit Decay

The rate of habit decay is governed by $\theta$, as in $\dot{H} = \theta(C - H)$. A natural survey question to elicit $\theta$ therefore varies the persistence of past spending. To point-identify $\theta$, the level of past spending must also vary to ensure a surjective mapping from $\theta$ to survey responses. Inverting this mapping recovers values of $\theta$ consistent with the responses, as formalized in Proposition 1. Appendix C provides proofs for all propositions.

**Proposition 1.** $\theta > -\ln\left(1 - \frac{\Delta C_{U1}}{\Delta C_{U2}}\right)$ *if a respondent chooses Universe One over Universe Two for a more satisfying future experience in a habit decay rate question.*[17]

Figure 3 presents a screenshot of the survey question for identifying $\theta$. The question asks respondents to choose the spending profile that would yield a more satisfying future experience: either a medium-high level of spending spread over an extended period in the past (Universe One), or a very high level of spending concentrated in the recent past (Universe Two), while future spending remains constant. The intuition behind this identification strategy is that a preference for the profile with more persistent past spending (Universe One) implies that recent past spending contributes more to habit than distant past spending. This suggests that habit decays quickly, relative to the threshold $-\ln\left(1 - \frac{\Delta C_{U1}}{\Delta C_{U2}}\right)$, as specified in the proposition.

$\Delta C_{U1}$ and $\Delta C_{U2}$ denote the deviations in the levels of monthly spending from the baseline spending level in Universe One and Universe Two, respectively. In Figure 3, $\Delta C_{U1} = \$2{,}000$ and

[17] The paper's identifying propositions are stated as conditional statements, sufficient for its results, though all can be strengthened to biconditional (if and only if) statements. The notations of $\Delta C_{U1}$ and $\Delta C_{U2}$ are defined below.

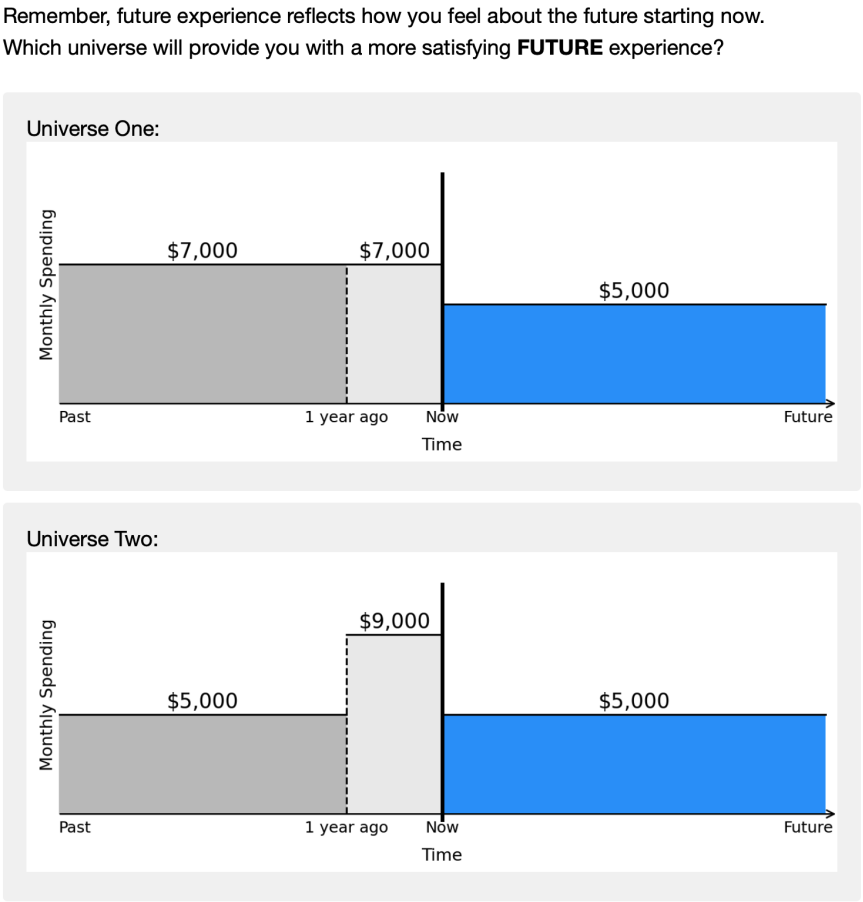



Figure 3: Survey Question on Speed of Habit Decay

$\Delta C_{U2} = \$4{,}000$. Thus, the survey question in Figure 3 partitions the possible values of $\theta$ into two complementary intervals, separated by the threshold $\ln 2$, which corresponds to an annual habit decay speed of 50%. Respondents selecting Universe One indicate a habit decay speed exceeding 50% per year, while those choosing Universe Two reveal a decay speed below this threshold.

To improve accuracy, the survey utilizes unfolding brackets to sequentially narrow the range of $\theta$ values based on respondents' choices. Each respondent answers a follow-up question that places their $\theta$ within one of four predefined brackets (see Figure 4). These brackets are designed to ensure that the spending profiles are easily comprehensible to respondents and that they cover an informative range of the parameter space, with the design refined through pilot studies. If a respondent selects Universe One (U1) in the initial question, indicating that their $\theta$ exceeds 0.5, they are then presented with a follow-up question tied to a threshold of 0.9 (see Appendix Figure A.2 for a screenshot of the question). If they subsequently choose Universe Two (U2), the module concludes, indicating that their habit decay factor lies between 0.5 and 0.9. Table 4 details all

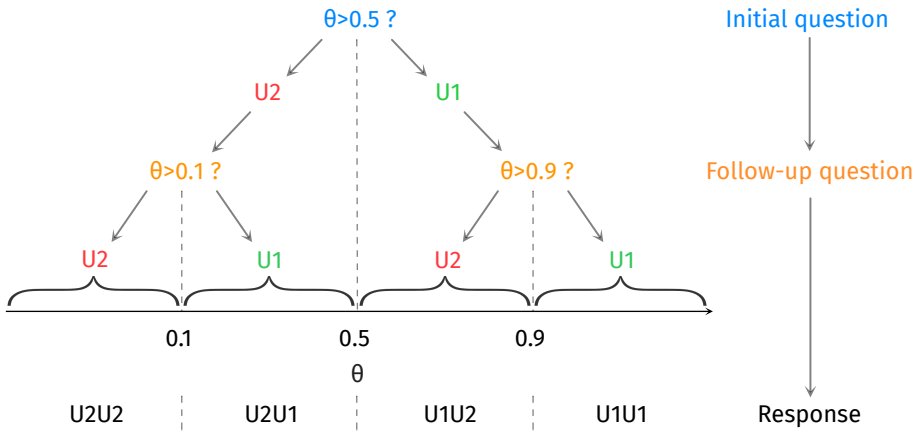



Figure 4: Unfolding Brackets

*Notes:* U1 and U2 stand for Universe One and Universe Two, respectively. All habit decay rates are annualized.

thresholds and the corresponding values of $\Delta C_{U1}$ and $\Delta C_{U2}$ used in the survey.

Applying the statistical model described in Section 2.5 to the responses yields an estimate of 1.03 for the habit decay rate, corresponding to an (annual) habit decay factor of 0.64 (Table 2). This decay speed implies that about 90% of habit depends on spending over the last two years, which is remarkably close to findings in the psychology literature indicating that income adaptation takes about two years (for a review, see Clark et al. 2008). The estimate's narrow confidence interval ([0.58, 0.69] at the 95% level) suggests that, contrary to common practice, the speed of habit decay should not be treated as a free parameter.

**Impact of habit decay speed on habit formation models.** The speed of habit decay can be critical to the efficacy of habit formation models in economics. To illustrate, we evaluate the impact habit decay speed could have in the widely cited habit formation framework by Campbell and Cochrane (1999), focusing on its implications for explaining the equity premium—a cornerstone application of habit formation in economic theory.

Theoretically, in simple additive habit formation models, a faster rate of habit decay reduces agents' risk aversion, as habit's rapid adjustment to consumption alleviates concerns about maintaining habitual spending. Also employing an additive habit framework, Campbell and Cochrane (1999), however, have agents who are more risk averse when habit decays faster, as their (implied) steady-state habit intensity rises with the habit decay rate rather than remaining constant.[18] Higher habit intensity amplifies the risk that consumption fluctuations will fall below the habit-intensity-adjusted threshold, thereby elevating agents' risk aversion. The overall effect of a higher habit

[18] In this study's data, responses to questions assessing the speed of habit decay exhibit negligible correlation with those gauging habit intensity. The average correlation coefficient is only -0.06.

Table 4: Quantities and Thresholds for Spending Profiles

| Question | Quantity and threshold | Baseline = $5,000 | | | Baseline = $3,000 | | |
|---|---|---|---|---|---|---|---|
| | | Choosing U2 | Initial question | Choosing U1 | Choosing U2 | Initial question | Choosing U1 |
| Habit decay rate | $\Delta C_{U1}$ | 400 | 2000 | 2000 | 200 | 1000 | 1000 |
| | $\Delta C_{U2}$ | 4000 | 4000 | 2200 | 2000 | 2000 | 1100 |
| | Threshold | 0.11 | 0.69 | 2.40 | 0.11 | 0.69 | 2.40 |
| $-u_H/u_C$ | $\Delta C_{\text{past}}$ | 2000 | 2000 | 2000 | 1000 | 1000 | 1000 |
| | $\Delta C_{\text{future}}$ | 1000 | 200 | 20 | 500 | 100 | 10 |
| | Threshold | 0.92 | 0.55 | 0.10 | 0.92 | 0.55 | 0.10 |
| $u_{C_{\text{others}}}/u_H$ | $\Delta C_{\text{others}}$ | 200 | 200 | 1000 | 100 | 100 | 500 |
| | $\Delta C$ | 4000 | 2000 | 2000 | 2000 | 1000 | 1000 |
| | Threshold | 1.80 | 0.90 | 0.18 | 1.80 | 0.90 | 0.18 |

*Notes:* This table presents the quantities and implied thresholds as mentioned in Propositions 1-3. "Choosing U1" and "Choosing U2" refer to the question shown after the respondent chooses Universe One and Universe Two in the initial question, respectively. All quantities are in U.S. dollars.

decay rate in this framework reflects the interplay of these opposing dynamics, ultimately rendering agents more risk averse.

Quantitatively, Table 5 presents the relevant moments for the equity premium in observed data (Column 1) and in Campbell and Cochrane's model under various habit decay rates. Column 2 shows that their model perfectly matches the observed data under their calibrated annual habit decay factor of 0.11. Column 3 indicates that with an estimated habit decay factor of 0.64, the model generates equity premiums that significantly exceed historical observations. This occurs because faster habit decay heightens agents' risk aversion, prompting them to demand unrealistically high returns to bear the historical level of consumption risk. Reducing the habit decay factor improves the alignment between the model moments and observed data, yet the percentage differences remain at least 40% even at a decay factor of 0.30 (Column 4), a speed well outside the 99% confidence interval for the habit decay factor.

The survey respondents may not fully represent the marginal investors who price assets. However, they need not mirror marginal investors in all characteristics. The preceding analysis remains robust provided the respondents' typical habit decay rate is close to that of marginal investors. This holds if the habit decay rate is a fundamental preference parameter with minimal variation across demographic groups. Evidence presented in Appendix E.1 supports this view, showing that the habit decay rate does not vary significantly with age, gender, household size, household income, historical or expected spending, race, education, or region.

The above analysis reveals that the performance of a widely cited habit formation framework can be sensitive to the speed of habit decay. This result, however, warrants cautious interpreta-

Table 5: Impact of Habit Decay Speed

| | Postwar | Habit formation | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Habit decay factor | - | 0.11 | **0.64** | **0.30** |
| Expected excess ln return | 6.69% | 6.71% | 41.11% | 16.51% |
| Standard deviation of excess ln return | 15.20% | 15.64% | 30.44% | 22.01% |
| Sharpe ratio | 0.43 | 0.43 | 1.35 | 0.75 |

*Notes:* Column 1 is based on postwar (1947–95) value-weighted New York Stock Exchange stock index returns and 3-month Treasury bill rate; Column 2 is based on the calibration of Campbell and Cochrane (1999) (0.11 is the annual habit decay factor implied by their calibration of the persistence coefficient, $\phi$, of the surplus consumption ratio); Column 3 is based on this paper's estimate of habit decay factor; Column 4 is based on a habit decay factor far smaller than the lower bound of the 99% confidence interval of this paper's estimate of it. Boldface indicates adjustments to Campbell and Cochrane's (1999) calibration. All annualized values.

tion. Given the evidence presented in the paper for the presence of habit formation, it is more plausible that existing models require further refinement rather than that the endeavor to model habit formation is fundamentally misguided.

**Predicting hedonic adaptation speed.** As a validation of our measure of habit decay and our broader methodological approach, we link responses from our survey with responses from a separate survey examining happiness reactions to the 2024 U.S. presidential election (Kimball et al., 2024a). The happiness survey, conducted independently in November and December 2024 on Prolific, comprises approximately 9,400 respondents. By matching unique identifiers, we identify 503 of their respondents who also participated in our survey.

The happiness survey measures respondents' happiness both before and after the 2024 U.S. presidential election using a standardized question: "On a scale of 0 to 100, where 0 is the lowest level possible and 100 is the highest level possible, how happy do you feel right now?" Supporters of the election winner tend to report higher happiness, while supporters of the loser tend to report lower happiness post-election, with both groups exhibiting hedonic adaptation toward their pre-election happiness levels (Kimball et al., 2024a). We utilize the survey's post-election waves to construct a measure of the speed of hedonic adaptation to the election outcome. Specifically, we calculate the absolute daily change in happiness for each respondent between two post-election survey waves at times $t_1$ and $t_2$: $\left|\frac{Happiness_{t_2} - Happiness_{t_1}}{t_2 - t_1}\right|$. The median date for $t_1$ is November 6, 2024, coinciding with the announcement of the election results. To capture the rapid nature of hedonic adaptation to election news, the time difference between $t_2$ and $t_1$ is randomized, ranging from 1 to 19 days, with a median of 4 days.

In the linked dataset, we find a statistically significant correlation (0.13, p-value 0.004) between

Table 6: Habit Decay Speed Predicts Hedonic Adaptation Speed

| | Absolute daily happiness changes | |
|---|---|---|
| | (1) | (2) |
| Fast habit decay (>50%/year) | 1.31 (0.48) | 1.30 (0.49) |
| Constant | 3.23 (0.35) | 5.39 (3.76) |
| Demographics | N | Y |
| Baseline spending levels | N | Y |
| Observations | 503 | 503 |

*Notes:* This table presents the regression results of absolute daily happiness changes on a binary indicator for habit decay speed exceeding 50% per year. Column 2 incorporates demographic controls, including age, age squared, gender, household income, historical and expected monthly household spending, household size, race, education, and region, as well as a binary indicator for baseline monthly spending of $3,000. Standard errors in parentheses.

responses to our survey question on habit decay speed and the hedonic adaptation speed. This suggests that individuals with faster habit decay and thus faster habit adjustment, as measured by our approach, exhibit faster happiness adaptation to the election outcome. Although consumption habit formation and hedonic adaptation are different, their plausible interconnectedness and the potential nonlinearity of this relationship render the correlation of 0.13 economically meaningful.

To quantify the extent to which individuals with faster habit decay rates adapt hedonically to the election outcome, we regress the measure of hedonic adaptation speed on a binary indicator for habit decay speed exceeding 50% per year. As reported in Column 1 of Table 6, respondents with habit decay speeds above this threshold exhibit, on average, a 1.31-point faster happiness adaptation rate, equivalent to a 40% increase relative to those with slower habit decay (below 50% per year). This finding remains robust when controlling for demographic characteristics and baseline spending levels from our survey, as shown in Column 2 of Table 6.

## 3.3 Welfare Impacts of Habit Formation and Peer Effects

This subsection details the measurement of two preference parameters expressed as ratios of derivatives from the utility function outlined in Section 2.1. The first parameter, $-\frac{u_H}{u_C}$, is the slope of the indifference curve and governs the welfare impact of habit formation relative to one's own consumption. The second parameter, $\frac{u_{C_{\text{others}}}}{u_H}$, assesses the relative welfare impacts of peer effects and habit formation. Both parameters are important for resolving the Easterlin paradox (Section 4). To identify the preference parameters while preserving the generality of the utility function, we establish identification up to second-order approximations of the utility differences between choice alternatives, with approximation errors bounded by the remainders of the corresponding

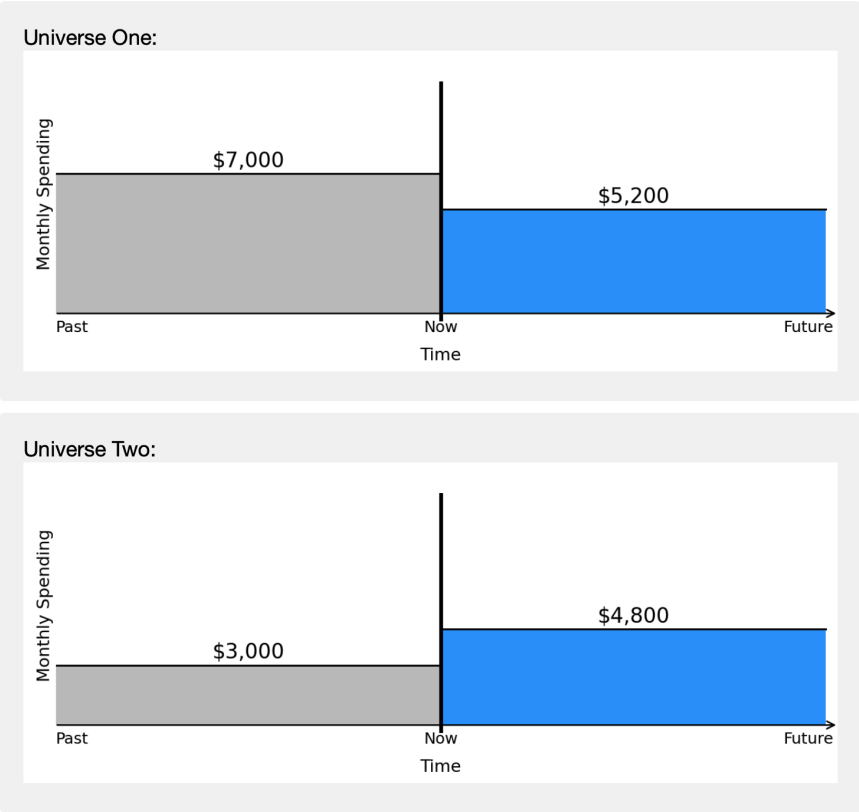



Figure 5: Spending Profiles for a Survey Question on Slope of Indifference Curve

Taylor expansions.[19] Exact identification, as established in Proposition 1, entails no approximation.

The slope of the indifference curve, $-\frac{u_H}{u_C}$, reflects the trade-off between habit and (future) spending. To identify it, the survey question uses a trade-off between past spending and future spending (Figure 5). Proposition 2 specifies how such variation identifies $-\frac{u_H}{u_C}$: preferring Universe One over Universe Two means that increasing future spending yields more utility gain than the utility loss from increasing past spending, and therefore $u_C$ is more important than $u_H$ (relative to the threshold $\frac{(\rho+\theta)\Delta C_{\text{future}}}{\rho\Delta C_{\text{past}}+\theta\Delta C_{\text{future}}}$), which explains the direction of the inequality in the proposition.

**Proposition 2.** *Under a second-order approximation,* $-\frac{u_H}{u_C} < \frac{(\rho+\theta)\Delta C_{future}}{\rho\Delta C_{past}+\theta\Delta C_{future}}$ *if a respondent chooses Universe One over Universe Two for a more satisfying future experience in a slope of indifference curve question.*[20]

[19] The approximation for $-\frac{u_H}{u_C}$ is of second order because the identifying variation is symmetric around the baseline, allowing second-order derivatives of the utility function to cancel out. Similarly, the approximation for $\frac{u_{C_{\text{others}}}}{u_H}$ is of first order, as the corresponding identifying variation lacks this symmetry. The alternative \$3,000 spending baseline, which induces smaller spending differences, provides a useful gauge of the magnitude of the approximation errors. Reassuringly, Appendix E.1 shows that parameter estimates are highly robust to the choice of baseline.

[20] In Figure 5, $\Delta C_{\text{past}} = \$2{,}000$ and $\Delta C_{\text{future}} = \$200$. Table 4 details additional values of $\Delta C_{\text{past}}$ and $\Delta C_{\text{future}}$.


Figure 6: Spending Profiles for a Survey Question on $\frac{u_{C_{\text{others}}}}{u_H}$

As the threshold depends on multiple parameters, the response distribution to this question alone is insufficient to fully characterize this parameter, necessitating the joint estimation of all relevant parameters. The estimated slope of the indifference curve is 0.63 (Table 2), implying that the habit intensity parameter for additive habit (everywhere) and multiplicative habit (in steady state) is about 0.6. This provides micro evidence for the parameter value often required to match macro data (Havranek et al., 2017). The magnitude of this estimate indicates that, to a first-order approximation, around 60% of the utility derived from total consumption is eventually habituated. This suggests a substantial welfare impact, consistent with Van Praag and Frijters (1999)'s finding that approximately 60% of income's effect on happiness is lost over time.

To assess the welfare consequence of peer effects relative to habit formation, we measure $\frac{u_{C_{\text{others}}}}{u_H}$. By accounting for the potential contemporaneous influence of others' spending (i.e., peer effects) in the utility function, $u(C,C_{\text{others}},H)$, the ratio $\frac{u_{C_{\text{others}}}}{u_H}$ can be elicited by posing a trade-off between others' future spending and one's own past spending. Proposition 3 shows how such variation identifies $\frac{u_{C_{\text{others}}}}{u_H}$. Figure 6 presents the resulting survey question implementing the identifying variation. Preferring Universe One implies that peer effects matter relatively less than habit

formation, explaining the direction of the inequality in the proposition.

**Proposition 3.** *Under a first-order approximation,* $\frac{u_{C_{others}}}{u_H} < \frac{\rho}{\rho+\theta}\frac{\Delta C}{\Delta C_{others}}$ *if a respondent chooses Universe One over Universe Two for a more satisfying future experience in a* $\frac{u_{C_{others}}}{u_H}$ *question.*[21]

The point estimate for $\frac{u_{C_{\text{others}}}}{u_H}$ is 0.30, suggesting that habit formation has about three times the welfare impact of peer effects.[22] Combining this parameter with the slope of the indifference curve yields an estimate of $\frac{u_{C_{\text{others}}}}{u_C}$ of -0.19. This indicates that others spending one dollar more is equivalent to me spending about 0.2 dollars less, which is consistent with existing estimates of the welfare impact of (consumption) peer effects (De Giorgi et al., 2020; Lewbel et al., 2022).

# 4 Explaining the Easterlin Paradox

The happiness–income paradox, proposed by Easterlin, states that income and happiness tend to be positively correlated in the short run and cross-section, but uncorrelated in the long run (Easterlin, 1973, 1974, 1995, 2001, 2017; Kaiser and Vendrik, 2019; Easterlin and O'Connor, 2025). Alternative views have been proposed, such as that U.S. data might be outliers (Stevenson and Wolfers, 2008), and that life satisfaction can be time-intensive (Kimball and Willis, 2023). Despite the debate, the literature seems broadly in agreement that the empirical gradient of happiness with respect to income is small, and that the cross-section and short-run gradients tend to be larger than the long-run gradient, especially when the time horizon is long enough to cover full economic cycles (Easterlin and O'Connor, 2022). This section explores an explanation of the happiness–income pattern through the lens of habit formation and peer effects. To clarify the intuition behind this explanation, we consider a zero long-run gradient, noting that alternative perspectives can be accommodated with minor adjustments to parameter values without altering the intuition.

Habit formation and peer effects have been the most popular potential explanations for the paradox (Easterlin, 2001; Rayo and Becker, 2007; Clark et al., 2008). Recent evidence on peer effects (Luttmer, 2005; De Giorgi et al., 2020; Lewbel et al., 2022) suggests that they are not powerful enough to fully explain the phenomenon. To our knowledge, evidence on whether habit formation can help explain the paradox is absent from the literature. Based on the measurements above, this section argues that while habit formation alone is also not strong enough to generate the happiness–income pattern of the Easterlin paradox, combining it with peer effects can.

Four clarifications merit discussion before proceeding. First, this section focuses on the causal mechanism by which income influences happiness. Everyday life experiences and studies ex-

[21] In Figure 6, $\Delta C = \$2{,}000$ and $\Delta C_{\text{others}} = \$200$. Additional values of $\Delta C$ and $\Delta C_{\text{others}}$ are detailed in Table 4.

[22] This paper's model and estimation place no restriction on the sign of $u_{C_{\text{others}}}$, which may be positive (indicating, e.g., altruism) or negative (reflecting, e.g., peer comparison). The estimated sign of $u_{C_{\text{others}}}$ implies that the overall welfare impact of (total consumption) peer effects is negative.

ploiting exogenous variations support this perspective (Frijters et al., 2004; Gardner and Oswald, 2007). Factors affecting happiness other than income offer little help in explaining the paradox because they generally improve with income, making the long-run flat happiness–income gradient even more mysterious (Di Tella and MacCulloch, 2008). Second, this analysis aligns with the Benthamite tradition (Bentham, 1781; Perez-Truglia, 2020), positing that distinctions between happiness and utility exert negligible influence on their relationships with habit formation and peer effects. This assumption is grounded in the complex and ambiguous normative status of their differentiation in contemporary literature (Benjamin et al., 2024, 2014a,b, 2012; Kimball and Willis, 2023). Third, the paradox persists when substituting consumption for income because consumption is closely related to income (Carroll and Summers, 1991),[23] while happiness still has a long-term trend of about zero. Accordingly, the ensuing discussion regards income and consumption as interchangeable. Fourth, the literature identifies three measures of happiness: affect, capturing recent feelings; life satisfaction, reflecting an evaluation of life as a whole; and eudaimonia, encompassing personal growth and meaning. This study focuses on affect and life satisfaction due to their measurement reliability, extensive investigation, and direct relevance to the paradox. Consistent with this focus, Layard and De Neve (2023) argue that eudaimonia is better thought of as a contributor to, rather than a direct measure of, well-being. In the subsequent analysis, affect is proxied by instantaneous utility, and life satisfaction by lifetime utility.

To assess the explanatory power of habit formation and peer effects regarding the Easterlin paradox, while ensuring robustness to potential misspecifications in existing habit formation models, we conduct semi-structural simulations grounded in this study's evidence of both phenomena. In particular, the simulations specify agents as influenced by both internal habit formation and peer effects. Habit evolves according to equation (1), with the decay rate calibrated to its estimated value of 1.03. Peer effects arise after agents observe changes in others' consumption, which is assumed to occur $k$ years after those changes.[24]

To first-order approximations, the effect of habit formation on utility is captured by the ratio $\frac{u_H}{u_C}$, while the impact of peer effects on utility is captured by $\frac{u_{C_{\text{others}}}}{u_C}$. As shown in Section 3.3, the estimates of $\frac{u_H}{u_C}$ and $\frac{u_{C_{\text{others}}}}{u_C}$ both exceed -1 at the 95% confidence level, indicating that habit formation and peer effects, considered separately, are insufficient to fully account for the Easterlin paradox.

The long-run nil happiness–income gradient dictates that

$$\frac{u_H}{u_C} + \frac{u_{C_{\text{others}}}}{u_C} = -1. \tag{2}$$

[23] Real GDP per capita and real personal consumption expenditure in the United States have a correlation coefficient of 0.99 from 1947 to 2024.

[24] The exact value of $k$ is irrelevant to the explanation, as it only affects the rate of convergence to the steady state.

The point estimate of the left-hand side of the above equation (-0.82) is greater than -1 and statistically indistinguishable from -1, the right-hand side, at the 99% level (though distinguishable at the 95% level). Aside from considerations of statistical precision, this leaves room for other proposed explanations of the paradox—such as inequality, scale use, and economic growth's externalities—to contribute to understanding the paradox. To highlight the intuition behind an explanation based on habit formation and peer effects, we focus on the scenario where the left-hand side is -1.

The intuition of equation (2) is that, to a first-order approximation, habit formation and peer effects fully offset the hedonic impact of permanent changes in consumption over the long run. To see this, consider an economy initially in a steady state, where residents maintain a constant level of happiness prior to time $t_0$. Suppose that, from $t_0$ onward, the economy experiences growth, resulting in a permanent increase in each individual's consumption by a small amount $\Delta c$ (Figure 7a). Consequently, to the first-order approximation,[25] at $t_0$, residents' happiness, as measured by affect, rises by $u_C \Delta c$. Over time, however, individuals gradually habituate to this elevated level of consumption, which diminishes affect (Figure 7b). At $t_0+k$, individuals realize that others in the economy also enjoy the same elevated consumption level. This peer comparison further depresses affect and, in conjunction with habit formation, ultimately restores affect to its initial level. Similarly, life satisfaction exhibits an initial increase followed by a gradual decline, ultimately reverting to its prior steady-state level (Figure 7c). This dynamic, hereafter termed the *wear-off effect*, reflects the combined influence of habit formation and peer effects, which gradually offset the enhancement in happiness induced by a one-episode permanent growth in consumption.

In reality, economies exhibit sustained growth over time, resulting in progressively higher earnings and consumption for individuals. To capture this key aspect, suppose that each agent's consumption rises permanently by $\Delta c$ at the beginning of every year following $t_0$, as depicted in Figure 7d. The corresponding evolution of the agent's happiness is illustrated in Figures 7e and 7f. Within each year after $t_0$, habit formation and peer effects diminish the happiness gains derived from consumption growth, consistent with the dynamics observed in the single-episode growth scenario. However, the long-term trajectory of happiness deviates significantly: rather than steadily reverting to its prior equilibrium, happiness incrementally rises and eventually plateaus at an elevated level. We label these two new patterns of happiness dynamics the *transition effect* and the *plateau effect*.

The transition effect arises from the recurring nature of consumption growth. Each annual increment boosts happiness while initiating a new wear-off effect, both of which stack onto those from previous years. In the short run, this compounding process creates an upward trend in happiness,

[25] This section focuses on first-order approximations because the identification of $\frac{u_{C_{\text{others}}}}{u_C}$ is under a first-order approximation. This is a good approximation when $\Delta c$ is small, which is maintained here.

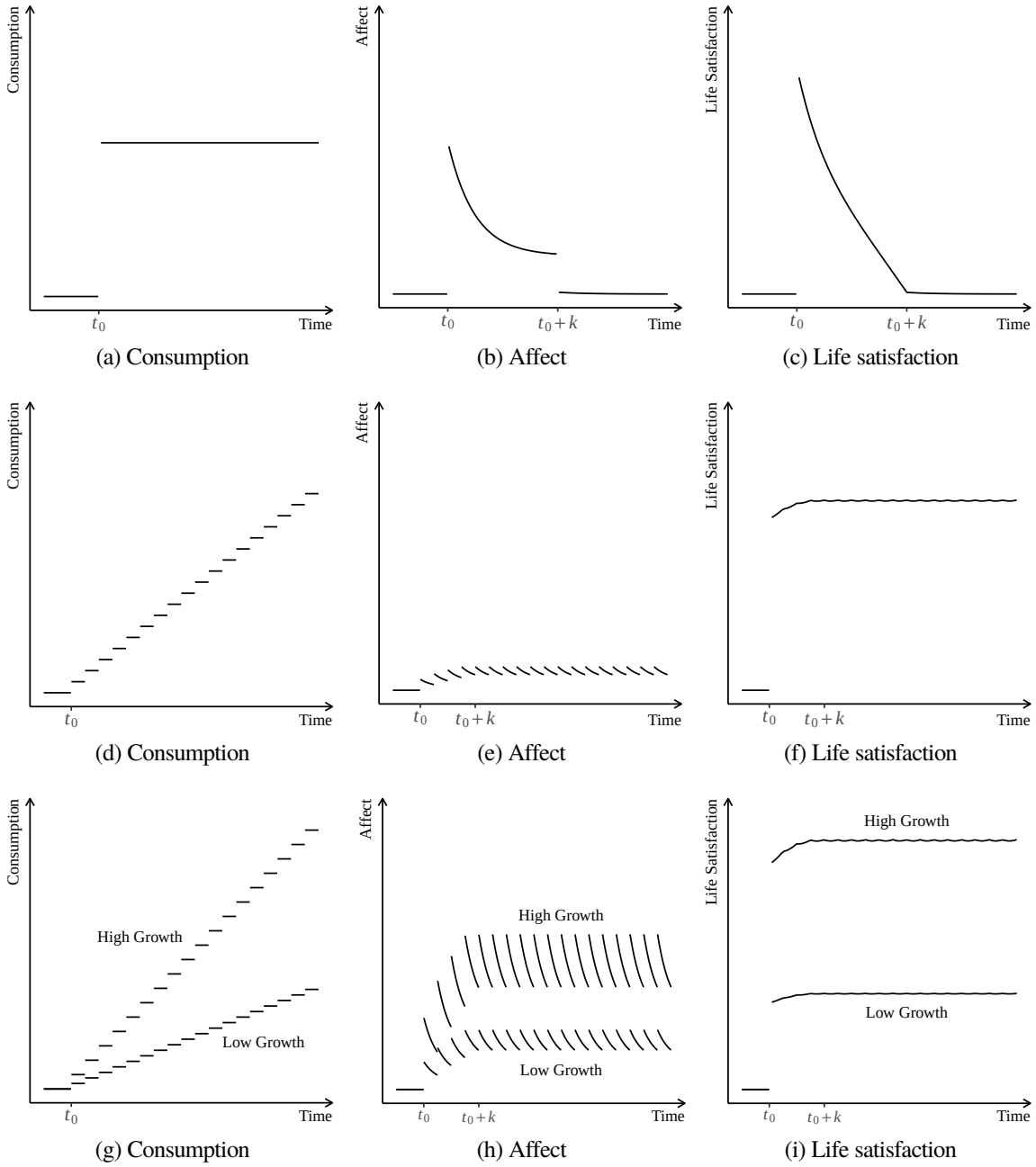



Figure 7: Happiness Simulations

*Notes:* Habit decay rate and time discount rate are calibrated to 1.03 and 0.10, respectively, based on our measurements. To highlight intuition, $\frac{u_H}{u_C}$ and $\frac{u_{C_{\text{others}}}}{u_C}$ are calibrated to -0.75 and -0.25, respectively, to preserve their relative welfare importance according to the measurements while setting their sum to negative one. To highlight the growth effect on affect, the vertical axis in panel (h) is 20% of that in panel (i). The discontinuities in affect at the onset of each year following $t_0$ in panels (e) and (h) stem solely from the simplifying assumption that consumption undergoes a permanent increase at the beginning of each year after $t_0$. If consumption changes occur continuously throughout the year, these discontinuities would be smoothed, and the analyses presented in this section would remain valid.

diverging from the downward trajectory typical of a one-episode growth. Over time, the countervailing forces of habit formation and peer effects progressively mitigate this happiness-enhancing momentum, eventually leading to the plateau effect, where happiness reaches a new steady state.

Because the wear-off effect is proportional to $\Delta c$, the transition and plateau effects are also proportional to $\Delta c$.[26] Consequently, more rapid consumption growth (Figure 7g) elicits stronger happiness responses (Figures 7h and 7i). This phenomenon, labeled the *growth effect*, implies that higher consumption growth induces more elevated happiness levels during both the transition and plateau phases.

The growth effect explains the positive cross-sectional correlation between income and happiness: higher income growth makes people or countries richer and places them on higher happiness trajectories. Economic fluctuations in reality cause consumption to fluctuate, frequently putting the agent into transition phases. The transition effect thus accounts for the short-term positive correlation between income and happiness. Whether income rises or falls, this effect always implies a positive association between income and happiness. The plateau effect explains the nil long-run correlation between income and happiness. Despite sustained income growth, happiness plateaus, yielding a zero correlation between happiness and income in the long run.

An alternative hypothesis for the Easterlin paradox posits that individuals' reporting scales change with income, rather than their actual happiness adapting to income (Deaton, 2008; Prati and Senik, 2024). To control for this rescaling channel, this study's survey employs a binary-choice format and was conducted over a brief period, minimizing the impact and likelihood of potential changes in respondents' scale-use tendencies. To more directly assess rescaling, the survey included visual calibration questions, as introduced by Benjamin et al. (2023), both before and after the core survey modules to measure scale-use consistency. Appendix Figure A.3 shows that respondents' scale-use shifters and stretchers before and after the core modules align closely along the 45-degree line, with an average correlation of 0.75. After adjusting for response errors based on the framework of Benjamin et al. (2023), the correlations indicate perfect consistency, confirming that no rescaling occurred during the survey. This analysis suggests that habit formation and peer effects could explain the Easterlin paradox without rescaling.

How does the above explanation address the questions that motivated the paradox: Does money buy happiness (Easterlin, 1973), and does economic growth improve the human lot (Easterlin, 1974)? To phrase the questions more accurately: to the extent that people ultimately care only about happiness, and that happiness eventually stops increasing with economic growth, should societies continue promoting economic growth after happiness plateaus? The answer implied by

[26] This is a direct implication of first-order approximations. Given positive marginal utility of consumption—a standard assumption in economics—the analysis holds for higher-order approximations: the utility difference between high and low consumption states, though likely reduced, remains positive, preserving qualitative implications.

the explanation is yes, because happiness would decrease if the economy were to grow at a slower rate. In other words, economic growth initially raises happiness and subsequently maintains it. Slower growth would precipitate a decline in happiness, stabilizing at a level lower than what would be achieved under sustained growth. This dynamic implies that maintaining economic growth remains critical even after happiness gains diminish, as it prevents the erosion of well-being that would accompany an economic slowdown.

# 5 Conclusions

This study introduces a novel measurement approach to provide micro-level evidence on habit formation in total consumption behavior. We specify key parameters governing habit's existence, decay speed, and welfare implications, and formally derive their separate identification through total consumption variations. By implementing the variations through survey experiments and validating the results in various ways, we provide evidence on habit formation that is robust to identification challenges inherent in observational, laboratory, or field data. In particular, we find that habit forms internally, decays by two-thirds annually, and generates a welfare effect equivalent to 63% of that from consumption and three times that from peer effects.

Our evidence supports incorporating habit formation into economic models via the dominant preference-based approach, with habit formulated relative to one's own past consumption. Our estimates suggest that the habit decay speed should not be treated as a free parameter, but rather constrained to an annual rate of approximately two-thirds. The micro-level evidence further provides a benchmark for the habit intensity parameter of approximately 0.6, aligning with values commonly used in macroeconomic models. When peer effects are incorporated, the evidence favors calibrating their welfare impact to roughly one-third that of habit formation.

The measurements also imply that while habit formation alone (or peer effects alone) cannot explain the Easterlin paradox, their combination could. People eventually habituate to their income and observe others' similar income changes, explaining the long-run nil happiness–income gradient. Before full habituation or realization of others' income changes, happiness moves in the same direction as income changes, explaining the short-run positive happiness–income gradient. Richer people and countries accumulate more happiness changes in the short run, accounting for the cross-sectional positive happiness–income gradient. This mechanism indicates that happiness may rise with increasing income, but only temporarily, before habit formation and peer effects stabilize happiness at a plateau. Although income may lack a long-run effect on happiness, sustained economic growth remains essential to maintaining the stabilized level of happiness. This highlights the critical role of policies that promote sustained economic growth, even as the happiness gains from such growth vanish.

These results point to ways in which innovative measurement approaches can shed light on modern economic theories that are difficult to assess with conventional approaches, fostering the parallel development of new theories and new measurements.

# References


**Abel, Andrew B**, "Asset Prices Under Habit Formation and Catching Up With the Joneses," *American Economic Review*, 1990, *80* (2), 38–42.

**Alexander, Samuel**, "Living Better on Less? Toward an Economics of Sufficiency," *Simplicity Institute Report 12c*, 2012.

**Almås, Ingvild, Orazio Attanasio, and Pamela Jervis**, "Presidential Address: Economics and Measurement: New Measures to Model Decision Making," *Econometrica*, 2024, *92* (4), 947–978.

**Ameriks, John, Andrew Caplin, John Leahy, and Tom Tyler**, "Measuring Self-Control Problems," *American Economic Review*, 2007, *97* (3), 966–972.

**_ , Joseph Briggs, Andrew Caplin, Matthew D Shapiro, and Christopher Tonetti**, "Long-Term-Care Utility and Late-In-Life Saving," *Journal of Political Economy*, 2020, *128* (6), 2375–2451.

**Andre, Peter, Carlo Pizzinelli, Christopher Roth, and Johannes Wohlfart**, "Subjective Models of the Macroeconomy: Evidence From Experts and Representative Samples," *The Review of Economic Studies*, 2022, *89* (6), 2958–2991.

**Aristotle**, *Nicomachean Ethics*, Translated by W. D. Ross. Oxford: Clarendon Press, 1925.

**Barsky, Robert B, F Thomas Juster, Miles S Kimball, and Matthew D Shapiro**, "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study," *The Quarterly Journal of Economics*, 1997, *112* (2), 537–579.

**Benjamin, Daniel J, Kristen B Cooper, Ori Heffetz, and Miles S Kimball**, "A Well-Being Snapshot in a Changing World," *American Economic Review Papers and Proceedings*, 2019, *109*, 344–49.

**_ , _ , _ , and _** , "From Happiness Data to Economic Conclusions," *Annual Review of Economics*, 2024, *16*.

**_ , _ , _ , _ , and Jiannan Zhou**, "Adjusting for Scale-Use Heterogeneity in Self-Reported Well-Being," *National Bureau of Economic Research*, 2023.

**_ , Ori Heffetz, Miles S Kimball, and Alex Rees-Jones**, "What Do You Think Would Make You Happier? What Do You Think You Would Choose?," *American Economic Review*, 2012, *102* (5), 2083–2110.

**_ , _ , _ , and _** , "Can Marginal Rates of Substitution be Inferred from Happiness Data? Evidence from Residency Choices," *American Economic Review*, 2014, *104* (11), 3498–3528.

**_ , _ , _ , and Nichole Szembrot**, "Beyond Happiness and Satisfaction: Toward Well-Being Indices Based on Stated Preference," *American Economic Review*, 2014, *104* (9), 2698–2735.

**Bentham, Jeremy**, "An Introduction to the Principles of Morals and Legislation," *History of Economic Thought Books*, 1781.

**Berinsky, Adam J, Gregory A Huber, and Gabriel S Lenz**, "Evaluating Online Labor Markets for Experimental Research: Amazon.com's Mechanical Turk," *Political Analysis*, 2012, *20* (3), 351–368.

**Block, Henry David and Jacob Marschak**, "Random Orderings and Stochastic Theories of Responses," in I. Olkin, S. G. Ghurye, W. Hoeffding, W. G. Madow, and H. B. Mann, eds., *Contributions to Probability and Statistics: Essays in Honor of Harold Hotelling*, Stanford University Press., 1960, pp. 97–132.

**Boisseau, Romain P, David Vogel, and Audrey Dussutour**, "Habituation in Non-Neural Organisms: Evidence From Slime Moulds," *Proceedings of the Royal Society B: Biological Sciences*, 2016, *283*

(1829), 20160446.

**Bordalo, Pedro, Katherine Coffman, Nicola Gennaioli, and Andrei Shleifer**, "Stereotypes," *The Quarterly Journal of Economics*, 2016, *131* (4), 1753–1794.

**Bowman, David, Deborah Minehart, and Matthew Rabin**, "Loss Aversion in a Consumption–Savings Model," *Journal of Economic Behavior and Organization*, 1999, *38* (2), 155–178.

**Breeden, Douglas T, Robert H Litzenberger, and Tingyan Jia**, "Consumption-Based Asset Pricing, Part 2: Habit Formation, Conditional Risks, Long-Run Risks, and Rare Disasters," *Annual Review of Financial Economics*, 2015, *7* (1), 85–131.

**Browning, Martin and M. Dolores Collado**, "Habits and Heterogeneity in Demands: A Panel Data Analysis," *Journal of Applied Econometrics*, 2007, *22* (3), 625–640.

**Brunnermeier, Markus K and Stefan Nagel**, "Do Wealth Fluctuations Generate Time-Varying Risk Aversion? Micro-Evidence on Individuals' Asset Allocation," *American Economic Review*, 2008, *98* (3), 713–736.

**Buyalskaya, Anastasia, Hung Ho, Katherine L. Milkman, Xiaomin Li, Angela L. Duckworth, and Colin Camerer**, "What Can Machine Learning Teach Us About Habit Formation? Evidence From Exercise and Hygiene," *Proceedings of the National Academy of Sciences*, 2023, *120* (17), e2216115120.

**Camerer, Colin, Yi Xin, and Clarice Zhao**, "A Neural Autopilot Theory of Habit: Evidence From Consumer Purchases and Social Media Use," *Journal of the Experimental Analysis of Behavior*, 2024, *121* (1), 108–122.

**Campbell, John Y and John H Cochrane**, "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior," *Journal of Political Economy*, 1999, *107* (2), 205–251.

**Caplin, Andrew**, "A Comment on:"Presidential Address: Economics and Measurement: New Measures to Model Decision Making" by Ingvild Almås, Orazio Attanasio, and Pamela Jervis," *Econometrica*, 2024, *92* (4), 979–985.

__ , "Data Engineering for Cognitive Economics," *Journal of Economic Literature*, 2025.

__ **, Mark Dean, and Daniel Martin**, "Search and Satisficing," *American Economic Review*, 2011, *101* (7), 2899–2922.

**Carroll, Christopher D and Lawrence H Summers**, "Consumption Growth Parallels Income Growth: Some New Evidence," in "National Saving and Economic Performance," University of Chicago Press, 1991, pp. 305–348.

__ **, Jody Overland, and David N Weil**, "Comparison Utility in a Growth Model," *Journal of Economic Growth*, 1997, *2* (4), 339–367.

__ **,** __ **, and** __ , "Saving and Growth with Habit Formation," *American Economic Review*, 2000, pp. 341–355.

**Charness, Gary and Uri Gneezy**, "Incentives to Exercise," *Econometrica*, 2009, *77* (3), 909–931.

**Chen, Xiaohong and Sydney C Ludvigson**, "Land of Addicts? An Empirical Investigation of Habit-Based Asset Pricing Models," *Journal of Applied Econometrics*, 2009, *24* (7), 1057–1093.

**Chetty, Raj and Adam Szeidl**, "Consumption Commitments and Habit Formation," *Econometrica*, 2016, *84* (2), 855–890.

**Chuang, Yating and Laura Schechter**, "Stability of Experimental and Survey Measures of Risk, Time, and Social Preferences: A Review and Some New Results," *Journal of Development Economics*, 2015, *117*, 151–170.

**Clark, Andrew E, Paul Frijters, and Michael A Shields**, "Relative Income, Happiness, and Utility: An Explanation for the Easterlin Paradox and Other Puzzles," *Journal of Economic Literature*, 2008, *46* (1), 95–144.

**Cochrane, John H**, "Macro-Finance," *Review of Finance*, 2017, *21* (3), 945–985.

**Coibion, Olivier, Dimitris Georgarakos, Yuriy Gorodnichenko, Geoff Kenny, and Michael Weber**, "The Effect of Macroeconomic Uncertainty on Household Spending," *American Economic Review*, 2024, *114* (3), 645–677.

__ **, Yuriy Gorodnichenko, and Michael Weber**, "Monetary Policy Communications and Their Effects on Household Inflation Expectations," *Journal of Political Economy*, 2022, *130* (6), 1537–1584.

**Confucius**, *The Analects*, Translated by Simon Leys. W.W. Norton & Company, 1997.

**Constantinides, George M**, "Habit Formation: A Resolution of the Equity Premium Puzzle," *Journal of Political Economy*, 1990, *98* (3), 519–543.

**Crawford, Ian**, "Habits Revealed," *The Review of Economic Studies*, 10 2010, *77* (4), 1382–1402.

**Deaton, Angus**, "Income, Health, and Well-Being Around the World: Evidence From the Gallup World Poll," *Journal of Economic Perspectives*, 2008, *22* (2), 53–72.

**DellaVigna, Stefano, Attila Lindner, Balázs Reizer, and Johannes F. Schmieder**, "Reference-Dependent Job Search: Evidence from Hungary," *The Quarterly Journal of Economics*, May 2017, *132* (4), 1969–2018.

**Di Tella, Rafael and Robert MacCulloch**, "Gross National Happiness as an Answer to the Easterlin Paradox?," *Journal of Development Economics*, 2008, *86* (1), 22–42.

**Douglas, Benjamin D., Patrick J. Ewell, and Markus Brauer**, "Data Quality in Online Human-Subjects Research: Comparisons Between Mturk, Prolific, Cloudresearch, Qualtrics, and Sona," *PLOS ONE*, 03 2023, *18* (3), 1–17.

**Duesenberry, James Stemble**, *Income, Saving, and the Theory of Consumer Behavior*, Harvard University Press, 1949.

**Dynan, Karen E**, "Habit Formation in Consumer Preferences: Evidence from Panel Data," *American Economic Review*, 2000, pp. 391–406.

__ **and Enrichetta Ravina**, "Increasing Income Inequality, External Habits, and Self-Reported Happiness," *American Economic Review*, Apr 2007, *97* (2), 226–231.

**Easterlin, Richard A**, "Does Money Buy Happiness?," *Public Interest*, 1973, *30*, 3.

__ , "Does Economic Growth Improve the Human Lot? Some Empirical Evidence," in "Nations and Households in Economic Growth," Elsevier, 1974, pp. 89–125.

__ , "Will Raising the Incomes of All Increase the Happiness of All?," *Journal of Economic Behavior and Organization*, 1995, *27* (1), 35–47.

__ , "Income and Happiness: Towards a Unified Theory," *The Economic Journal*, 2001, *111* (473), 465–484.

__ , "Paradox Lost?," *Review of Behavioral Economics*, 2017, *4* (4), 311–339.

__ **and Kelsey J O'Connor**, "Explaining Happiness Trends in Europe," *Proceedings of the National Academy of Sciences*, 2022, *119* (37), e2210639119.

__ **and** __ , "The Happiness Revolution in Europe," *Elements in Economics of European Integration*, 2025.

**Epstude, Kai and Neal J Roese**, "The Functional Theory of Counterfactual Thinking," *Personality and Social Psychology Review*, 2008, *12* (2), 168–192.

**Farrell, Diana and Fiona Greig**, "Weathering Volatility: Big Data on the Financial UPS and Downs of Us Individuals," *New York: JP Morgan Chase Institute*, 2015.

**Frijters, Paul, John P Haisken-DeNew, and Michael A Shields**, "Money Does Matter! Evidence from Increasing Real Income and Life Satisfaction in East Germany Following Reunification," *American Economic Review*, 2004, *94* (3), 730–740.

**Fuhrer, Jeffrey C**, "Habit Formation in Consumption and Its Implications for Monetary-Policy Models," *American Economic Review*, 2000, pp. 367–390.

**Gardner, Jonathan and Andrew J Oswald**, "Money and Mental Well-being: A Longitudinal Study of Medium-Sized Lottery Wins," *Journal of Health Economics*, 2007, *26* (1), 49–60.

**Giorgi, Giacomo De, Anders Frederiksen, and Luigi Pistaferri**, "Consumption Network Effects," *The Review of Economic Studies*, 2020, *87* (1), 130–163.

**Gneezy, Uri, Yoram Halevy, Brian Hall, Theo Offerman, and Jeroen van de Ven**, "How Real is Hypothetical? A High-Stakes Test of the Allais Paradox," *Harvard Business School Working Paper 25-005*, 2024.

**Grishchenko, Olesya V**, "Internal vs. External Habit Formation: The Relative Importance for Asset Pricing.," *Journal of Economics and Business*, 2010, *62* (3), 176–194.

**Haghani, Milad, Michiel CJ Bliemer, John M Rose, Harmen Oppewal, and Emily Lancsar**, "Hypothetical Bias in Stated Choice Experiments: Part I. Macro-Scale Analysis of Literature and Integrative Synthesis of Empirical Evidence From Applied Economics, Experimental Psychology and Neuroimaging," *Journal of Choice Modelling*, 2021, *41*, 100309.

**_ , _ , _ , _ , and _** , "Hypothetical Bias in Stated Choice Experiments: Part II. Conceptualisation of External Validity, Sources and Explanations of Bias and Effectiveness of Mitigation Methods," *Journal of Choice Modelling*, 2021, *41*, 100322.

**Hainmueller, Jens, Dominik Hangartner, and Teppei Yamamoto**, "Validating Vignette and Conjoint Survey Experiments Against Real-World Behavior," *Proceedings of the National Academy of Sciences*, 2015, *112* (8), 2395–2400.

**Havranek, Tomas, Marek Rusnak, and Anna Sokolova**, "Habit Formation in Consumption: A Meta-Analysis," *European Economic Review*, 2017, *95*, 142–167.

**Hussam, Reshmaan, Atonu Rabbani, Giovanni Reggiani, and Natalia Rigol**, "Rational Habit Formation: Experimental Evidence From Handwashing in India," *American Economic Journal: Applied Economics*, 2022, *14* (1), 1–41.

**Johnston, Robert J, Kevin J Boyle, Wiktor Adamowicz, Jeff Bennett, Roy Brouwer, Trudy Ann Cameron, W Michael Hanemann, Nick Hanley, Mandy Ryan, Riccardo Scarpa et al.**, "Contemporary Guidance for Stated Preference Studies," *Journal of the Association of Environmental and Resource Economists*, 2017, *4* (2), 319–405.

**Kahneman, Daniel and Amos Tversky**, "Prospect Theory: An Analysis of Decision under Risk," *Econometrica*, Mar 1979, *47* (2), 263.

**_ , Jack L Knetsch, and Richard H Thaler**, "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias," *Journal of Economic Perspectives*, 1991, *5* (1), 193–206.

**Kaiser, Caspar F. and Maarten C. M. Vendrik**, "Different Versions of the Easterlin Paradox: New Evidence for European Countries," *Economics of Happiness*, 2019, pp. 27–55.

**Kapteyn, Arie and Federica Teppa**, "Hypothetical Intertemporal Consumption Choices," *Economic Journal*, 2003, *113* (486), C140–C152.

**Keynes, John Maynard**, *The General Theory of Employment, Interest, and Money*, London: Macmillan, 1936.

**Khanal, Aditya R., Ashok K. Mishra, and S Nedumaran**, "Consumption, Habit Formation, and Savings: Evidence from a Rural Household Panel Survey," *Review of Development Economics*, Sep 2018, *23* (1), 256–274.

**Kimball, Miles S and Robert J Willis**, "Utility and Happiness," *National Bureau of Economic Research*, 2023.

**_ , Claudia R Sahm, and Matthew D Shapiro**, "Imputing Risk Tolerance from Survey Responses," *Journal of the American Statistical Association*, 2008, *103* (483), 1028–1038.

**_ , _ , and _** , "Risk Preferences in the PSID: Individual Imputations and Family Covariation," *American Economic Review Papers and Proceedings*, Apr 2009, *99* (2), 363–368.

**_ , Collin B Raymond, Jiannan Zhou, Junya Zhou, Fumio Ohtake, and Yoshiro Tsutsui**, "Happiness Dynamics, Reference Dependence, and Motivated Beliefs in U.S. Presidential Elections," *National Bureau of Economic Research*, 2024.

**_ , Daniel Reck, Fudong Zhang, Fumio Ohtake, and Yoshiro Tsutsui**, "Diminishing Marginal Utility Revisited," *National Bureau of Economic Research*, 2024.

**Kőszegi, Botond and Matthew Rabin**, "A Model of Reference-Dependent Preferences," *The Quarterly Journal of Economics*, 2006, *121* (4), 1133–1165.

**Kumar, Saten, Yuriy Gorodnichenko, and Olivier Coibion**, "The Effect of Macroeconomic Uncertainty on Firm Decisions," *Econometrica*, 2023, *91* (4), 1297–1332.

**Kuziemko, Ilyana, Michael I Norton, Emmanuel Saez, and Stefanie Stantcheva**, "How Elastic Are Preferences for Redistribution? Evidence from Randomized Survey Experiments," *American Economic Review*, 2015, *105* (4), 1478–1508.

**Larrimore, Jeff, Alicia Lloro, Zofsha Merchant, Ellen A Merry, Fatimah Shaalan, Julie Siwicki, and Mike Zabek**, "Economic Well-Being of US Households in 2024," Technical Report, Board of Governors of the Federal Reserve System (US) 2025.

**Layard, Richard and Jan-Emmanuel De Neve**, *Wellbeing*, Cambridge University Press, 2023.

**Lewbel, Arthur, Samuel Norris, Krishna Pendakur, and Xi Qu**, "Consumption Peer Effects and Utility Needs in India," *Quantitative Economics*, 2022, *13* (3), 1257–1295.

**List, John A**, "Do Explicit Warnings Eliminate the Hypothetical Bias in Elicitation Procedures? Evidence From Field Auctions for Sportscards," *American Economic Review*, 2001, *91* (5), 1498–1507.

**Liu, Xuemei, Juan Lai, Chuanliang Han, Hao Zhong, Kang Huang, Yuanming Liu, Xutao Zhu, Pengfei Wei, Liming Tan, Fuqiang Xu, and Liping Wang**, "Neural Circuit Underlying Individual Differences in Visual Escape Habituation," *Neuron*, 2025.

**Ljungqvist, Lars and Harald Uhlig**, "Tax Policy and Aggregate Demand Management Under Catching up With the Joneses," *American Economic Review*, Jun 2000, *90* (3), 356–366.

**Loewenstein, George, Ted O'Donoghue, and Matthew Rabin**, "Projection Bias in Predicting Future Utility," *The Quarterly Journal of Economics*, 2003, *118* (4), 1209–1248.

**Lucas, Robert E**, "Econometric Policy Evaluation: A Critique," in "Carnegie-Rochester Conference Series on Public Policy," Vol. 1 1976, pp. 19–46.

**Luttmer, Erzo F. P.**, "Neighbors as Negatives: Relative Earnings and Well-Being," *The Quarterly Journal of Economics*, 08 2005, *120* (3), 963–1002.

**Manski, Charles F**, "Measuring Expectations," *Econometrica*, 2004, *72* (5), 1329–1376.

**Markowitz, Harry**, "The Utility of Wealth," *Journal of Political Economy*, 1952, *60* (2), 151–158.

**Masatlioglu, Yusufcan and Efe A Ok**, "A Canonical Model of Choice With Initial Endowments," *The Review of Economic Studies*, 2014, *81* (2), 851–883.

**Matousek, Jindrich, Tomas Havranek, and Zuzana Irsova**, "Individual Discount Rates: A Meta-Analysis of Experimental Evidence," *Experimental Economics*, 2022, *25* (1), 318–358.

**Matyskova, Ludmila, Brian Rogers, Jakub Steiner, and Keh-Kuan Sun**, "Habits as Adaptations: An Experimental Study," *Games and Economic Behavior*, 2020, *122*, 391–406.

**Meghir, Costas and Guglielmo Weber**, "Intertemporal Nonseparability or Borrowing Restrictions? A Disaggregate Analysis Using a U.S. Consumption Panel," *Econometrica*, Sep 1996, *64* (5), 1151.

**Naik, Narayan Y and Michael J Moore**, "Habit Formation and Intertemporal Substitution in Individual Food Consumption," *Review of Economics and Statistics*, 1996, *78* (2), 321–328.

**Peer, Eyal, David Rothschild, Andrew Gordon, Zak Evernden, and Ekaterina Damer**, "Data Quality of Platforms and Panels for Online Behavioral Research," *Behavior Research Methods*, 2022, *54* (4), 1643–1662.

**Perez-Truglia, Ricardo**, "The Effects of Income Transparency on Well-Being: Evidence from a Natural Experiment," *American Economic Review*, April 2020, *110* (4), 1019–54.

**Pinsker, Harold, Irving Kupfermann, Vincent Castellucci, and Eiuc Kandel**, "Habituation and Dishabituation of the Gill-Withdrawal Reflex in Aplysia," *Science*, 1970, *167* (3926), 1740–1742.

**Pollak, Robert A**, "Habit Formation and Dynamic Demand Functions," *Journal of Political Economy*, 1970, *78* (4), 745–763.

**Post, Thierry, Martijn J Van den Assem, Guido Baltussen, and Richard H Thaler**, "Deal or No Deal? Decision Making Under Risk in a Large-Payoff Game Show," *American Economic Review*, 2008, *98* (1), 38–71.

**Praag, Bernard M. S. Van and Paul Frijters**, "The Measurement of Welfare and Well-Being: The Leyden Approach," in "Well-Being: Foundations of Hedonic Psychology," Russell Sage Foundation, 1999, pp. 413–433.

**Prati, Alberto and Claudia Senik**, "Is It Possible to Raise National Happiness?," *HAL SHS Working Paper 04850502*, 2024.

**Ravn, Morten, Stephanie Schmitt-Grohé, and Martin Uribe**, "Deep Habits," *The Review of Economic Studies*, 2006, *73* (1), 195–218.

**Rayo, Luis and Gary S Becker**, "Evolutionary Efficiency and Happiness," *Journal of Political Economy*, 2007, *115* (2), 302–337.

**Royer, Heather, Mark Stehr, and Justin Sydnor**, "Incentives, Commitments, and Habit Formation in Exercise: Evidence From a Field Experiment With Workers at a Fortune-500 Company," *American Economic Journal: Applied Economics*, 2015, *7* (3), 51–84.

**Ryder, Harl E and Geoffrey M Heal**, "Optimal Growth With Intertemporally Dependent Preferences," *The Review of Economic Studies*, 1973, *40* (1), 1–31.

**Sergeyev, Dmitriy, Chen Lian, and Yuriy Gorodnichenko**, "The Economics of Financial Stress," *The Review of Economic Studies*, 2024, p. rdae110.

**Siniscalchi, Marciano**, "Vector Expected Utility and Attitudes Toward Variation," *Econometrica*, 2009, *77* (3), 801–855.

**Smith, Adam**, *An Inquiry into the Nature and Causes of the Wealth of Nations*, London: W. Strahan and T. Cadell, 1776.

**Spinnewyn, Frans**, "Rational Habit Formation," *European Economic Review*, 1981, *15* (1), 91 – 109.

**Stantcheva, Stefanie**, "How to Run Surveys: A Guide to Creating Your Own Identifying Variation and Revealing the Invisible," *Annual Review of Economics*, 2023, *15* (1), 205–234.

**Stevenson, Betsey and Justin Wolfers**, "Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox," *Brookings Papers on Economic Activity*, 2008, *2008* (1), 1–87.

**Stiglitz, Joseph E**, "Where Modern Macroeconomics Went Wrong," *Oxford Review of Economic Policy*, 2018, *34* (1-2), 70–106.

**Strauss, Milton E and Gregory T Smith**, "Construct Validity: Advances in Theory and Methodology," *Annual Review of Clinical Psychology*, 2009, *5*, 1–25.

**Weidmann, Ben and David J Deming**, "Team Players: How Social Skills Improve Team Performance," *Econometrica*, 2021, *89* (6), 2637–2657.

**Wood, Wendy and Dennis Rünger**, "Psychology of Habit," *Annual Review of Psychology*, 2016, *67* (1), 289–314.

# Online Appendices A-F for "Measuring Habit Formation"

The appendices present the proof of the observational equivalence of linear and nonlinear habit evolutions under general habit preferences, aggregation of preference parameters, proofs of identifying propositions, response correlations, robustness checks, and additional survey questions.

## A Observational Equivalence of Linear and Nonlinear Habit Evolutions Under General Habit Preferences

This appendix shows that the model with the linear habit evolution equation outlined in Section 2.1 (Model $L$ below) and the models with (potentially) nonlinear habit evolutions (Model $N$ below) are observationally equivalent (in the sense of Definition 1 below), via a monotonic transformation of the scale on which habit is measured.

**Model** $L$: $\mathbb{E}_0\int_0^\infty e^{-\rho t}u(C,H)dt$ s.t. $\dot{H}=\theta(C-H)$.

**Model** $N$: $\mathbb{E}_0\int_0^\infty e^{-\rho t}v(C,\mathcal{H})dt$ s.t. $\dot{\mathcal{H}}=f(C,\mathcal{H})$, where $f$ can be a nonlinear function of $C$ and $\mathcal{H}$.

Note that $H_t = h(C_0,H_0,t)$ if $C_t = \bar{C}\ \forall t \geq 0$ where the subscripts index time. Similarly, $\mathcal{H}_t=\eta(C_0,\mathcal{H}_0,t)$ if $C_t=\bar{C}\ \forall t\geq 0$. That is, if consumption does not change $\forall t\geq 0$, $H_t$ and $\mathcal{H}_t$ are functions of time only, with $C_0$, $H_0$, and $\mathcal{H}_0$ as their parameters.

**Definition 1.** Two models are observationally equivalent if they lead to the same set of optimal choices.

**Definition 2.** Monotonicities of two functions are entangled with respect to a variable if i) the two functions share this variable as an argument, and ii) ceteris paribus, when one function is monotonic in the variable, the other function is also monotonic in the variable.

Because $H$ and $\mathcal{H}$ are two measures of one fundamental—habit, they change at the same time when habit changes (though potentially in different ways), and they stop changing when habit ceases to change. By Definition 2, their monotonicities are entangled with respect to time.[1]

**Proposition 4.** *Model L and Model N are observationally equivalent if the monotonicities of $H$ and $\mathcal{H}$ are entangled with respect to time.*

[1]That is, the product $\dot{H}_t\cdot\dot{\mathcal{H}}_t$ maintains a constant sign over time. While it is possible that $\dot{H}_t\cdot\dot{\mathcal{H}}_t=0$ in certain time intervals, the sign of $\dot{H}_t\cdot\dot{\mathcal{H}}_t$ remains constant in the neighborhoods of those intervals.

*Proof.* Suppose that consumption changes at instant $0$ and stays at that level afterward: $C_t = C_{t+\varepsilon} \neq C_{-\varepsilon}\ \forall\, t \geq 0$ and $\varepsilon > 0$. Without loss of generality, suppose also that habit reaches its new steady state at instant $T$. Since consumption changed solely at $t = 0$, $H$ and $\mathcal{H}$ are entangled monotonically with respect to time: $H$ and $\mathcal{H}$ are monotonic from instant $0$ to instant $T$ and subsequently stay at constant levels, denoted $\bar{H}$ and $\bar{\mathcal{H}}$, respectively. That is, with explicit time indexing, we have $H_t = a(t|C_0,H_0)$ and $\mathcal{H}_t = b(t|C_0,\mathcal{H}_0)$, where $a(\cdot)$ and $b(\cdot)$ are monotonic functions of $t$ for $0 \leq t \leq T$ and are constant for $t > T$.

Because

$$\mathcal{H}_t = b(t|C_0,\mathcal{H}_0) = b\big(a^{-1}(a(t|C_0,H_0)|C_0,H_0)|C_0,\mathcal{H}_0\big) = b\big(a^{-1}(H_t|C_0,H_0)|C_0,\mathcal{H}_0\big)$$

for $0 \leq t \leq T$ and

$$\mathcal{H}_t = \frac{\bar{\mathcal{H}}}{\bar{H}} H_t$$

for $t > T$, there always exists a bijective function $G$ that maps $H_t$ onto $\mathcal{H}_t$:

$$\mathcal{H}_t = G(H_t) \equiv \begin{cases} b(a^{-1}(H_t|C_0,H_0)|C_0,\mathcal{H}_0) & 0 \leq t \leq T \\ \frac{\bar{\mathcal{H}}}{\bar{H}} H_t & t > T. \end{cases}$$

Because $v(C,\mathcal{H}) = v(C,G(H)) \equiv u(C,H)$, Model $N$ yields the same utility as Model $L$ for any consumption profile that is constant for $t \geq 0$.

When the consumption profile is not constant for $t \geq 0$, the utilities from the two models remain equal. To see this, start from the instant when consumption changes for the last time and apply the above logic to obtain the same utility from the two models from that instant onward. Then, go back to the instant when consumption changes for the second-to-last time and apply the same logic. The same utility results for the two models again. Continue this process until reaching the first instant of interest.

Because the utilities from the two models are the same, the consumption choices generated by these models coincide. This can be demonstrated through a proof by contradiction: suppose that the two models lead to different optimal consumption profiles—that is, $\{C_L^*\} \neq \{C_N^*\}$ for at least one instant, where

$$\{C_L^*\} = \underset{\{C\}}{\operatorname{argmax}} \mathbb{E}_0 \int_0^\infty e^{-\rho t} u(C,H)\,dt \equiv \underset{\{C_L\}}{\operatorname{argmax}} U(\{C_L\},H_0)$$

and

$$\{C_N^*\} = \underset{\{C\}}{\operatorname{argmax}} \mathbb{E}_0 \int_0^\infty e^{-\rho t} v(C,\mathcal{H})\,dt \equiv \underset{\{C_N\}}{\operatorname{argmax}} V(\{C_N\},\mathcal{H}_0).$$

If $U(\{C_L^*\},H_0) \neq V(\{C_N^*\},\mathcal{H}_0)$, then at least one of the two consumption profiles is not maximizing lifetime utility, contradicting their optimality in their respective models. If $U(\{C_L^*\},H_0) =$

$V(\{C_N^*\},\mathcal{H}_0)$, then the consumption profile $\{C_L^*\}$ is also a solution to Model $N$, while $\{C_N^*\}$ is also a solution to Model $L$.[2] Therefore, both $\{C_H^*\}$ and $\{C_{\mathcal{H}}^*\}$ are solutions to the two models. In other words, the two models share the same set of solutions. Thus, by Definition 1, the two models are observationally equivalent. □

Because the monotonicities of $H$ and $\mathcal{H}$ are entangled with respect to time, by Proposition 4, Model $L$ and Model $N$ are observationally equivalent.

It is straightforward to incorporate external habit formation and peer effects into the models; the proof of the equivalence result in these cases is simple because other people's spending is exogenous to the agent.

# B Aggregation

What do the preference parameters of individual respondents tell us about the preference parameters of a representative agent? This question is of particular interest because almost all current models with habit formation assume a representative agent. This appendix shows that, given its existence, the representative agent's preference parameters are averages of the individuals' preference parameters.

To aggregate individuals, their welfare needs to be comparable to that of each other (comparability), and the representative agent's welfare should represent the average of the individuals' welfare (representativeness). To formalize the idea of comparability, we assume that at the homogeneous steady state of $\bar{C}_i = \bar{H}_i = \varphi \ \forall i$, spending an extra dollar while holding habit constant brings the same marginal utility to every individual: $u_{i,C}\left(\bar{C}_i,\bar{H}_i\right) = u_{j,C}\left(\bar{C}_j,\bar{H}_j\right) = \bar{u} \ \forall i,j$.

With the comparability of individuals' utilities, the representativeness of the representative agent ($R$) implies that $Nu_R(C_R,H_R) = \sum_i u_i(C_i,H_i)$ when $C_R = C_i = A$ and $H_R = H_i = B$ $\forall i$ and $\forall A,B$ in the domains of the utility functions, where $N$ is the number of individuals in the economy. That is, when the heterogeneities in behaviors (i.e., consumption and habit) are homogenized, the representative agent is the average individual agent in terms of welfare. To see what this condition means, first note that the difference between a representative-agent model and a heterogeneous-agent model is that in the former, everyone in the economy is the same, while in the latter, each individual can be different. If everyone in the heterogeneous economy becomes the same (i.e., homogeneous in consumption, habit, utility function, etc.), then the representative agent model should behave exactly the same as the homogenized heterogeneous-agent model, which results in the equality of $Nu_R(C_R,H_R) = \sum_i u_i(C_i,H_i)$ under $C_R = C_i$, $H_R = H_i$, and $u_R = u_i \ \forall i$. Now, allowing individuals to be heterogeneous along the dimension of the utility

[2] The constraints, aside from habit evolution, are identical across both models, rendering the two consumption profiles feasible in both models.

function after the normalization of the comparability condition, the representativeness condition simply formalizes the requirement that the representative agent represents the individuals along the welfare dimension, after controlling for consumption and habit.

## B.1 Aggregation of Habit Decay Rate

Even though the habit decay rate ($\theta$) and habit ($H$) are mapped one-to-one at each instant prior to reaching a steady state for any given consumption profile, there exist infinitely many pairs of $\theta$ and $H$ that simultaneously satisfy the representative agent's habit evolution equation ($\dot{H}_R = \theta_R(C_R - H_R)$), the individuals' habit evolution equation ($\dot{H}_i = \theta_i(C_i - H_i)$), and the comparability condition. The intuition is that while habit depends on the habit decay rate, its steady-state level does not. In other words, a different value of $\theta$ leads to a different value of $H$ at every instant before the steady state, but this difference vanishes once the steady state is reached. The representativeness condition eliminates this indeterminacy and determines a unique $\theta_R$ given the individuals' $\theta_i$'s.

To find the mapping between the aggregate habit decay rate ($\theta_R$) and the individuals' habit decay rates ($\theta_i$'s), imagine that everyone starts at the homogeneous steady state and increases their consumption by the same small amount. That is, starting from $C_i = C_j = C_R = H_i = H_j = H_R$ $\forall i,j$, increase consumption by the iota amount $\Delta C_i = \Delta C_j = \Delta C_R$ $\forall i,j$. The resulting changes in utilities are

$$\begin{aligned}\Delta u_R(C_R,H_R) &= u_{R,C}(C_R,H_R)\Delta C_R + u_{R,H}(C_R,H_R)\Delta H_R \\ &= u_{R,C}(C_R,H_R)\Delta C_R + u_{R,H}(C_R,H_R)\theta_R \Delta C_R\end{aligned}$$

and

$$\begin{aligned}\Delta u_i(C_i,H_i) &= u_{i,C}(C_i,H_i)\Delta C_i + u_{i,H}(C_i,H_i)\Delta H_i \\ &= u_{i,C}(C_i,H_i)\Delta C_i + u_{i,H}(C_i,H_i)\theta_i \Delta C_i,\end{aligned}$$

where $u_{X,Y} \equiv \partial u_X / \partial Y$.

Since $N\Delta u_R(C_R,H_R) = \sum_i \Delta u_i(C_i,H_i)$, as implied by the representativeness condition,

$$u_{R,C}(C_R,H_R)\Delta C_R + u_{R,H}(C_R,H_R)\theta_R \Delta C_R = \frac{1}{N}\sum_i [u_{i,C}(C_i,H_i)\Delta C_i + u_{i,H}(C_i,H_i)\theta_i \Delta C_i].$$

Because $\Delta C_R = \Delta C_i$ and $u_{R,C}(C_R,H_R) = u_{i,C}(C_i,H_i)$ $\forall i$ (see Appendix B.2),

$$\frac{u_{R,H}(C_R,H_R)}{u_{R,C}(C_R,H_R)}\theta_R = \frac{1}{N}\sum_i \frac{u_{i,H}(C_i,H_i)}{u_{i,C}(C_i,H_i)}\theta_i = \frac{1}{N}\sum_i \frac{u_{i,H}(C_i,H_i)}{u_{i,C}(C_i,H_i)} \cdot \frac{1}{N}\sum_i \theta_i,$$

where the second equality holds because of the independence between the slope of the indifference curve and the habit decay rate. With $u_{R,H}(C_R,H_R) = \frac{1}{N}\sum_i u_{i,H}(C_i,H_i)$ (see Appendix B.2) and

$u_{R,C}(C_R,H_R)=u_{i,C}(C_i,H_i)\ \forall i$, it follows that

$$\theta_R=\frac{1}{N}\sum_i\theta_i.$$

That is, the representative agent's habit decay rate equals the average of the individual agents' habit decay rates.

## B.2 Aggregation of Ratios of Utility Derivatives

In this appendix, we derive the relationships between the utility derivatives of the representative agent and those of the heterogeneous agents at the homogeneous steady state ($\bar{C}_R=\bar{H}_R=\bar{C}_i=\bar{H}_i\ \forall i$).

Because $Nu_R(C_R,H_R)=\sum_i u_i(C_i,H_i)$ when $C_R=C_i=A$ and $H_R=H_i=B\ \forall i$ and $\forall A,B$ in the domains of the utility functions, the utility derivatives of the representative agent are the averages of the utility derivatives of the individuals:

$$u_{R,X}(C_R,H_R)=\frac{1}{N}\sum_i u_{i,X}(C_i,H_i),$$

where $X$ denotes the variable of differentiation (e.g., $C$, $H$).

Next, we derive the relationships between the ratios of the utility derivatives of the representative agent and those of the heterogeneous agents at the steady state, in three steps.

1. Under the normalization of $u_{R,C}\left(\bar{C}_R,\bar{H}_R\right)=u_{i,C}\left(\bar{C}_i,\bar{H}_i\right)=\bar{u}\ \forall i$,

$$\frac{1}{N}\sum_i u_{i,H}=-\frac{1}{N}\sum_i\left(-\frac{u_{i,H}}{u_{i,C}}\cdot u_{i,C}\right)=-\left[\frac{1}{N}\sum_i\left(-\frac{u_{i,H}}{u_{i,C}}\right)\right]\cdot u_{i,C}\equiv-\mu_{-\frac{u_{i,H}}{u_{i,C}}}\cdot\bar{u},$$

   where $\mu_{-\frac{u_{i,H}}{u_{i,C}}}\equiv\frac{1}{N}\sum_i\left(-\frac{u_{i,H}}{u_{i,C}}\right)$. Similar notation is used hereafter.

2. Because the parameters are independent,

$$\frac{1}{N}\sum_i u_{i,C_{\text{others}}}=\frac{1}{N}\sum_i\left(\frac{u_{i,C_{\text{others}}}}{u_{i,H}}\cdot u_{i,H}\right)=\frac{1}{N}\sum_i\frac{u_{i,C_{\text{others}}}}{u_{i,H}}\cdot\frac{1}{N}\sum_i u_{i,H}.$$

3. With the above, the parameters of the representative agent can be calculated as follows:

$$-\frac{u_{R,H}}{u_{R,C}}=-\frac{\frac{1}{N}\sum_i u_{i,H}}{\frac{1}{N}\sum_i u_{i,C}}=-\frac{\frac{1}{N}\sum_i u_{i,H}}{\bar{u}}=\mu_{-\frac{u_{i,H}}{u_{i,C}}},$$

   and

$$\frac{u_{R,C_{\text{others}}}}{u_{R,H}}=\frac{\frac{1}{N}\sum_i u_{i,C_{\text{others}}}}{\frac{1}{N}\sum_i u_{i,H}}=\frac{\frac{1}{N}\sum_i\frac{u_{i,C_{\text{others}}}}{u_{i,H}}\cdot\frac{1}{N}\sum_i u_{i,H}}{\frac{1}{N}\sum_i u_{i,H}}=\mu_{\frac{u_{i,C_{\text{others}}}}{u_{i,H}}}.$$

In summary, the representative agent's ratios of utility derivatives equal the averages of the individuals' ratios of utility derivatives.

# C Proofs of Propositions

This appendix presents proofs for the propositions in the main text. It begins by establishing three lemmas and deriving three quantities, which are used in the subsequent proofs of the propositions.

## C.1 Three Lemmas

**Lemma 1.** *For* $a,b,c\in\mathbb{R}$*, if* $a(a+b)>0$ *and* $0\leq c\leq 1$*, then* $a(a+cb)>0$.

*Proof.* $a\,(a+b)>0$ is equivalent to $a^2>-ab$. If $ab<0$, $-abc\leq -ab<a^2$. If $ab\geq 0$, $-abc\leq 0<a^2$. In both cases, $a(a+cb)>0$. □

In words, the lemma states that if $a$ and $a+b$ share the same sign and $0\leq c\leq 1$, then $a+cb$ also shares that sign.

**Lemma 2.** *For* $\Delta e,\Delta f,M\in\mathbb{R}^+$*, if* $M-\Delta e-\Delta f\geq 0$*, then* $\sum_{s=0}^{n}(\Delta e)^s(\Delta f)^{n-s}/M^n$ *is decreasing in* $n\in\mathbb{N}^+$.

*Proof.* $\forall n\in\mathbb{N}^+$,

$$
\begin{aligned}
&\frac{\sum_{s=0}^{n}(\Delta e)^s(\Delta f)^{n-s}}{M^n}-\frac{\sum_{s=0}^{n+1}(\Delta e)^s(\Delta f)^{n+1-s}}{M^{n+1}}\\
&=\frac{1}{M^{n+1}}\left[\sum_{s=0}^{n}(\Delta e)^s(\Delta f)^{n-s}(M-\Delta f)-(\Delta e)^{n+1}\right]\\
&=\frac{(\Delta e)^n(M-\Delta f)}{M^{n+1}}\left[\sum_{s=0}^{n}\left(\frac{\Delta f}{\Delta e}\right)^{n-s}-\frac{\Delta e}{M-\Delta f}\right]\\
&=\frac{(\Delta e)^n(M-\Delta f)}{M^{n+1}}\left[\sum_{s=0}^{n-1}\left(\frac{\Delta f}{\Delta e}\right)^{n-s}+\frac{M-\Delta e-\Delta f}{M-\Delta f}\right]\\
&>0,
\end{aligned}
$$

where the inequality holds because $M-\Delta e-\Delta f\geq 0$ and $\Delta e,\Delta f,M\in\mathbb{R}^+$. □

**Lemma 3.** *If i)* $\Delta e,\Delta f,M,\theta,t\in\mathbb{R}^+$ *with* $M-\Delta e-\Delta f\geq 0$*, ii)* $u(C,H)$ *is analytic with* $u_H<0$ $\forall H$*, and iii)* $\partial^{l_r}u/\partial H^{l_r}\leq\Lambda_r$ $\forall r\in\mathbb{N}_{\geq 2}$ *with* $\partial^{l_1}u/\partial H^{l_1}<\Lambda_1$*, where* $l_r$ *is the* $r$*-th smallest element of* $L\equiv\left\{l\middle|\partial^l u/\partial H^l>0,l\in\mathbb{N}^+\right\}$ *and*

$$
\Lambda_r\equiv-\sum_{n=1}^{l_r-1}e^{(l_r-n)\theta t}\frac{l_r!\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}}{n!\sum_{s=0}^{l_r-1}(\Delta e)^s(\Delta f)^{l_r-1-s}}\left[\frac{\partial^n u}{\partial H^n}1(n\notin L)+\Lambda_{R(n)}1(n\in L)\right]
$$

*with* $R(n) \equiv \sum_{r\in\mathbb{N}} r1(n=l_r)$ *and* $1(\cdot)$ *denoting the indicator function, then*

$$\sum_{n=1}^{\infty} e^{-n\theta t}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]<0.$$

*Proof.* By $u_H<0\ \forall H$, the analyticity of $u(C,H)$, and $Me^{-\theta t}>0$,

$$u\big(C,H+Me^{-\theta t}\big)-u(C,H)=\sum_{n=1}^{\infty}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\big(Me^{-\theta t}\big)^n<0. \tag{3}$$

Because $\Delta e$, $\Delta f$, $M>0$, and $M-\Delta e-\Delta f\geq 0$, $0<\frac{\Delta e+\Delta f}{M}\leq 1$.
By $u_H<0$, inequality (3), and Lemma 1,

$$u_H Me^{-\theta t}+\frac{\Delta e+\Delta f}{M}\left[\sum_{n=2}^{\infty}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\big(Me^{-\theta t}\big)^n\right]<0,$$

which implies

$$\begin{aligned}
&u_H Me^{-\theta t}+\frac{1}{2}u_{HH}\big(Me^{-\theta t}\big)^2\frac{\Delta e+\Delta f}{M}+\frac{\Delta e+\Delta f}{M}\left[\sum_{n=3}^{\infty}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\big(Me^{-\theta t}\big)^n\right]\\
=&\sum_{n=1}^{2}e^{-n\theta t}M\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]+\frac{\Delta e+\Delta f}{M}\left[\sum_{n=3}^{\infty}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\big(Me^{-\theta t}\big)^n\right]\\
<&0.
\end{aligned} \tag{4}$$

By Lemma 2,

$$0\leq\frac{\frac{\sum_{s=0}^{2}(\Delta e)^s(\Delta f)^{2-s}}{M^2}}{\frac{\Delta e+\Delta f}{M}}<1.$$

If $u_{HH}\leq 0$, apply Lemma 1 to inequality (4) to obtain

$$\begin{aligned}
&\sum_{n=1}^{2}e^{-n\theta t}M\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]\\
&+\frac{\frac{\sum_{s=0}^{2}(\Delta e)^s(\Delta f)^{2-s}}{M^2}}{\frac{\Delta e+\Delta f}{M}}\frac{\Delta e+\Delta f}{M}\left[\sum_{n=3}^{\infty}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\big(Me^{-\theta t}\big)^n\right]\\
=&\sum_{n=1}^{3}e^{-n\theta t}M\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]\\
&+\frac{\sum_{s=0}^{2}(\Delta e)^s(\Delta f)^{2-s}}{M^2}\left[\sum_{n=4}^{\infty}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\big(Me^{-\theta t}\big)^n\right]\\
<&0.
\end{aligned} \tag{5}$$

This process of successive applications of Lemmas 1 and 2 can continue until $\partial^{l_1}u/\partial H^{l_1}>0$. Note that $l_1\geq 2$ since $u_H<0$. In general, when $\partial^l u/\partial H^l>0$ for $l\in L$, it is necessary to bound the $\partial^l u/\partial H^l$ terms from above, so that

$$\sum_{n=1}^{l} e^{-n\theta t} M \frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]<0,$$

which enables the continued application of Lemmas 1 and 2. Next, we show that the bounds of $\{\Lambda_r\}$ achieve this goal.[3]

Suppose that for some $l_r\in L$ and $\forall z\leq l_r$,

$$\sum_{n=1}^{z-1} e^{-n\theta t} M \frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]<0. \tag{6}$$

By inequalities (3) and (6), Lemmas 1 and 2 can be applied to all $z\leq l_r$ in the same manner in which inequality (5) is derived from inequality (3), which yields

$$\begin{aligned}
&\sum_{n=1}^{l_r} e^{-n\theta t} M \frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]\\
&+\frac{\sum_{s=0}^{l_r-1}(\Delta e)^s(\Delta f)^{l_r-1-s}}{M^{l_r-1}}\left[\sum_{n=l_r+1}^{\infty}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left(Me^{-\theta t}\right)^n\right]\\
&<0.
\end{aligned}$$

Now,

$$\begin{aligned}
&\sum_{n=1}^{l_r} e^{-n\theta t} M \frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]\\
=&\sum_{n=1}^{l_r-1} e^{-n\theta t} M \frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]+e^{-l_r\theta t} M \frac{1}{l_r!}\frac{\partial^{l_r} u}{\partial H^{l_r}}\left[\sum_{s=0}^{l_r-1}(\Delta e)^s(\Delta f)^{l_r-1-s}\right]\\
\leq&\sum_{n=1}^{l_r-1} e^{-n\theta t} M \frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]+e^{-l_r\theta t} M \frac{1}{l_r!}\left[\sum_{s=0}^{l_r-1}(\Delta e)^s(\Delta f)^{l_r-1-s}\right]\\
&\cdot\left\{-\sum_{n=1}^{l_r-1} e^{(l_r-n)\theta t}\frac{l_r!\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}}{n!\sum_{s=0}^{l_r-1}(\Delta e)^s(\Delta f)^{l_r-1-s}}\left[\frac{\partial^n u}{\partial H^n}1(n\notin L)+\Lambda_{R(n)}1(n\in L)\right]\right\}\\
=&\sum_{n=1}^{l_r-1} e^{-n\theta t} M \frac{1}{n!}\left[\sum_{s=0}^{n-1}(\Delta e)^s(\Delta f)^{n-1-s}\right]\left(\frac{\partial^n u}{\partial H^n}-\Lambda_{R(n)}\right)1(n\in L)
\end{aligned}$$

[3]Additive and multiplicative habits with power utility satisfy these bounds under common parameter values.

$$<0, \tag{7}$$

where the inequalities hold because $\partial^l u/\partial H^l \leq \Lambda_{R(l)} \forall l \in L$ and $\partial^{l_1} u/\partial H^{l_1} < \Lambda_1$. That is, inequality (6) holds for $z = l_r + 1$.

Since $\partial^n u/\partial H^n < 0$ for $l_r < n < l_{r+1}$, inequality (6) also holds $\forall z \leq l_{r+1}$. In other words, if inequality (6) holds $\forall z \leq l_r$, it also holds for $z \leq l_{r+1}$. Since it is trivially true that inequality (6) holds $\forall z \leq l_1$ (note that $\partial^n u/\partial H^n < 0 \; \forall n < l_1$), inequality (6) holds $\forall z \leq l \; \forall l \in L$.

In particular, inequality (6) holds for the largest element of $L$: $l_{|L|}$, where $|L|$ denotes the cardinality of the set $L$. Setting $z = l_{|L|}$ in inequality (6) and following the subsequent derivation to inequality (7) leads to

$$\sum_{n=1}^{l_{|L|}} e^{-n\theta t} M \frac{1}{n!} \frac{\partial^n u}{\partial H^n} \left[ \sum_{s=0}^{n-1} (\Delta e)^s (\Delta f)^{n-1-s} \right] < 0. \tag{8}$$

Finally,

$$\begin{aligned}
&\sum_{n=1}^{\infty} e^{-n\theta t} \frac{1}{n!} \frac{\partial^n u}{\partial H^n} \left[ \sum_{s=0}^{n-1} (\Delta e)^s (\Delta f)^{n-1-s} \right] \\
=&\frac{1}{M} \left\{ \sum_{n=1}^{l_{|L|}} e^{-n\theta t} M \frac{1}{n!} \frac{\partial^n u}{\partial H^n} \left[ \sum_{s=0}^{n-1} (\Delta e)^s (\Delta f)^{n-1-s} \right] \right. \\
&\left. + \sum_{n=l_{|L|}+1}^{\infty} e^{-n\theta t} M \frac{1}{n!} \frac{\partial^n u}{\partial H^n} \left[ \sum_{s=0}^{n-1} (\Delta e)^s (\Delta f)^{n-1-s} \right] \right\} \\
<&0,
\end{aligned}$$

where the inequality follows from inequality (8) and the fact that $\partial^n u/\partial H^n < 0 \; \forall n > l_{|L|}$. □

## C.2 Three Quantities

This subsection derives three quantities regarding the utility differences between three classes of spending profiles used in the survey questions and the baseline steady state of $C(t) = H(t) = \bar{C} = \bar{H}$ $\forall t$, facilitating the proofs of the identifying propositions.

To start, note that $\dot{H} = \theta(C - H)$ leads to

$$H(t) = e^{-\theta(t-t_0)} H(t_0) + \int_{t_0}^{t} e^{-\theta(t-s)} \theta C(s) ds,$$

which implies that the deviation of habit from its steady-state level is

$$\Delta H(t) \equiv H(t) - \bar{H}$$

$$
\begin{aligned}
&= e^{-\theta(t-t_0)}\big(H(t_0)-\bar{H}\big)+\int_{t_0}^{t} e^{-\theta(t-s)}\theta\big(C(s)-\bar{H}\big)ds \\
&= e^{-\theta(t-t_0)}\Delta H(t_0)+\int_{t_0}^{t} e^{-\theta(t-s)}\theta\Delta C(s)ds,
\end{aligned}
$$

where $\Delta C(t)\equiv C(t)-\bar{C}=C(t)-\bar{H}$.

**The first quantity.** The first quantity pertains to the class of spending profiles characterized by $\Delta C(t)=A\cdot 1(t\leq 0)+B\cdot 1(t>0)$. Under such spending profiles, for $t\geq 0$,

$$
\begin{aligned}
\Delta H(t) &= e^{-\theta\infty}\Delta H(-\infty)+\int_{-\infty}^{0} e^{-\theta(t-s)}\theta A ds+\int_{0}^{t} e^{-\theta(t-s)}\theta B ds \\
&= e^{-\theta t}A+\big(1-e^{-\theta t}\big)B. \qquad (9)
\end{aligned}
$$

For the second equality, note that $\Delta H(-\infty)$ is finite by the definition of habit.

The difference between lifetime utilities starting now ($t=0$), $\int_0^\infty e^{-\rho t}u(C(t),H(t))dt$, under this class of spending profiles and under the steady state $\big(\bar{C},\bar{H}\big)$ is

$$
\begin{aligned}
&\Psi(A,B) \\
&\equiv \int_0^\infty e^{-\rho t}u(C(t),H(t))dt-\int_0^\infty e^{-\rho t}u\big(\bar{C},\bar{H}\big)dt \\
&= \int_0^\infty e^{-\rho t}\big[u\big(\bar{C}+B,\bar{H}+e^{-\theta t}A+\big(1-e^{-\theta t}\big)B\big)-u\big(\bar{C},\bar{H}\big)\big]dt \\
&= \int_0^\infty e^{-\rho t}\Big\{u_C B+\frac{1}{2}u_{CC}B^2+u_{CH}B\big(e^{-\theta t}A+\big(1-e^{-\theta t}\big)B\big)+\cdots \\
&\quad +\Big[u_H\big(e^{-\theta t}A+\big(1-e^{-\theta t}\big)B\big)+\frac{1}{2}u_{HH}\big(e^{-\theta t}A+\big(1-e^{-\theta t}\big)B\big)^2+\cdots\Big]\Big\}dt
\end{aligned}
$$

where the last equality holds because $u$ is analytic, and all the utility derivatives are evaluated at the steady state.

**The second quantity.** The second quantity is related to the class of spending profiles characterized by

$$\Delta C(t)=A\cdot 1(-1<t\leq 0)+B\cdot 1(0<t\leq 1).$$

It follows that, for $t\geq 0$,

$$
\begin{aligned}
\Delta H(t) &= e^{-\theta\infty}\Delta H(-\infty)+\int_{-1}^{0} e^{-\theta(t-s)}\theta A ds+\int_{0}^{\min\{1,t\}} e^{-\theta(t-s)}\theta B ds \\
&= e^{-\theta t}\big[\big(1-e^{-\theta}\big)A+\big(e^{\theta\min\{1,t\}}-1\big)B\big].
\end{aligned}
$$

The difference between lifetime utilities starting now, $\int_0^\infty e^{-\rho t}u(C(t),H(t))dt$, under this class

of spending profiles and under the steady state $\left(\bar{C},\bar{H}\right)$ is

$$
\begin{aligned}
&\Upsilon(A,B)\\
&\equiv\int_0^\infty e^{-\rho t}u(C(t),H(t))dt-\int_0^\infty e^{-\rho t}u\left(\bar{C},\bar{H}\right)dt\\
&=\int_0^1 e^{-\rho t}\left[u\left(\bar{C}+B,\bar{H}+e^{-\theta t}\left(\left(1-e^{-\theta}\right)A+\left(e^{\theta t}-1\right)B\right)\right)-u\left(\bar{C},\bar{H}\right)\right]dt\\
&\quad+\int_1^\infty e^{-\rho t}\left[u\left(\bar{C},\bar{H}+e^{-\theta t}\left(1-e^{-\theta}\right)\left(A+Be^{\theta}\right)\right)-u\left(\bar{C},\bar{H}\right)\right]dt\\
&=\int_0^1 e^{-\rho t}\Bigg\{u_C B+\frac{1}{2}u_{CC}B^2+u_{CH}Be^{-\theta t}\left(\left(1-e^{-\theta}\right)A+\left(e^{\theta t}-1\right)B\right)+\cdots\\
&\quad+\left[u_H e^{-\theta t}\left(\left(1-e^{-\theta}\right)A+\left(e^{\theta t}-1\right)B\right)+\frac{1}{2}u_{HH}\left(e^{-\theta t}\left(\left(1-e^{-\theta}\right)A+\left(e^{\theta t}-1\right)B\right)\right)^2+\cdots\right]\Bigg\}dt\\
&\quad+\int_1^\infty e^{-\rho t}\left[u_H e^{-\theta t}\left(1-e^{-\theta}\right)\left(A+Be^{\theta}\right)+\frac{1}{2}u_{HH}\left(e^{-\theta t}\left(1-e^{-\theta}\right)\left(A+Be^{\theta}\right)\right)^2+\cdots\right]dt.
\end{aligned}
$$

**The third quantity.** When others' spending varies, it is necessary to consider peer effects and the class of spending profiles with $\Delta C(t)=A\cdot 1(t\leq 0)+B\cdot 1(t>0)$ and $\Delta C_{\text{others}}(t)=D\cdot 1(t\leq 0)+E\cdot 1(t>0)$.

The difference between lifetime utilities starting now, $\int_0^\infty e^{-\rho t}u(C(t),C_{\text{others}}(t),H(t))dt$, under this class of spending profiles and under the steady state $\left(\bar{C},\bar{C}_{\text{others}},\bar{H}\right)$—the third quantity—is

$$
\begin{aligned}
&\Phi(A,B,D,E)\\
&\equiv\int_0^\infty e^{-\rho t}u(C(t),C_{\text{others}}(t),H(t))dt-\int_0^\infty e^{-\rho t}u\left(\bar{C},\bar{C}_{\text{others}},\bar{H}\right)dt\\
&=\int_0^\infty e^{-\rho t}\left[u\left(\bar{C}+B,\bar{C}_{\text{others}}+E,\bar{H}+e^{-\theta t}A+\left(1-e^{-\theta t}\right)B\right)-u\left(\bar{C},\bar{C}_{\text{others}},\bar{H}\right)\right]dt\\
&=\int_0^\infty e^{-\rho t}\Big\{u_C B+u_{C_{\text{others}}}E+u_H\left[e^{-\theta t}A+\left(1-e^{-\theta t}\right)B\right]\\
&\quad+\frac{1}{2}u_{CC}B^2+\frac{1}{2}u_{C_{\text{others}}C_{\text{others}}}E^2+\frac{1}{2}u_{HH}\left[e^{-\theta t}A+\left(1-e^{-\theta t}\right)B\right]^2\\
&\quad+u_{CC_{\text{others}}}BE+u_{CH}B\left[e^{-\theta t}A+\left(1-e^{-\theta t}\right)B\right]\\
&\quad+u_{C_{\text{others}}H}E\left[e^{-\theta t}A+\left(1-e^{-\theta t}\right)B\right]+\cdots\Big\}dt.
\end{aligned}
$$

## C.3 Proof of Proposition 1

**Proposition 1.** $\theta>-\ln\left(1-\frac{\Delta C_{U1}}{\Delta C_{U2}}\right)$ *if a respondent chooses Universe One over Universe Two for a more satisfying future experience in a habit decay rate question.*

*Proof.* That $\theta$ is habit decay rate implies $\theta \in \mathbb{R}^+$. Setting $M$ to the baseline spending gives $M-\Delta C_{U1}-\left(1-e^{-\theta}\right)\Delta C_{U2}>0$ in all the questions for habit decay rate.[4]

A respondent preferring Universe One for a better future experience in a habit decay rate question implies

$$
\begin{aligned}
&U(\text{Universe One})-U(\text{Universe Two})\\
=&[U(\text{Universe One})-U(\text{Baseline})]-[U(\text{Universe Two})-U(\text{Baseline})]\\
=&\Psi(\Delta C_{U1},0)-\Upsilon(\Delta C_{U2},0)\\
=&\int_0^\infty e^{-\rho t}\left[u_H e^{-\theta t}\Delta C_{U1}+\frac{1}{2}u_{HH}\left(e^{-\theta t}\Delta C_{U1}\right)^2+\cdots\right]dt\\
&-\int_0^\infty e^{-\rho t}\left[u_H e^{-\theta t}\left(1-e^{-\theta}\right)\Delta C_{U2}+\frac{1}{2}u_{HH}\left(e^{-\theta t}\left(1-e^{-\theta}\right)\Delta C_{U2}\right)^2+\cdots\right]dt\\
=&\int_0^\infty e^{-\rho t}\Bigg\{u_H e^{-\theta t}\left[\Delta C_{U1}-\left(1-e^{-\theta}\right)\Delta C_{U2}\right]\\
&+\frac{1}{2}u_{HH}e^{-2\theta t}\left[\left(\Delta C_{U1}\right)^2-\left(\left(1-e^{-\theta}\right)\Delta C_{U2}\right)^2\right]+\cdots\Bigg\}dt\\
=&\left[\Delta C_{U1}-\left(1-e^{-\theta}\right)\Delta C_{U2}\right]\int_0^\infty e^{-\rho t}\left\{u_H e^{-\theta t}+\frac{1}{2}u_{HH}e^{-2\theta t}\left[\Delta C_{U1}+\left(1-e^{-\theta}\right)\Delta C_{U2}\right]+\cdots\right\}dt\\
=&\left[\Delta C_{U1}-\left(1-e^{-\theta}\right)\Delta C_{U2}\right]\int_0^\infty e^{-\rho t}\sum_{n=1}^{\infty}e^{-n\theta t}\frac{1}{n!}\frac{\partial^n u}{\partial H^n}\left[\sum_{s=0}^{n-1}\left(\Delta C_{U1}\right)^s\left(\left(1-e^{-\theta}\right)\Delta C_{U2}\right)^{n-1-s}\right]dt\\
>&0.
\end{aligned}
$$

The inequality, by Lemma 3, implies

$$\theta>-\ln\left(1-\frac{\Delta C_{U1}}{\Delta C_{U2}}\right).$$

□

## C.4 Proof of Proposition 2

**Proposition 2.** *Under a second-order approximation,* $-\frac{u_H}{u_C}<\frac{(\rho+\theta)\Delta C_{future}}{\rho\Delta C_{past}+\theta\Delta C_{future}}$ *if a respondent chooses Universe One over Universe Two for a more satisfying future experience in a slope of indifference curve question.*

*Proof.* A respondent preferring Universe One for a better future experience in a slope of indif-

[4]Table 4 reports all the values of $\Delta C_{U1}$ and $\Delta C_{U2}$ in the survey.

ference curve question implies

$$
\begin{aligned}
&U(\text{Universe One})-U(\text{Universe Two})\\
=&[U(\text{Universe One})-U(\text{Baseline})]-[U(\text{Universe Two})-U(\text{Baseline})]\\
=&\Psi(\Delta C_{\text{past}},\Delta C_{\text{future}})-\Psi(-\Delta C_{\text{past}},-\Delta C_{\text{future}})\\
=&\frac{1}{\rho}\Bigg\{u_C\Delta C_{\text{future}}+u_H\frac{\rho\Delta C_{\text{past}}+\theta\Delta C_{\text{future}}}{\rho+\theta}+\frac{1}{2}\Big[u_{CC}(\Delta C_{\text{future}})^2\\
&+2u_{CH}\frac{\rho\Delta C_{\text{past}}C_{\text{future}}+\theta(\Delta C_{\text{future}})^2}{\rho+\theta}\\
&+u_{HH}\frac{\rho(\rho+\theta)(\Delta C_{\text{past}})^2+2\rho\theta\Delta C_{\text{past}}\Delta C_{\text{future}}+2\theta^2(\Delta C_{\text{future}})^2}{(\rho+\theta)(\rho+2\theta)}\Big]\Bigg\}\\
&-\frac{1}{\rho}\Bigg\{u_C(-\Delta C_{\text{future}})+u_H\frac{\rho(-\Delta C_{\text{past}})+\theta(-\Delta C_{\text{future}})}{\rho+\theta}\\
&+\frac{1}{2}\Bigg[u_{CC}(\Delta C_{\text{future}})^2+2u_{CH}\frac{\rho\Delta C_{\text{past}}C_{\text{future}}+\theta(\Delta C_{\text{future}})^2}{\rho+\theta}\\
&+u_{HH}\frac{\rho(\rho+\theta)(\Delta C_{\text{past}})^2+2\rho\theta\Delta C_{\text{past}}\Delta C_{\text{future}}+2\theta^2(\Delta C_{\text{future}})^2}{(\rho+\theta)(\rho+2\theta)}\Bigg]\Bigg\}\\
=&\frac{2}{\rho}\left(u_C\Delta C_{\text{future}}+u_H\frac{\rho\Delta C_{\text{past}}+\theta\Delta C_{\text{future}}}{\rho+\theta}\right)\\
>&0,
\end{aligned}
$$

where the third equality holds under a second-order approximation.

The inequality, by $u_C>0$ and $\rho>0$,[5] implies

$$-\frac{u_H}{u_C}<\frac{(\rho+\theta)\Delta C_{\text{future}}}{\rho\Delta C_{\text{past}}+\theta\Delta C_{\text{future}}}.$$

□

## C.5 Proof of Proposition 3

**Proposition 3.** *Under a first-order approximation,* $\frac{u_{C_{others}}}{u_H}<\frac{\rho}{\rho+\theta}\frac{\Delta C}{\Delta C_{others}}$ *if a respondent chooses Universe One over Universe Two for a more satisfying future experience in a* $\frac{u_{C_{others}}}{u_H}$ *question.*

*Proof.* A respondent preferring Universe One for a better future experience in a $\frac{u_{C_{\text{others}}}}{u_H}$ question

[5] The sign of $\rho$ is elicited in the time discount rate question (Appendix F.1).

implies

$$
\begin{aligned}
&U(\text{Universe One}) - U(\text{Universe Two}) \\
=&[U(\text{Universe One}) - U(\text{Baseline})] - [U(\text{Universe Two}) - U(\text{Baseline})] \\
=&\Phi(0,0,0,\Delta C_{\text{others}}) - \Phi(\Delta C,0,0,0) \\
=&\int_0^\infty e^{-\rho t} u_{C_{\text{others}}} \Delta C_{\text{others}} dt - \int_0^\infty e^{-(\rho+\theta)t} u_H \Delta C dt \\
=&\frac{1}{\rho} u_{C_{\text{others}}} \Delta C_{\text{others}} - u_H \frac{1}{\rho+\theta} \Delta C \\
>&0,
\end{aligned}
$$

where the third equality holds under a first-order approximation.

The last inequality, by $u_H < 0$ and $\rho > 0$,[6] implies

$$\frac{u_{C_{\text{others}}}}{u_H} < \frac{\rho}{\rho+\theta} \frac{\Delta C}{\Delta C_{\text{others}}}.$$

□

# D Response Correlations

Table A.1 presents the correlation matrix of survey responses across questions and waves. The results reveal generally low correlations among survey questions, indicating that most parameters of interest capture distinct facets of preference. However, several noteworthy exceptions emerge. Internal habit formation exhibits a negative correlation with $-\frac{u_H}{u_C}$ and a positive correlation with $\frac{u_{C_{others}}}{u_H}$. This suggests that respondents exhibiting internal habit formation perceive habit as having a diminished impact on their welfare relative to own and others' consumption. One potential explanation is that individuals who are more aware of habit may feel more in control of it, leading them to consider habit as impacting them less (relative to own and others' consumption). Furthermore, the negative correlation between $-\frac{u_H}{u_C}$ and $\frac{u_{C_{others}}}{u_H}$ aligns with the notion that respondents who perceive habit as having a substantial welfare impact relative to their own consumption also tend to view habit as significant relative to others' consumption.

The test-retest correlations indicate moderate temporal stability, averaging 0.45 across all main questions. This excludes the question on the existence of external habit formation, as the absence of external habit formation implies random responses and naturally low correlation. Ranging from 0.38 to 0.56, these test-retest correlations are consistent with those of typical choice-based experimental measures of economic preferences (Chuang and Schechter, 2015; Meier and Sprenger,

[6] The signs are elicited in the existence of internal habit formation (Section 3.1) and time discount rate questions (Appendix F.1).

Table A.1: Correlation Matrix of Survey Responses

| Question | | Internal | | External | | $\theta$ | | $-\frac{u_H}{u_C}$ | | $\frac{u_{C_{others}}}{u_H}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wave | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| Internal | 1 | 1.00 | 0.56 | 0.06 | 0.01 | 0.02 | 0.09 | -0.49 | -0.34 | 0.35 | 0.21 |
| | 2 | 0.56 | 1.00 | 0.07 | 0.06 | 0.08 | 0.05 | -0.37 | -0.54 | 0.32 | 0.31 |
| External | 1 | 0.06 | 0.07 | 1.00 | 0.18 | 0.02 | 0.01 | -0.05 | -0.03 | -0.01 | 0.08 |
| | 2 | 0.01 | 0.06 | 0.18 | 1.00 | 0.00 | -0.03 | 0.00 | -0.03 | 0.01 | 0.01 |
| $\theta$ | 1 | 0.02 | 0.08 | 0.02 | 0.00 | 1.00 | 0.38 | -0.01 | -0.07 | -0.02 | 0.00 |
| | 2 | 0.09 | 0.05 | 0.01 | -0.03 | 0.38 | 1.00 | -0.06 | -0.11 | 0.01 | 0.05 |
| $-\frac{u_H}{u_C}$ | 1 | -0.49 | -0.37 | -0.05 | 0.00 | -0.01 | -0.06 | 1.00 | 0.45 | -0.33 | -0.20 |
| | 2 | -0.34 | -0.54 | -0.03 | -0.03 | -0.07 | -0.11 | 0.45 | 1.00 | -0.28 | -0.31 |
| $\frac{u_{C_{others}}}{u_H}$ | 1 | 0.35 | 0.32 | -0.01 | 0.01 | -0.02 | 0.01 | -0.33 | -0.28 | 1.00 | 0.39 |
| | 2 | 0.21 | 0.31 | 0.08 | 0.01 | 0.00 | 0.05 | -0.20 | -0.31 | 0.39 | 1.00 |

*Notes:* This table presents the correlations of survey responses across questions and waves, with combined baselines. The responses for internal habit formation (Internal) and external habit formation (External) are binary, taking values of 1 (exists) or 0 (does not exist). The responses for the remaining parameters range from 1 to 4, corresponding to the choices U1U1, U1U2, U2U1, and U2U2, respectively. For $\theta$, higher response values indicate lower parameter values. For $-\frac{u_H}{u_C}$ and $\frac{u_{C_{others}}}{u_H}$, higher response values correspond to higher parameter values.

2015). The variability in these correlations across questions may be due to response errors, the complexity or novelty of individual questions, or underlying heterogeneity in preferences.

# E Robustness

This appendix evaluates the robustness of the findings across several dimensions, including demographics, baseline spending levels, time horizons, additional attention checks, and response biases and errors with nonzero and wave-varying means.

## E.1 Effects of Demographics and Spending Baselines

The survey gathers demographic data on respondents' age, gender, household income and spending, household size, race, education, and region. Table A.2 presents the sample's demographic distributions alongside those of the 2020 U.S. Census. Incorporating these demographic variables as shifters of the parameter distributions in the statistical model reveals that none of their effects are statistically significant at conventional confidence levels after adjusting for multiple hypothesis testing (Table A.3). This is consistent with the literature's finding that demographics generally explain very little of the variation in deep structural parameters measured through experiments (Gillen et al., 2019; Falk et al., 2018).

Some respondents were randomized into a survey version with a baseline spending level of $3,000, aligning more closely with their real-life spending. To assess the impact of baseline spend-

Table A.2: Respondent Demographics

| Demographic | Category | First wave | Second wave | Census |
|---|---|---|---|---|
| Gender | Male | 48.7% | 47.3% | 49.0% |
| | Female | 51.3 | 52.7 | 51.0 |
| Age | 18-29 | 21.0 | 17.6 | 20.6 |
| | 30-39 | 20.1 | 20.9 | 17.5 |
| | 40-49 | 17.0 | 19.3 | 16.0 |
| | 50-64 | 30.0 | 31.0 | 24.9 |
| | 65 and older | 11.9 | 11.2 | 21.1 |
| Highest education | High school graduate or less | 9.9 | 9.5 | 28.3 |
| level completed | Some college | 32.3 | 31.8 | 27.1 |
| | Bachelor's degree | 38.0 | 37.5 | 22.2 |
| | Graduate degree | 19.8 | 21.2 | 12.8 |
| Household income | Less than $30,000 | 16.8 | 18.1 | 22.1 |
| | $30,000–$49,999 | 15.1 | 16.2 | 15.7 |
| | $50,000–$69,999 | 17.4 | 17.1 | 13.4 |
| | $70,000–$89,999 | 12.7 | 12.9 | 10.8 |
| | $90,000–$119,999 | 25.3 | 24.8 | 12.0 |
| | $120,000 and above | 12.7 | 11.0 | 26.0 |
| Race | White | 68.4 | 69.9 | 61.6 |
| | Black | 11.1 | 10.1 | 12.1 |
| | Hispanic or Latino | 8.6 | 9.3 | 14.9 |
| | Asian | 6.7 | 5.5 | 5.9 |
| | Other | 5.2 | 5.2 | 5.5 |
| Household size | 1 | 20.4 | 21.8 | 28.5 |
| | 2 | 33.3 | 33.3 | 35.0 |
| | 3 | 20.0 | 19.3 | 15.0 |
| | 4 and above | 26.3 | 25.6 | 21.5 |
| Region | Midwest | 18.8 | 18.7 | 20.8 |
| | Northeast | 17.1 | 17.1 | 17.4 |
| | South | 41.3 | 39.4 | 38.1 |
| | West | 22.7 | 24.9 | 23.7 |
| Observations | | 1,367 | 730 | |

*Notes:* Summary statistics are based on the author's surveys and 2020 U.S. Census. All values are expressed as percentages.

ing, we included an indicator for the $3,000 baseline in the regressions. The results suggest that the baseline spending does not significantly impact $\theta$ and $\frac{u_{C_{others}}}{u_H}$, and exerts a marginally significant impact on $-\frac{u_H}{u_C}$ after false discovery adjustment (Table A.3). Aside from statistical precision considerations, the negative impact of the baseline on $-\frac{u_H}{u_C}$ potentially reflects the parameter's direct dependence on $C$ and is consistent with diminishing marginal utility of consumption. It is worth noting that the respondents' real-life historical and expected spending do not significantly

affect $-\frac{u_H}{u_C}$, suggesting that our respondents effectively engaged with the hypothetical scenarios in the experiments, providing responses unconfounded by their real-life circumstances. This highlights the effectiveness of our approach in inducing desired variations.

To further investigate how deviations of baseline spending from real-life spending might affect our estimates, we allow the parameter estimates to differ for each baseline in our statistical model and estimate the modified model using our sample of respondents with real-life monthly household spending less than \$4,000. Each of these respondents was randomized with a 50-50 chance into either baseline. Column 1 of Table A.4 shows that none of the parameter estimates are statistically significantly different between the baselines at the 99% level.

Assessing the same issue from a different angle, we restrict our sample to respondents with real-life monthly spending within \$1,000 deviations from the baselines and re-estimate the parameters of interest. The resulting estimates, shown in Column 2 of Table A.4, are essentially the same as our benchmark estimates in Table 2. Overall, the above evidence suggests that our parameter estimates are robust to deviations between our baseline spending and respondents' real-life spending.

## E.2 Finite Horizon

The model outlined in Section 2.1 adopts an infinite horizon, consistent with nearly all contemporary habit formation models in the literature. To assess the impact of this assumption, we rederive the identifying propositions for the preference parameters under finite horizons and find that the resulting changes are negligible. Specifically, the thresholds for the existence of internal habit formation, external habit formation, and the habit decay rate remain identical across both infinite and finite horizons. For other parameters, the thresholds adjust by replacing 1 with $1-e^{-\rho T}$, $1-e^{-(\rho+\theta)T}$, or $1-e^{-(\rho+2\theta)T}$, which closely approximate 1 for reasonable values of $T$, the finite time horizon of interest.[7] Consequently, estimates under the finite horizon yield parameter values (Column 3 of Table A.4) that are virtually indistinguishable from the benchmark estimates under the infinite horizon.

## E.3 Response Bias and Error with Nonzero and Wave-Varying Mean

The statistical model assumes a zero mean for the response error across both waves of the survey. By relaxing this assumption, we obtain a statistical model that allows response biases and errors to have nonzero means, which may also differ across waves. Without loss of generality,[8] the joint

[7] The survey instructs respondents: "If easier, think of ... 'Future' as the next 30 years." Accordingly, $T$ is set to 30 in the finite-horizon estimation.

[8] Only two means, one for each wave, can be identified. The specification here, which identifies the average and the difference of the means, is equivalent to a specification that uses two parameters, one for each mean. If the two means are different, $\mu_\varepsilon$ should be statistically significantly different from 0.

Table A.3: Demographic Effects on Parameter Estimates

| Demographic | $\theta$ | $-u_H/u_C$ | $u_{C_{\text{others}}}/u_H$ |
|---|---|---|---|
| Demeaned age | 0.00 (0.00) | 0.00 (0.00) | 0.02 (0.01) |
| Demeaned age$^2$ | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| Male | -0.27 | 0.00 (0.07) | 0.17 (0.19) |
| | (0.14) | | |
| Log(household income) | 0.00 (0.12) | -0.06 | 0.03 (0.17) |
| | | (0.06) | |
| Log(past household monthly spending) | 0.41 (0.22) | 0.06 (0.11) | 0.34 (0.29) |
| Log(expected household monthly spending) | -0.42 | -0.09 | -0.24 |
| | (0.22) | (0.11) | (0.28) |
| Household size | 0.11 (0.05) | -0.01 | 0.01 (0.07) |
| | | (0.03) | |
| Black | 0.33 (0.23) | 0.01 (0.12) | 0.73 (0.30) |
| Hispanic | 0.34 (0.26) | -0.13 | 0.56 (0.33) |
| | | (0.14) | |
| Asian | -0.14 | -0.15 | 0.63 (0.38) |
| | (0.29) | (0.15) | |
| Other race | -0.06 | -0.06 | -0.18 |
| | (0.32) | (0.16) | (0.42) |
| College graduate | -0.14 | 0.14 (0.08) | -0.16 |
| | (0.15) | | (0.20) |
| West | 0.31 (0.21) | 0.19 (0.11) | -0.05 |
| | | | (0.29) |
| South | 0.12 (0.19) | 0.16 (0.10) | 0.15 (0.26) |
| Northeast | 0.00 (0.23) | 0.03 (0.12) | -0.12 |
| | | | (0.31) |
| Outside of U.S. | 0.59 (1.02) | 0.12 (0.52) | 0.29 (1.31) |
| Baseline=$3,000 | 0.18 (0.16) | -0.23$^{\dagger}$ | 0.13 (0.21) |
| | | (0.09) | |
| Observations | 2,097 | 2,097 | 2,097 |

*Notes:* Standard errors in parentheses. $^{\dagger}$, $^{\dagger\dagger}$, and $^{\dagger\dagger\dagger}$ indicate false-discovery-rate significance levels at the 90%, 95%, and 99% levels, respectively, based on the Benjamini-Hochberg procedure.

distribution of parameter $\tilde{x}$ for individual $i$ in both waves becomes

$$\begin{bmatrix} \tilde{x}_{i,1} \\ \tilde{x}_{i,2} \end{bmatrix} \sim \mathcal{N}\left( \begin{bmatrix} \mu_x + \mu_\varepsilon \\ \mu_x - \mu_\varepsilon \end{bmatrix}, \begin{bmatrix} \sigma_x^2 + \sigma_{\varepsilon_x}^2 & \sigma_x^2 \\ \sigma_x^2 & \sigma_x^2 + \sigma_{\varepsilon_x}^2 \end{bmatrix} \right).$$

The estimates of the means of the response biases and errors in wave one (or, equivalently, the negatives of the means of the response biases and errors in wave two) are indistinguishable from zero at the 99% level for all parameters of interest. This implies that the parameter estimates are

Table A.4: Robustness Check Estimates

| | | | | | Additional attention checks | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | Difference between baselines (1) | Actual spending close to baseline spending (2) | Finite horizon (3) | Flexible response bias and error (4) | Instruction manipulation checks (5) | Exit comprehension checks (6) | Identical past checks (7) | Maximum self-reported effort (8) | No polar response (9) |
| $\text{sgn}(Q_{HI})$ | 0.00 | -1.00 | -1.00 | -1.00 | -1.00 | -1.00 | -1.00 | -1.00 | -1.00 |
| | [0.00, 0.00] | [-1.00, -1.00] | [-1.00, -1.00] | [-1.00, -1.00] | [-1.00, -1.00] | [-1.00, -1.00] | [-1.00, -1.00] | [-1.00, -1.00] | [-1.00, -1.00] |
| $\text{sgn}(Q_{HE})$ | -0.01 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | [-2.00, 2.00] | [-1.00, 1.00] | [-1.00, 1.00] | [-1.00, 1.00] | [-1.00, 1.00] | [-1.00, 1.00] | [-1.00, 1.00] | [-1.00, 1.00] | [-1.00, 1.00] |
| $\theta$ | -0.14 | 0.95 | 1.02 | 1.03 | 1.04 | 1.03 | 0.79 | 1.02 | 0.95 |
| | [-0.54, 0.27] | [0.57, 1.27] | [0.80, 1.21] | [0.82, 1.22] | [0.79, 1.24] | [0.78, 1.25] | [0.26, 1.10] | [0.74, 1.24] | [0.69, 1.17] |
| $-u_H/u_C$ | 0.18 | 0.58 | 0.63 | 0.64 | 0.62 | 0.66 | 0.62 | 0.61 | 0.68 |
| | [-0.07, 0.43] | [0.43, 0.75] | [0.55, 0.74] | [0.54, 0.73] | [0.51, 0.72] | [0.55, 0.74] | [0.49, 0.76] | [0.51, 0.72] | [0.59, 0.79] |
| $u_{C_{\text{others}}}/u_H$ | 0.01 | 0.34 | 0.29 | 0.29 | 0.29 | 0.27 | 0.35 | 0.36 | 0.21 |
| | [-0.54, 0.49] | [0.06, 0.67] | [0.08, 0.53] | [0.09, 0.52] | [0.02, 0.53] | [0.02, 0.51] | [-0.15, 0.96] | [0.13, 0.65] | [-0.06, 0.49] |
| $u_{C_{\text{others}}}/u_C$ | -0.05 | -0.20 | -0.18 | -0.19 | -0.18 | -0.17 | -0.21 | -0.23 | -0.14 |
| | [-0.41, 0.28] | [-0.47, 0.03] | [-0.34, -0.05] | [-0.34, -0.06] | [-0.34, -0.01] | [-0.34, -0.02] | [-0.57, 0.09] | [-0.40, -0.08] | [-0.34, 0.04] |
| $u_H/u_C+u_{C_{\text{others}}}/u_C$ | -0.28 | -0.79 | -0.82 | -0.83 | -0.80 | -0.82 | -0.81 | -0.83 | -0.82 |
| | [-0.72, 0.19] | [-1.14, -0.51] | [-1.02, -0.66] | [-1.01, -0.65] | [-1.01, -0.59] | [-1.02, -0.64] | [-1.21, -0.49] | [-1.07, -0.64] | [-1.06, -0.62] |
| Observations | 1,264 | 847 | 2,097 | 2,097 | 1,706 | 1,926 | 707 | 1,668 | 1,335 |

*Notes:* This table presents estimates of preference parameters and statistics of interest under various robustness checks. Column 1 presents the differences of the parameter estimates between the baseline $5,000 and the baseline $3,000, while the rest columns show the parameter estimates. Column 2 reports parameter estimates obtained from the subsample restricted to respondents with monthly spending no more than $1,000 above or below the baseline spending levels. 99% confidence intervals are in brackets.

robust to response biases and errors with nonzero, wave-varying means, as confirmed by Column 4 of Table A.4.

## E.4 Additional Attention Checks

In fielding the survey, explicit attention checks were used to exclude respondents who failed to comprehend the hypothetical scenario or monthly spending profiles, or who did not correctly respond to two instruction manipulation checks—questions prompting specific responses. This subsection employs additional attention checks to investigate whether undetected lapses in respondent attention, not captured by the default measures, may introduce bias into the estimates.

In the benchmark sample, respondents failing both instruction manipulation checks are excluded. Excluding respondents who fail either check results in a reduction of the sample size by 247 in the first wave and 144 in the second wave. Estimates derived from this subsample (Column 5 of Table A.4) are essentially the same as those from the main sample.

At the conclusion of the survey, respondents' comprehension of the hypothetical scenario was reassessed using a six-question quiz, identical to the comprehension checks administered earlier in the survey. In the first wave, 132 respondents and, in the second wave, 39 respondents made one or more errors. Excluding these responses from the sample does not noticeably alter the estimates (Column 6 of Table A.4).

A third supplementary attention check evaluates whether respondents exhibit indifference between response options that are objectively the same. In the time discount rate question (see Appendix F.1), past spending profiles are identical across the two universes, requiring respondents

to report consistent past experiences. Excluding respondents who provided inconsistent responses substantially reduces the sample by 1,390 observations across both waves. This significant reduction may be attributed to the unique design of this question, which is the only question throughout the survey that includes a response option reflecting identical past spending profiles. Despite the increased standard errors resulting from the smaller sample size, the estimates (Column 7 of Table A.4) remain closely aligned with the baseline estimates.

A fourth supplementary attention check utilizes self-reported effort levels collected from respondents at both the midpoint and conclusion of the survey. Specifically, the sample was restricted to include only those respondents who reported exerting the highest level of effort and maintaining full attention during the survey. This filtering process resulted in the exclusion of 279 responses in the first wave and 150 responses in the second wave. The estimates derived from this refined subsample (Column 8 of Table A.4) remain indistinguishable from the benchmark estimates.

Finally, we employ a measure of response consistency across waves as an additional attention check. Given its speculative nature, this check excludes only those respondents who provided at least one polar response—defined as selecting the first (or last) bracket of parameter values in wave one and the last (or first) in wave two. This criterion results in the exclusion of 762 responses across both waves combined. Nevertheless, the estimates derived from this filtered sample (Column 9 of Table A.4) remain virtually identical to the baseline estimates. Collectively, these attention checks substantiate the robustness of this study's core findings against potential response inattention.

# F Additional Survey Questions

This appendix presents the supplementary survey questions referenced in the main text, including those related to the time discount rate and the annual habit decay rate of 0.9, along with an analysis of scale-use tendencies derived from calibration questions.

## F.1 Time Discount Rate

To elicit the time discount rate, the survey presents respondents with a trade-off between a larger spending increase in the subsequent year and a smaller spending increase sustained across all future years. The corresponding survey question features spending profiles as illustrated in Figure A.1. Choosing the larger spending increase in the next year indicates greater impatience, which explains the direction of the inequality in Proposition 5.

**Proposition 5.** *Under a first-order approximation,* $\rho > -\ln\left(1-\frac{\Delta C_2}{\Delta C_1}\right)$ *if a respondent chooses Universe One over Universe Two for a better future experience in a time discount rate question.*[9]

[9] In Figure A.1, $\Delta C_1 = \$2{,}000$ and $\Delta C_2 = \$200$. Table A.5 provides additional values of $\Delta C_1$ and $\Delta C_2$ used in the survey.


Figure A.1: Spending Profiles for a Survey Question on Time Discount Rate

*Proof.* A respondent preferring Universe One over Universe Two for a better future experience in the time discount rate question implies

$$
\begin{aligned}
&U(\text{Universe One}) - U(\text{Universe Two}) \\
=&[U(\text{Universe One}) - U(\text{Baseline})] - [U(\text{Universe Two}) - U(\text{Baseline})] \\
=&\Upsilon(0, \Delta C_1) - \Psi(0, \Delta C_2) \\
=&\int_0^1 e^{-\rho t}\left[u_C \Delta C_1 + u_H\left(1 - e^{-\theta t}\right)\Delta C_1\right] dt + \int_1^\infty e^{-\rho t}\left[u_H e^{-\theta t}\left(e^{\theta} - 1\right)\Delta C_1\right] dt \\
&- \int_0^\infty e^{-\rho t}\left[u_C \Delta C_2 + u_H\left(1 - e^{-\theta t}\right)\Delta C_2\right] dt \\
=&\left[\Delta C_1\left(1 - e^{-\rho}\right) - \Delta C_2\right]\frac{1}{\rho}\left(u_C + u_H \frac{\theta}{\rho + \theta}\right) \\
>&0,
\end{aligned}
$$

where the 3rd equality holds under a first-order approximation.

Table A.5: Quantities and Thresholds for Spending Profiles for Time Discount Rate

| Quantity | Baseline = $5,000 | | | Baseline = $3,000 | | |
|---|---|---|---|---|---|---|
| and threshold | Choosing U2 | Initial question | Choosing U1 | Choosing U2 | Initial question | Choosing U1 |
| $\Delta C_1$ | 2000 | 2000 | 2000 | 1000 | 1000 | 1000 |
| $\Delta C_2$ | 100 | 200 | 500 | 50 | 100 | 300 |
| Threshold | 0.05 | 0.11 | 0.29 | 0.05 | 0.11 | 0.36 |

*Notes:* This table reports the quantities and implied thresholds as outlined in Proposition 5. "Choosing U1" and "Choosing U2" correspond to the follow-up questions presented after respondents select Universe One or Universe Two, respectively, in the initial question. All quantities are in U.S. dollars.

The inequality implies $\Delta C_1(1-e^{-\rho})-\Delta C_2>0$,[10] or equivalently

$$\rho>-\ln\left(1-\frac{\Delta C_2}{\Delta C_1}\right).$$

□

Estimation yields a time discount rate of 0.10, with a standard error of 0.01, which aligns with the conventional range of experimental estimates for this parameter (Matousek et al., 2022).

## F.2 Habit Decay Speed Question for $\theta=0.9$

Figure A.2 presents the spending profiles from the survey question designed to examine the relationship between 0.9 and the (annual) habit decay factor.

## F.3 Scale-Use Tendency

To assess scale-use tendencies, the survey incorporates nine visual calibration questions developed by Benjamin et al. (2023), which evaluate the perceived darkness of a circle, shape complexity, and a hypothetical individual's confidence level. For instance, Figure A.3a illustrates a question prompting respondents to assess the darkness of a circle. Appendix G provides screenshots of all survey questions, including those related to shape complexity and confidence. Although these calibration questions—selected for their rapid response times—may not fully capture scale use in the happiness dimension, Benjamin et al. (2023) demonstrate their effectiveness in measuring general scale-use tendencies. Following the framework of Benjamin et al. (2023), we derive respondent-level scale-use parameters—namely, the shifter and stretcher—based on responses to these questions, which were administered both before and after the core survey modules. Figures A.3b and A.3c

[10] Note that $u_C>-u_H$ and $0<\frac{\theta}{\rho+\theta}<1$, both of which are satisfied by the estimates of the relevant parameters. Applying Lemma 1 leads to $u_C+u_H\frac{\theta}{\rho+\theta}>0$.

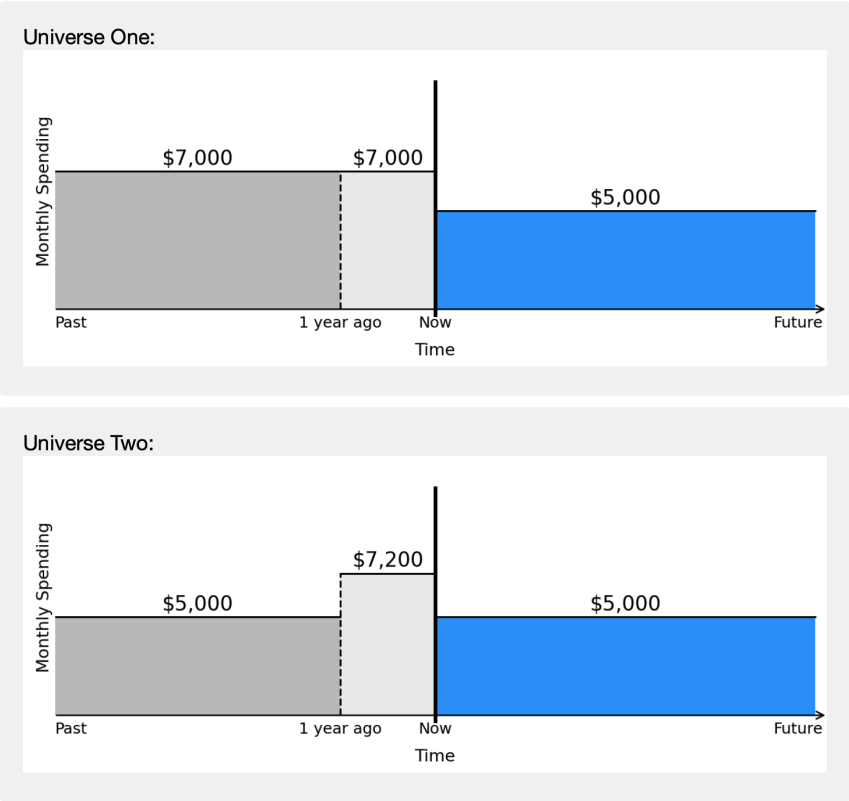



Figure A.2: Spending Profiles for Relationship Between (Annual) Habit Decay Factor and 0.9

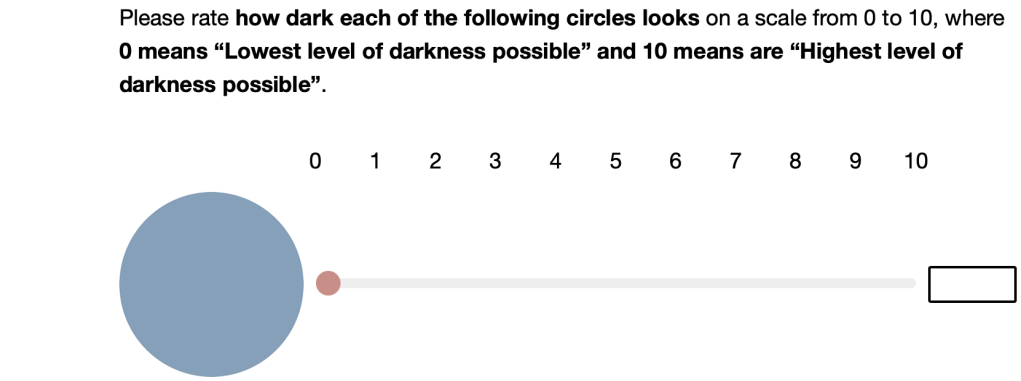
present scatterplots of the scale-use parameters across both administrations, demonstrating a high level of consistency in scale-use tendencies between the beginning and end of the survey.

# Appendix-Specific References

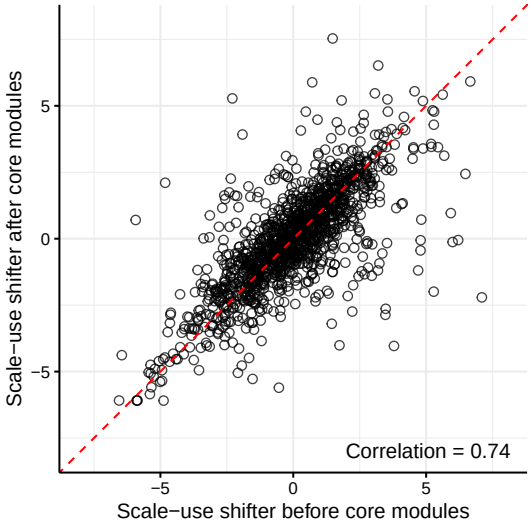
**Falk, Armin, Anke Becker, Thomas Dohmen, Benjamin Enke, David Huffman, and Uwe Sunde**, "Global Evidence on Economic Preferences," *The Quarterly Journal of Economics*, 2018, *133* (4), 1645–1692.

**Gillen, Ben, Erik Snowberg, and Leeat Yariv**, "Experimenting With Measurement Error: Techniques With Applications to the Caltech Cohort Study," *Journal of Political Economy*, 2019, *127* (4), 1826–1863.

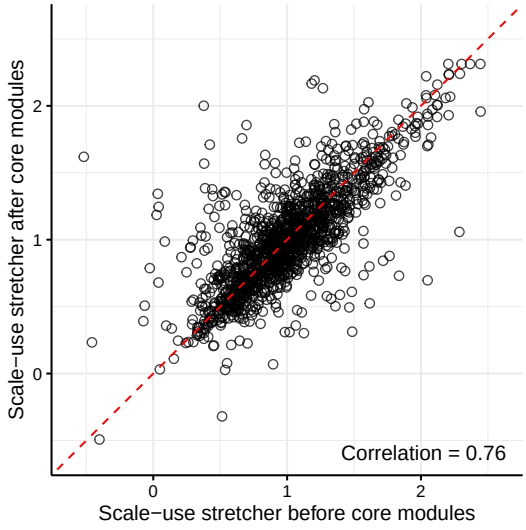
**Meier, Stephan and Charles D Sprenger**, "Temporal Stability of Time Preferences," *Review of Economics and Statistics*, 2015, *97* (2), 273–286.




(a) An example calibration question




(b) Scale-use shifter before and after core modules




(c) Scale-use stretcher before and after core modules

Figure A.3: Example Calibration Question and Consistency of Scale-Use Tendencies

*Notes:* The calibration question in panel (a) prompts respondents to rate the darkness of a circle using a slider. Each point in panels (b) and (c) represents an individual respondent. The red lines depict 45-degree reference lines.

# Online Appendix G for "Measuring Habit Formation"

This appendix contains all the survey questions.[1]

A live version of the survey can be accessed at the following link: https://cuboulder.qualtrics.com/jfe/form/SV_eDtwoPL5nA4ZCrY

[1] Due to space considerations, only the first wave is presented here. The second wave replicates the first wave, except for reordered modules and response options, as well as the exclusion of demographic and calibration questions.

**Consent form**

**We are a group of academic researchers.** Our goal is to understand people's spending behaviors. This is an important matter, and by completing this survey, you are contributing to our knowledge as a society. You may skip any question that you do not feel comfortable answering, except for some mandatory questions, such as demographics and comprehension questions, which are required for completing the survey. Our survey will give you an opportunity to express your own views.

Please note that it is very important for the success of our research that you **answer honestly** and **read the questions very carefully** before answering. Any time you don't know an answer, just give your best guess. However, please be sure to spend enough time reading and understanding the question. To ensure the quality of survey data, your responses will be subject to sophisticated statistical control methods, which can detect incoherent or rushed answers. **Responding without adequate effort or skipping many questions may result in your responses being flagged for low quality and you may not receive your payment.**

It is also very important for the success of our research project that you **complete the entire survey**, once you have started. This survey should take about 35 minutes to complete. If you complete the entire survey, you may be invited to take another paid follow-up survey two weeks from now.

Only **one submission per participant** is allowed in this study. If multiple responses are submitted, only the first will be considered for payment.

For the best experience and to ensure all crucial survey information is easily readable, we strongly recommend completing this survey on a large-screen device such as a **laptop or tablet**. The smaller screens of phones will render some critical details difficult or impossible to read.

*Notes: Your participation in this study is purely voluntary. Your name will never be recorded by researchers. Results may include summary data, but you will never be identified. The data will be stored on our servers and will be kept confidential. The collected anonymous data may be made available to other researchers for replication purposes. Please print or make a screenshot of this page for your records. If you have any question about this study or your rights as a research participant, you may contact us at spendingsurvey@icloud.com.*

- ◯ Yes, I would like to take part in this study, and confirm that I AM A U.S. RESIDENT and I am 18 or older
- ◯ No, I would not like to participate

**Demographics**

What is your gender?

◯ Male ◯ Female

What is your age?

How many people, including yourself, live in your household?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6
- ◯ 7
- ◯ 8
- ◯ 9
- ◯ 10 or more

What was your **TOTAL household** income, **before taxes**, last year?

- ◯ $0 - $9,999
- ◯ $10,000 - $14,999
- ◯ $15,000 - $19,999
- ◯ $20,000 - $29,999
- ◯ $30,000 - $39,999
- ◯ $40,000 - $49,999
- ◯ $50,000 - $69,999
- ◯ $70,000 - $89,999
- ◯ $90,000 - $109,999
- ◯ $110,000 - $149,999
- ◯ $150,000 - $199,999
- ◯ $200,000 or more

What was the **TOTAL** amount your **household typically SPENT per month** in the **past** year?

- ◯ $0 - $999
- ◯ $1,000 - $1,999
- ◯ $2,000 - $2,999
- ◯ $3,000 - $3,999
- ◯ $4,000 - $4,999
- ◯ $5,000 - $5,999
- ◯ $6,000 - $6,999
- ◯ $7,000 - $7,999
- ◯ $8,000 - $8,999
- ◯ $9,000 - $9,999
- ◯ $10,000 - $14,999
- ◯ $15,000 - $19,999
- ◯ $20,000 or more

How would you describe your ethnicity/race?

- ◯ European American/White
- ◯ African American/Black
- ◯ Hispanic/Latino
- ◯ Asian/Asian American
- ◯ Other

Which category best describes your highest level of education?

- ◯ Eighth Grade or less
- ◯ Some High School
- ◯ High School Degree / GED
- ◯ Some College
- ◯ 2-year College Degree
- ◯ 4-year College Degree
- ◯ Master's Degree
- ◯ Doctoral Degree
- ◯ Professional Degree (JD, MD, MBA)

What is the **TOTAL** amount your **household expects to spend per month** over the **next** year?

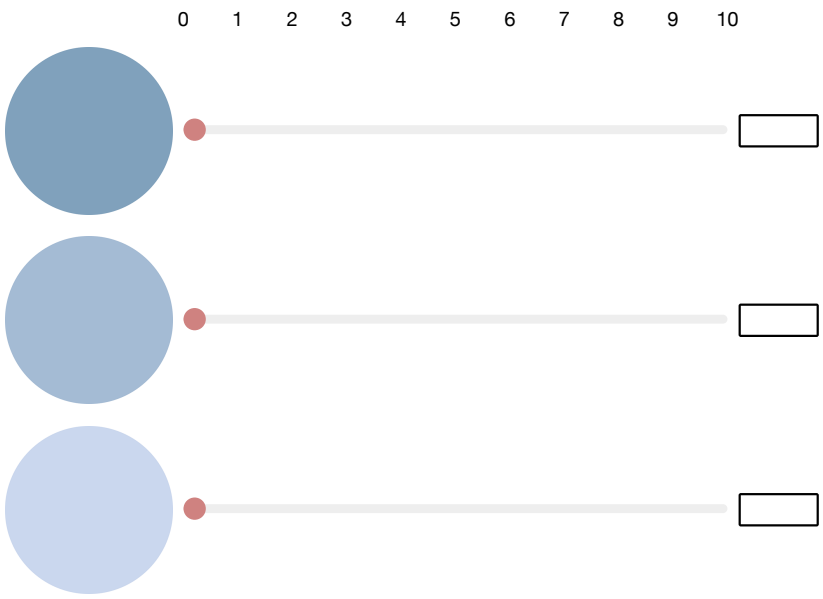
- ○ $0 - $999
- ○ $1,000 - $1,999
- ○ $2,000 - $2,999
- ○ $3,000 - $3,999
- ○ $4,000 - $4,999
- ○ $5,000 - $5,999
- ○ $6,000 - $6,999
- ○ $7,000 - $7,999
- ○ $8,000 - $8,999
- ○ $9,000 - $9,999
- ○ $10,000 - $14,999
- ○ $15,000 - $19,999
- ○ $20,000 or more

**Calibration questions**

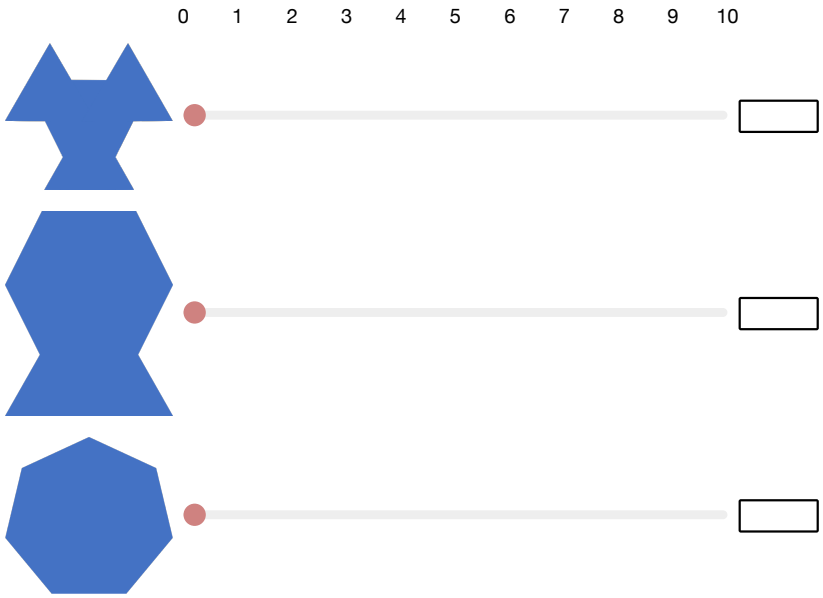
Please rate **how confident each of the following individuals looks** on a scale from 0 to 10, where **0 means "Lowest level of confidence possible" and 10 means are "Highest level of confidence possible"**.

0 1 2 3 4 5 6 7 8 9 10

Please rate **how dark each of the following circles looks** on a scale from 0 to 10, where **0 means "Lowest level of darkness possible" and 10 means are "Highest level of darkness possible"**.




Please rate **how complex each of the following shapes looks** on a scale from 0 to 10, where **0 means "Lowest level of complexity possible" and 10 means are "Highest level of complexity possible"**.




**Instruction: Reading monthly spending charts**

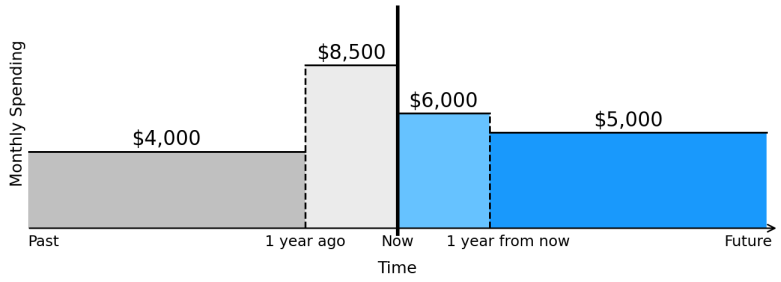
## Instruction 1/2

**Please note: This page includes essential instructions and practice questions to help you grasp a key visual tool used throughout the survey. While it may be a bit lengthy, taking the time to carefully read and complete this section is crucial.**

In this survey, you will compare your experience in two hypothetical universes: Universe

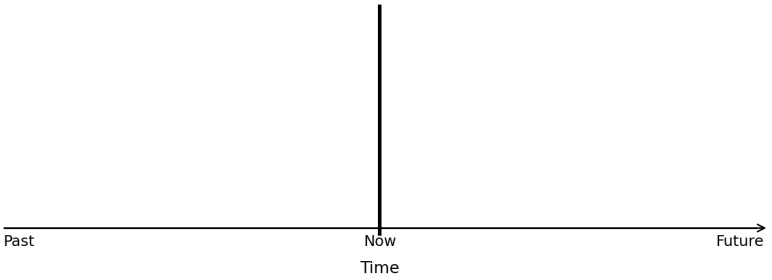
One and Universe Two. These universes are **identical in every way except for your monthly spending**. Monthly spending refers to the **total** amount of money your household **spends**, not earns, each month. This includes all expenditures, both necessities and leisure. Your task is to determine **in which universe you would have a more satisfying experience based on the specified spending levels**.

To intuitively visualize your monthly spending, we use monthly spending charts, like the example below:




---

Let's learn to read a monthly spending chart. The first element of the chart is the timeline, with the past on the left, now in the middle, and the future on the right. A thick vertical line representing now separates the past from the future.

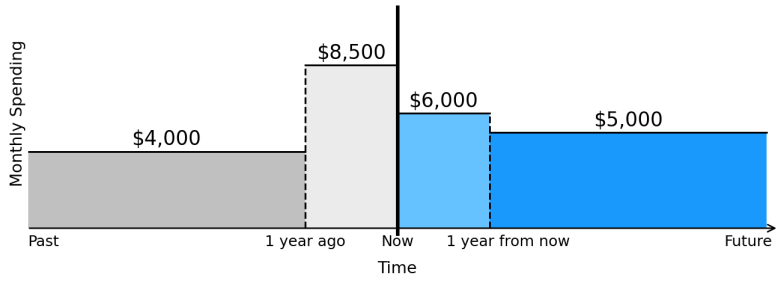



To clarify, **past refers to as far back in time as you can remember, and future refers to as far ahead as you can imagine**. If it helps, you can think of the past as the last 30 years and the future as the next 30 years.

The second element of a monthly spending chart is the bars above the timeline.

- The height of each bar represents the level of monthly spending (again, not income).
- The exact amount of monthly spending is labeled at the top of each bar.
- The location and width of each bar indicate the specific time frame during which that level of monthly spending occurred.
- Different colors are used for the bars to distinguish between the various time periods.

For example, if the following monthly spending chart represents your spending:

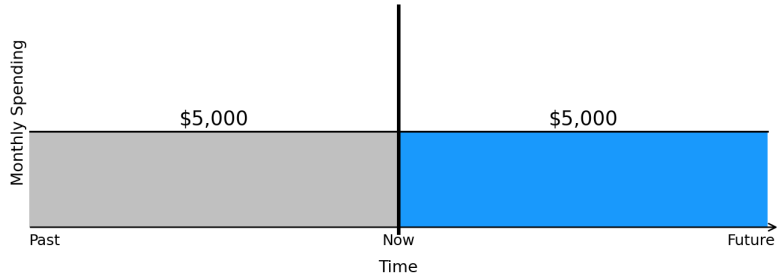


- You spent $4,000 per month in the past, up until 1 year ago.
- You have been spending $8,500 per month from 1 year ago until now (over the past year).
- You plan to spend $6,000 per month from now until 1 year from now (over the next year).
- You will spend $5,000 per month from 1 year from now onward.

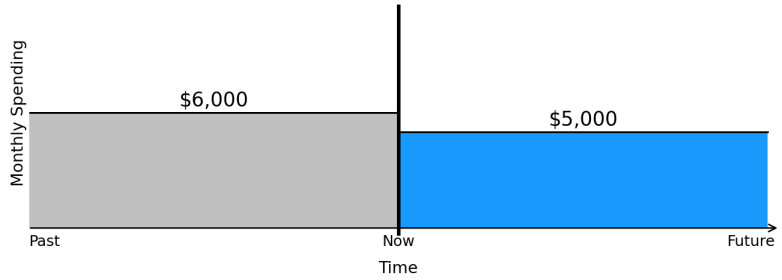
In summary, this chart shows that your spending increased significantly over the past year and will decrease slightly in the future.

---

In some cases, the time frames shown in the charts may be combined into two or three broader periods to highlight differences in monthly spending. For instance, if your monthly spending chart in Universe One is:




And in Universe Two, your monthly spending chart is:




Then the difference between the two universes is that in Universe Two, you spent $1,000 more per month in the past up until now compared to Universe One, where you spent $5,000 per month during that same period. In both universes, you will spend $5,000 per month from now onward.

Below are several questions to test your understanding of the above instructions.

---

## Practice Questions

When we refer to "**in the past**" in this survey, what time frame are we talking about?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ The last 3 years
- ○ As far back as I can remember
- ○ The last year

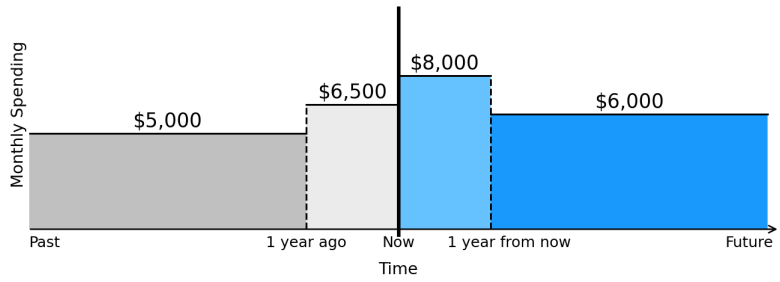
When we refer to "**in the future**" in this survey, what time frame are we talking about?

*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ The next 2 years
- ○ As far ahead as I can imagine
- ○ The next year

---

Imagine that your monthly spending is represented by the following monthly spending chart:




How much will you spend per month **in the next year**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ $5,000
- ○ $6,000
- ○ $6,500
- ○ $8,000

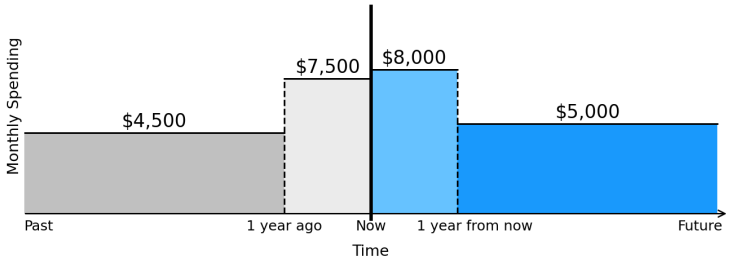
How much did you spend per month **in the past until 1 year ago**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ $5,000
- ○ $6,000
- ○ $6,500
- ○ $8,000

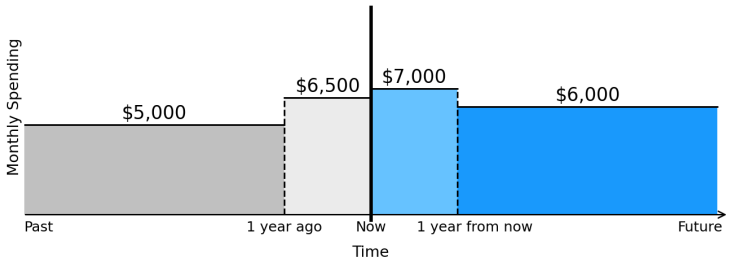
---

Imagine that your monthly spending in Universe One and Universe Two are represented by the following monthly spending charts.
**[Please click on the chart to select your answer.]**
In which universe did you spend **more in the past year**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

○ Universe One:



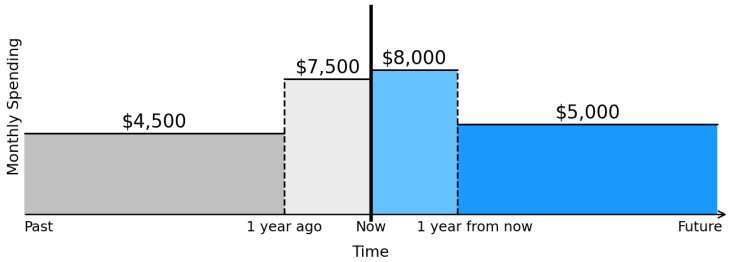

○ Universe Two:



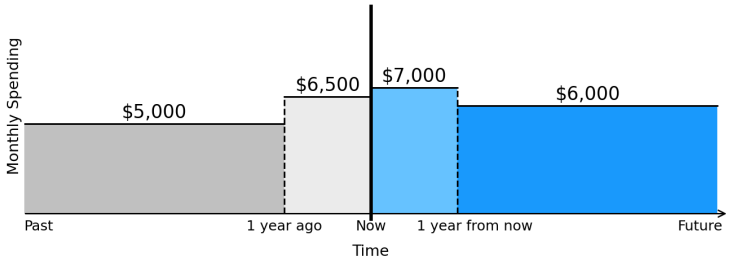

---

In which universe will you spend **more from 1 year from now onward**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

○ Universe One:




○ Universe Two:




---

In the last question, how much **more** did you spend in Universe Two than in Universe One **in the past until 1 year ago**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get*

*this question correct.*

- ○ $0
- ○ $500
- ○ $1,000
- ○ $5,500

**Wrong answer first**

Your answers to the previous questions suggest that you might not have fully understood the instructions. This is an important part of the survey, so please click next to review the instructions and revisit your answers to the practice questions.

**Instruction: Hypothetical situation**

## Instruction 2/2

To simplify the comparison of your experience under various spending patterns, please evaluate your experience in the following hypothetical situation:

- There is **no inflation**, and prices of everything stay the same over time.
- You **rent the durable goods** you use, including residence, furniture, car, etc.
- Your **preferences do not change** over time.
- **People not mentioned in the questions always spend $5,000 per month**, regardless of their income or wealth.
- **Any other factors not specified in the questions are identical between the universes and remain identical over time**.

The last point means that factors, including but not limited to your income, savings, wealth, control over finances, and the state of the economy, are the same between the universes and remain the same over time. **Only your spending mentioned in the questions varies between the universes**, so please focus solely on those spending differences when making your evaluations.

*Note:* Even though your income, savings, and wealth are the same across universes, your spending doesn't have to be identical. For the purposes of this survey, you can imagine a hypothetical external financial system that automatically adjusts your savings at no cost to you, allowing your spending to vary while keeping everything else unchanged.

Throughout this survey, "you" refers to your household, including everyone living with you. "Other people" or "others" refers to other households, meaning everyone outside of your household. **Both you and others can afford the monthly spending** specified in the questions.

Below are several questions to test your understanding of this hypothetical situation.

---

## Practice Questions

In this survey's hypothetical situation, if you can buy 3 bananas with one dollar in the last year, how many bananas can you buy with one dollar in the next year?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ 5
- ○ 3
- ○ 1

In this survey's hypothetical situation, which of the following do you own (i.e., not rent)?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ Residence
- ○ Car
- ○ Furniture
- ○ I do not own any of these

In this survey's hypothetical situation, do things you want change over time?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ Yes
- ○ No

In this survey's hypothetical situation, how much do people not mentioned in questions always spend each month?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ $4,000
- ○ $5,000
- ○ $6,500
- ○ $8,000

In this survey's hypothetical situation, do things not mentioned in the questions change?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ Yes
- ○ No

In this survey's hypothetical situation, which of the following is the **only difference** between the universes?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ My income
- ○ My savings
- ○ My control over my finances
- ○ My spending
- ○ The economy

**Final instruction**

## Final Instruction

To enhance the accuracy of this study, many questions are followed by slightly varied versions of previous ones. This may occasionally make the survey feel repetitive, but please pay close attention and answer each question as accurately as possible. We sincerely appreciate your careful attention to detail throughout this survey.

This survey includes both explicit and implicit attention checks. Responses indicating inattentiveness may be rejected. Aside from these checks, there are no right or wrong answers. Please respond to the best of your ability.

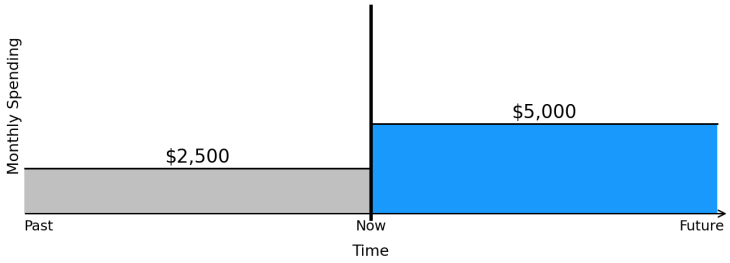
To reward excellence, a $5 bonus will be randomly awarded to a select group of participants who demonstrate high-quality responses, with a 1 in 100 chance of winning. Your standard payment will not be affected by this lottery.

When you feel ready to begin the main survey questions, please proceed.

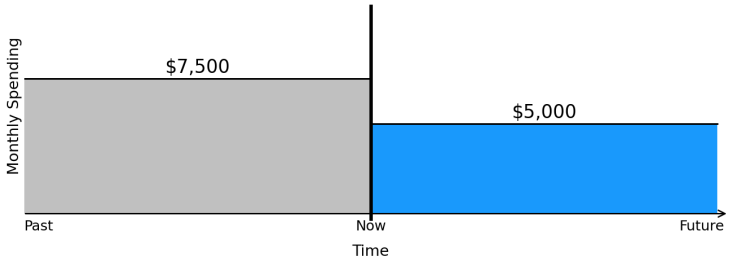
**Existence of internal habit formation**

Imagine two universes that are identical, except for your monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



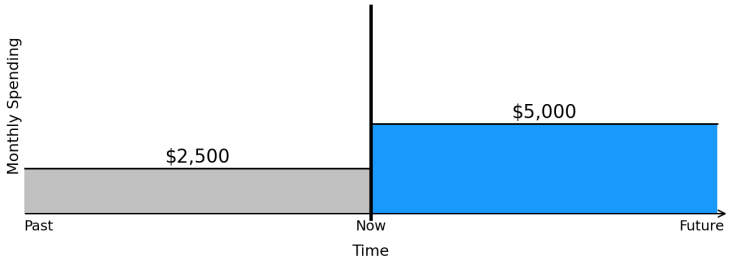

○ Universe Two:



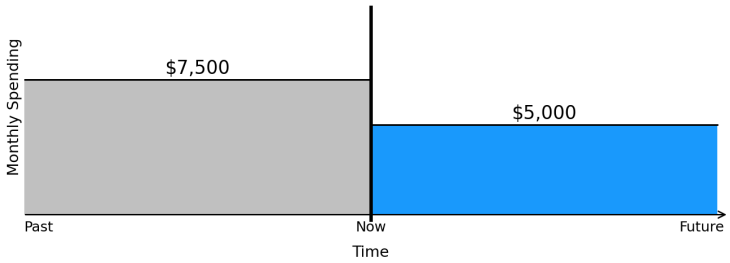

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



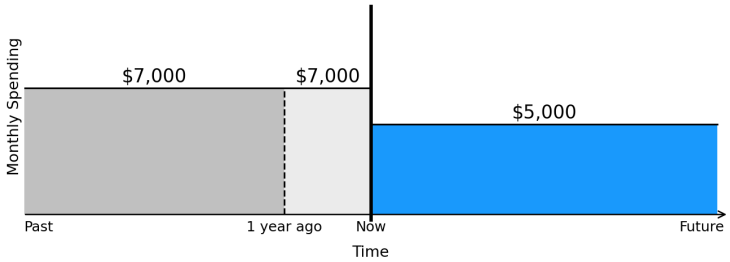

○ Universe Two:



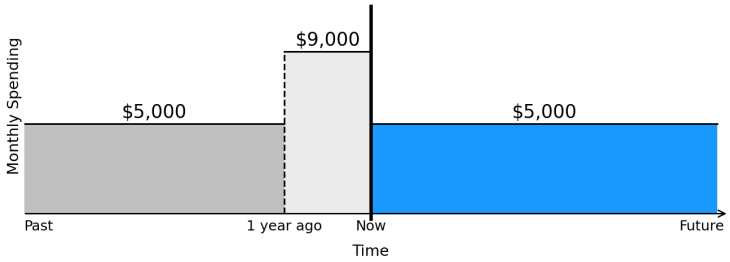

**Habit decay rate**

Imagine two universes that are identical, except for your monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



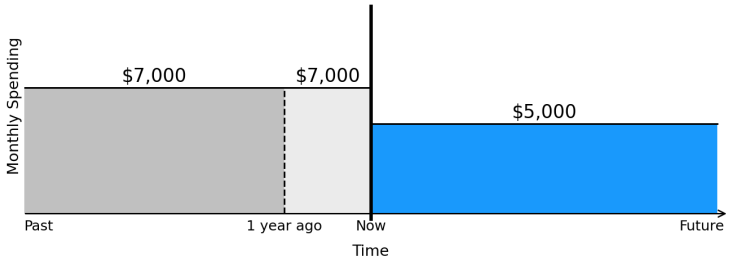

○ Universe Two:



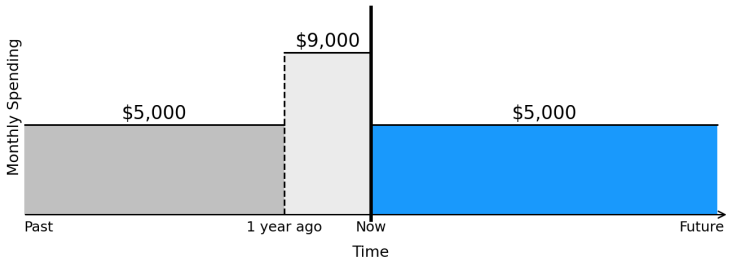

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

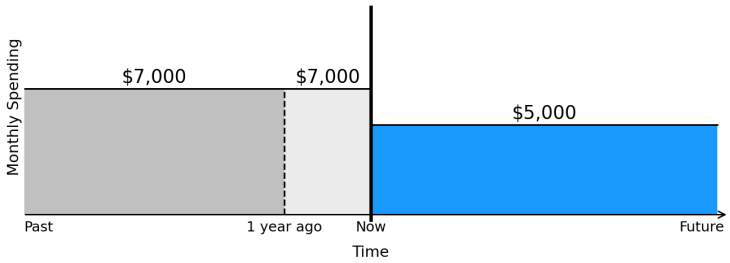



○ Universe Two:

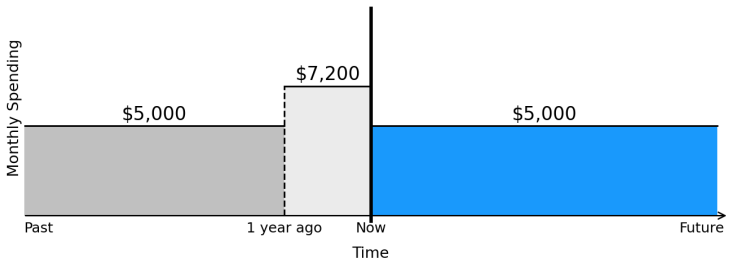



Imagine that the monthly spending in the **past year decreases to $7,200 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



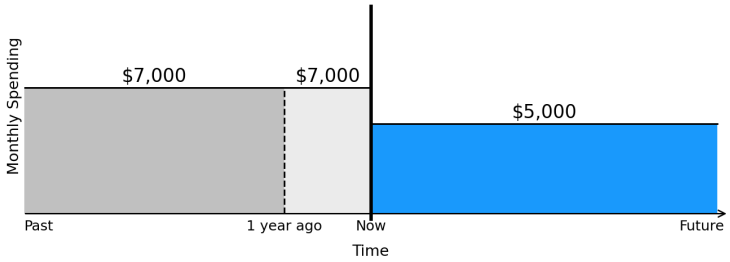

○ Universe Two:



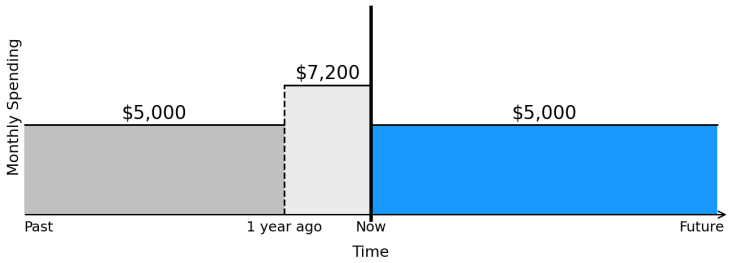

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

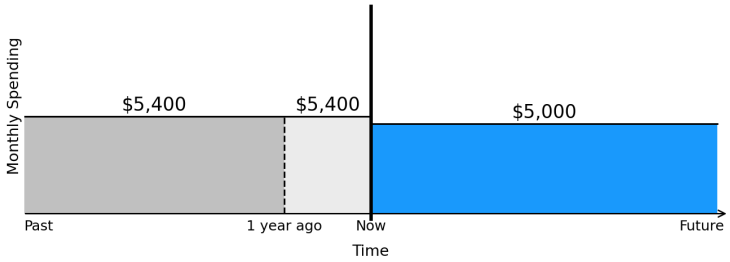



○ Universe Two:

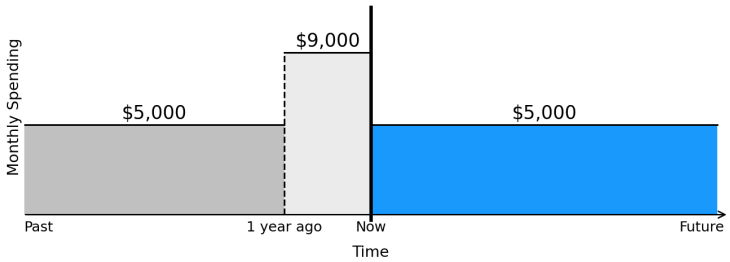



Imagine that the monthly spending in the **past decreases to $5,400 in Universe One.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



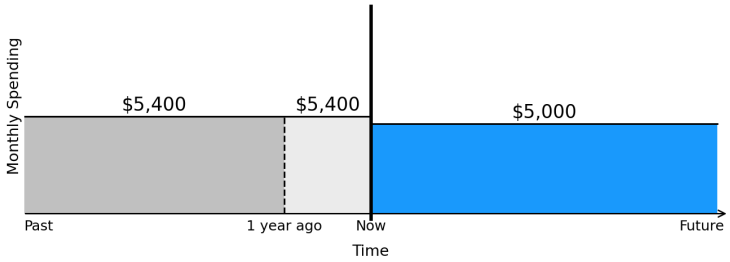

○ Universe Two:



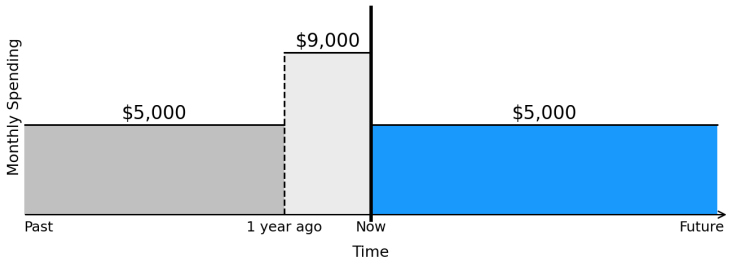

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



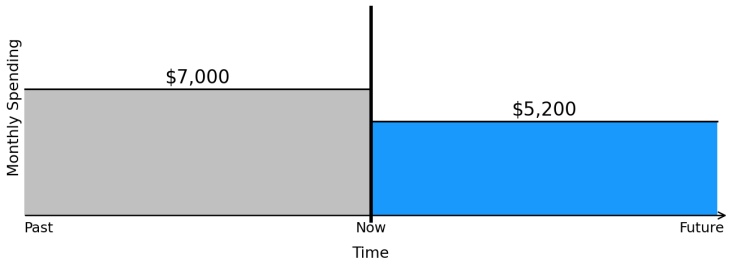

○ Universe Two:



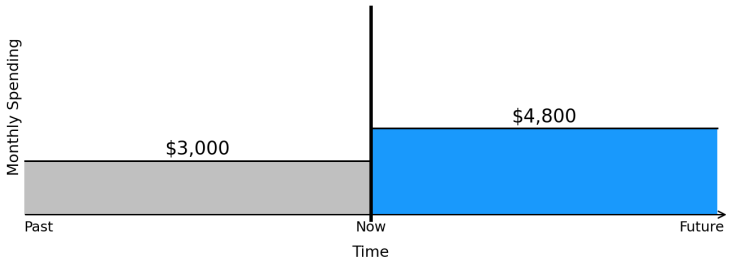

**Slope of indifference curve**

Imagine two universes that are identical, except for your monthly spending in the **past** and the **future**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



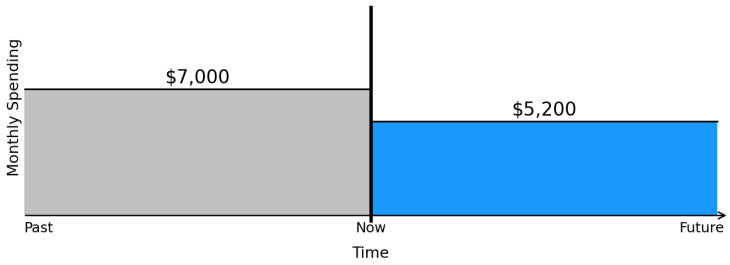

○ Universe Two:



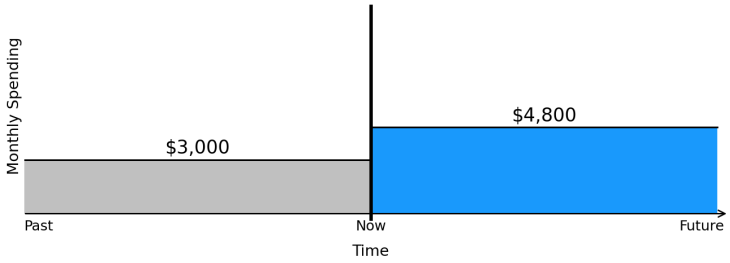

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

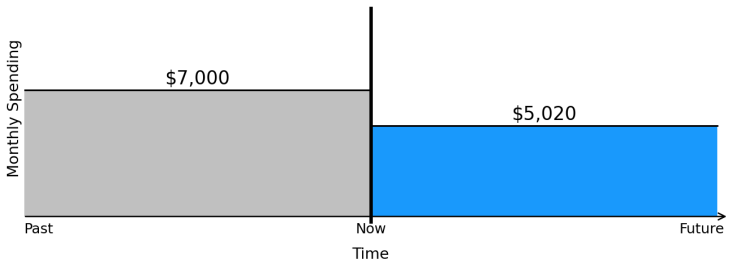



○ Universe Two:

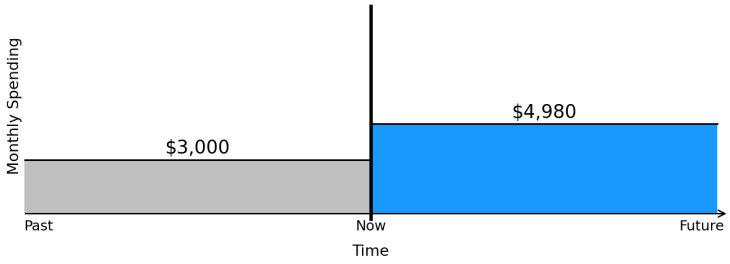



Imagine that the monthly spending in the **future decreases to $5,020 in Universe One and increases to $4,980 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



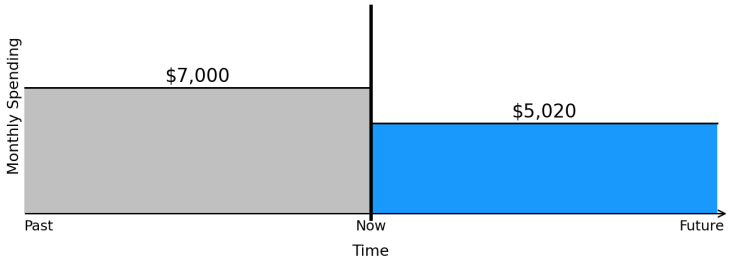

○ Universe Two:



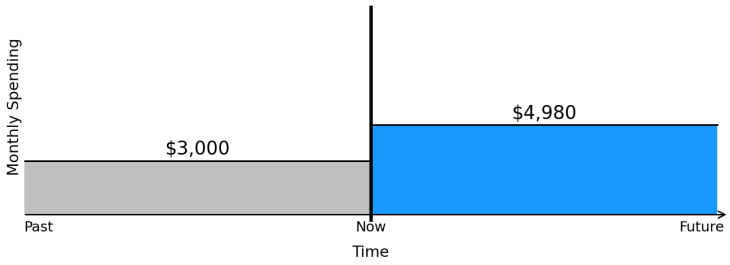

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

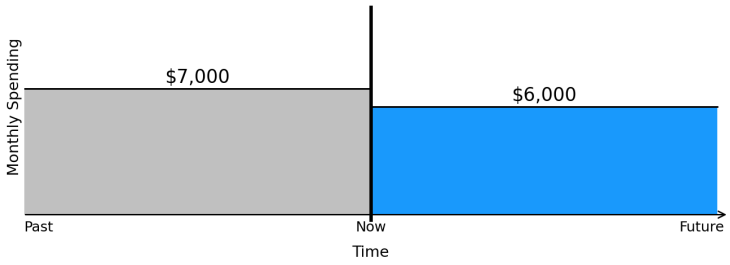



○ Universe Two:

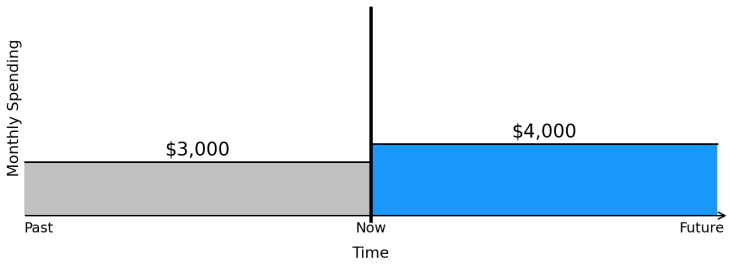



Imagine that the monthly spending in the **future increases to $6,000 in Universe One and decreases to $4,000 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



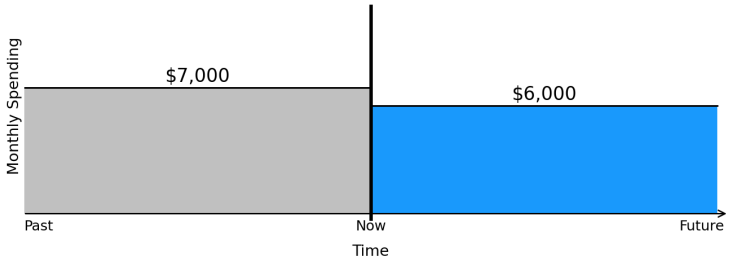

○ Universe Two:



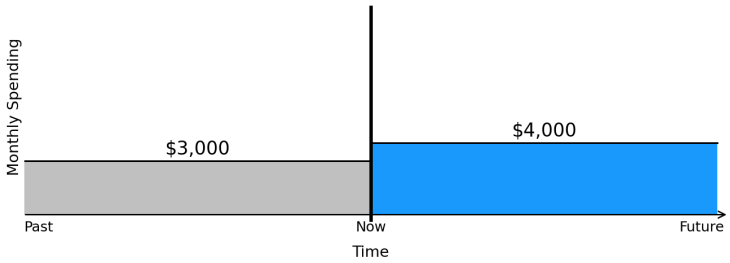

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



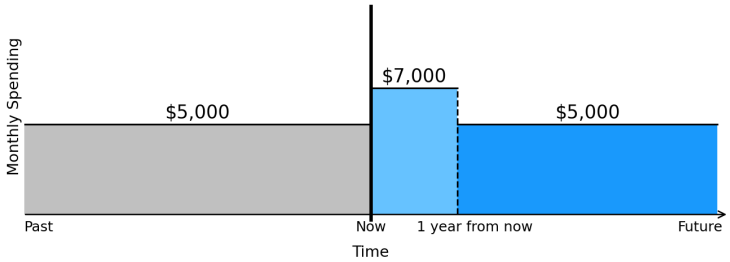

○ Universe Two:



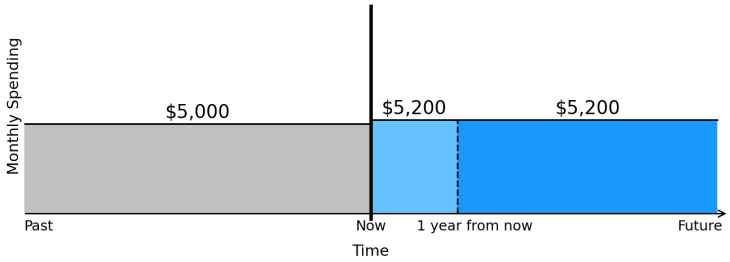

**Time discount rate**

Imagine two universes that are identical, except for your monthly spending in the **future**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:




○ Universe Two:



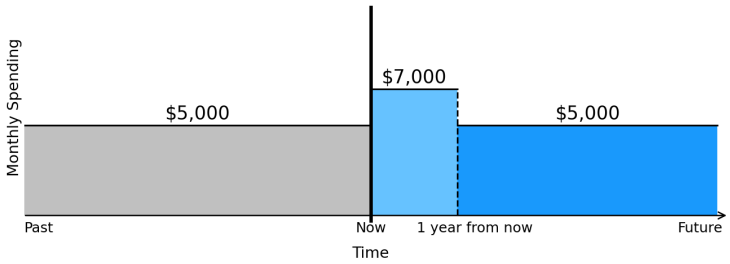

○ Same past experience in both universes

---

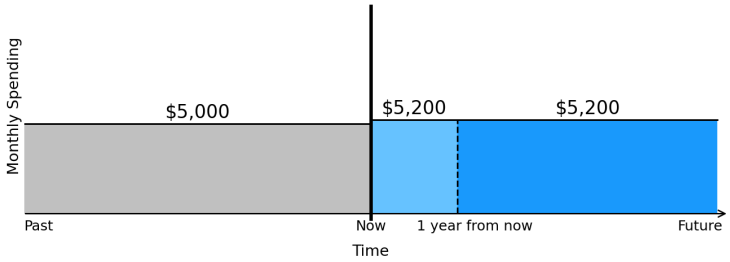
Remember, future experience reflects how you feel about the future starting now.

Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

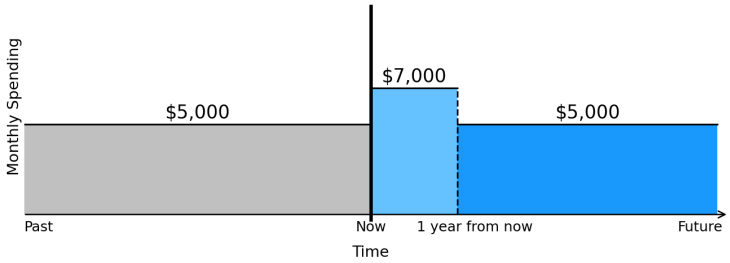



○ Universe Two:

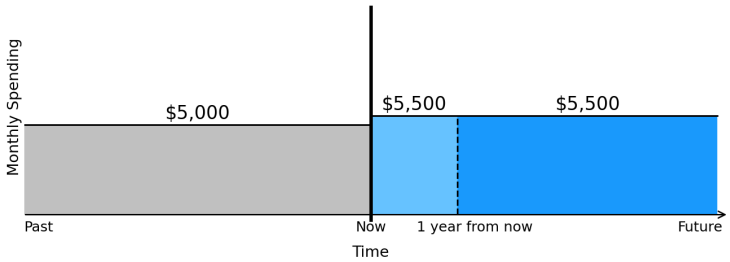



Imagine that the monthly spending in the **future increases to $5,500 in Universe Two.** Remember, past experience reflects how you felt about the past until now.
**Please choose Universe One regardless of your actual preference for this specific question (about the past). For other questions, including the one below about the future, please answer based on your actual preferences.**
Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:



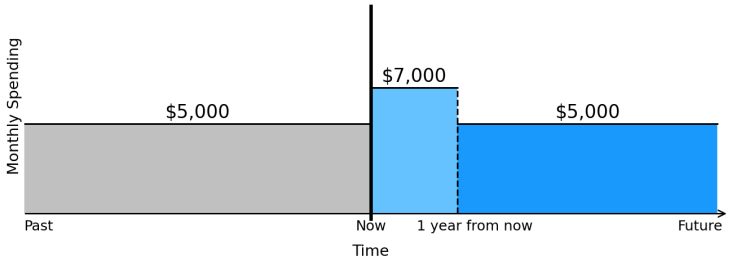

○ Universe Two:



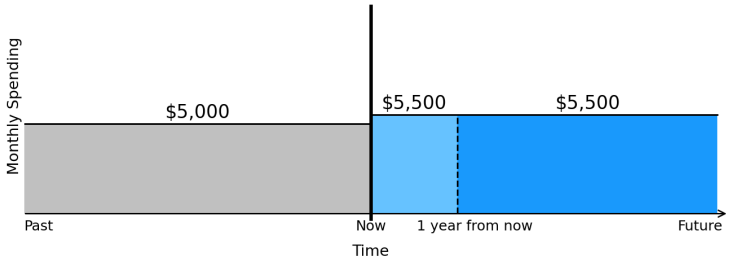

○ Same past experience in both universes

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

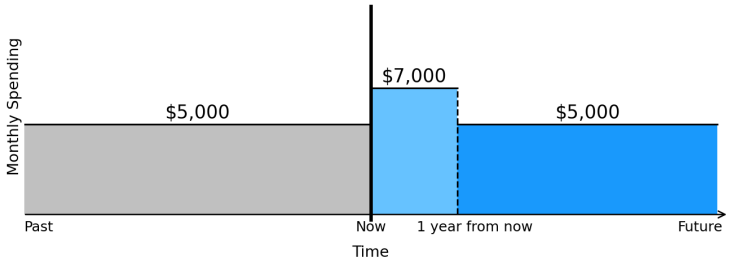



○ Universe Two:

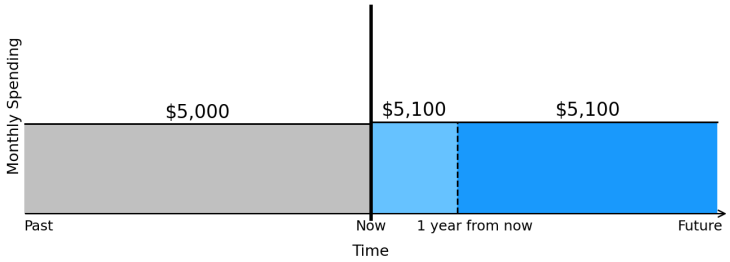



Imagine that the monthly spending in the **future decreases to $5,100 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
**Please choose Universe Two regardless of your actual preference for this specific question (about the past). For other questions, including the one below about the future, please answer based on your actual preferences.**
Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:



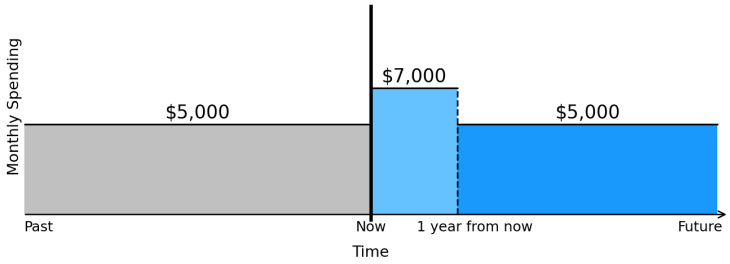

○ Universe Two:



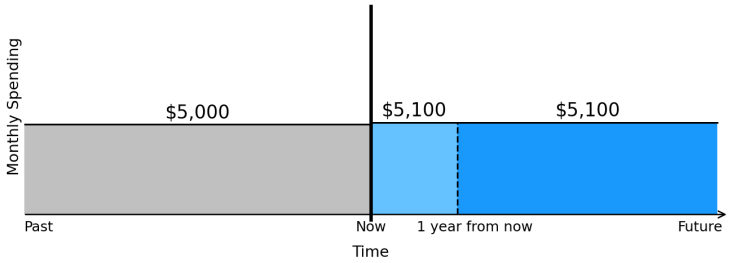

○ Same past experience in both universes

Remember, future experience reflects how you feel about the future starting now. Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:




○ Universe Two:




**Self-report attention**

**Before proceeding to the next set of questions, we want to ask for your feedback about the responses you provided so far.** It is vital to our study that we only include responses from people who devoted their full attention to this study. Your answer to this question will not affect in any way the payment you will receive for taking this survey. In your honest opinion, should we use your responses, or should we discard your responses since you did not devote your full attention to the questions so far?

○ Yes, I have devoted full attention to the questions so far and I think you should use my responses for your study.

○ No, I have not devoted full attention to the questions so far and I think you should not use my responses for your study.

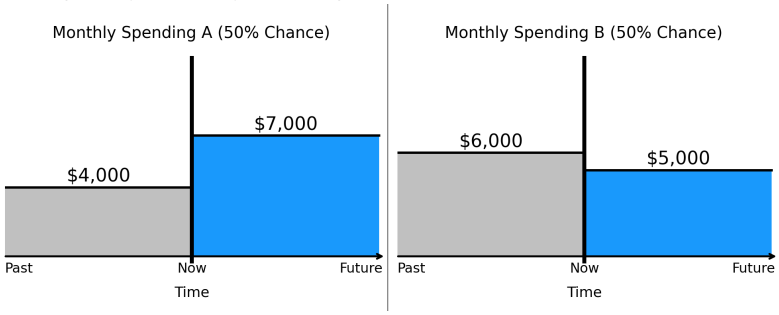
**Instruction: Uncertainty**

## Introduction to Uncertainty

In the next few questions, you will be asked to consider situations where there might be **uncertainty in your monthly spending within each universe**. This uncertainty is **represented by one universe having two different spending charts**.

Please review the example spending charts below, which depict two possible scenarios: “Monthly Spending A” and “Monthly Spending B.” **Each scenario has an equal 50% chance of occurring**. That is, in this universe, there is a 50% chance that your past spending was $4,000 per month with future spending increasing to $7,000 per month.

Alternatively, there is a 50% chance that your past spending was $6,000 per month, with future spending decreasing to $5,000 per month.



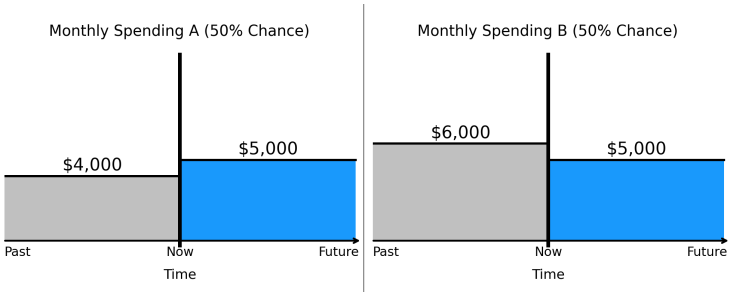

To save screen space and make it easier for you to compare the universes, the charts have been shrunken in size. However, please note that the time frames represented in these smaller charts are identical to those in the larger charts you've seen previously.

As you proceed, consider each universe carefully, taking into account any uncertainty within them, and evaluate which universe overall you would find more satisfying based on the given spending patterns.

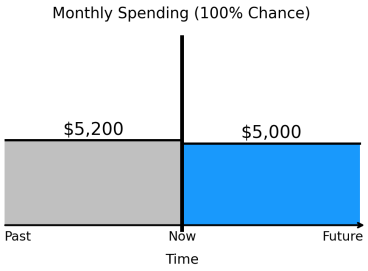
**euHH**

Imagine two universes that are identical, except for your monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



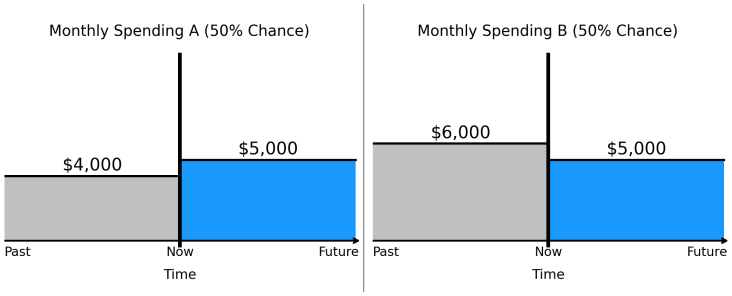

○ Universe Two:



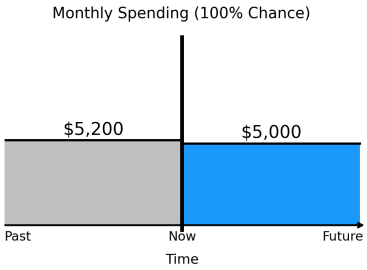

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

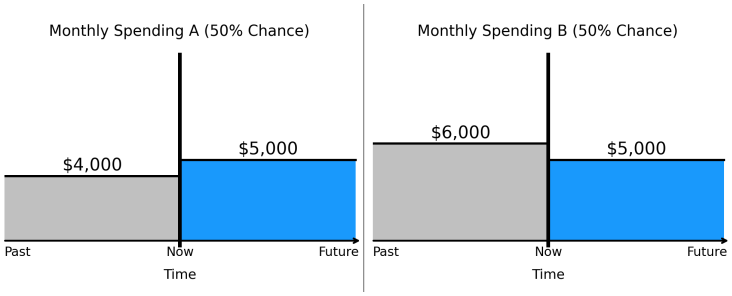



○ Universe Two:

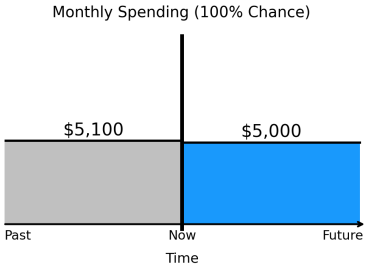



Imagine that the monthly spending in the **past decreases to $5,100 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



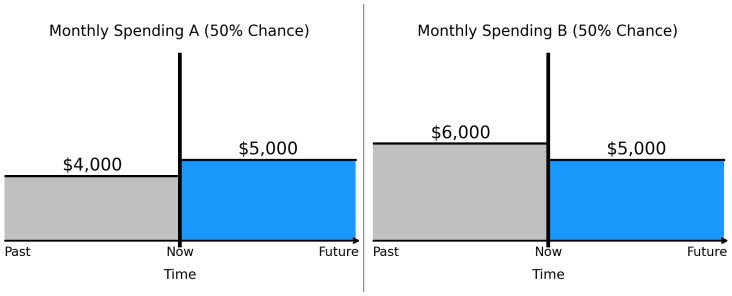

○ Universe Two:



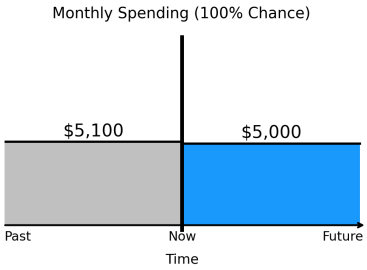

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

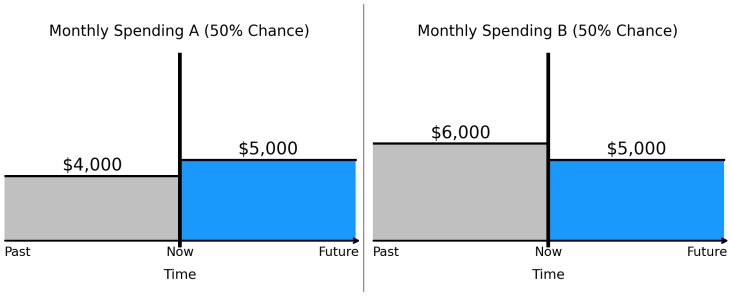



○ Universe Two:

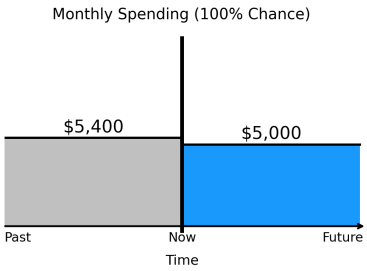



Imagine that the monthly spending in the **past increases to $5,400 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



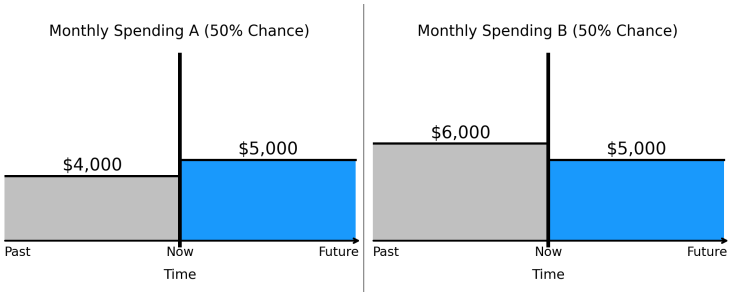

○ Universe Two:



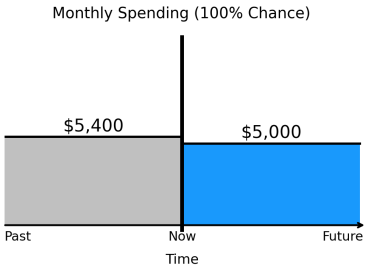

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



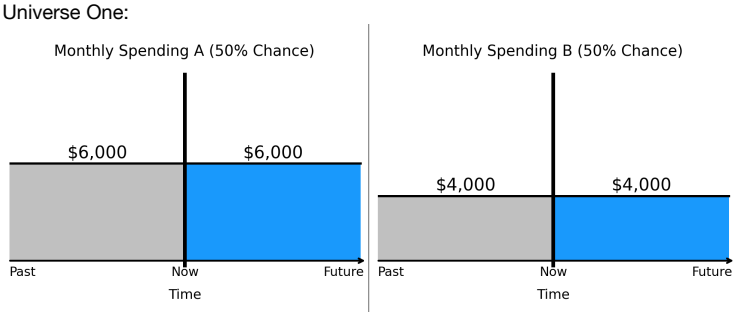

○ Universe Two:



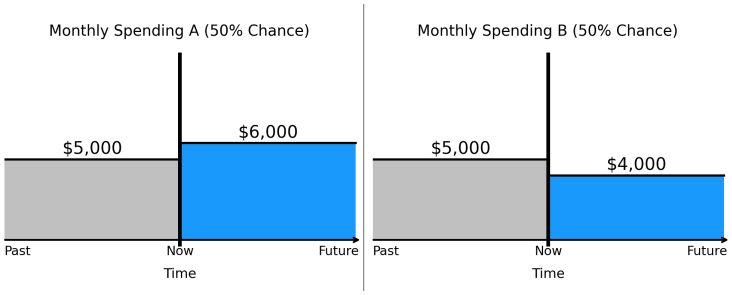

**uCHuHH**

Imagine two universes that are identical, except for your monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



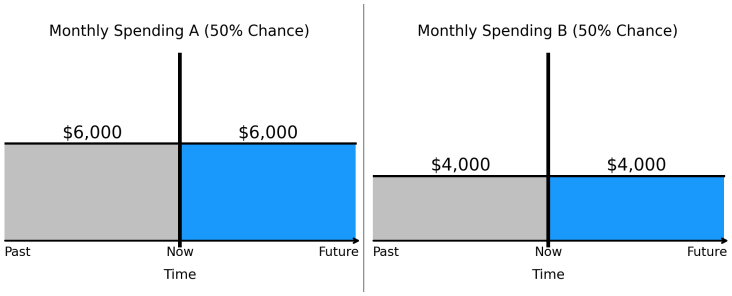

○ Universe Two:



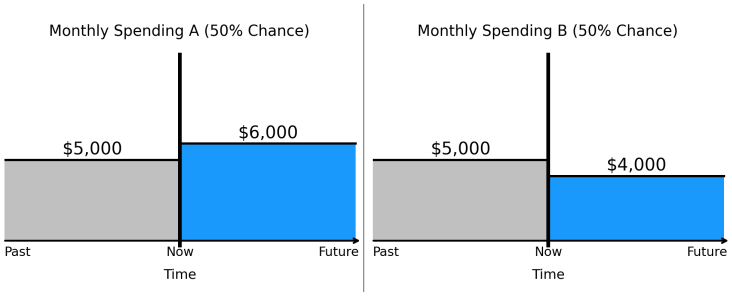

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

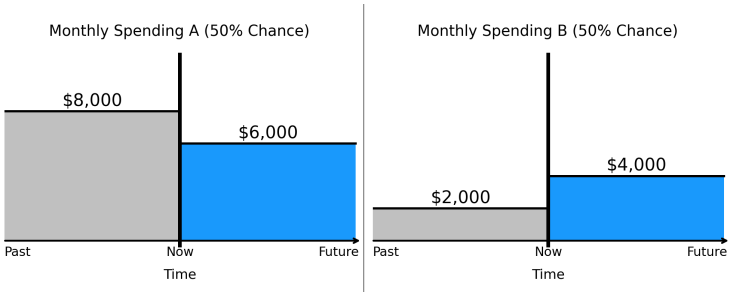



○ Universe Two:

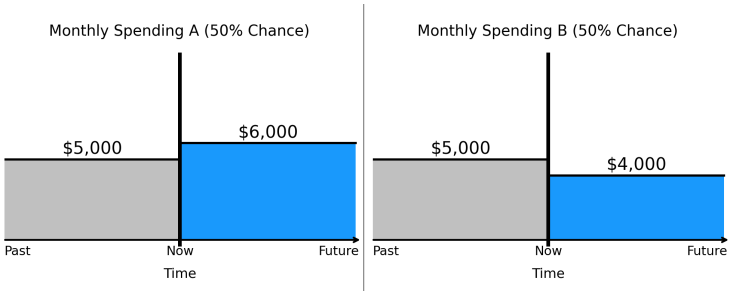



Imagine that in **Universe One**, the monthly spending in the **past increases to $8,000 in Monthly Spending A while decreases to $2,000 in Monthly Spending B**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



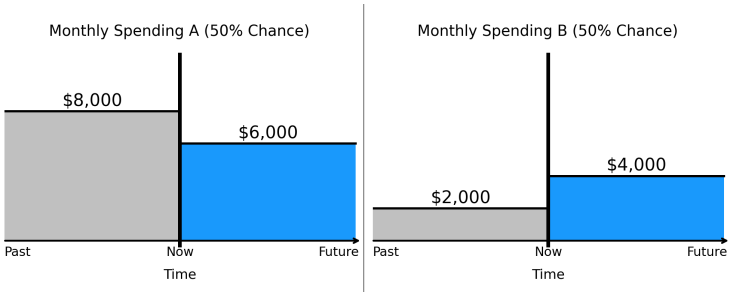

○ Universe Two:



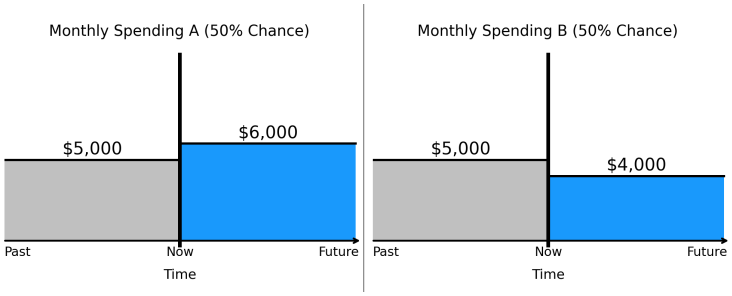

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

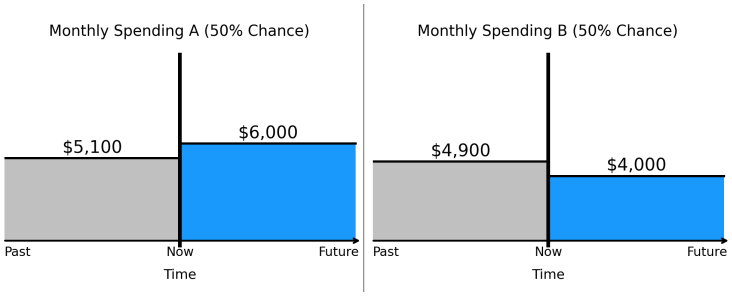



○ Universe Two:

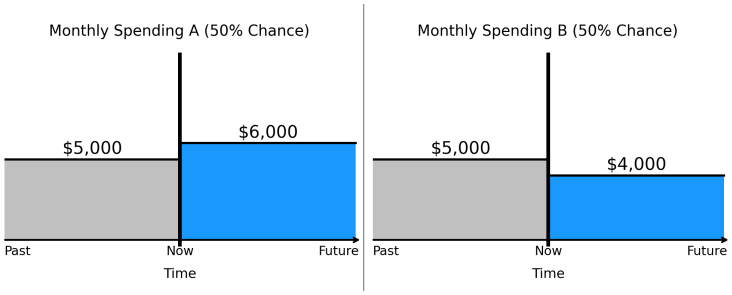



Imagine that in **Universe One**, the monthly spending in the **past decreases to $5,100 in Monthly Spending A while increases to $4,900 in Monthly Spending B**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



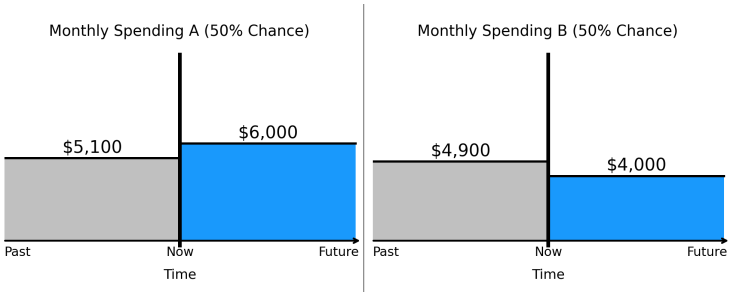

○ Universe Two:



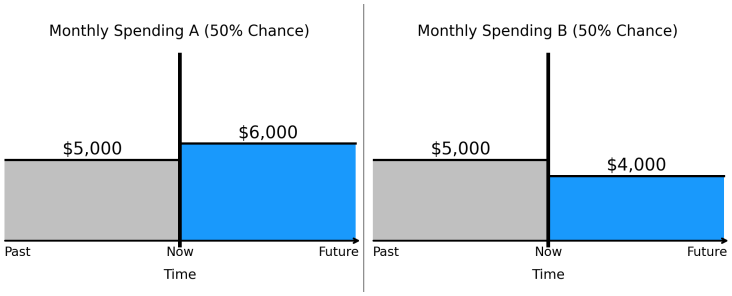

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



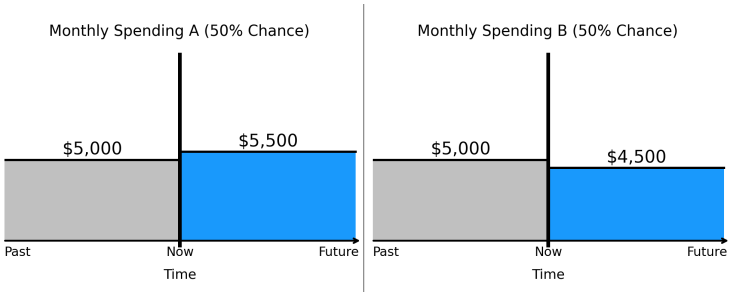

○ Universe Two:



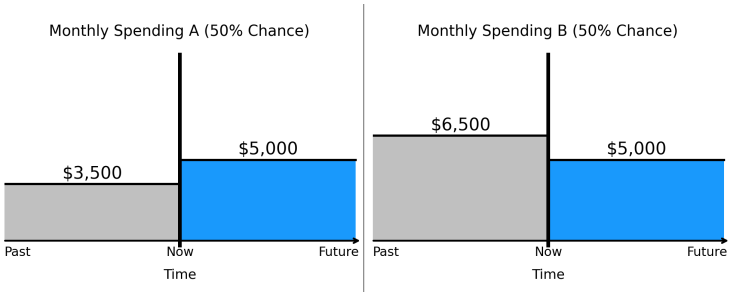

**uCCuHH**

Imagine two universes that are identical, except for your monthly spending in the **past** and the **future**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



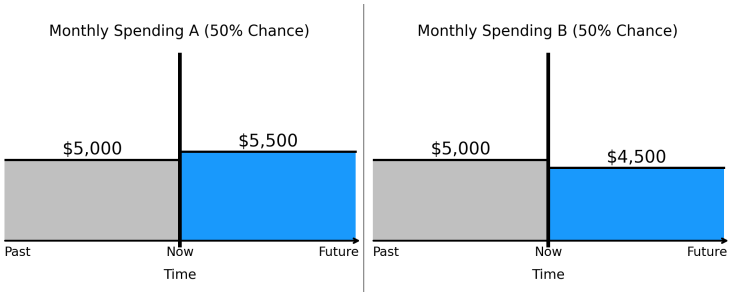

○ Universe Two:



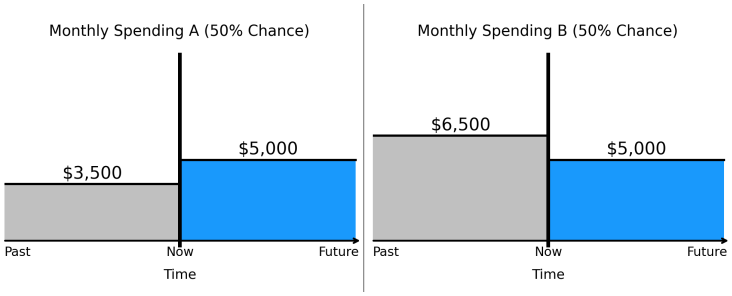

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

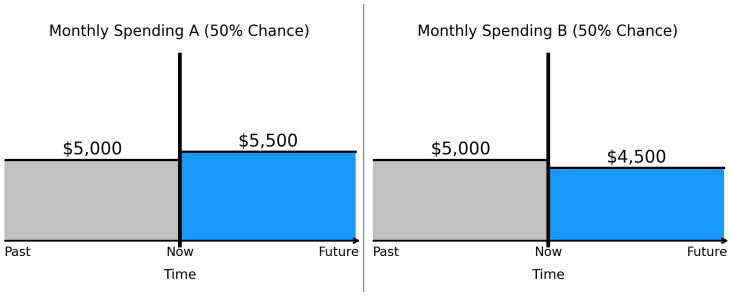



○ Universe Two:

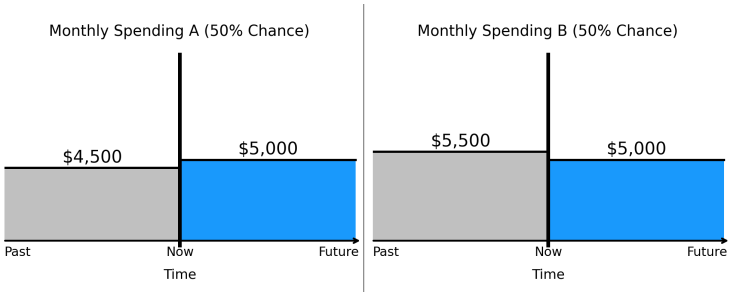



Imagine that in **Universe Two**, the monthly spending in the **past increases to $4,500 in Monthly Spending A while decreases to $5,500 in Monthly Spending B**.
Remember, past experience reflects how you felt about the past until now.
**Please choose Universe Two regardless of your actual preference for this specific question (about the past). For all other questions, including the one below about the future, please answer based on your actual preferences.**
Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:

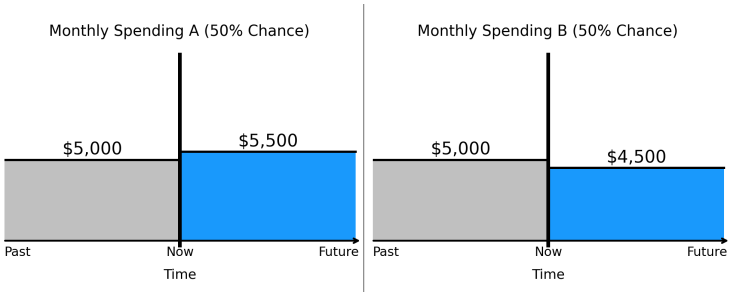



○ Universe Two:

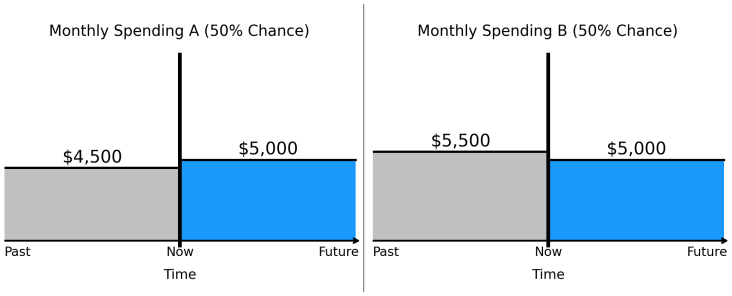


Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

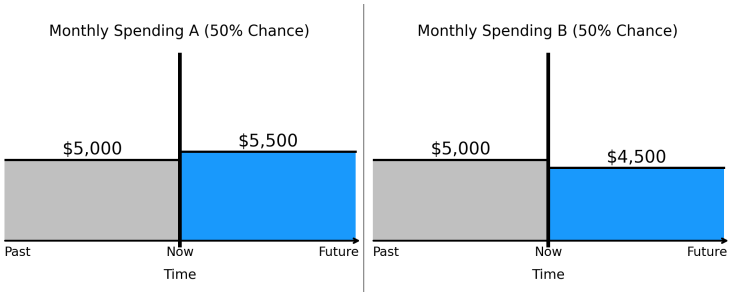



○ Universe Two:

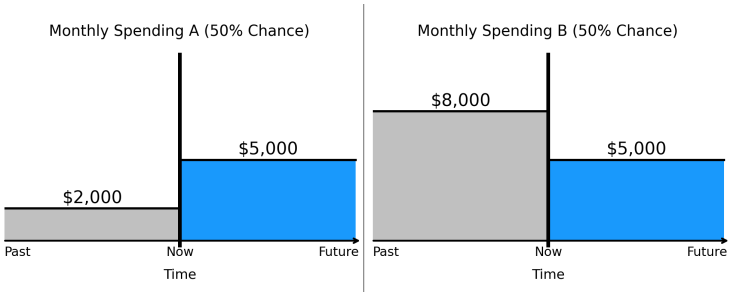



Imagine that in **Universe Two**, the monthly spending in the **past decreases to $2,000 in Monthly Spending A while increases to $8,000 in Monthly Spending B**.
Remember, past experience reflects how you felt about the past until now.
**Please choose Universe One regardless of your actual preference for this specific question (about the past). For all other questions, including the one below about the future, please answer based on your actual preferences.**
Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:

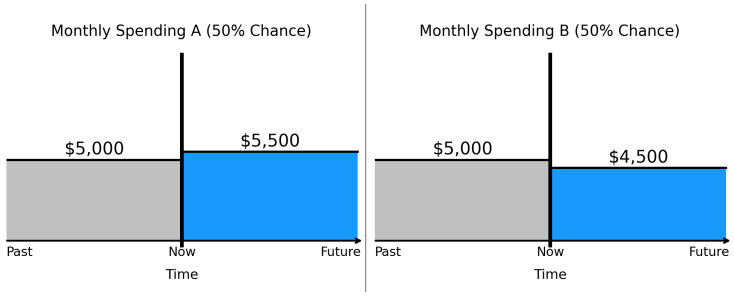



○ Universe Two:

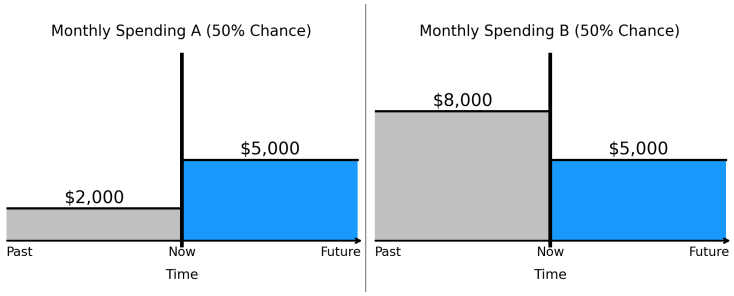


Remember, future experience reflects how you feel about the future starting now. Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:




○ Universe Two:




**Fail attention checks notification**

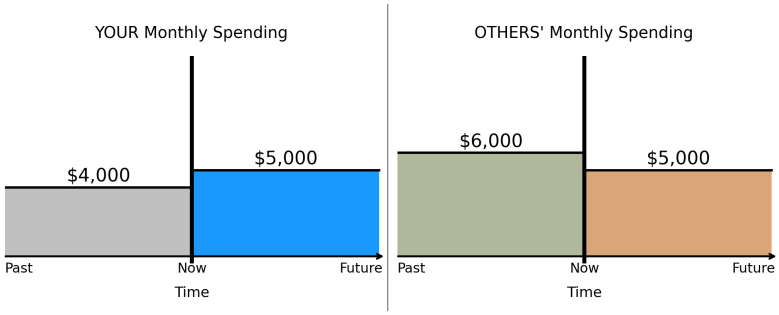
We regret to inform you that you've failed attention checks too many times to proceed with the survey. You'll be redirected to Prolific automatically. Thank you for your time!

**Instruction: Others**

## Introduction to Other People's Spending

In the next few questions, you will be asked to consider not only your own monthly spending but also the spending of other people (referred to as "others"). Unlike the previous questions involving uncertainty, there is no uncertainty in these comparisons—both your spending and others' spending are fixed in each universe.

As shown in the example below, **your monthly spending is represented by the left chart, while others' monthly spending is shown in the right chart**. The two spending charts are differentiated by color to help you easily distinguish between them. Your spending chart is shaded as before in gray and blue, while others' spending chart is shaded in green and brown.

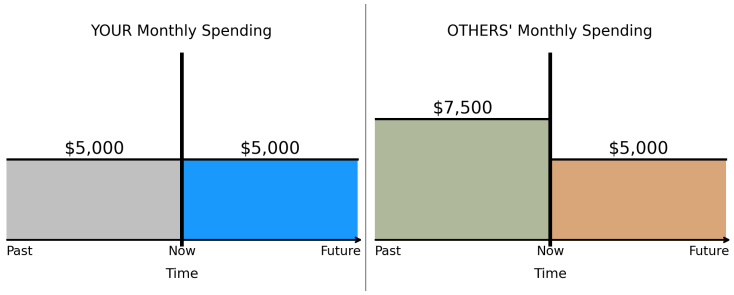



As you proceed, consider both your spending and the spending of others when evaluating which universe **you** would find more satisfying.

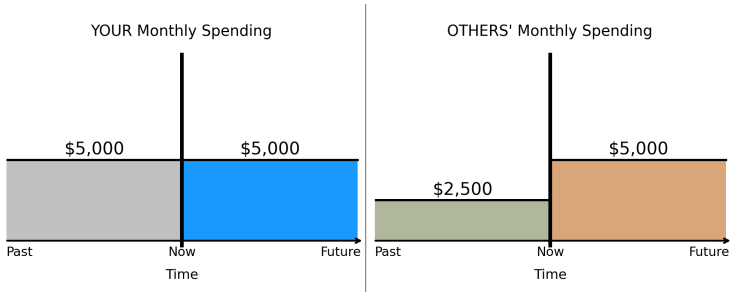
**Existence of external habit formation**

Imagine two universes that are identical, except for **other people's** monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



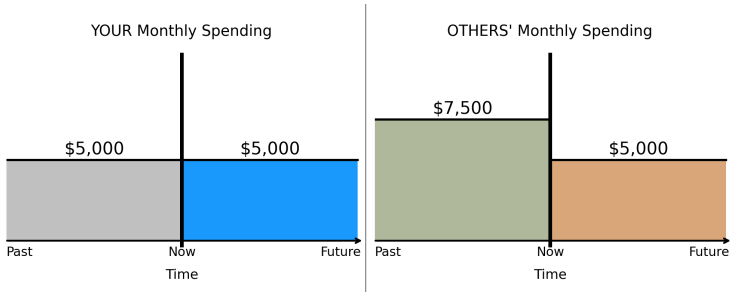

○ Universe Two:



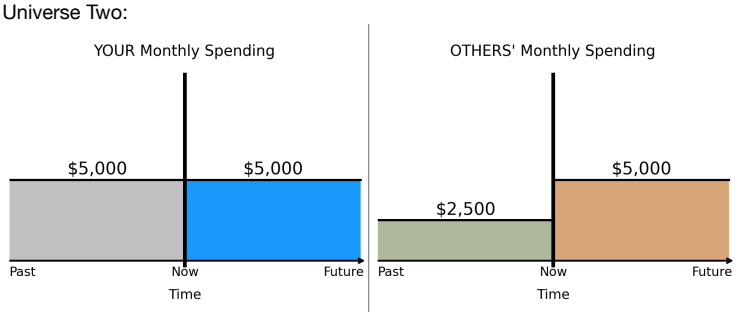

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:



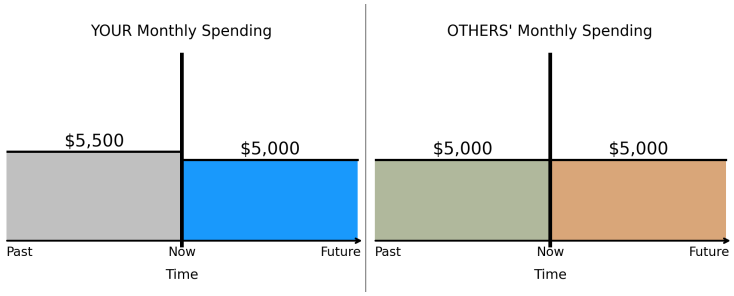

○ Universe Two:



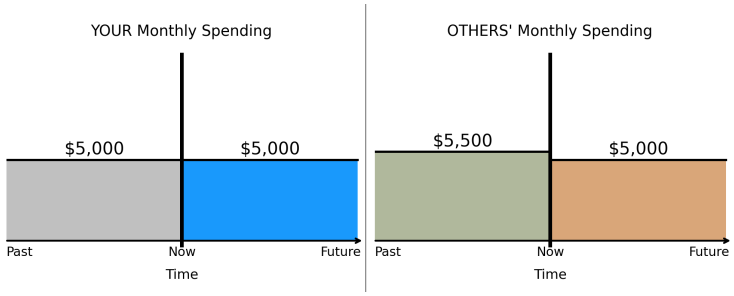

**Mixture habit**

Imagine two universes that are identical, except for **your and other people's** monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



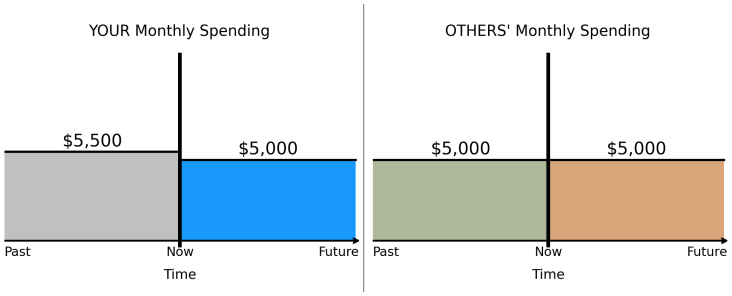

○ Universe Two:



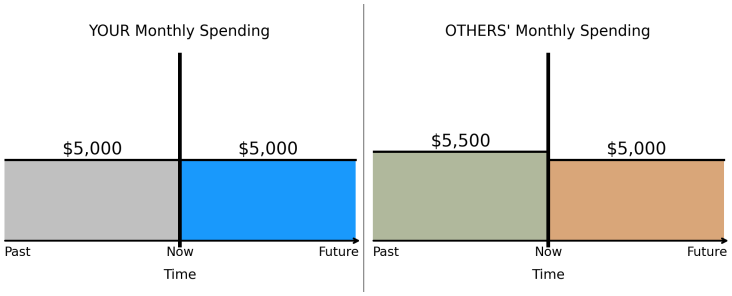

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

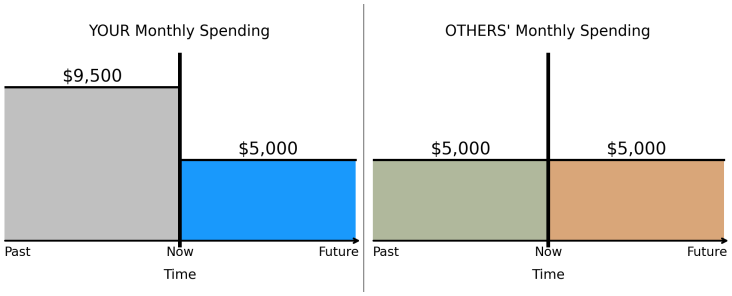



○ Universe Two:

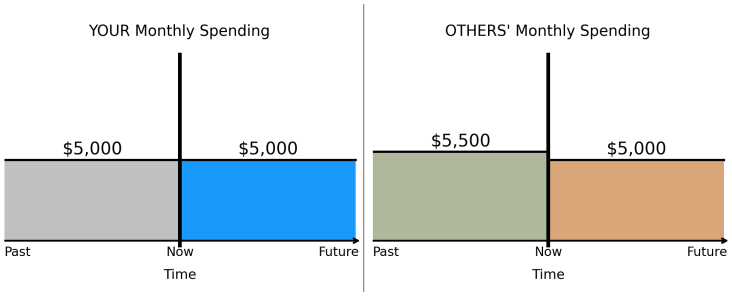



Imagine that **YOUR** monthly spending in the **past increases to $9,500 in Universe One**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



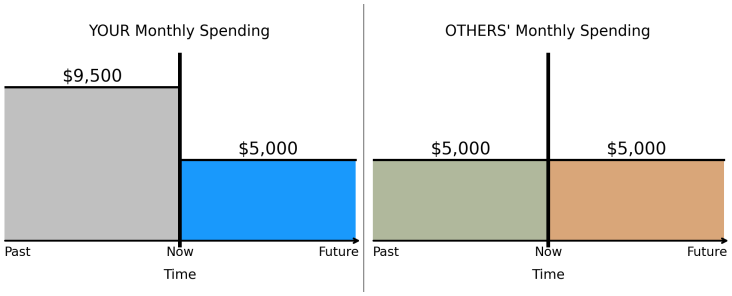

○ Universe Two:



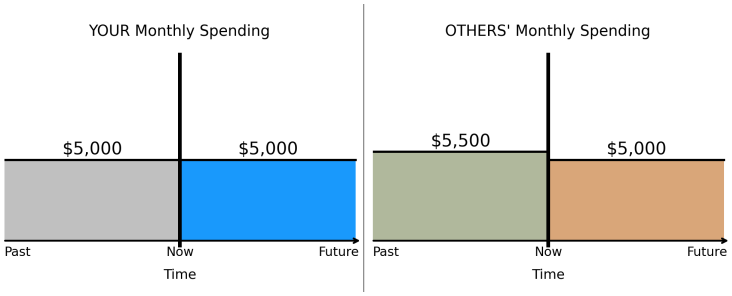

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

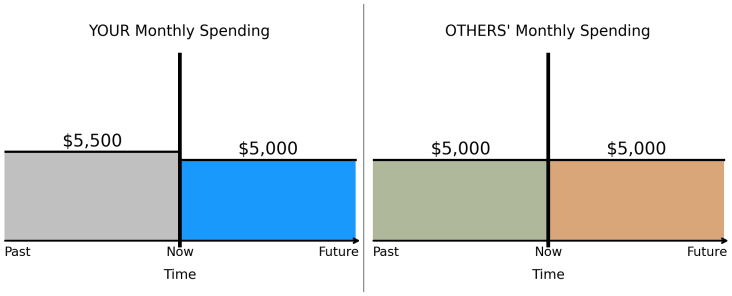



○ Universe Two:

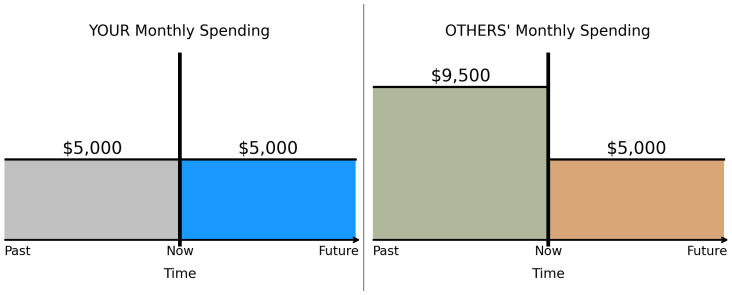



Imagine that **OTHER PEOPLE's** monthly spending in the **past increases to $9,500 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



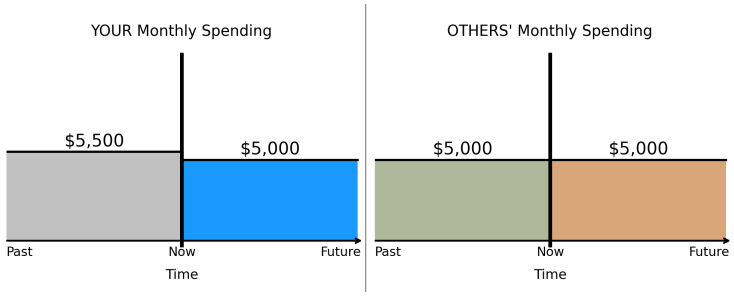

○ Universe Two:



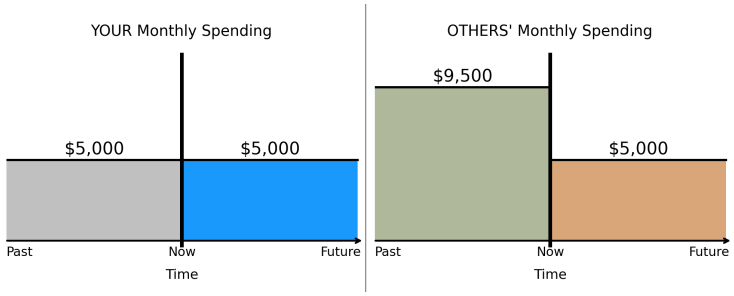

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:



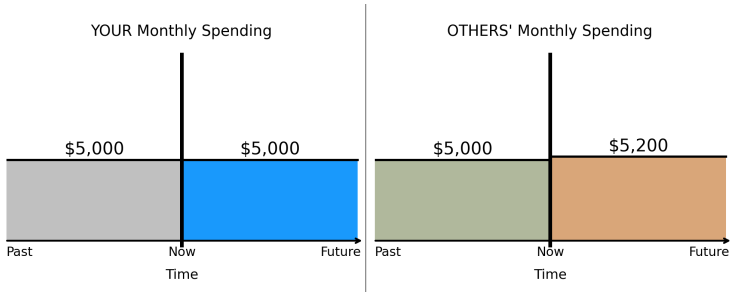

○ Universe Two:



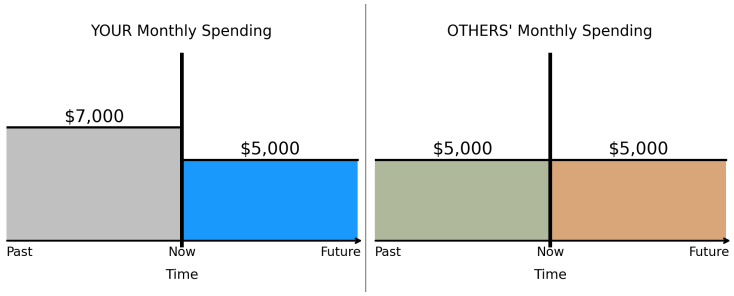

**uCothers uH**

Imagine two universes that are identical, except for **your past** monthly spending and **other people's future** monthly spending.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



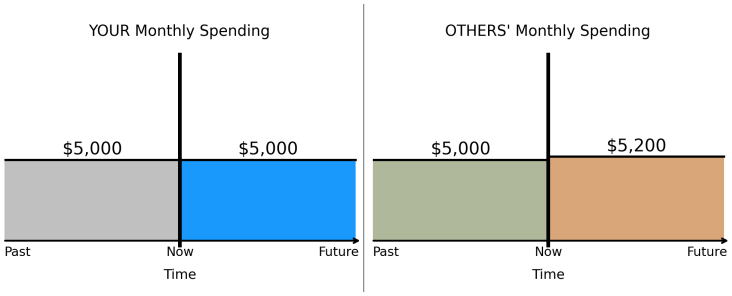

○ Universe Two:



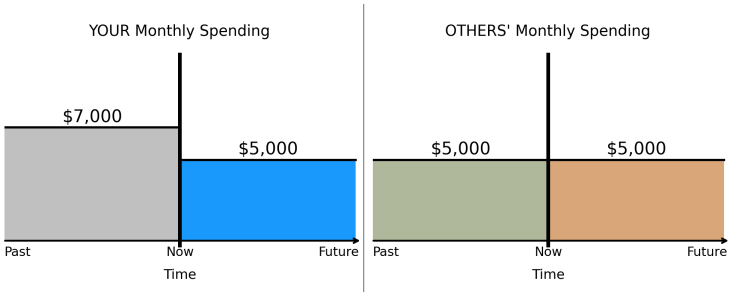

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

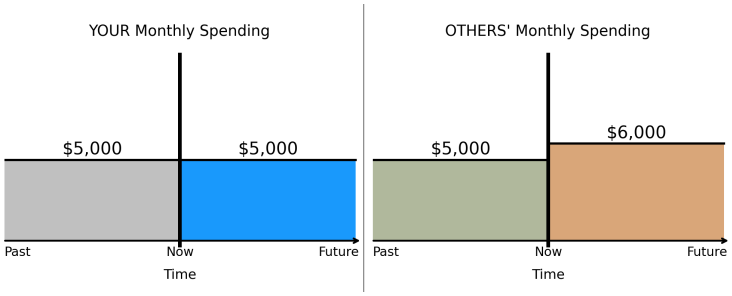



○ Universe Two:

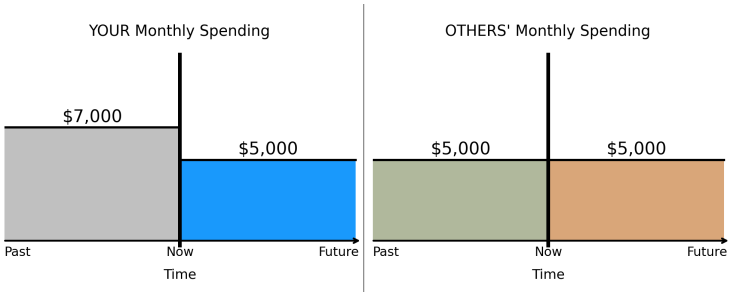



Imagine that **OTHER PEOPLE's** monthly spending in the **future increases to $6,000 in Universe One**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



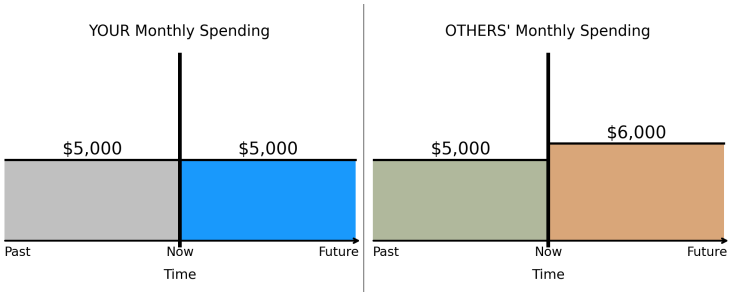

○ Universe Two:



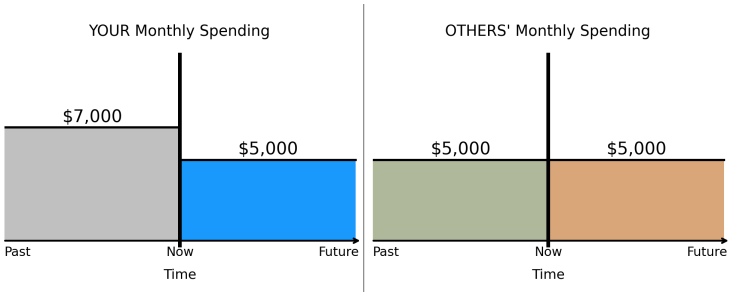

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

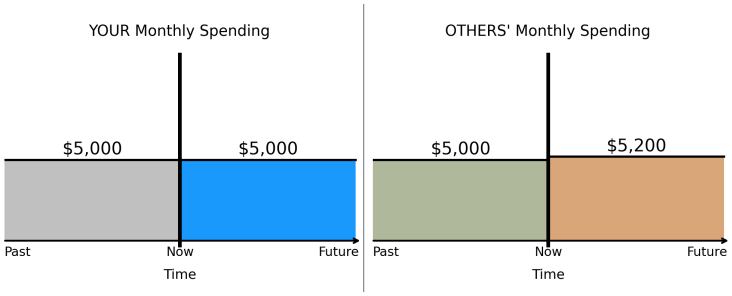



○ Universe Two:

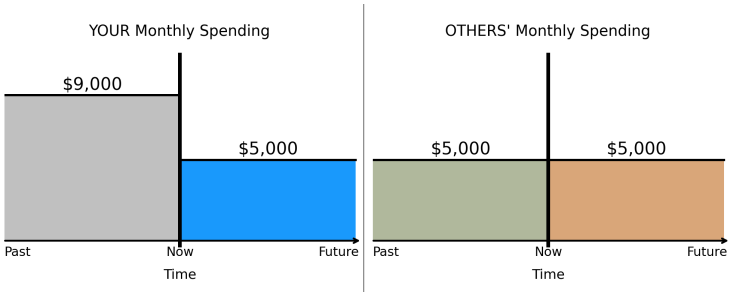



Imagine that **YOUR** monthly spending in the **past increases to $9,000 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



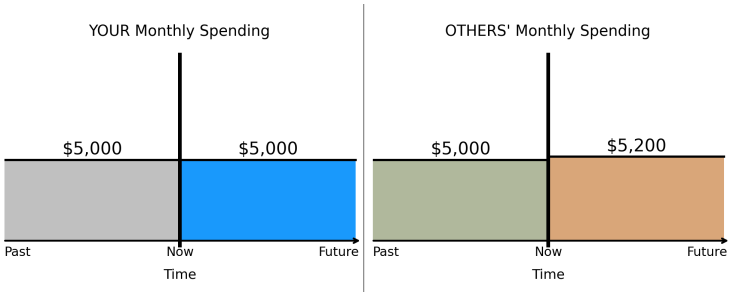

○ Universe Two:



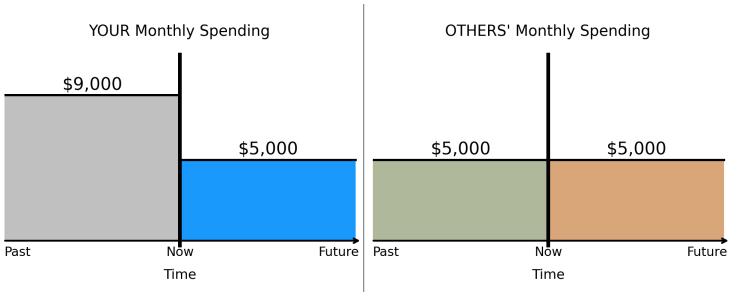

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:




○ Universe Two:




**Comprehension checks on hypothetical situation (repeated)**

Under the hypothetical situation of this survey, if you can buy 3 bananas with one dollar in the last year, how many bananas can you buy with one dollar in the next year?

○ 5
○ 3
○ 1
○ No idea

Under the hypothetical situation of this survey, which of the following do you own (i.e., not rent)?

○ Residence
○ Car
○ Furniture
○ I do not own any of these
○ No idea

Under the hypothetical situation of this survey, do things you want change over time?

○ Yes
○ No

Under the hypothetical situation of this survey, do things not mentioned in the questions change?

○ Yes
○ No

Under the hypothetical situation of this survey, how much do people not mentioned in the questions always spend each month?

- ○ $4,000
- ○ $5,000
- ○ $6,500
- ○ $8,000
- ○ No idea

Under the hypothetical situation of this survey, which of the following is the **only difference** between the universes?

- ○ My income
- ○ My savings
- ○ My control over my finances
- ○ My spending
- ○ The economy

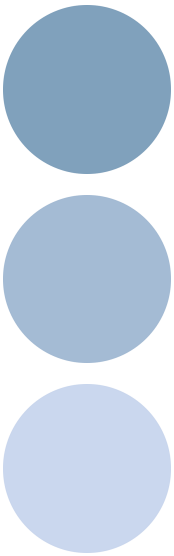
**Calibration questions (repeated)**

Please rate **how confident each of the following individuals looks** on a scale from 0 to 10, where **0 means "Lowest level of confidence possible" and 10 means are "Highest level of confidence possible"**.

0 1 2 3 4 5 6 7 8 9 10

Please rate **how dark each of the following circles looks** on a scale from 0 to 10, where **0 means “Lowest level of darkness possible” and 10 means are “Highest level of darkness possible”**.

0 1 2 3 4 5 6 7 8 9 10



Please rate **how complex each of the following shapes looks** on a scale from 0 to 10, where **0 means “Lowest level of complexity possible” and 10 means are “Highest level of complexity possible”**.

0 1 2 3 4 5 6 7 8 9 10

**Exit questions**

Here are some final questions about the survey. Approval of your work will not depend on your answers to these questions.

---

Would you like to participate in a follow-up survey in the future?

- ○ Yes
- ○ Maybe
- ○ No

---

Off the top of your head, what do you recall the inflation rate in the US was for **2023**?

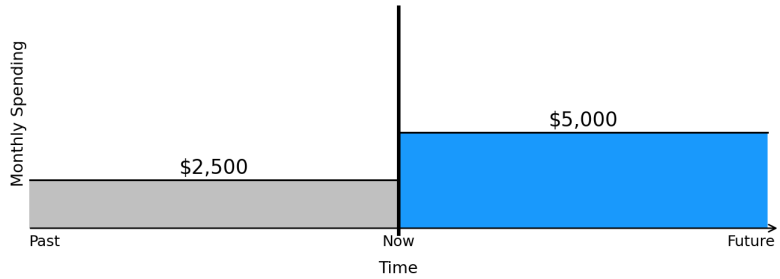
- ○ 2%
- ○ 4%
- ○ 6%
- ○ 8%
- ○ Cannot remember

---

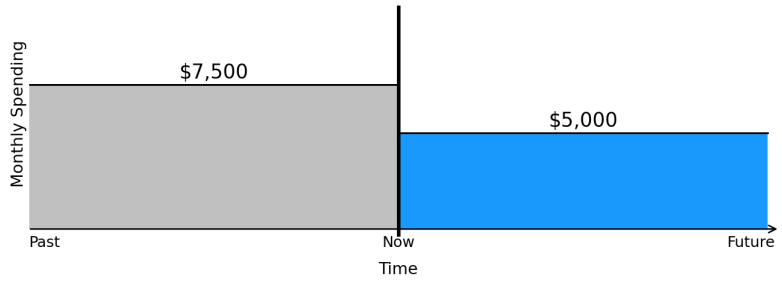
Could you explain why you selected **"${e://Field/ExistenceInternalChoice}"** in the following question?

Imagine two universes that are identical, except for your monthly spending in the **past**. Remember, future experience reflects how you feel about the future starting now. Which universe will provide you with a more satisfying **FUTURE** experience?

Universe One:




Universe Two:




It is vital to our study that we only include responses from people that devoted their full attention to this study. Otherwise, years of effort (the researchers' and the time of other participants) could be wasted. Your payment will not be affected by your answer. Please tell us **how much effort you put forth towards this study.**

- ○ I put forth almost no effort
- ○ I put forth very little effort
- ○ I put forth some effort
- ○ I put forth quite a bit of effort
- ○ I put forth a lot of effort

Please feel free to give us any feedback or impression regarding this survey.

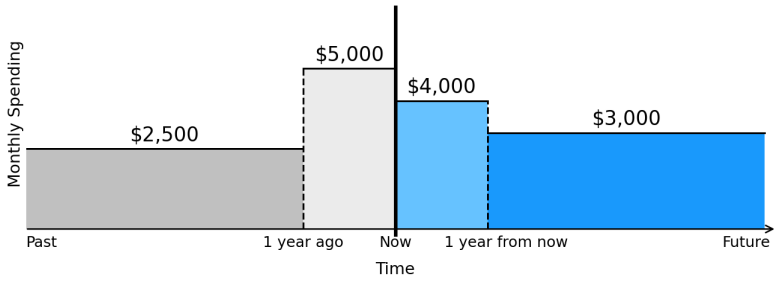
**Instruction: Reading monthly spending charts [3000]**

## Instruction 1/2

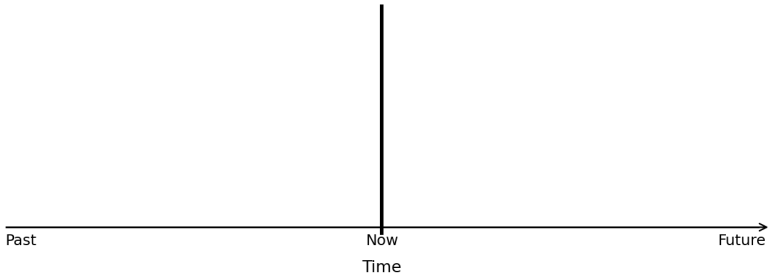
**Please note: This page includes essential instructions and practice questions to help you grasp a key visual tool used throughout the survey. While it may be a bit lengthy, taking the time to carefully read and complete this section is crucial.**

In this survey, you will compare your experience in two hypothetical universes: Universe One and Universe Two. These universes are **identical in every way except for your monthly spending**. Monthly spending refers to the **total** amount of money your household **spends**, not earns, each month. This includes all expenditures, both necessities and leisure. Your task is to determine **in which universe you would have a more satisfying experience based on the specified spending levels**.

To intuitively visualize your monthly spending, we use monthly spending charts, like the example below:




Let's learn to read a monthly spending chart. The first element of the chart is the timeline, with the past on the left, now in the middle, and the future on the right. A thick vertical line representing now separates the past from the future.

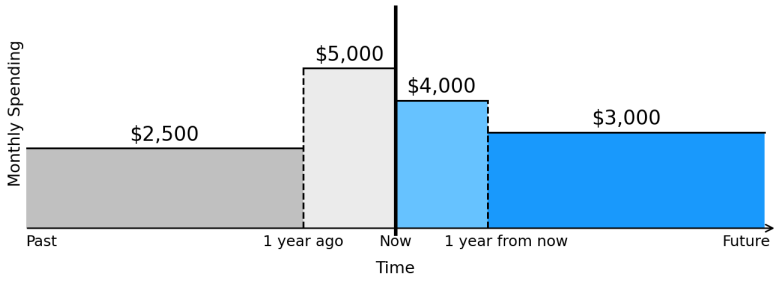



To clarify, **past refers to as far back in time as you can remember, and future refers to as far ahead as you can imagine**. If it helps, you can think of the past as the last 30 years and the future as the next 30 years.

The second element of a monthly spending chart is the bars above the timeline.

- The height of each bar represents the level of monthly spending (again, not income).
- The exact amount of monthly spending is labeled at the top of each bar.
- The location and width of each bar indicate the specific time frame during which that level of monthly spending occurred.
- Different colors are used for the bars to distinguish between the various time periods.

For example, if the following monthly spending chart represents your spending:



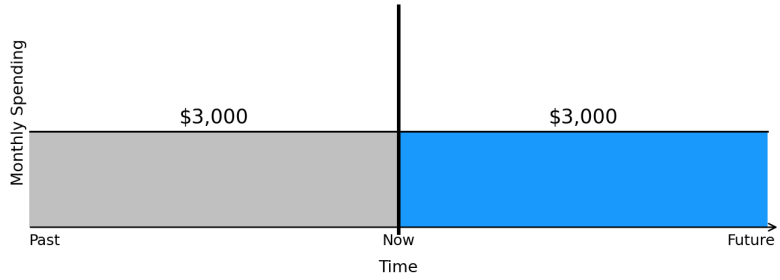

- You spent $2,500 per month in the past, up until 1 year ago.
- You have been spending $5,000 per month from 1 year ago until now (over the past year).
- You plan to spend $4,000 per month from now until 1 year from now (over the next year).
- You will spend $3,000 per month from 1 year from now onward.

In summary, this chart shows that your spending increased significantly over the past year

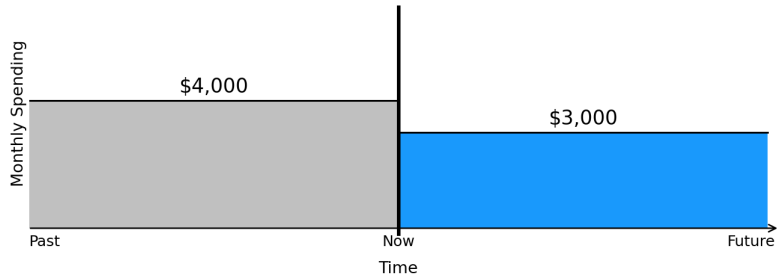
and will decrease slightly in the future.

---

In some cases, the time frames shown in the charts may be combined into two or three broader periods to highlight differences in monthly spending. For instance, if your monthly spending chart in Universe One is:




And in Universe Two, your monthly spending chart is:




Then the difference between the two universes is that in Universe Two, you spent $1,000 more per month in the past up until now compared to Universe One, where you spent $3,000 per month during that same period. In both universes, you will spend $3,000 per month from now onward.

Below are several questions to test your understanding of the above instructions.

---

## Practice Questions

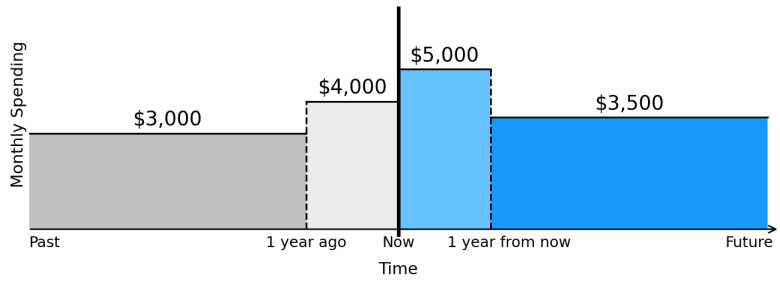
When we refer to "**in the past**" in this survey, what time frame are we talking about?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ The last 3 years
- ○ As far back as I can remember
- ○ The last year

When we refer to "**in the future**" in this survey, what time frame are we talking about?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ The next 2 years
- ○ As far ahead as I can imagine
- ○ The next year

Imagine that your monthly spending is represented by the following monthly spending chart:




How much will you spend per month **in the next year**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

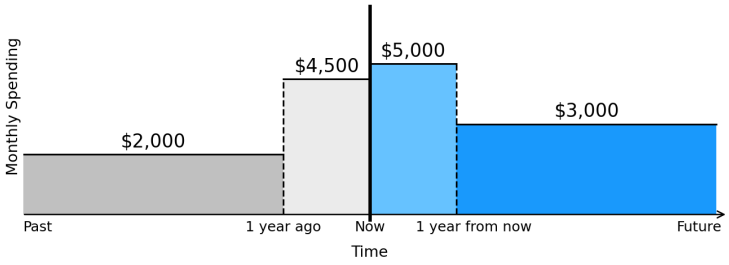
- ○ $3,000
- ○ $3,500
- ○ $4,000
- ○ $5,000

How much did you spend per month **in the past until 1 year ago**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

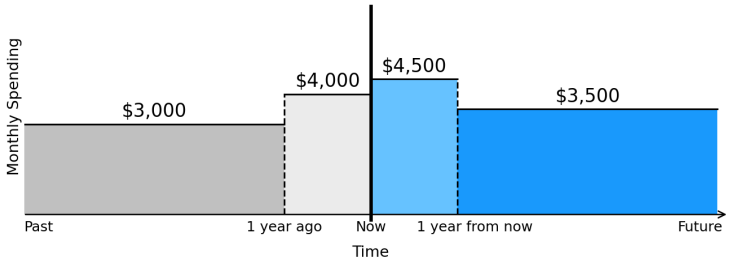
- ○ $3,000
- ○ $3,500
- ○ $4,000
- ○ $5,000

Imagine that your monthly spending in Universe One and Universe Two are represented by the following monthly spending charts.
**[Please click on the chart to select your answer.]**
In which universe did you spend **more in the past year**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ Universe One:



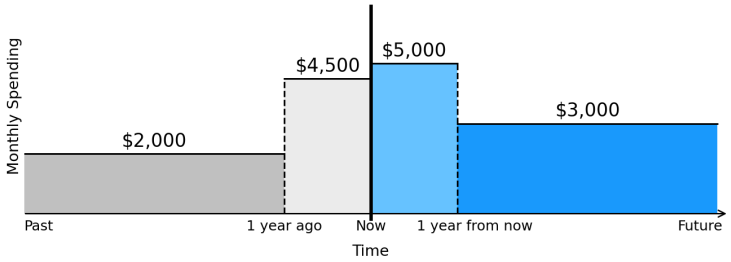
○ Universe Two:



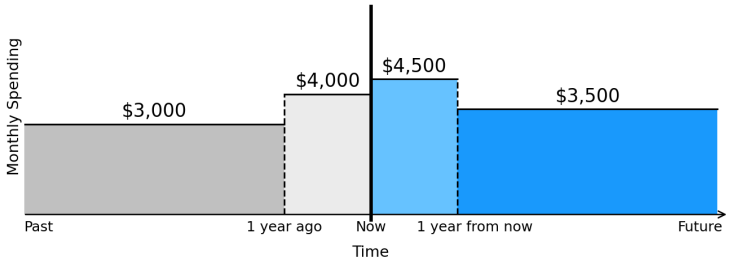

---

In which universe will you spend **more from 1 year from now onward**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

○ Universe One:




○ Universe Two:




---

In the last question, how much **more** did you spend in Universe Two than in Universe One **in the past until 1 year ago**?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

○ $0
○ $500
○ $1,000
○ $3,500

**Instruction: Hypothetical situation [3000]**

## Instruction 2/2

To simplify the comparison of your experience under various spending patterns, please evaluate your experience in the following hypothetical situation:

- There is **no inflation**, and prices of everything stay the same over time.
- You **rent the durable goods** you use, including residence, furniture, car, etc.
- Your **preferences do not change** over time.
- **People not mentioned in the questions always spend $3,000 per month**, regardless of their income or wealth.
- **Any other factors not specified in the questions are identical between the universes and remain identical over time**.

The last point means that factors, including but not limited to your income, savings, wealth, control over finances, and the state of the economy, are the same between the universes and remain the same over time. **Only your spending mentioned in the questions varies between the universes**, so please focus solely on those spending differences when making your evaluations.

*Note:* Even though your income, savings, and wealth are the same across universes, your spending doesn't have to be identical. For the purposes of this survey, you can imagine a hypothetical external financial system that automatically adjusts your savings at no cost to you, allowing your spending to vary while keeping everything else unchanged.

Throughout this survey, "you" refers to your household, including everyone living with you. "Other people" or "others" refers to other households, meaning everyone outside of your household. **Both you and others can afford the monthly spending** specified in the questions.

Below are several questions to test your understanding of this hypothetical situation.

---

## Practice Questions

In this survey's hypothetical situation, if you can buy 3 bananas with one dollar in the last year, how many bananas can you buy with one dollar in the next year?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ 5
- ○ 3
- ○ 1

In this survey's hypothetical situation, which of the following do you own (i.e., not rent)?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ Residence
- ○ Car
- ○ Furniture
- ○ I do not own any of these

In this survey's hypothetical situation, do things you want change over time?

*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ Yes
- ○ No

In this survey's hypothetical situation, how much do people not mentioned in questions always spend each month?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ $2,000
- ○ $3,000
- ○ $4,500
- ○ $6,000

In this survey's hypothetical situation, do things not mentioned in the questions change?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ Yes
- ○ No

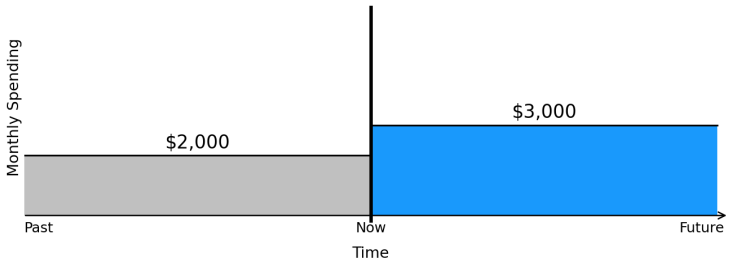
In this survey's hypothetical situation, which of the following is the **only difference** between the universes?
*Please re-read the instructions above if you are not sure. You have two opportunities to get this question correct.*

- ○ My income
- ○ My savings
- ○ My control over my finances
- ○ My spending
- ○ The economy

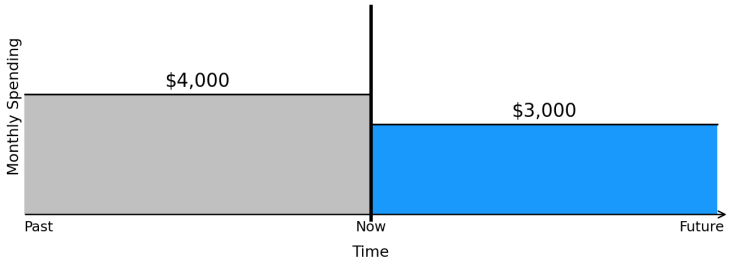
**Existence of internal habit formation [3000]**

Imagine two universes that are identical, except for your monthly spending in the **past**. Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

- ○ Universe One:



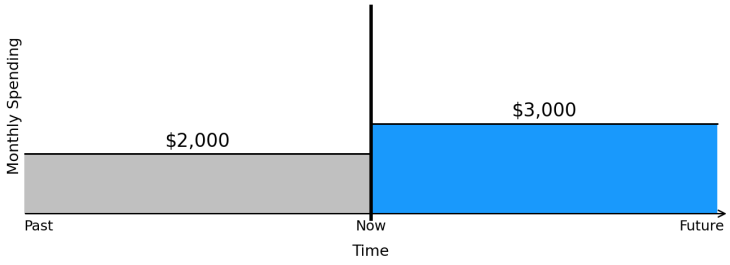
○ Universe Two:



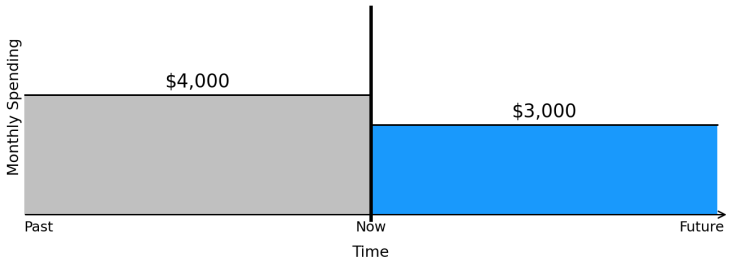

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



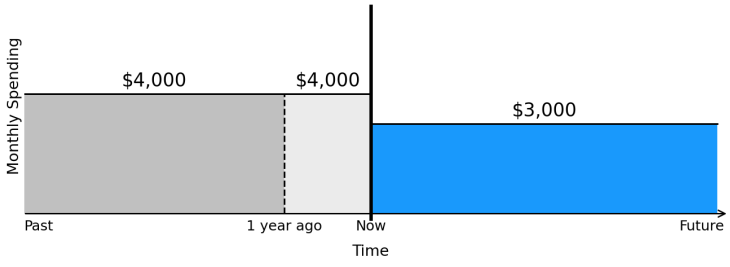

○ Universe Two:



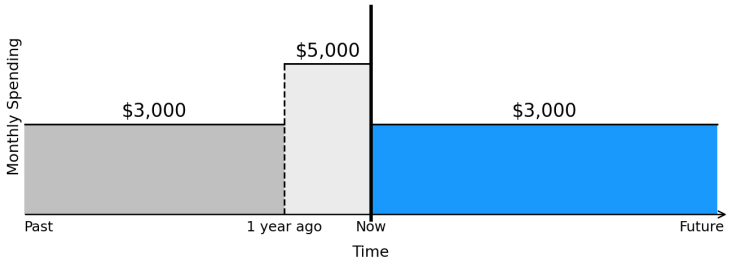

**Habit decay rate [3000]**

Imagine two universes that are identical, except for your monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



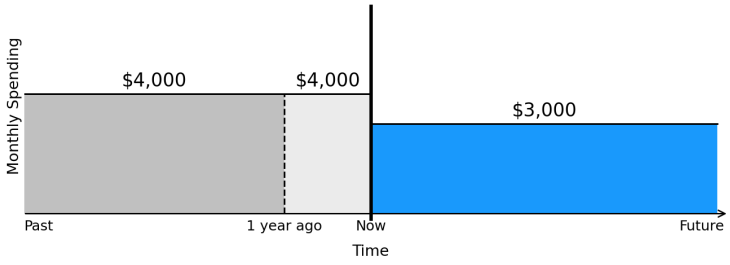
○ Universe Two:



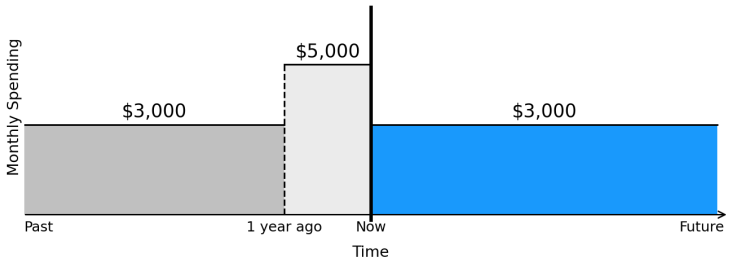

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

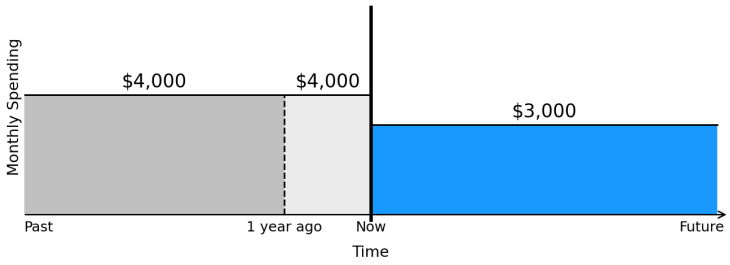



○ Universe Two:

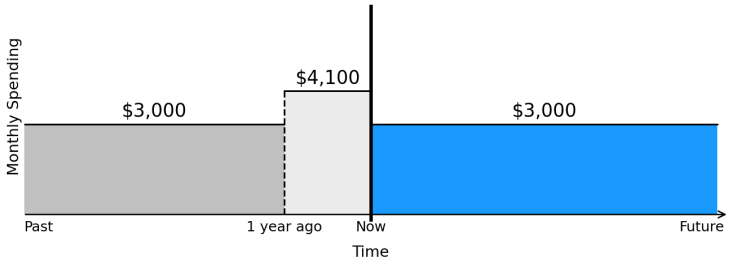



Imagine that the monthly spending in the **past year decreases to $4,100 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



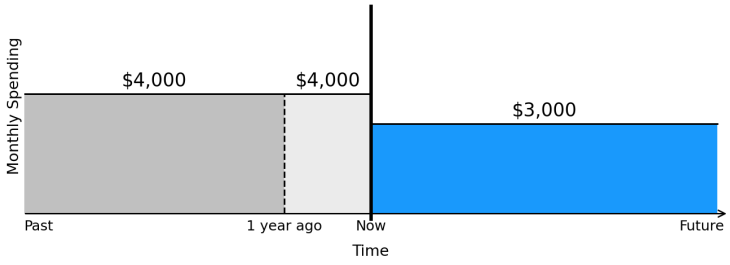
○ Universe Two:



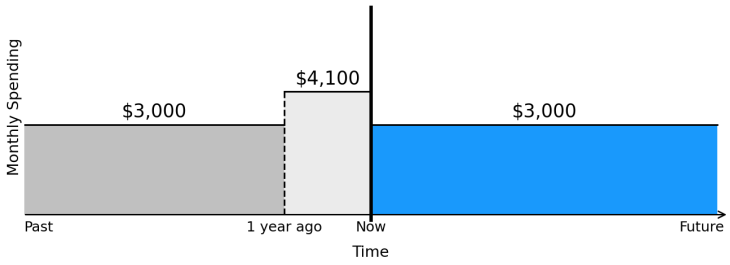

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

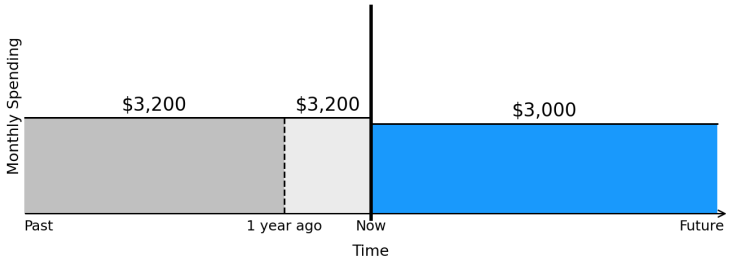



○ Universe Two:

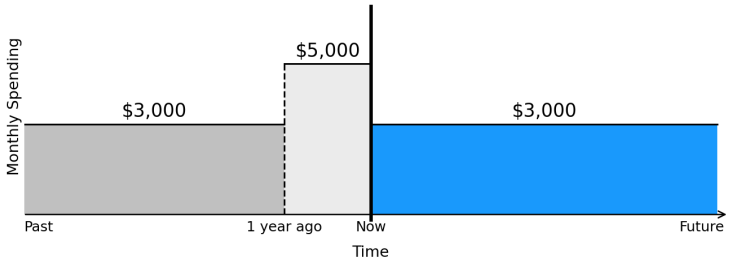



Imagine that the monthly spending in the **past decreases to $3,200 in Universe One.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



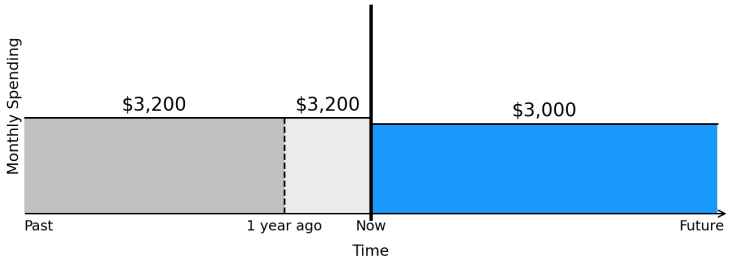
○ Universe Two:



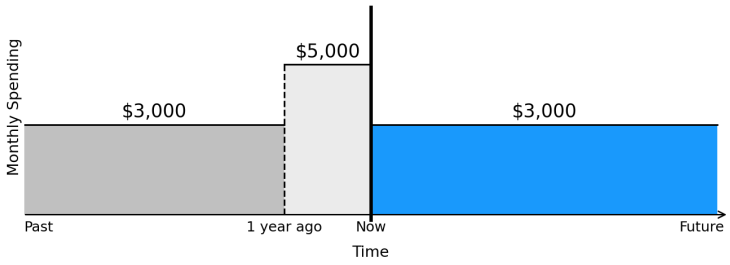

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



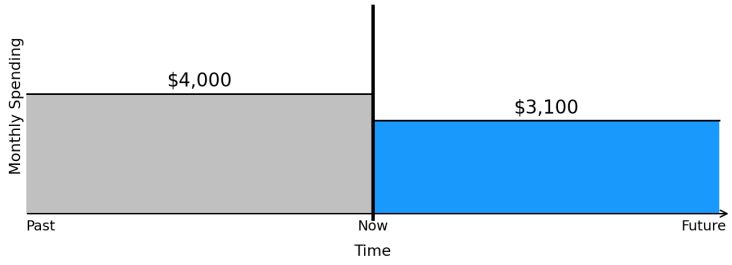

○ Universe Two:



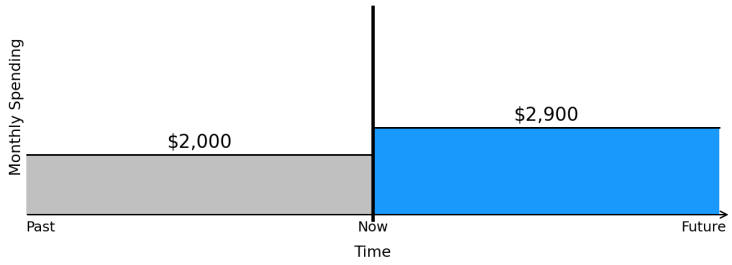

**Slope of indifference curve [3000]**

Imagine two universes that are identical, except for your monthly spending in the **past** and the **future**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



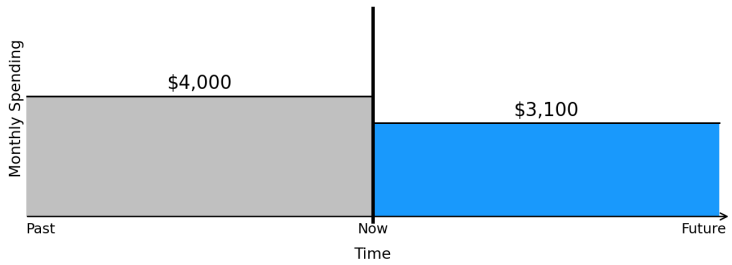

○ Universe Two:



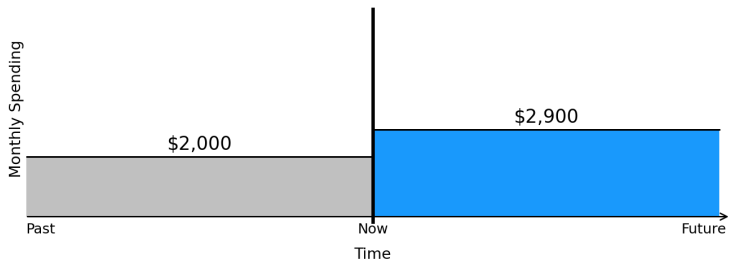

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

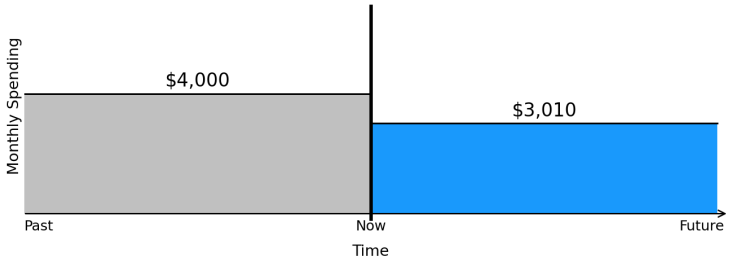



○ Universe Two:

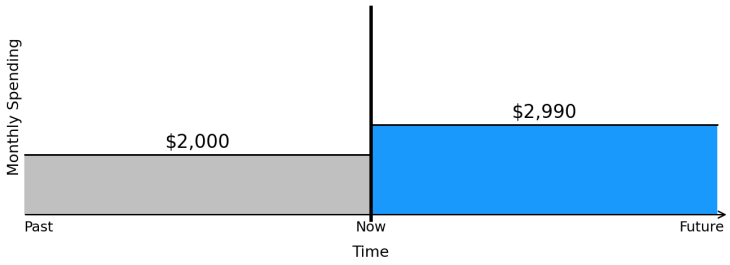



Imagine that the monthly spending in the **future decreases to $3,010 in Universe One and increases to $2,990 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



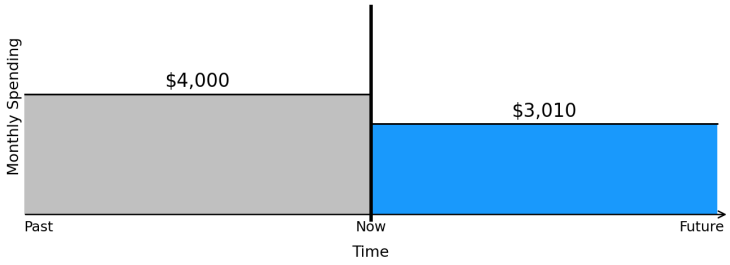

○ Universe Two:



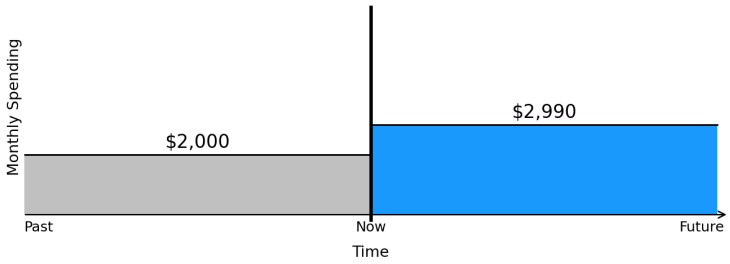

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

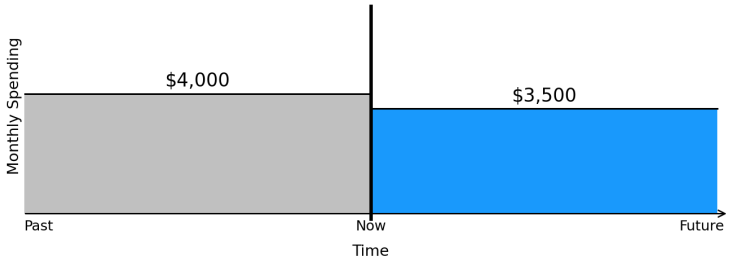



○ Universe Two:

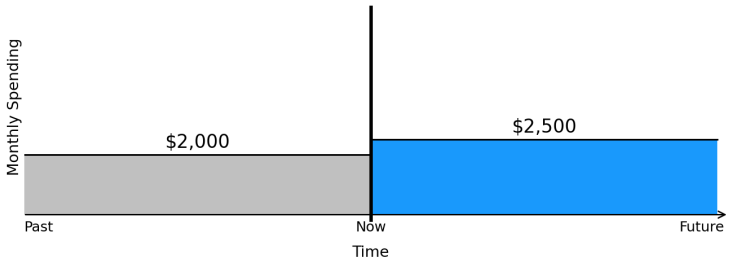



Imagine that the monthly spending in the **future increases to $3,500 in Universe One and decreases to $2,500 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



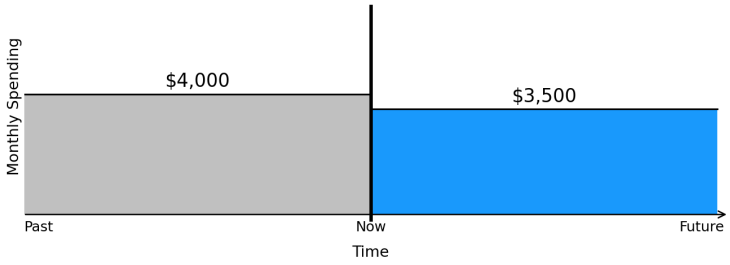

○ Universe Two:



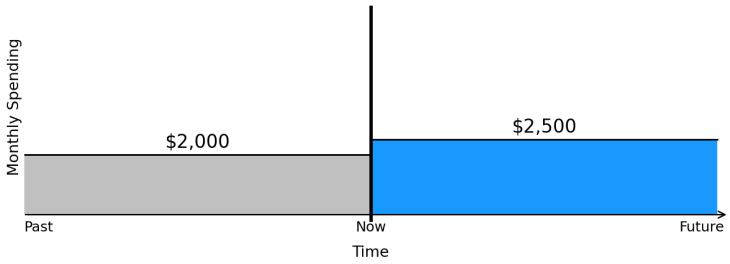

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



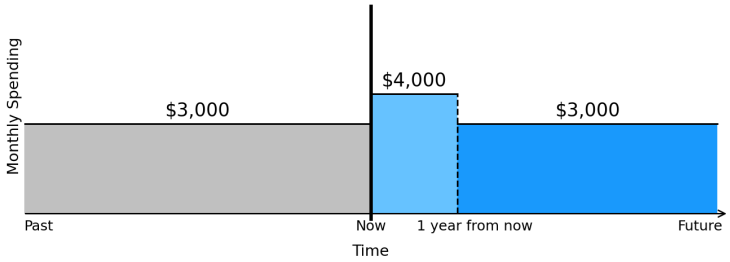

○ Universe Two:



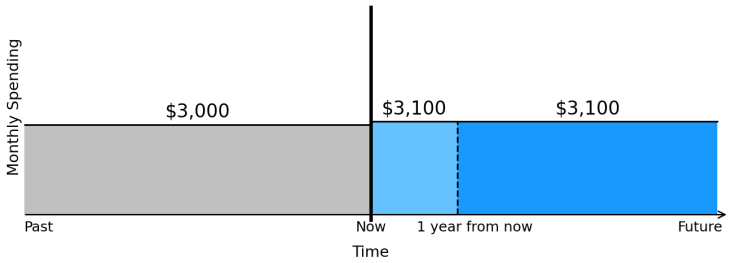

**Time discount rate [3000]**

Imagine two universes that are identical, except for your monthly spending in the **future**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:




○ Universe Two:

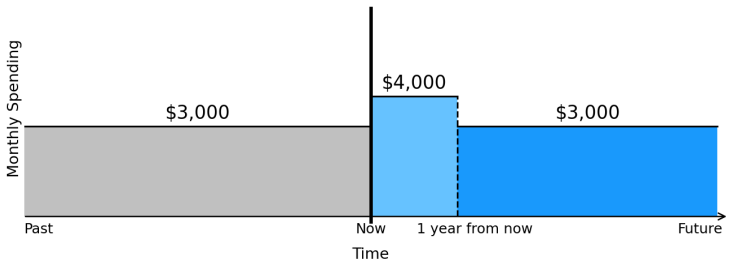



○ Same past experience in both universes

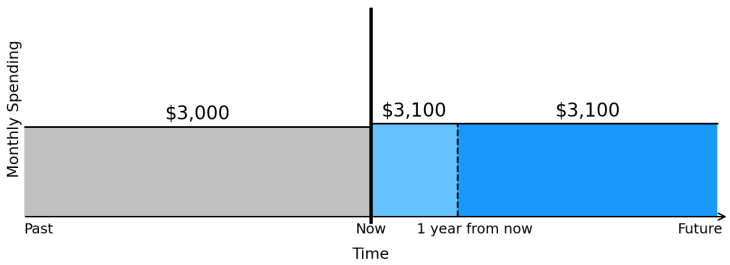
---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



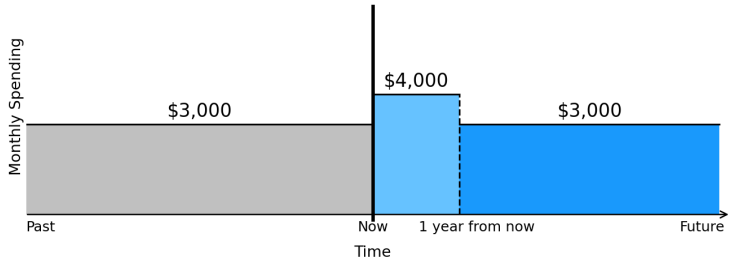

○ Universe Two:



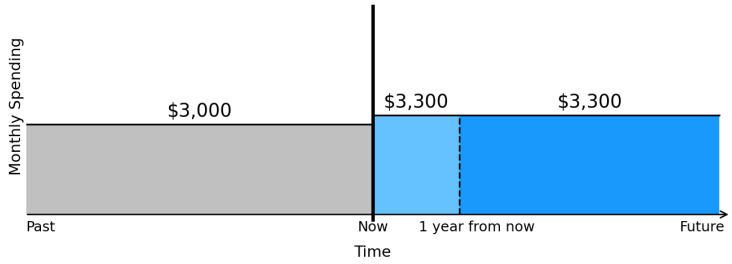

Imagine that the monthly spending in the **future increases to $3,300 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.
**Please choose Universe One regardless of your actual preference for this specific question (about the past). For other questions, including the one below about the future, please answer based on your actual preferences.**

Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:




○ Universe Two:

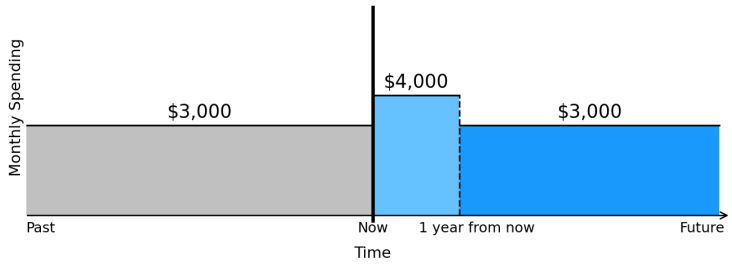



○ Same past experience in both universes

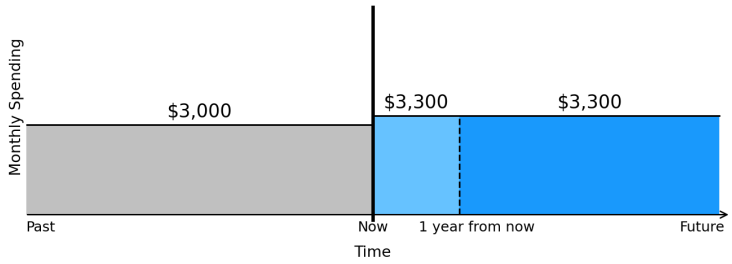
---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



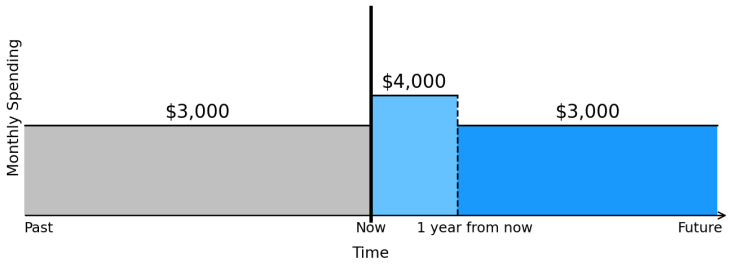

○ Universe Two:



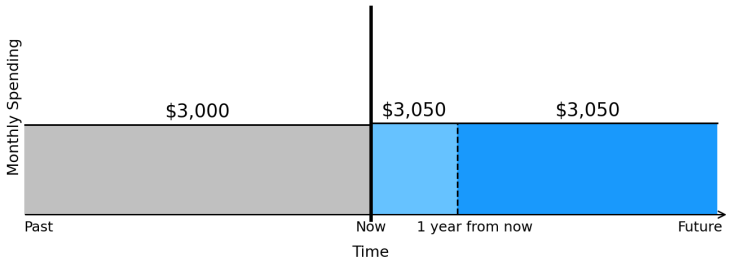

Imagine that the monthly spending in the **future decreases to $3,050 in Universe Two.**
Remember, past experience reflects how you felt about the past until now.

**Please choose Universe Two regardless of your actual preference for this specific question (about the past). For other questions, including the one below about the future, please answer based on your actual preferences.**
Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:




○ Universe Two:

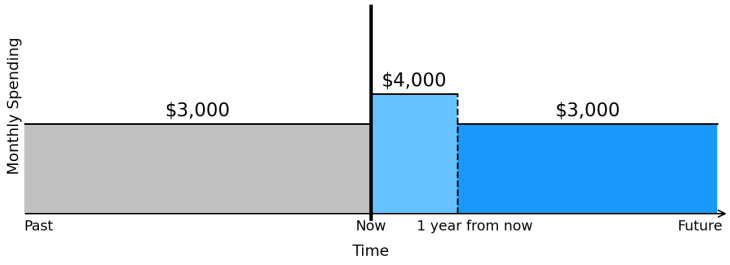



○ Same past experience in both universes

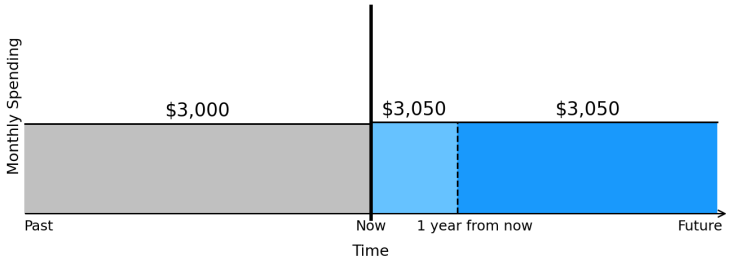
---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:




○ Universe Two:

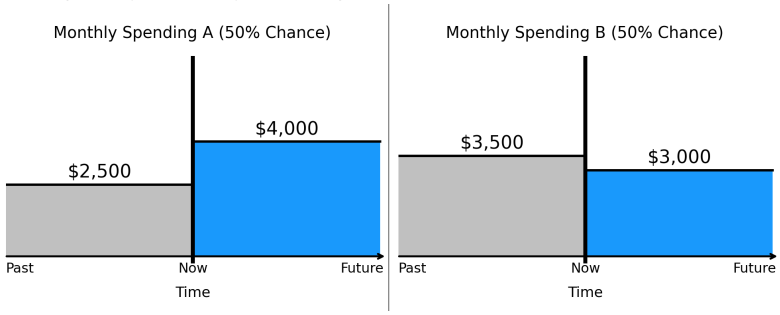


**Instruction: Uncertainty [3000]**

## Introduction to Uncertainty

In the next few questions, you will be asked to consider situations where there might be **uncertainty in your monthly spending within each universe**. This uncertainty is **represented by one universe having two different spending charts**.

Please review the example spending charts below, which depict two possible scenarios: “Monthly Spending A” and “Monthly Spending B.” **Each scenario has an equal 50% chance of occurring**. That is, in this universe, there is a 50% chance that your past spending was $2,500 per month with future spending increasing to $4,000 per month. Alternatively, there is a 50% chance that your past spending was $3,500 per month, with future spending decreasing to $3,000 per month.



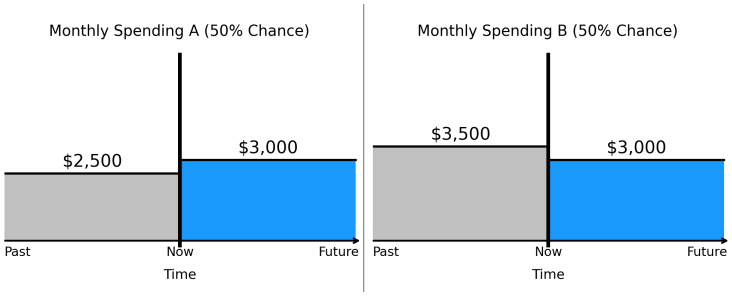

To save screen space and make it easier for you to compare the universes, the charts have been shrunken in size. However, please note that the time frames represented in these smaller charts are identical to those in the larger charts you’ve seen previously.

As you proceed, consider each universe carefully, taking into account any uncertainty within them, and evaluate which universe overall you would find more satisfying based on the given spending patterns.

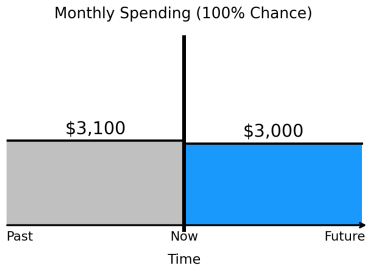
**euHH [3000]**

Imagine two universes that are identical, except for your monthly spending in the **past**. Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



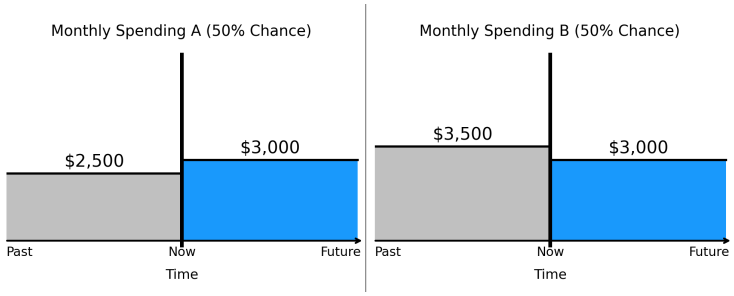
○ Universe Two:



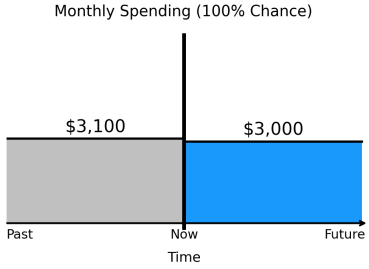

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

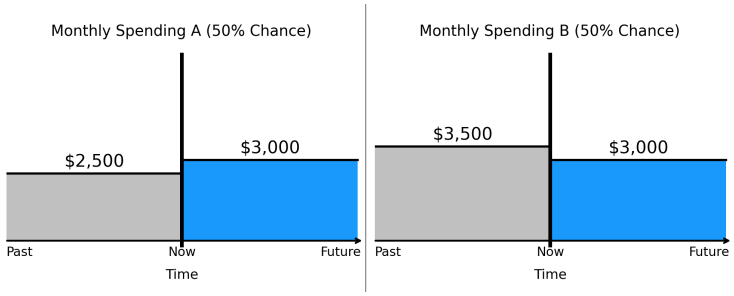



○ Universe Two:

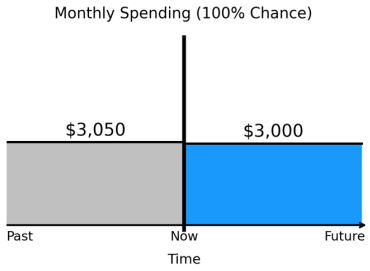



Imagine that the monthly spending in the **past decreases to $3,050 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



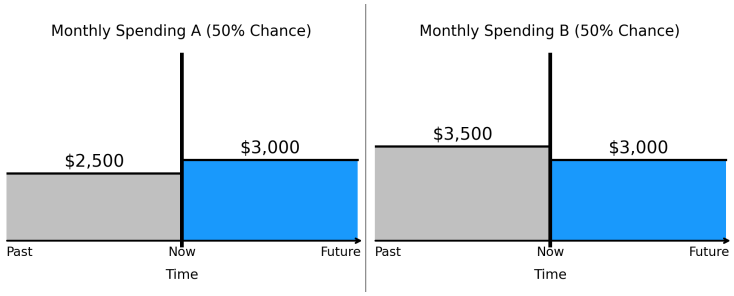
○ Universe Two:



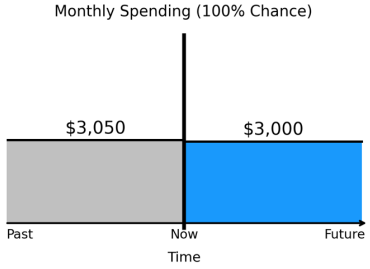

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

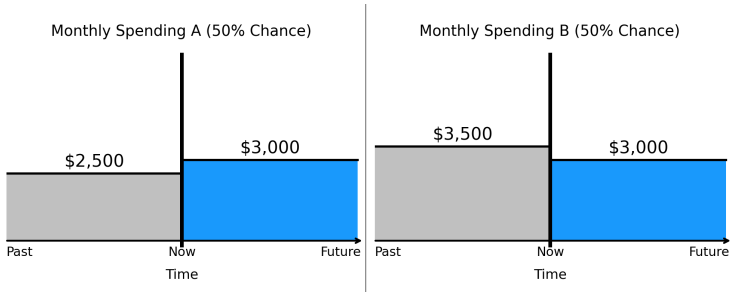



○ Universe Two:

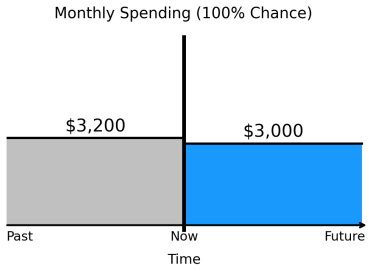



Imagine that the monthly spending in the **past increases to $3,200 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



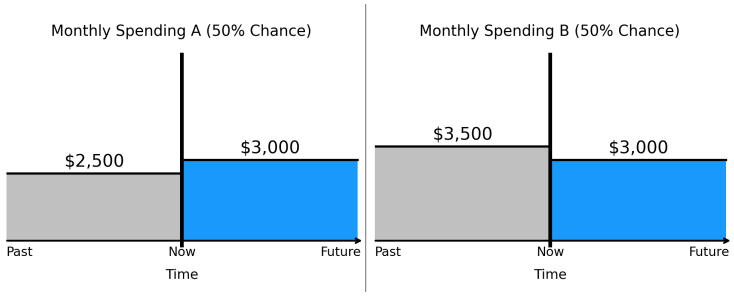
○ Universe Two:



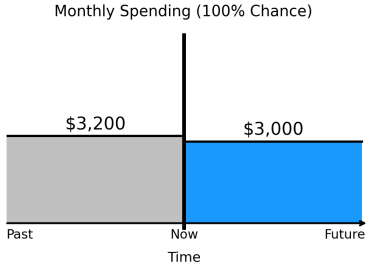

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



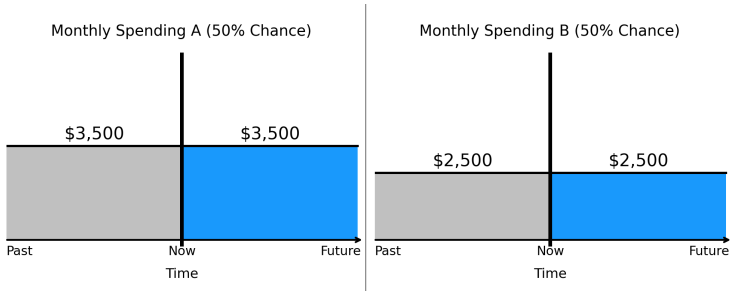

○ Universe Two:



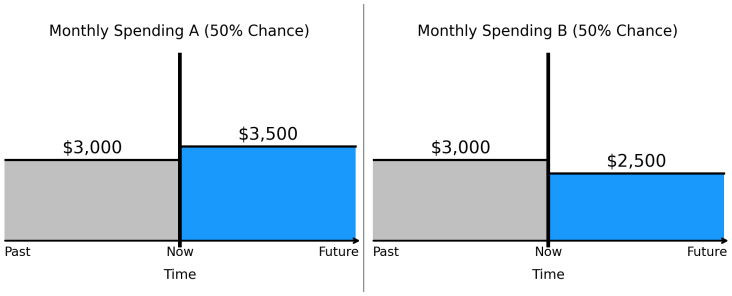

**uCHuHH [3000]**

Imagine two universes that are identical, except for your monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



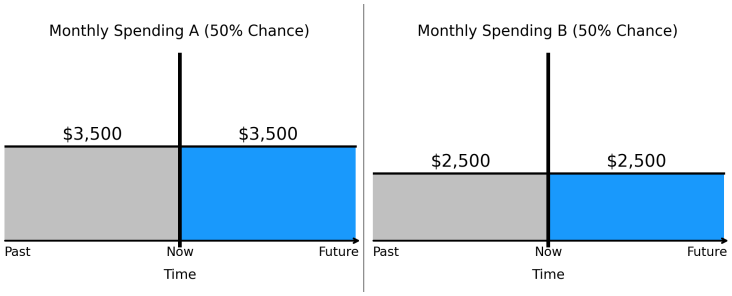
○ Universe Two:



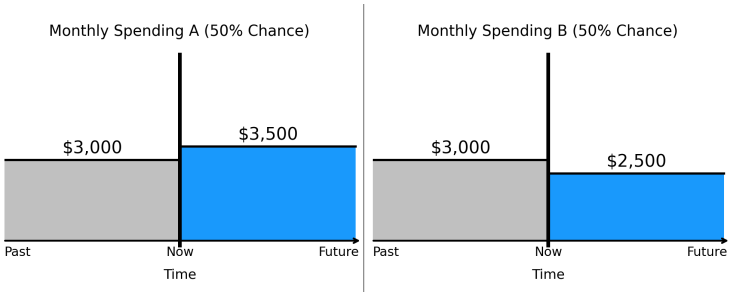

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

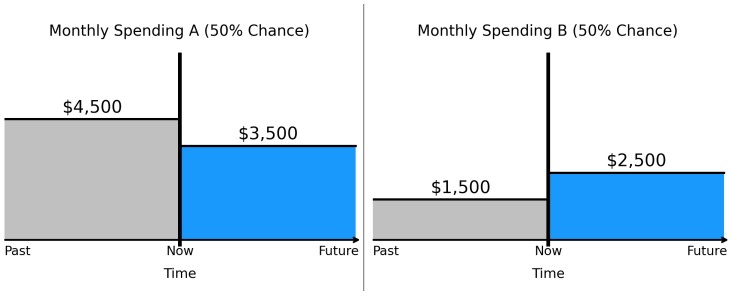



○ Universe Two:

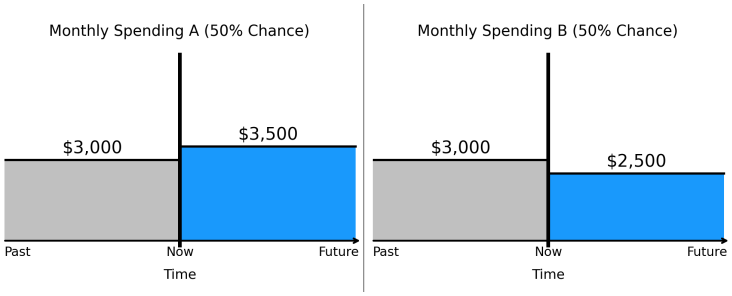



Imagine that in **Universe One**, the monthly spending in the **past increases to $4,500 in Monthly Spending A while decreases to $1,500 in Monthly Spending B**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



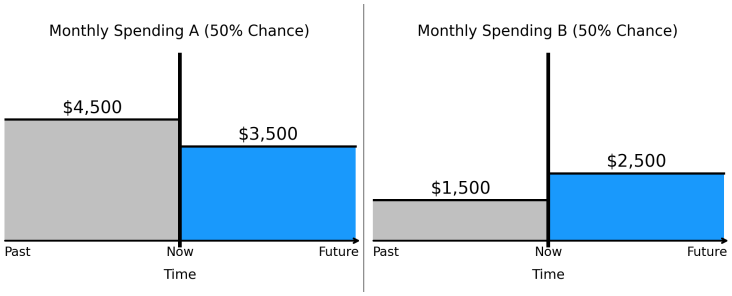
○ Universe Two:



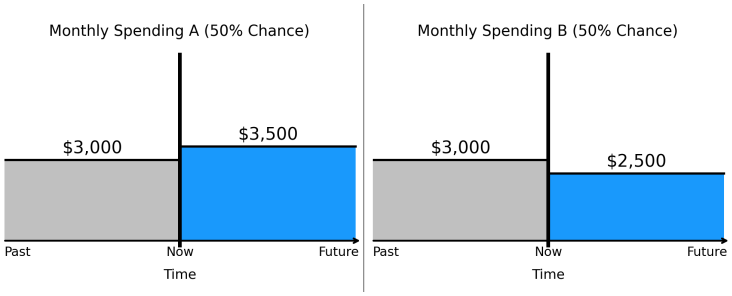

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:

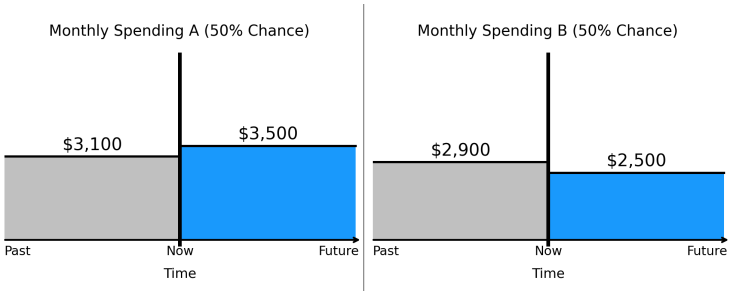



○ Universe Two:

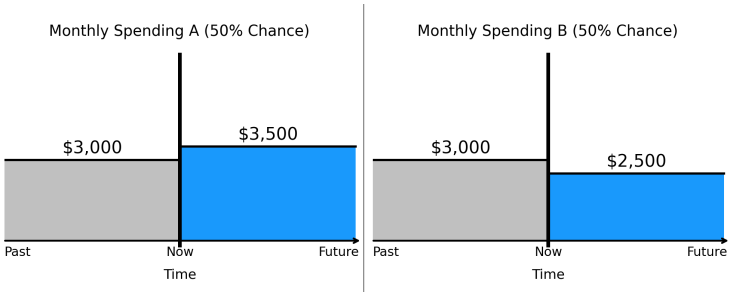



Imagine that in **Universe One**, the monthly spending in the **past decreases to $3,100 in Monthly Spending A while increases to $2,900 in Monthly Spending B**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



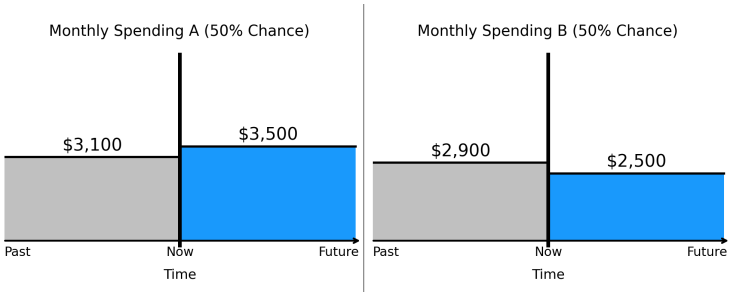
○ Universe Two:



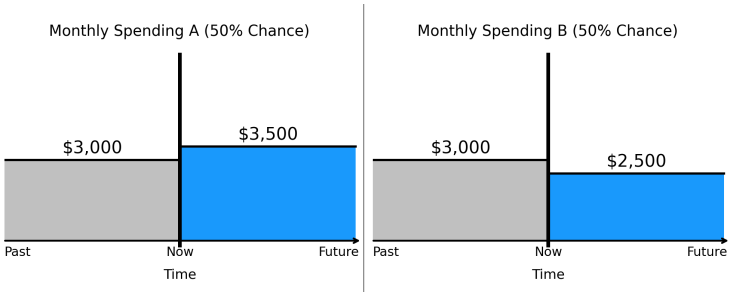

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



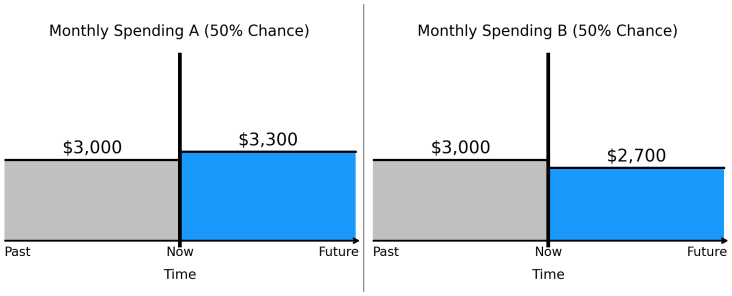

○ Universe Two:



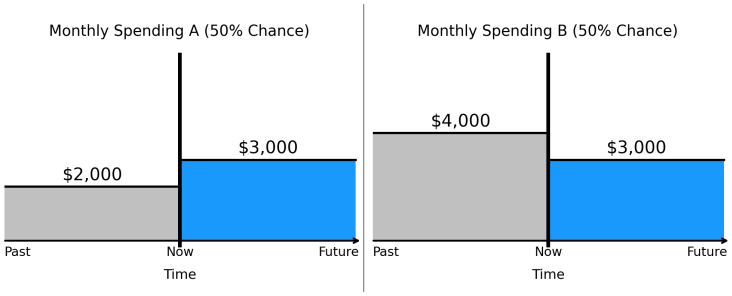

**uCCuHH [3000]**

Imagine two universes that are identical, except for your monthly spending in the **past** and the **future**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided you with a more satisfying **PAST** experience?

○ Universe One:



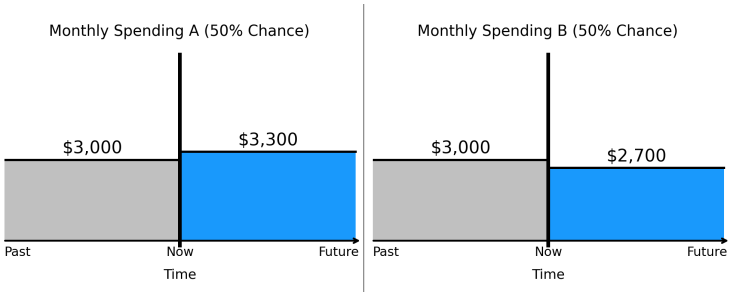

○ Universe Two:



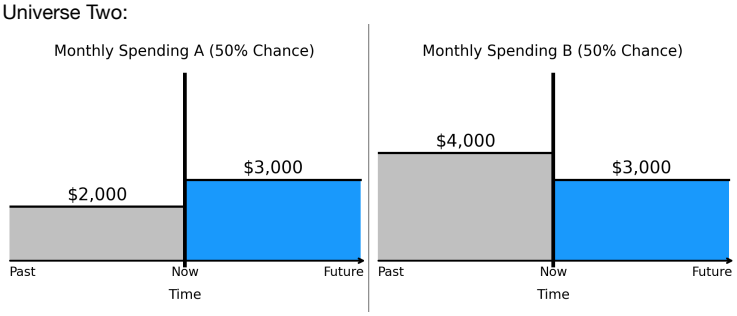

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



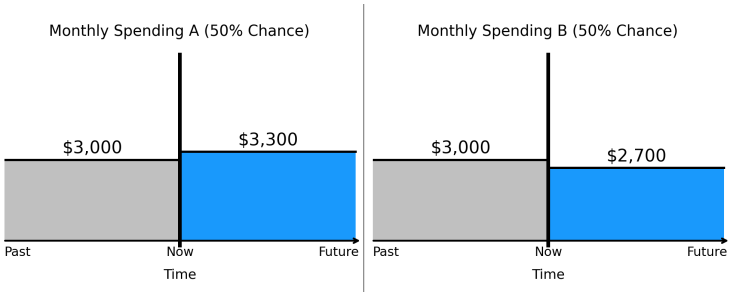

○ Universe Two:



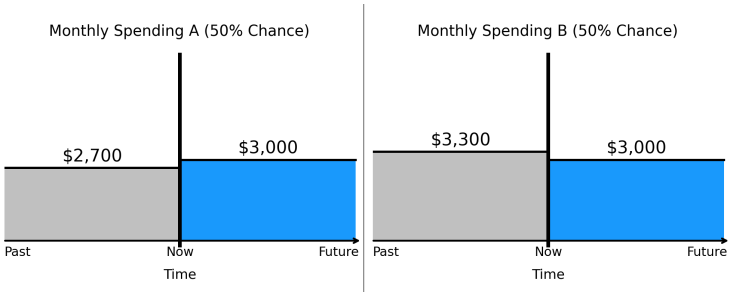

Imagine that in **Universe Two**, the monthly spending in the **past increases to $2,700 in Monthly Spending A while decreases to $3,300 in Monthly Spending B**.
Remember, past experience reflects how you felt about the past until now.
**Please choose Universe Two regardless of your actual preference for this specific question (about the past). For all other questions, including the one below about the future, please answer based on your actual preferences.**

Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:



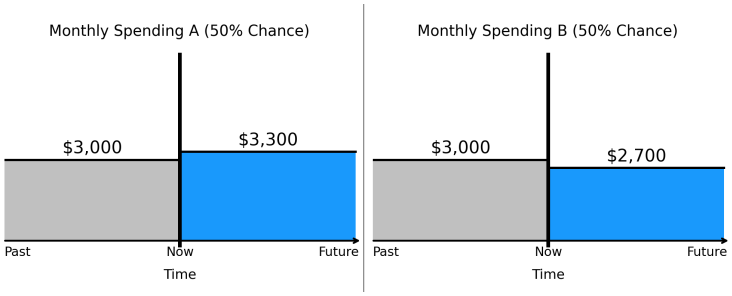

○ Universe Two:



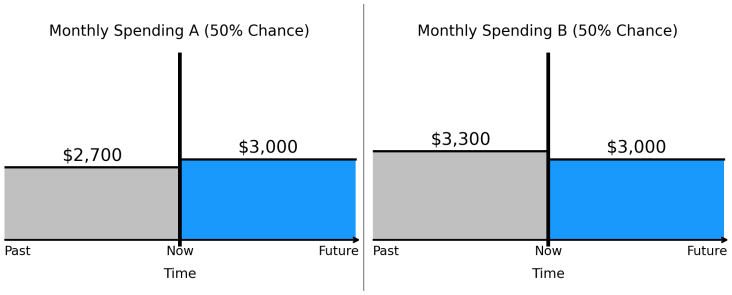

---

Remember, future experience reflects how you feel about the future starting now. Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:



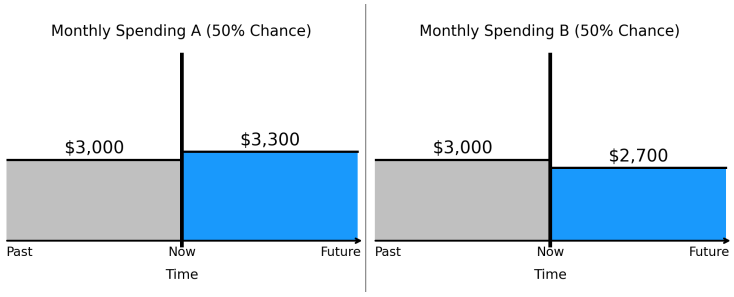

○ Universe Two:



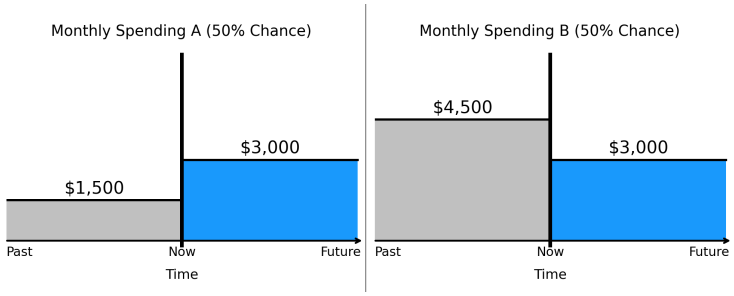

Imagine that in **Universe Two**, the monthly spending in the **past decreases to $1,500 in Monthly Spending A while increases to $4,500 in Monthly Spending B**. Remember, past experience reflects how you felt about the past until now.

**Please choose Universe One regardless of your actual preference for this specific question (about the past). For all other questions, including the one below about the future, please answer based on your actual preferences.**
Which universe would have provided you with a more satisfying **PAST** experience, based on the above instructions?

○ Universe One:



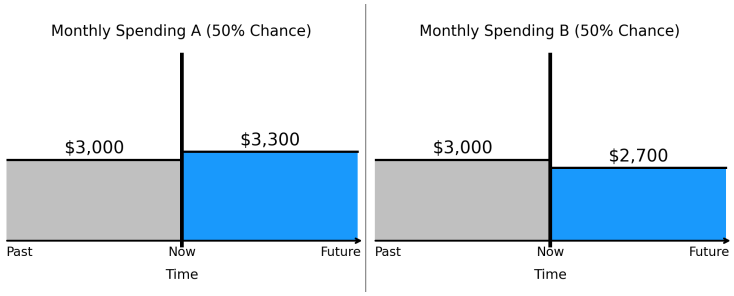

○ Universe Two:



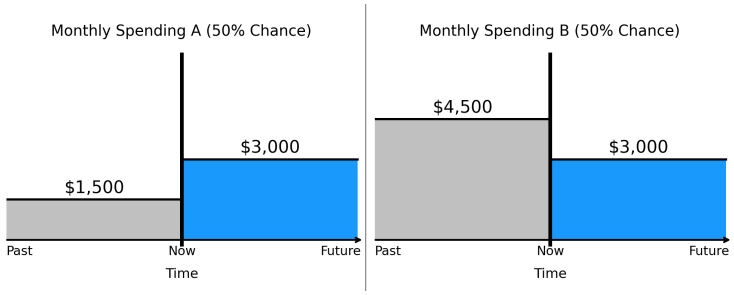

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide you with a more satisfying **FUTURE** experience?

○ Universe One:




○ Universe Two:

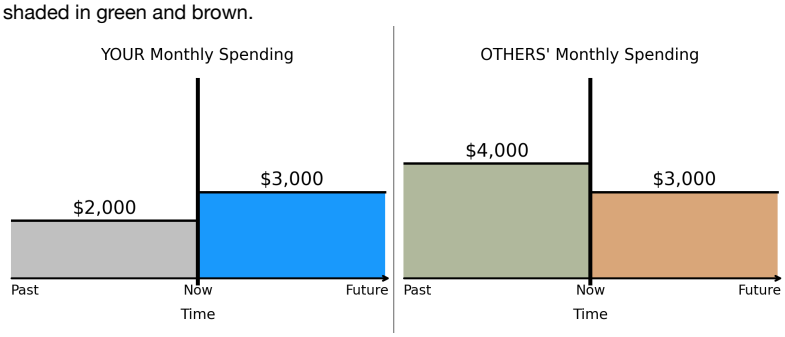


**Instruction: Others [3000]**

## Introduction to Other People's Spending

In the next few questions, you will be asked to consider not only your own monthly spending but also the spending of other people (referred to as "others"). Unlike the previous questions involving uncertainty, there is no uncertainty in these comparisons—both your spending and others' spending are fixed in each universe.

As shown in the example below, **your monthly spending is represented by the left chart, while others' monthly spending is shown in the right chart**. The two spending charts are differentiated by color to help you easily distinguish between them. Your spending chart is shaded as before in gray and blue, while others' spending chart is shaded in green and brown.

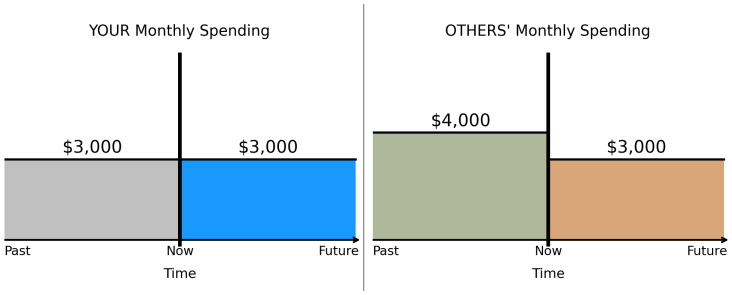



As you proceed, consider both your spending and the spending of others when evaluating which universe **you** would find more satisfying.

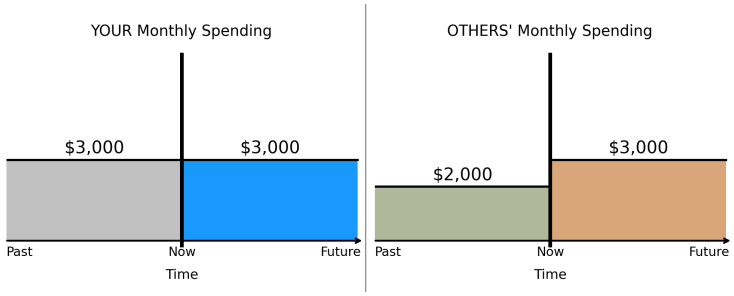
**Existence of external habit formation [3000]**

Imagine two universes that are identical, except for **other people's** monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



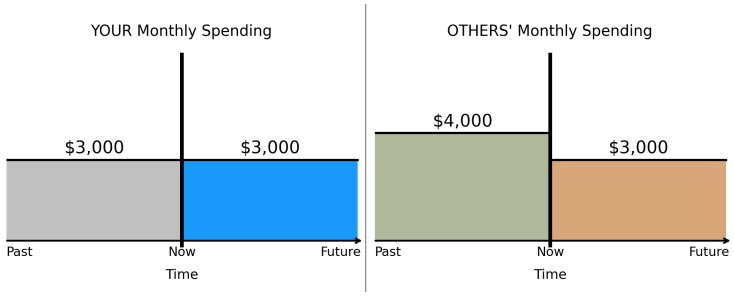
○ Universe Two:



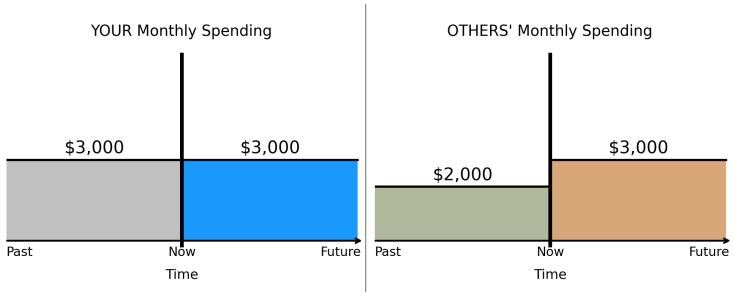

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:



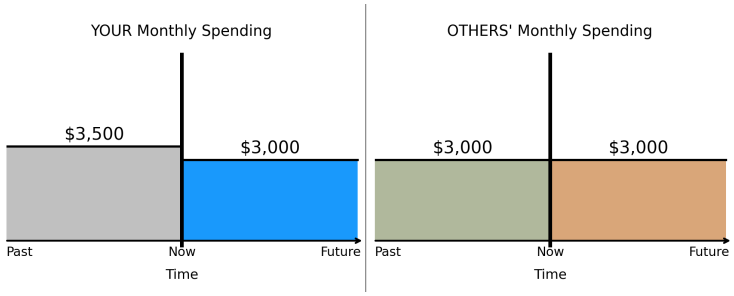

○ Universe Two:



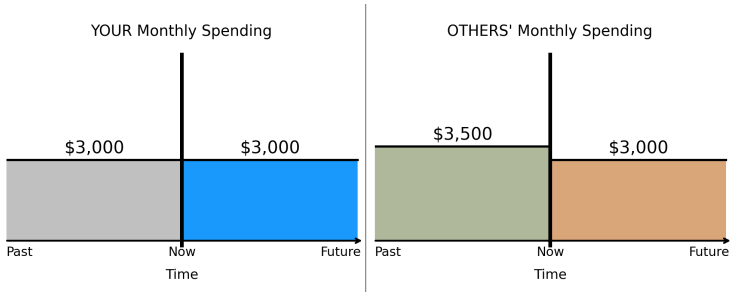

**Mixture habit [3000]**

Imagine two universes that are identical, except for **your and other people's** monthly spending in the **past**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



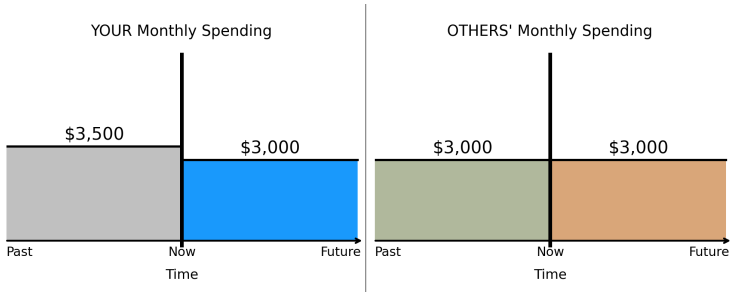

○ Universe Two:



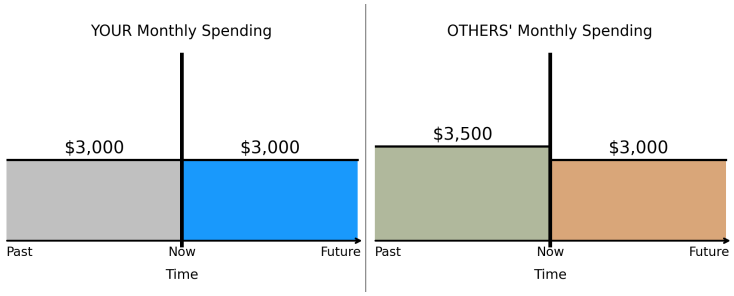

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

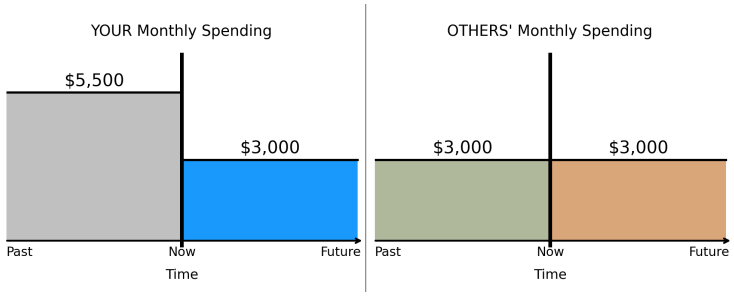



○ Universe Two:

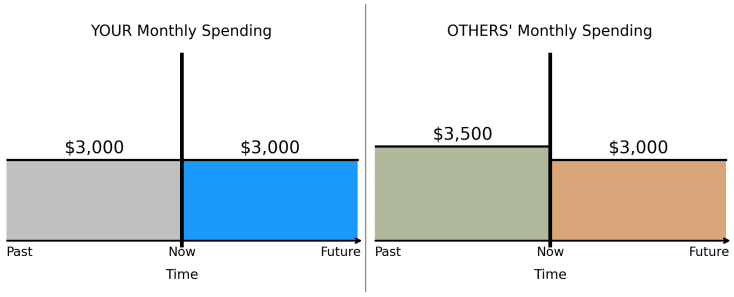



Imagine that **YOUR** monthly spending in the **past increases to $5,500 in Universe One**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



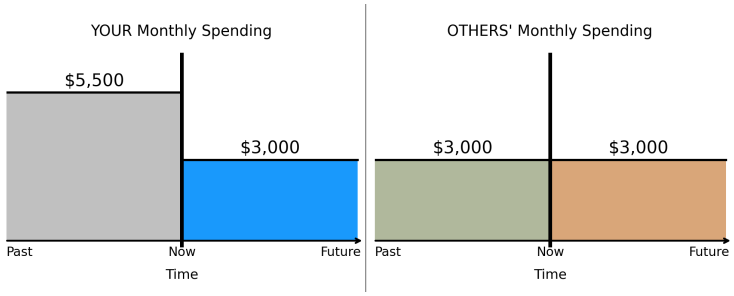

○ Universe Two:



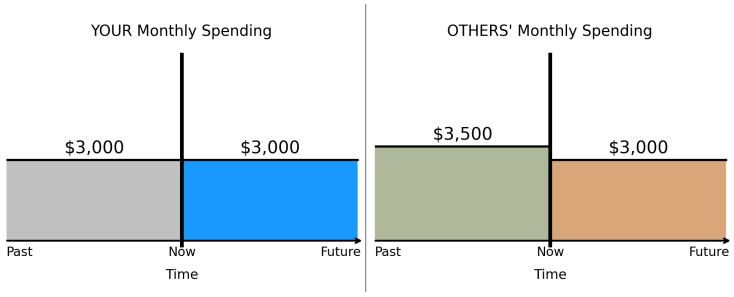

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

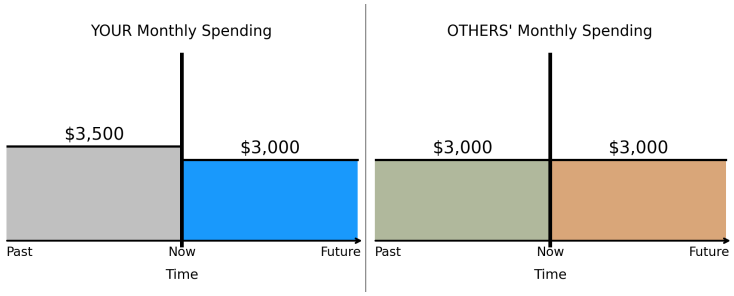



○ Universe Two:

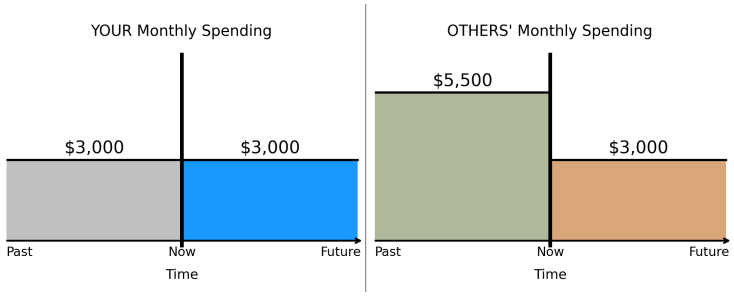



Imagine that **OTHER PEOPLE's** monthly spending in the **past increases to $5,500 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



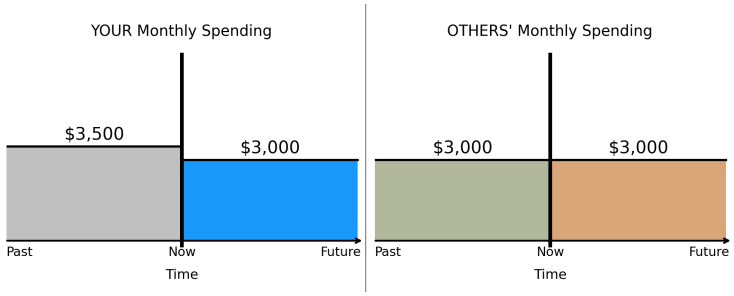

○ Universe Two:



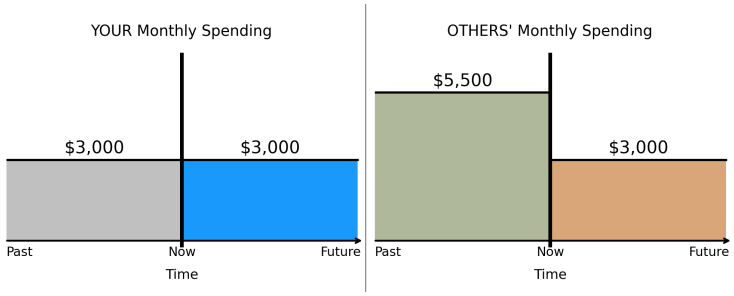

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:



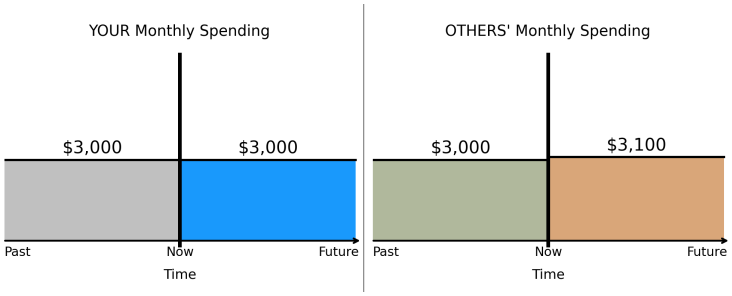

○ Universe Two:



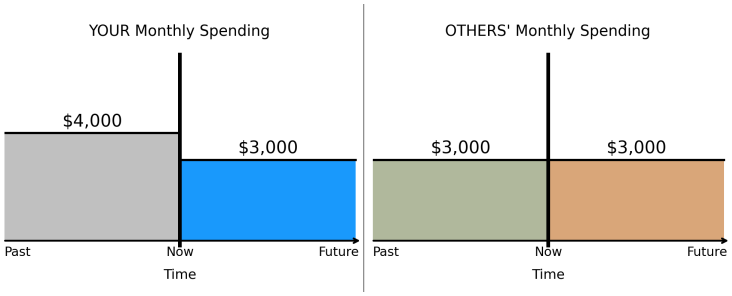

**uCothers uH [3000]**

Imagine two universes that are identical, except for **your past** monthly spending and **other people's future** monthly spending.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



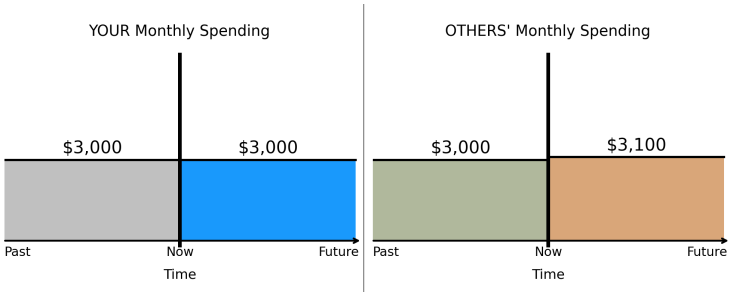

○ Universe Two:



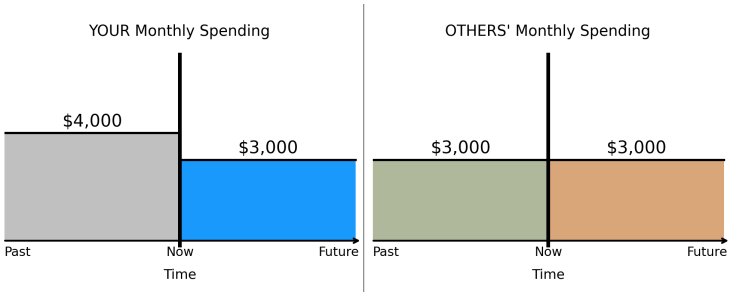

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

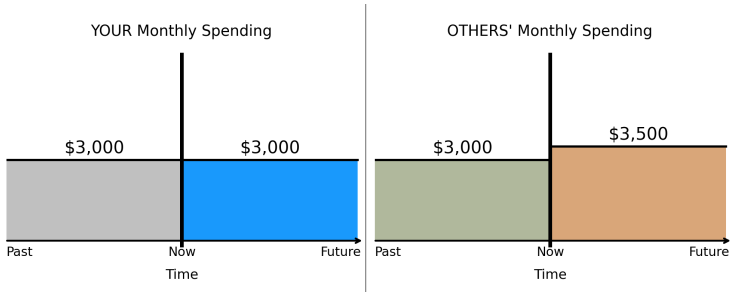



○ Universe Two:

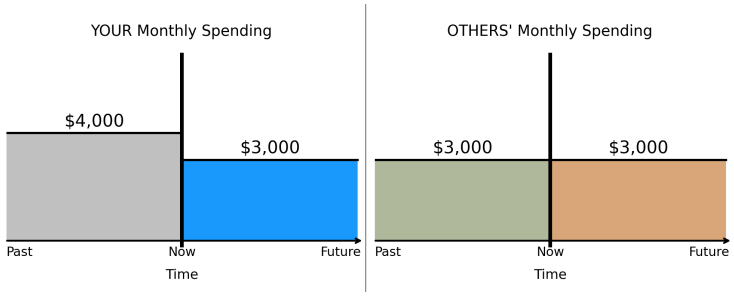



Imagine that **OTHER PEOPLE's** monthly spending in the **future increases to $3,500 in Universe One**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



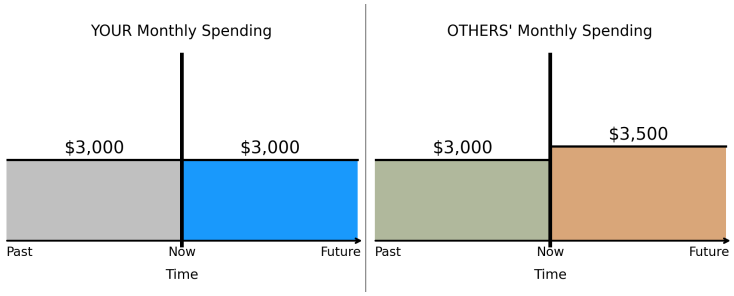

○ Universe Two:



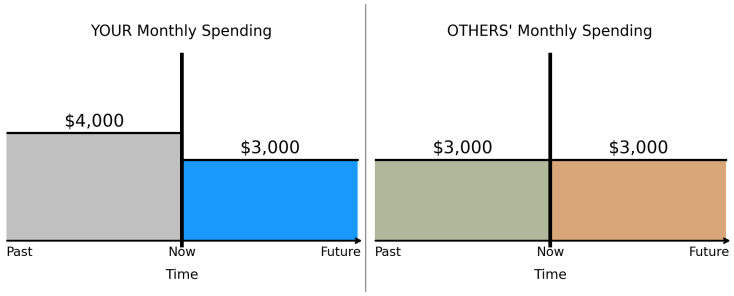

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:

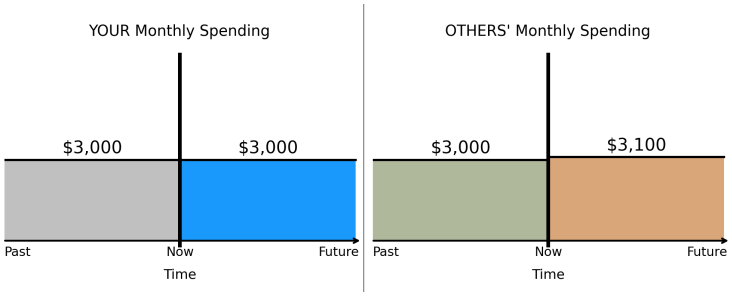



○ Universe Two:

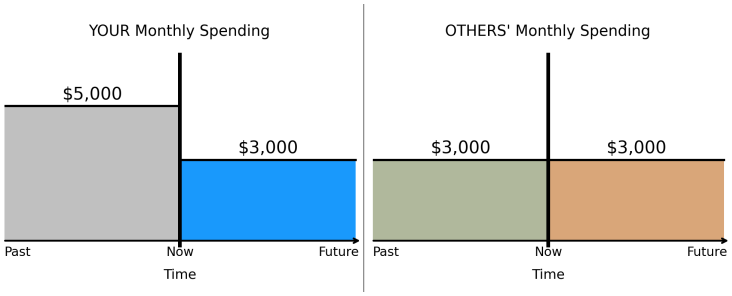



Imagine that **YOUR** monthly spending in the **past increases to $5,000 in Universe Two**.
Remember, past experience reflects how you felt about the past until now.
Which universe would have provided **you** with a more satisfying **PAST** experience?

○ Universe One:



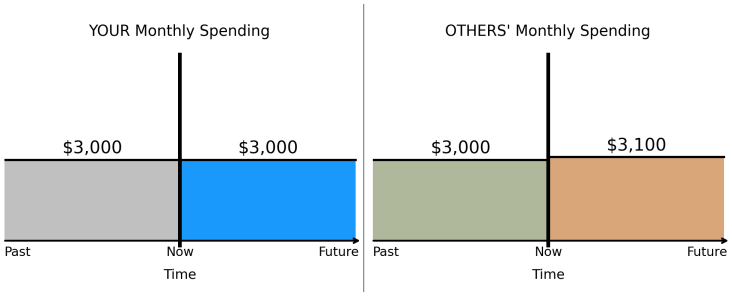

○ Universe Two:



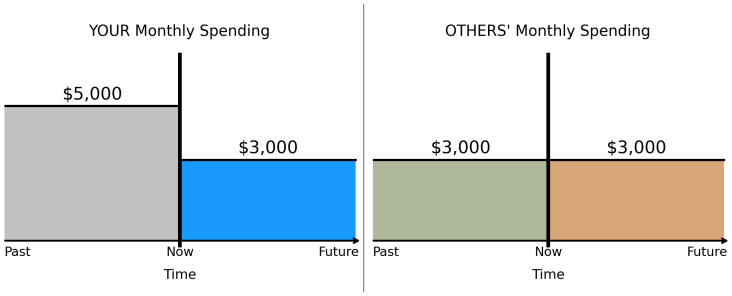

---

Remember, future experience reflects how you feel about the future starting now.
Which universe will provide **you** with a more satisfying **FUTURE** experience?

○ Universe One:




○ Universe Two:




**Comprehension checks on hypothetical situation (repeated) [3000]**

Under the hypothetical situation of this survey, if you can buy 3 bananas with one dollar in the last year, how many bananas can you buy with one dollar in the next year?

○ 5

- ○ 3
- ○ 1
- ○ No idea

Under the hypothetical situation of this survey, which of the following do you own (i.e., not rent)?

- ○ Residence
- ○ Car
- ○ Furniture
- ○ I do not own any of these
- ○ No idea

Under the hypothetical situation of this survey, do things you want change over time?

- ○ Yes
- ○ No

Under the hypothetical situation of this survey, do things not mentioned in the questions change?

- ○ Yes
- ○ No

Under the hypothetical situation of this survey, how much do people not mentioned in the questions always spend each month?

- ○ $2,000
- ○ $3,000
- ○ $4,500
- ○ $6,000
- ○ No idea

Under the hypothetical situation of this survey, which of the following is the **only difference** between the universes?

- ○ My income
- ○ My savings
- ○ My control over my finances
- ○ My spending
- ○ The economy

**Exit questions [3000]**

Here are some final questions about the survey. Approval of your work will not depend on your answers to these questions.

Would you like to participate in a follow-up survey in the future?

- ○ Yes
- ○ Maybe
- ○ No

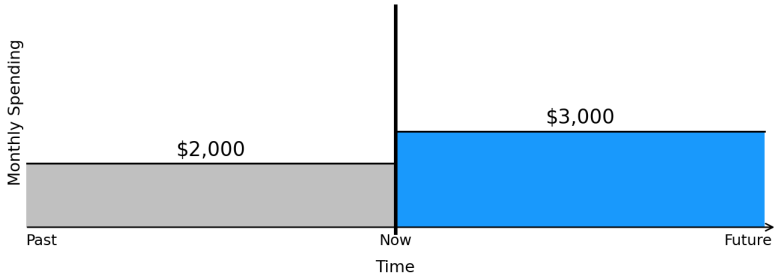
Off the top of your head, what do you recall the inflation rate in the US was for **2023**?

- ○ 2%
- ○ 4%
- ○ 6%
- ○ 8%
- ○ Cannot remember

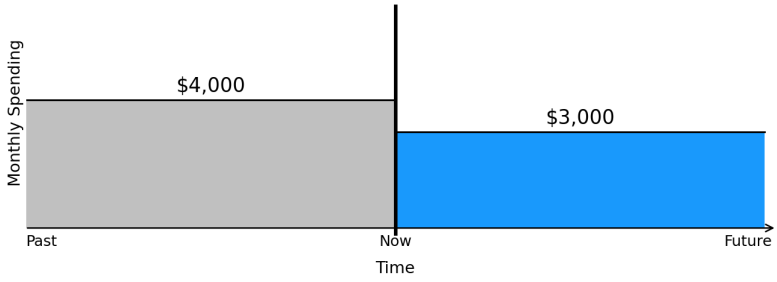
Could you explain why you selected **"${e://Field/ExistenceInternalChoice}"** in the following question?

Imagine two universes that are identical, except for your monthly spending in the **past**. Remember, future experience reflects how you feel about the future starting now. Which universe will provide you with a more satisfying **FUTURE** experience?

Universe One:




Universe Two:



It is vital to our study that we only include responses from people that devoted their full attention to this study. Otherwise, years of effort (the researchers' and the time of other participants) could be wasted. Your payment will not be affected by your answer. Please tell us **how much effort you put forth towards this study.**

- ○ I put forth almost no effort
- ○ I put forth very little effort
- ○ I put forth some effort
- ○ I put forth quite a bit of effort
- ○ I put forth a lot of effort

---

Please feel free to give us any feedback or impression regarding this survey.