The Limits of "Unlimited" Offers:

How Quantifying Constraints Can Increase Valuation

CONSUMER RELEVANCE AND CONTRIBUTION STATEMENT

Transportation providers offer unlimited passes, mobile carriers offer unlimited minutes, gyms offer flat-rate plans. With the rise of digital products and services—for which marginal costs are typically low—the prevalence of unlimited offers is likely to grow. Previous research has found that consumers are particularly drawn to unlimited offers, even when it would be more financially sensible to pay per use. We recognize that unlimited offers can be framed in different ways. Although most are *explicitly* unlimited (e.g., "unlimited internet access during your 5-day stay"), natural constraints on consumption often allow them to be framed in *de facto* unlimited terms (e.g., "120 hours of internet access…").

Presumably, marketers have gravitated toward explicitly unlimited offers because they promise unconstrained use without highlighting the necessary constraints on potential consumption. But de facto unlimited offers—through making explicit a (necessarily large) discrete usage limit—acquire appeal for two reasons. First, discrete limits serve as high anchors that elevate anticipated usage. Whereas previous work has emphasized that consumers are drawn toward (explicitly) unlimited offers due to overly optimistic usage forecasts, the present research shows that de facto unlimited offers further elevate such forecasts. Second, discrete limits facilitate comparison with other, constrained offers (e.g., "1 hour of internet"). Consumers are especially likely to recruit and be influenced by these reference offers when trying to monetarily value de facto unlimited offers, which leads them to scale up to larger monetary valuations than

they otherwise would have reached. These forces produce a preference reversal, which aids in researchers' understanding of differences in subjective (e.g., liking, attractiveness) and monetary (e.g., WTP, estimated price) valuation. These insights can also benefit practitioners who are currently failing to leverage alternate unlimited offer frames. The wisdom of using each frame depends on how a context requires consumers to express their preferences.

ABSTRACT

Consumers are often drawn to offers that promise unlimited access to a product or service (e.g., unlimited monthly mobile plans). Because actual consumption opportunities are typically finite, most unlimited offers can be framed not merely as explicitly unlimited (e.g., "unlimited minutes per month"), but also as de facto unlimited (e.g., "43,200 minutes per month"). Across seven studies, this manuscript identifies and explains a novel preference reversal rooted in how such offers are valued. Although explicitly unlimited offers are valued subjectively (as particularly attractive), de facto unlimited offers are seen as more monetarily valuable (eliciting higher willingness to pay, estimated prices). Two processes explain why de facto unlimited frames—despite imposing superficial constraints—elevate valuation. First, discrete usage limits serve as anchors that increase anticipated usage. Second, these discrete limits uniquely permit comparison with other (necessarily smaller) finite-usage plans that are simpler to price. Consumers thus call to mind and rely on these reference prices more often when pricing de facto unlimited offers, thereby explaining their greater monetary valuation. Discussion focuses on the ways in which this work moves research on unlimited offers in a qualitatively new direction and managerial implications for how unlimited offers should be presented in the marketplace.

Keywords: unlimited offers, framing, valuation, preference reversals

Consider a traveler who arrives at an all-inclusive beach resort for a weeklong vacation. Part of the travel package's appeal was the promise of unlimited food and drinks, unlimited live entertainment, and unlimited off-property excursions. But upon checking in, the traveler receives punch cards that place finite limits on each of these offerings. What was advertised as a constraint-free experience may seem to fall short of that promise.

Unlimited offers are widespread. Not just all-inclusive resorts, but internet service providers, cell phone carriers, and fitness clubs all offer unlimited packages, often as an alternative to paying per use. In theory, unlimited offers promise infinite use; however, real life is finite. There are only so many minutes in a day, so many meals one can eat, and so many shows one can see. At a resort that offers three meals a day and shows that start at 8pm each night, a weeklong resort guest has natural constraints on just how many times they can use these amenities. As a result, punch cards may not actually interfere with their "unlimited" experience.

Most *explicitly* unlimited offers can be reframed in terms of an equivalent discrete usage limit. If this limit is equal to (or greater than) the most one could possibly use, the offer is *de facto* unlimited. Which frame—explicitly or de facto unlimited—will seem more valuable to consumers? At first glance, explicitly unlimited offers may seem superior in every respect. Why would marketers advertise usage constraints if they do not have to? When MoviePass began offering unlimited movies for $9.95 per month and when Frontier Airlines unveiled an "all-you-can-fly" pass for $599 per year, they presumably sought to capitalize on the intuitive allure of explicitly unlimited offers. Why work out the math of just how many movies one could possibly watch or flights one could realistically take if "unlimited" is already as good as it gets? Unlimited service can be hard to value, but it is certainly more valuable than any finite offering.

However, it is the difficulty of valuing explicitly unlimited offers that can thwart their intuitive advantage. De facto unlimited offers spell out information that explicitly unlimited offers only imply: the actual amount that one *could* use. As we will argue and demonstrate, this can make de facto unlimited offers seem more valuable than explicitly unlimited offers, particularly when consumers express their valuation in monetary terms. The divergence between the intuitive appeal of infinite use and the provision of a high but meaningless finite usage limit can produce a robust preference reversal whereby explicitly unlimited offers are more subjectively attractive, while de facto unlimited offers seem more monetarily valuable.

TWO TYPES OF VALUATION

There are many ways in which consumers can express their preferences. They can rate how much they like a product, indicate their willingness to pay, express how likely they are to purchase, or select an option from a choice set. According to the assumption of procedure invariance that underlies rational choice and expected utility theories, consumers' relative preferences should not depend on how they are elicited (Holt 1986; Segal 1988; Tversky and Thaler 1990). In practice, however, different elicitation methods sometimes yield different patterns of valuation, which can give rise to *preference reversals* (Grether and Plott 1979; Tversky, Slovic and Kahneman 1990; Tversky and Thaler 1990).

Early demonstrations of preference reversals examined contexts in which consumers chose X over Y but also priced Y higher than X. In other words, they chose items that they believed to be less monetarily valuable (Grether and Plott 1979; Lichtenstein and Slovic 1971, 1973; Lindman 1971). Consider the appeal of a high-probability, low-payoff gamble (e.g., a 90%

chance to win $10) relative to a low-probability, high-payoff gamble (e.g., a 10% chance to win $90). In one study, 73% of participants consistently showed a preference reversal: Whenever they chose the former (high-probability, low-payoff) type of gamble, they also demanded a higher selling price for the latter (low-probability, high-payoff) type of gamble (Lichtenstein and Slovic 1971). Preference reversals like these do not simply emerge in evaluations of gambles. They have also been observed in preferences for smaller-sooner versus larger-later rewards (Slovic, Griffin and Tversky 1990), hedonic versus utilitarian products (O'Donnell and Evers 2019), and digital versus physical goods (Catapano, Shennib and Levav 2022).

Preference reversals are interesting in their own right. For one, they challenge traditional economic assumptions about how consumers access and then reveal their preferences. By showing that revealed preferences for the same product depend on the elicitation method, preference reversals reinforce that consumers partially construct their preferences on the spot, rather than consulting preexisting, well-formed, stable preference orderings (Bettman, Luce and Payne 1998). But also, if different elicitation methods produce systematically different preferences, then these different methods must be prompting different approaches to valuation.

We argue there are two broad types of valuation that different elicitation methods probe. Some measure more holistic *subjective* valuations, whereas others capture *monetary* valuations. Subjective valuation can be probed with liking or attractiveness ratings, and it typically revealed through choice. Just as consumers often choose high-probability, low-payoff gambles more frequently than would be implied by their willingness to pay, they also rate such gambles as more attractive (Goldstein and Einhorn 1987). More directly supporting the link between subjective valuation and choice, liking of a product is a more reliable predictor of choice than is willingness to pay (Hascher, Desai and Krajbich 2021). Subjective valuations often reflect the

expected pleasure of owning or consuming a product (Amir, Ariely and Carmon 2008). When expressing subjective valuation, consumers are guided by easy-to-assess, intuitive cues. For example, subjective valuations are disproportionately driven by attributes that are prominent (Tversky, Sattath and Slovic 1988), vivid (Shiv and Huber 2000), or intuitively appealing (O'Donnell and Evers 2019). It is the intuitive allure of hedonic goods as pleasant, fun, or exciting that leads them to be chosen more often than utilitarian goods (those that are practical, functional, or goal-oriented), despite utilitarian goods' eliciting higher willingness to pay. In one study, 72% of participants chose to receive two pints of ice cream rather than a pack of trash bags, but only 14% were willing to pay more for the ice cream (O'Donnell and Evers 2019).

In contrast, monetary valuations are revealed when consumers indicate how much they think a product is worth—either by estimating its market price or reporting their willingness to pay (WTP). Although market price and WTP are conceptually distinct, WTP is guided by *beliefs* about market price (Thaler 1985), which can themselves be informed by reference prices, firm costs, and marketplace norms (Amir et al. 2008). In one classic demonstration, consumers reported higher WTP for the same beer to be bought from a fancy resort hotel instead of a run-down grocery store (Thaler 1985). Relatedly, Catapano et al. (2022) found that consumers are willing to pay more for physical goods (vs. digital goods) than their choices would imply. In both cases, beliefs about what a product would cost guided WTP. Two reasons have been proposed for this link. First, because WTP is expressed in monetary terms, it is disproportionately swayed by monetary attributes (e.g., a gamble's monetary payoff, a product's market price). This is one specific application of the *compatibility principle*, the notion that the weight of an input to valuation is enhanced by its compatibility with the output (Tversky et al. 1988). Second,

according to Thaler's (1985) notion of transaction utility, a product's market price sets consumers' expectations for what is reasonable or fair to pay for it.

We proceed by using the distinction between subjective and monetary valuation to understand how consumers value unlimited offers. We will argue that each unlimited offer frame is appealing to consumers for different reasons. Because one reason applies uniquely to monetary valuation, we theorize that consumers' relative preference for explicitly and de facto unlimited offers will depend on which type of valuation they are expressing.

UNLIMITED OFFERS

Consumers find unlimited offers highly attractive. Typically, this has been established by comparing interest in explicitly unlimited offers to offers that require paying per use. Many consumers choose unlimited access to a service even when they could have saved money by paying for each individual use (Train 1991). This *flat-rate bias* (essentially, an economically unwise preference for unlimited offers) has been observed through consumers' seemingly excessive interest in unlimited telephone services (Kridel, Lehman and Weisman 1993; Train 1991), gym memberships (DellaVigna and Malmendier 2006), online grocery shopping subscriptions (Nunes 2000), and internet services (Lambrecht and Skiera 2006; Train, Ben-Akiva and Atherton 1989).

These explicitly unlimited offers have clear intuitive appeal. They not only promise a constraint-free experience, but also allow consumers to avoid the pain of individual payments (Lambrecht and Skiera 2006). Anyone who has repeatedly flinched as a taxi meter ticks up by has experienced the pain of paying per use firsthand. Furthermore, unlimited offers keep one

from accidentally racking up large pay-per-use bills, thereby offering a sense of safety to the risk averse (Musiol and Steul-Fischer 2019). For these reasons, although unlimited offers may have high up-front costs, consumers anticipate that they will enjoy consuming such offers due to the accompanying psychological benefits (Prelec and Loewenstein 1998).

Therefore, a straightforward initial assumption is that an explicitly "unlimited" offer will seem quite valuable to consumers, because it promises a quantity of use that cannot be exceeded. And in terms of a simple subjective valuation, we expect explicitly unlimited offers to fare quite well. After all, the "unlimited" label is a straightforward, easy-to-evaluate cue indicating that an offer is as good as it could possibly be; thus, it maps clearly onto consumers' intuitive sense of goodness versus badness. Such cues are weighed especially heavily in subjective valuation (Slovic et al. 2002, 2007). In contrast, when an unlimited offer is presented in de facto unlimited terms, the mere presence of a discrete usage limit may undermine these perceived psychological benefits and thus lower its subjective valuation. Whereas the attractiveness of an "unlimited" label is easy to assess, evaluating the attractiveness of a discrete usage limit may require the consideration of additional details. We thus expect consumers will typically see de facto unlimited offers as less subjectively valuable than explicitly unlimited offers.

However, previous research suggests that consumers do not simply mindlessly gravitate toward unlimited offers. In fact, part of what drives the perceived value of unlimited offers are consumers' beliefs about how much they will actually use them (Lambrecht and Skiera 2006; Nunes 2000). For example, consumers expect to visit the gym more often than they actually do (DellaVigna and Malmendier 2006), and these unrealistic expectations help explain who prefers unlimited over pay-per-use offers. Such optimism may even be strategic, with a belief that

purchasing unlimited offers will encourage more use. This suggests that factors that encourage even *greater* optimism about anticipated usage should elevate valuation even further.

When putting a *monetary* value on an unlimited offer, there are additional challenges that arise. For example, an all-inclusive vacation to Hawaii may sound quite subjectively appealing. But to decide how much one is actually willing to pay for such a trip, more details are needed. One might consider the trip's scope (e.g., "How many nights will we stay?") and the implications for its likely price (e.g., "The last all-inclusive resort we stayed at cost $500 a night."). Because the monetary valuation process is more complex than formulating a simple subjective valuation, it is important to consider how unlimited offer frames shape this process in particular.

Our analysis focuses on two processes that we theorize will elevate the perceived value of de facto unlimited offers and thus work against the baseline intuitive advantage that explicitly unlimited offers likely hold. First, de facto unlimited offers are unique in quantifying their true usage limit, which reveals to consumers how much these offers *could* be used. We argue that such limits serve as anchors that increase de facto unlimited offers' perceived value (the *usage-based anchoring* account). Second, de facto unlimited offers are more comparable to other (constrained) offers. This comparability is especially relevant when consumers move beyond subjective assessments to offer reasonable monetary valuations (the *reference-offer* account).

Usage-Based Anchoring Account

Unlimited offers derive their value in part from the amount that consumers expect to use them (Lambrecht and Skiera 2006; Nunes 2000). Whereas previous research has asked whether such usage expectations are systematically inflated—thereby calling into question the wisdom of

choosing an unlimited plan in the first place—we instead consider how different unlimited frames influence these expectations. De facto unlimited offers are differentiated from explicitly unlimited ones by their provision of a discrete usage limit. When consumers are considering how much they will use an offer, this usage limit may serve as an anchor. Of greatest relevance, it will always be a *high* anchor, because it represents the maximum possible amount of usage. Although consumers considering explicitly unlimited offers *could* reframe the offer in de facto unlimited terms, people tend to focus narrowly on the information provided to them instead of spontaneously appreciating alternative frames (Kahneman 2011).

Anchoring effects have been studied extensively in research on judgment and decision making. As people formulate numeric judgments, they often consider values that are not the exact answers to the questions they are considering—and are sometimes completely irrelevant—but that exert an assimilative pull on responses nonetheless. In some cases, anchors are self-generated (Epley and Gilovich 2001, 2006; Inbar and Gilovich 2011). This occurs when people do not know the answer to the question they are considering (e.g., "How many days is Venus's orbit?"), but they do know the answer to a related question (e.g., "I know Venus's orbit must be shorter than Earth's 365-day orbit."). However, in other cases—like in Kahneman and Tversky's (1974) original demonstration of anchoring—the numeric value is externally provided. Although there are many distinct mechanisms by which anchoring effects can occur (Brewer and Chapman 2002; Critcher and Gilovich 2008; Frederick and Mochon 2012; Mussweiler and Strack 1999; Strack and Mussweiler 1997; Tversky and Kahneman 1974), what unites these phenomena—and thus is central to our reasoning—is that responses are distorted toward the anchors (Critcher and Rosenzweig 2022). Furthermore, anchors continue to exert their pull even (and especially) when

they are implausibly large (Mussweiler and Strack 2001; Strack and Mussweiler 1997), which will typically be true of the usage limits specified by de facto unlimited offers.

Anchoring effects have been observed not merely in people's responses to trivia-style questions, but also in more consequential contexts. Opening offers in negotiations (Galinsky and Mussweiler 2001) and list prices in assessments of real-estate value (Northcraft and Neale 1987) can serve as anchors that draw final outcomes toward them. Willingness to pay for common products such as books and toasters are also influenced by anchors, in the form of list prices (Ariely, Loewenstein and Prelec 2003) and even arbitrary values such as the last two digits of one's social security number (Simonson and Drolet 2004). In one field experiment, consumers paid more for a bundle of items when the slider payment scale started at a default price of $20 or $9 than when it started at $3, even though everyone was free to pay any price (Jung, Perfecto and Nelson 2016). These examples vary in the extent to which the anchors may communicate new information, but they all demonstrate anchors' assimilative pull on judgments and decisions.

The present proposal differs from most existing anchoring literature in two ways. First, anchoring effects typically emerge when a salient number draws the target numeric judgment toward it. Such an influence is straightforward; it operates directly on the judgment of interest. For example, when consumers could pay what they wanted for a bundle of items, their payments did not stray very far from the anchor itself—in this case, the slider scale's starting value (Jung et al. 2016). We instead consider an anchor that operates not directly on the target judgment (i.e., valuation), but instead on an *input* to that judgment (i.e., anticipated usage). As consumers consider a de facto unlimited offer's value, the discrete usage limit may affect their response to a question that is relevant but not (already) asked: how much one would actually use the offer. By

increasing estimates of how much the de facto unlimited offer would be used, the discrete usage limit may serve as an anchor that indirectly increases valuation.

Second, anchoring is typically demonstrated by comparing the influence of high and low numbers (Tversky and Kahneman 1974). We instead compare the influence of a high anchor (the de facto unlimited offer's limit) to no anchor (because the explicitly unlimited frame lacks this feature). Although this type of anchoring effect has been less commonly identified, it does have some precedent. For example, when in-store shoppers were told that there was a (high) limit on the number of cans of soup they could buy (a dozen), they purchased more cans than when no limit, and thus no anchor, was present (Wansink, Kent and Hoch 1998).

Reference-Offer Account

Whereas subjective valuations merely require simple holistic assessments, monetary valuations are more demanding. They force consumers to translate their product attitudes and impressions into a price. In pricing *unlimited* offers, there is an additional challenge: One must price not just a single unit of consumption (e.g., "What is a reasonable price for one gym visit?"), but a larger quantity (e.g., "What is a reasonable price for the ability to go to the gym as often as I want for the next month?"). Because de facto unlimited offers replace the vague concept of "unlimited" with a discrete value, they help make the target of evaluation more concrete.

When consumers consider de facto unlimited offers' usage limits, these quantities—although precise—are still likely to be difficult to value directly. More generally, many quantitative attributes are difficult to evaluate in isolation (Hsee 1996). Such attributes acquire meaning through comparisons. For example, a dictionary with 20,000 entries might seem more

valuable when it is evaluated alongside one with only 10,000 entries (Hsee et al. 1999). Although marketers can offer up reference values strategically (Zha et al. 2021), reference values may also be conjured from consumers' memory (Stewart, Chater and Brown 2006). In evaluating the size of a 24-inch computer monitor, for example, consumers may call to mind the size of other monitors they have encountered in the past.

In judging the value of a voucher providing 120 hours of internet access, or a meal plan providing 21 meal swipes per week, one might instead consider a smaller offer that is more familiar or interpretable (Amir et al. 2008). For example, consumers may recall what they have paid for 24-hour internet access, or determine what they consider a fair price for a single meal. We call these *reference offers*. Even if consumers do not (and likely should not) value the meal plan 21 times more than they value the single meal, the intuitive allure of this proportional reasoning may encourage such scaling (Ariely et al. 2003). For example, when participants in one study were asked how much they would donate to help 20 needy children, they reported greater willingness to donate if they first considered how much they would donate to help a single child (Hsee et al. 2013). The smaller reference opportunity encouraged a massive scale-up.

By contrast, an explicitly unlimited offer—because it does not specify a discrete usage limit—is not directly comparable to such reference offers. Consumers may thus be less likely to spontaneously recruit a reference offer when pricing explicitly unlimited offers. And even when they do, reference offers can serve less as a basis for proportionally scaling up. Together, this leads to the two core predictions of our *reference-offer* account. First, in determining the monetary value of a de facto (vs. explicitly) unlimited offer, consumers should be more likely to consider a reference offer. Second, when consumers do consider such a reference offer, it should elevate the monetary valuation of de facto unlimited offers more than explicitly unlimited offers.

Note that this logic applies specifically to monetary valuation, because subjective valuation does not follow the same proportional logic. If a consumer values a bottle of wine at $5, they should value six bottles of that wine at approximately $30. But if they feel the bottle merits only a 1 on a 1-to-7 attractiveness scale, they should not necessarily rate six bottles as a 6 out of 7. As a result, subjective valuations tend to be insensitive to the presence of reference values (e.g., prices of smaller offerings) even when they are supplied (Amir et al. 2008).

OVERVIEW OF STUDIES

We present seven experiments that examine whether, when, and why consumers value de facto and explicitly unlimited offers differently depending on how their preferences are elicited. Study 1 establishes the basic subjective-monetary valuation dissociation for de facto and explicitly unlimited offers. Study 2 extends the dissociation beyond one marker of monetary valuation (WTP) to a second (estimated price). Study 3 varies whether participants are exposed to the alternate frame, the one not used by the firm. This allows us to distinguish whether it is the frames themselves that affect valuation, rather than information about the firm that is signaled by the use of one frame or the other.

All studies test the usage-based anchoring account by assessing whether participants anticipate greater usage of de facto than explicitly unlimited offers, and whether this can explain increased valuation. In addition, study 4 adds a de facto unlimited frame whose discrete limit is impossibly high. Given extreme anchors are still influential—and sometimes especially so—we tested whether even impossibly high discrete usage limits elevate valuation. Studies 5 and 6 test the reference-offer account using a thought-listing protocol (study 5) and an experimental

manipulation of reference prices (study 6). Study 7 examines downstream consequences. We test whether consumers' engagement with an ad for an actual unlimited offer depends on the unlimited frame, as well as how such patterns change when the ad includes pricing information (thus making monetary valuation more relevant).

We preregistered studies 1-4 and 6-7 (as well as the coding guidelines for study 5) on AsPredicted.org. Our preregistrations, materials, data, and analysis code are available at https://researchbox.org/1255&PEER_REVIEW_passcode=QBCJAH. Additional analyses, measures, and deviations from our preregistrations are detailed in the web appendix.

STUDY 1

Study 1 tested whether consumers' valuation of de facto (relative to explicitly) unlimited offers is greater for monetary (vs. subjective) valuation. Participants considered a series of unlimited offers: Half were *explicitly* unlimited, and half were *de facto* unlimited. For each offer, participants provided a monetary valuation (i.e., WTP) and a subjective valuation (i.e., an attractiveness rating). We predicted that de facto unlimited offers would elicit higher WTP, even while explicitly unlimited offers were perceived as more attractive.

Participants also estimated how much each offer would be used. This allowed us to examine two (non-mutually exclusive) possibilities. First, we probed our *usage-based anchoring* account by testing whether anticipated usage is greater for de facto (vs. explicitly) unlimited offers, and whether greater anticipated usage predicts higher valuation. These measures allowed us to probe an alternative *differential-weighting* account—that valuation is more a function of

anticipated usage for explicitly unlimited offers (for which no usage is suggested by the offer itself) than for de facto unlimited offers (which include a specific usage quantity).

Method

Participants and design. One-hundred ninety-six undergraduates at an American university participated as part of an hour-long session for which they received course credit. After applying preregistered exclusions, we were left with a final sample of 193 participants.

Procedure. Participants considered six vouchers that each described an offer from a different product category and context: shuttle service on a vacation, internet at a hotel, movies on an airplane, a data-usage plan for a tablet on a trip, a mobile phone plan for international travel, and an audiobook subscription. Each voucher would provide what was essentially unlimited use of the service over the course of a specified period of time. For half of the vouchers, the offer was *explicitly* unlimited (e.g., "unlimited internet access for use over 5 days"), whereas for the other half, it was *de facto* unlimited (e.g., "120 hours of internet access for use over 5 days"). For each participant, we randomly selected three vouchers to be presented in an explicitly unlimited frame while the other three were presented in a de facto unlimited frame. Participants evaluated all six offers in a random order. Table S1 provides more specific information on all vouchers used in all studies.

Participants evaluated each voucher on two measures. First, they indicated their WTP for it: "In U.S. dollars, what is the most you would be willing to pay for this offer?" Responses were elicited using an open-ended numeric text box that permitted responses greater than or equal to

$0. Second, participants indicated how attractive they found the offer: “How attractive is this offer to you?” (1 = “Not at all attractive”, 7 = “Very attractive”).

After evaluating all six vouchers, participants answered a few additional questions about each one, including their WTP for one unit of the service (e.g., WTP for *one* in-flight movie), which allowed us to account for individual differences in category valuation; an estimate of their personal usage of the service within the time frame specified on the voucher (e.g., “How many movies would you expect to watch during a 10-hour flight?”); and an estimate of the usage of a typical consumer for the same time frame (e.g., “How many movies would you expect a typical person to watch during a 10-hour flight?”). The two usage items were averaged (after standardizing them within each offer category) to create an *anticipated usage* composite (r = .72). Participants answered these questions about each offer before proceeding to the next one.

Results and Discussion

Monetary-subjective valuation dissociation. We began by testing whether the unlimited frame had divergent effects on monetary and subjective evaluations. To do this, we calculated a difference score between WTP and attractiveness for each voucher. We began by partialing out the effect of unit WTP on each valuation measure to control for baseline differences in valuation across participants for each voucher category. That is, we conducted separate linear regressions for each voucher with the dependent variable (log-transformed WTP or attractiveness) predicted by log-transformed unit WTP. We saved the standardized residuals from these models. We then calculated a *relative valuation* difference score for each voucher by subtracting the attractiveness standardized residual from the WTP standardized residual. Higher scores on this measure reflect

that a participant values a particular voucher relatively higher in monetary (vs. subjective) terms. Following our preregistration, we excluded the 1 observation whose log-transformed WTP value was more than 3.5 standard deviations above or below the mean for that particular offer.

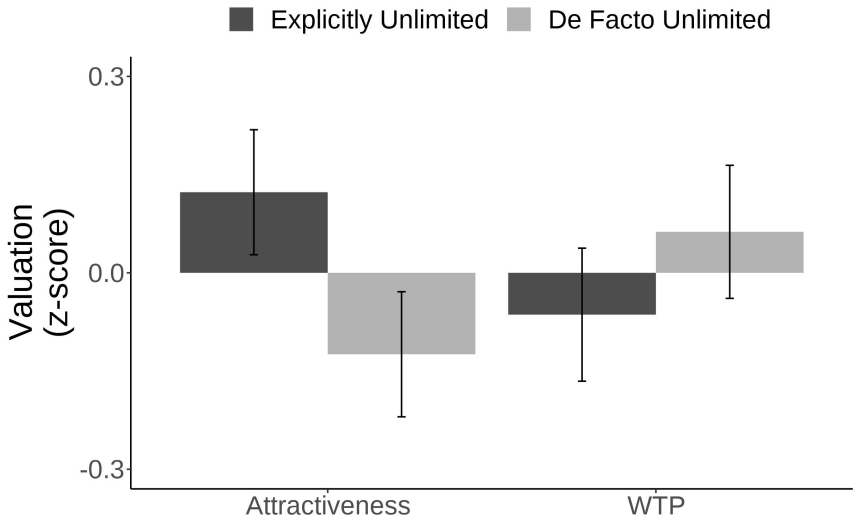
To test whether the unlimited frame manipulation led to a dissociation between monetary and subjective valuations, we conducted a linear mixed-effects regression with the relative valuation difference score predicted by the unlimited frame (-0.5 = explicit, 0.5 = de facto), with random intercepts for participant and offer category. Providing direct evidence of the dissociation, the effect of unlimited frame was significant, $b = 0.37$, $SE = 0.05$, $t(963.20) = 7.01$, $p < .001$. To interpret the dissociation, we decompose the difference score to examine the effects of the unlimited frame on attractiveness and WTP separately (figure 1). We report the aggregated effects in the main text, but effects by voucher for each study (and, where possible, averaged across studies) in the web appendix. For every voucher, those average effects are directionally consistent with the aggregate results reported below.

Attractiveness. Participants rated de facto unlimited offers ($M = 3.87$, $SD = 1.75$) as less attractive than explicitly unlimited offers ($M = 4.26$, $SD = 1.79$), $b = -0.25$, $SE = 0.05$, $t(963.08) = -4.72$, $p < .001$. As predicted, when providing subjective valuations, participants seemed to value explicitly unlimited offers more than de facto unlimited offers.

Willingness to pay. Monetary valuation also varied as a function of the unlimited frame, but in the opposite direction, $b = 0.13$, $SE = 0.05$, $t(963.05) = 2.53$, $p = .012$. Despite finding de facto unlimited offers less attractive than explicitly unlimited offers, participants were willing to pay more for them. Given monetary valuations varied considerably by voucher (something our standardization accounted for in terms of analyses), we capture monetary valuation effects by reporting the back-transformed means (in this and future studies) for the voucher whose effect

FIGURE 1

MONETARY AND SUBJECTIVE VALUATION AS A FUNCTION OF UNLIMITED FRAME (STUDY 1).



NOTE.—Error bars represent 95% confidence intervals for the model-predicted values.

was most similar to and at least as large of the overall effect. This *representative effect* was the two-week audiobook subscription, which elicited an average WTP of $8.45 in the de facto unlimited frame but only $7.24 in the explicitly unlimited frame.

Anticipated usage. First, we examined whether de facto unlimited offers are expected to be used more than explicitly unlimited offers. We then tested whether this statistically mediated the effect of frame on monetary valuation (consistent with the *usage-based anchoring* account). Second, we tested whether anticipated usage is less predictive of monetary valuation for de facto unlimited offers than for explicitly unlimited offers (consistent with the alternative *differential-weighting* account). We used the same linear mixed-effects model, but this predicted anticipated usage instead of valuation. This revealed that participants expected to use de facto unlimited offers more than explicitly unlimited offers, $b = 0.15$, $SE = 0.05$, $t(883) = 2.72$, $p = .007$. We then

added anticipated usage and its interaction with the unlimited frame manipulation to the model that predicted WTP. Although greater anticipated usage was associated with higher WTP, b = 0.07, SE = 0.03, $t(1082.47) = 2.51$, $p = .012$, the association did not depend on the unlimited frame, $t < 1$. Moreover, although the unlimited frame manipulation remained a significant predictor of estimated price, this effect was somewhat weaker, $b = 0.12$, $SE = 0.05$, $t(962.29) = 2.30$, $p = .022$ (Sobel $z = 1.85$, $p = .065$). These results are consistent with the usage-based anchoring, but not the differential-weighting, account.

We observed a nearly identical pattern of monetary valuation results across subsequent studies. As reported in the Web Appendix, the unlimited frame significantly changed anticipated usage in the predicted direction in 7 out of 7 relevant tests; anticipated usage, with the condition(s) controlled, significantly ($p < .05$) predicted monetary valuation in 6 of 8 relevant tests and marginally ($p < .10$) predicted it in one of the remaining cases. Also summarized in the Web Appendix, greater anticipated usage predicted not only greater monetary, but also greater subjective, valuation. However, we focus on the monetary valuation effects given it is only there that forces (including usage-based anchoring) fully overcome the intuitive allure of explicitly unlimited offers to make de facto unlimited offers seem more valuable. Regarding subjective valuation, greater anticipated usage may simply limit just how much of an advantage explicitly unlimited offers enjoy (akin to a suppressor effect).

Summary. Altogether, study 1 supported our prediction that consumers value explicitly unlimited offers more in subjective terms but de facto unlimited offers more in monetary terms. We also found initial support for the usage-based anchoring account: Participants anticipated using de facto unlimited offers more, which in turn predicted greater valuation.

STUDY 2

Study 2 examined whether the dissociation between monetary and subjective valuation of unlimited offers also extends to another form of monetary valuation: the estimated price of an offer. Because consumers determine their WTP, in part, based on their market beliefs (Thaler 1985), we expected that the greater WTP for de facto unlimited offers would be traceable to their beliefs that such offers are priced higher.

Method

Participants and design. We requested 600 U.S.-based participants from Amazon Mechanical Turk (MTurk) via CloudResearch. After applying preregistered exclusions, we were left with a final sample of 593 participants.

Procedure. Participants considered six vouchers providing unlimited use of a service, similar to those in study 1: a coffee subscription, a monthly train pass, TV episodes on an airplane, a data-usage plan for a tablet on a trip, a mobile phone plan for international travel, and an audiobook subscription. For each participant, three vouchers were randomly selected to be presented in an *explicitly* unlimited frame, and the other three were presented in a *de facto* unlimited frame. The six offers were presented in a random order.

After reading a description of a voucher, participants first estimated the price of the voucher using an open-ended numeric text box: “In U.S. dollars, what do you estimate is the price of this voucher?” They then completed the same WTP and attractiveness measures used in study 1. After evaluating all six vouchers, participants completed a set of additional measures for

each voucher (one voucher at a time): WTP for one unit of the service (again to control for baseline interest in the category), and estimates of how much they and a typical consumer would use the voucher. The two usage items were standardized within each voucher and then averaged (r = .76) to create an *anticipated usage* composite for each participant for each voucher.

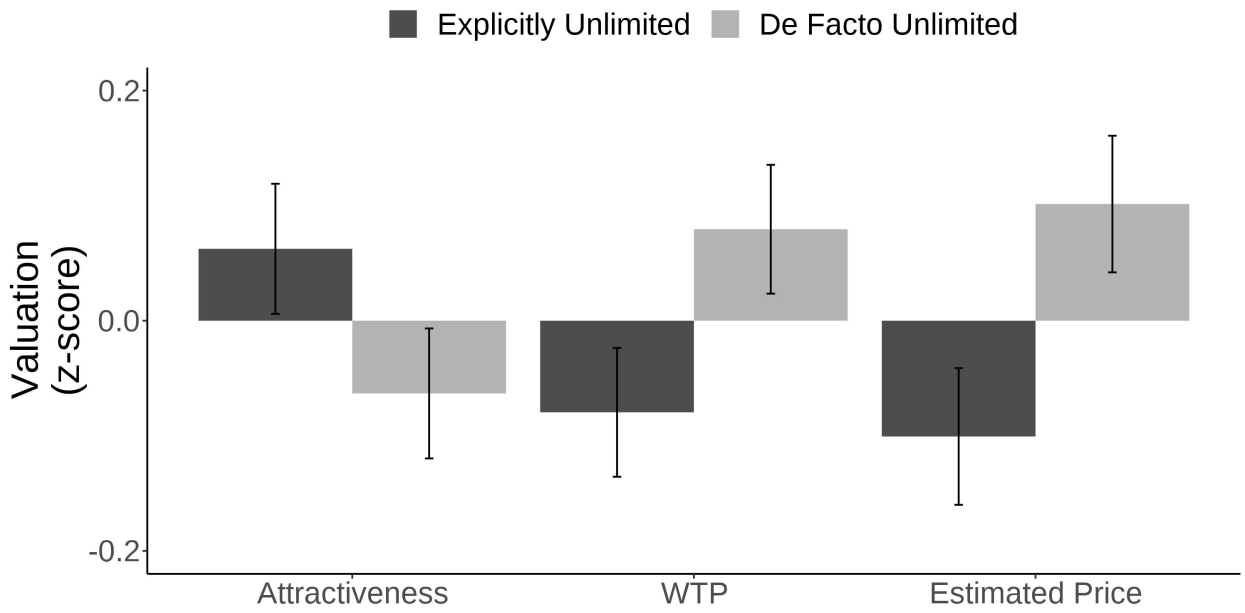
Results and Discussion

Monetary-subjective valuation dissociation. We began by testing whether the two unlimited frames have divergent effects on monetary and subjective valuation. Given we had two measures of monetary valuation, in this case we calculated (following the same approach detailed in the Results of study 1) two relative valuation difference scores: WTP-attractiveness relative valuation (WTP minus attractiveness) and price-attractiveness relative valuation (estimated price minus attractiveness). Higher values indicate greater monetary valuation relative to subjective valuation. As preregistered, we excluded the 11 observations whose log-transformed WTP or estimated price values were more than 3.5 standard deviations from the mean for that particular voucher.

Replicating the basic dissociation observed in study 1, WTP-attractiveness relative valuation was greater for de facto unlimited offers than for explicitly unlimited offers, b = 0.29, SE = 0.03, $t(2953.90) = 8.85$, $p < .001$. The analogous effect emerged for price-attractiveness relative valuation, b = 0.33, SE = 0.04, $t(2952.99) = 8.90$, $p < .001$. Both effects reflect that participants valued de facto unlimited offers more in monetary terms (i.e., WTP, estimated price) than in subjective terms. In order to understand these dissociations more clearly, we proceed to examine the effects of unlimited offer frame on each valuation measure separately (figure 2).

FIGURE 2

MONETARY AND SUBJECTIVE VALUATION AS A FUNCTION OF UNLIMITED FRAME (STUDY 2).



NOTE.—Error bars represent 95% confidence intervals for the model-predicted values.

Attractiveness. Like in study 1, explicitly unlimited offers were perceived as more attractive (M = 4.10, SD = 1.95) than de facto unlimited offers (M = 3.82, SD = 1.91), b = -0.13, SE = 0.03, t(2955.04) = -4.30, $p < .001$.

Willingness to pay. In contrast, participants reported higher WTP for de facto unlimited offers than for explicitly unlimited offers, b = 0.16, SE = 0.03, t(2952.68) = 5.40, $p < .001$. The representative effect was the monthly train pass, which was expected to cost $62.15 in the de facto unlimited frame and $51.91 in the explicitly unlimited frame (back-transformed means).

Estimated price. On the new measure of monetary valuation, participants estimated higher prices for de facto unlimited offers than for explicitly unlimited offers, b = 0.20, SE =

0.03, $t(2950.44) = 7.32$, $p < .001$. Participants expected the train pass to cost $82.24 when in a de facto unlimited frame, but only $69.25 when explicitly unlimited (back-transformed means).

Previous work suggests that WTP is itself a function of estimated price (Thaler 1985). We returned to the model predicting WTP, but added estimated price as a predictor. Estimated price strongly predicted WTP, $b = 0.57$, $SE = 0.01$, $t(3,397) = 39.68$, $p < .001$. But with estimated price controlled, there was only a marginally significant effect of the unlimited frame on WTP, $b = 0.04$, $SE = 0.03$, $t(2974.70) = 1.75$, $p = .081$ (Sobel $z = 7.20$, $p < .001$).

Summary. This study showed that the basic dissociation extends beyond WTP to consumers' estimates of how much an offer will cost. Because WTP is largely a function of beliefs about estimated price, and participants' greater WTP for de facto unlimited offers could be traced to a similar effect on estimated price, the effect on WTP may reflect a downstream consequence of consumers' efforts to determine a reasonable price for each offer. This logic suggests that eliciting estimated prices is likely a more direct method for examining the dissociation. The subsequent studies thus compare attractiveness to estimated price.

STUDY 3

Study 3 examined whether the different patterns of valuation for de facto unlimited and explicitly unlimited offers are driven by the unlimited frames themselves (as we argued in the Introduction) or by inferences consumers draw from a firm's choice to use a particular frame. Participants once again saw offers that were either explicitly unlimited or de facto unlimited. But for some participants, we then redescribed the offer using the other frame—the one that the firm did not select. If participants' valuations are driven by inferences about the firm based on its

choice of frame (e.g., “This service must be cheap to provide if they are touting it as ‘unlimited’”), then highlighting the non-chosen frame should either have no effect or even exaggerate the monetary-subjective valuation dissociation by calling attention to this non-chosen frame. But if instead consumers subjectively value explicitly unlimited offers because they clearly signal a lack of constraints, and monetarily value de facto unlimited offers because they make explicit a high discrete usage limit, then providing both frames should eliminate the dissociation. Specifically, reframing a de facto unlimited offer as explicitly unlimited should enhance its subjective valuation, and reframing an explicitly unlimited offer as de facto unlimited frame should enhance its monetary valuation.

Method

Participants and design. We requested 600 U.S.-based MTurk participants via CloudResearch. After applying preregistered exclusions, we were left with 551 participants. Participants were randomly assigned to one of two *dual-frame* conditions: present or absent.

Procedure. Participants considered a set of six vouchers nearly identical to those used in study 1. For each participant, three vouchers were randomly selected to be presented in an *explicitly* unlimited frame; the other three were presented in a *de facto* unlimited frame. When the dual frame was *present*, we also supplied the offer frame that was not depicted on the voucher itself (figure 3). The alternate frame was described in text immediately afterward. For example, in the de facto [explicitly] unlimited condition, dual frame present participants read, “Because there are 120 hours in a 5-day period, this offer is essentially equivalent to unlimited [120 hours] of internet access.” Offers were presented in a random order.

FIGURE 3

EXAMPLE DUAL FRAME PRESENT UNLIMITED OFFERS (STUDY 3)

NOTE.— Explicitly unlimited offer (left panel) and de facto unlimited offer (right panel).

After reading a description of an offer, participants completed the same estimated price and attractiveness measures used in study 2. After evaluating all six offers, participants completed the same set of additional measures about each voucher (one voucher at a time) as in study 1: their WTP for one unit of the service as well as estimates of how much they and a typical consumer would use the voucher. The two usage items were standardized within each offer category and then averaged (r = .62) to create an *anticipated usage* composite.

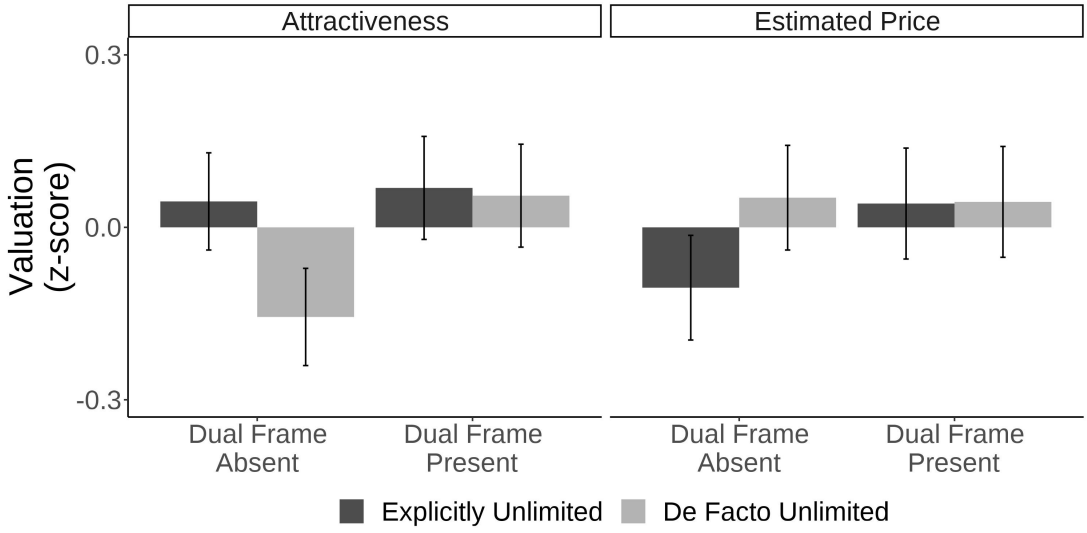
Results and Discussion

Monetary-subjective valuation dissociation. We began by testing whether the unlimited frame had divergent effects on monetary and subjective evaluations and whether this effect was moderated by the dual-frame manipulation. We created a *relative valuation* difference score for

each voucher as in previous studies. As preregistered, we excluded the 26 observations whose log-transformed estimated price values were more than 3.5 standard deviations away from the mean for that particular voucher. We conducted a linear mixed-effects regression with the relative valuation difference score predicted by unlimited frame (-0.5 = explicit, 0.5 = de facto), dual frame (-0.5 = absent, 0.5 = present), and their interaction, with random intercepts for both participant and offer category. Replicating the basic dissociation observed in previous studies, we found that de facto (vs. explicitly) unlimited offers elicited relatively higher monetary (vs. subjective) valuations, $b = 0.19$, $SE = 0.03$, $t(2727.00) = 5.36$, $p < .001$. Of particular interest, the Unlimited Frame X Dual Frame interaction was significant $b = -0.34$, $SE = 0.07$, $t(2727.00) = 4.89$, $p < .001$ (figure 4). The negative coefficient reflects that the dissociation was significantly attenuated when the alternate (non-chosen) frame was also supplied.

FIGURE 4

MONETARY AND SUBJECTIVE VALUATION AS A FUNCTION OF UNLIMITED FRAME AND DUAL FRAME (STUDY 3).



NOTE.—Error bars represent 95% confidence intervals for the model-predicted values.

Attractiveness. We observed a significant main effect of the unlimited frame manipulation on attractiveness ratings, $b = -0.11$, $SE = 0.03$, $t(2732.49) = -3.72$, $p < .001$, but this effect depended on the presence of the dual frame, $b = 0.19$, $SE = 0.06$, $t(2732.49) = 3.25$, $p = .001$. When the dual frame was absent, explicitly unlimited offers were once again perceived as more attractive ($M = 4.68$, $SD = 1.86$) than de facto unlimited offers ($M = 4.28$, $SD = 1.96$), $b = -0.20$, $SE = 0.04$, $t(2731.30) = -5.08$, $p < .001$. However, when the dual frame was present, ratings of explicitly unlimited offers ($M = 4.65$, $SD = 1.91$) and de facto unlimited offers ($M = 4.65$, $SD = 1.90$) did not differ, $t < 1$. Moreover, the dual frame manipulation did not influence the attractiveness of explicitly unlimited offers, $t < 1$; instead, it significantly increased the attractiveness of de facto unlimited offers, $b = 0.21$, $SE = 0.06$, $t(867.40) = 3.36$, $p < .001$.

Estimated price. We observed a significant main effect of the unlimited frame on estimated price, $b = 0.08$, $SE = 0.03$, $t(2723.43) = 3.02$, $p = .003$, but this effect depended on the presence of the dual frame, $b = -0.15$, $SE = 0.05$, $t(2723.43) = 2.91$, $p = .004$. When the dual frame was absent, de facto unlimited offers elicited higher estimated prices than explicitly unlimited offers, $b = 0.16$, $SE = 0.04$, $t(2722.48) = 4.32$, $p < .001$. The representative effect (in the dual-frame-absent condition) was the one-week international cell phone minutes plan, which was expected to cost $38.63 in the de facto unlimited frame and $33.49 in the explicitly unlimited frame (back-transformed means). However, when the dual frame was present, participants estimated similar prices for de facto and explicitly unlimited offers, $t < 1$. Moreover, the dual frame manipulation did not influence price estimates for de facto unlimited offers, $t < 1$, but significantly increased price estimates for explicitly unlimited offers, $t(748.90) = 2.16$, $p = .031$.

Summary. The dissociation between monetary and subjective valuation disappeared once participants were supplied with both possible frames. This rules out the possibility that the dissociation results from any signal sent by the firm's choice of an explicitly unlimited or de facto unlimited frame. Rather, it is the "unlimited" label itself that makes offers attractive, and the discrete usage limit that makes them seem monetarily valuable.

STUDY 4

Study 4 examined whether the dissociation between monetary and subjective valuation persists when the de facto unlimited offer's usage limit is impossibly high, a question that is especially relevant to our usage-based anchoring account. Thus far, we have set the usage limit for de facto unlimited offers to be equal to or just above the maximum amount one could possibly use. We have repeatedly shown that such limits increase valuation in part through their effect on anticipated usage. If the discrete usage limit were transparently set much *higher* than the maximum amount one could use (which we term *impossibly* unlimited), consumers may immediately reframe it as "unlimited" or simply view it as uninformative, thus not factoring it into their usage estimates. As a result, the monetary-valuation advantage enjoyed by impossibly unlimited offers may be smaller than that of standard de facto unlimited offers. However, given that implausible anchors can be just as influential or even more influential than plausible ones (Mussweiler and Strack 1999; Strack and Mussweiler 1997), discrete usage limits may have a similar or even stronger effect on anticipated usage and valuation when they are impossibly high.

Method

Participants. We requested 600 U.S.-based MTurk participants via CloudResearch. After applying preregistered exclusions, we were left with a final sample of 598 participants.

Procedure. Participants considered six vouchers similar to those used in previous studies: a meal plan, free daily coffee or tea during a specified window, access to movies on a flight, a mobile phone plan for international travel, a monthly commuter train pass, and an audiobook subscription. For two of the vouchers, the stated offer was *explicitly* unlimited (e.g., "unlimited audiobooks for use over 2 weeks"). For two others, it was *de facto* unlimited (e.g., "68 audiobooks for use over 2 weeks"; additional information made clear there was time to start and listen to only 68 books). For the remaining two, it was *impossibly* unlimited (e.g., "999 audiobooks for use over 2 weeks"). We randomly varied for each participant which two offers were presented in each frame. The six offers were presented in a random order.

Unlike in previous studies, this study provided an explanation for the discrete limit to those considering de facto and impossibly unlimited offers. Specifically, we explained that the firm's system simply required that a discrete limit be entered. For de facto unlimited offers, participants were explicitly told (though in all conditions it was calculable that the limit was) "the highest number one could possibly use." For impossibly unlimited offers, they were told that the number entered was "an impossibly high number."

For each voucher, participants completed the same estimated price and attractiveness measures used in studies 2 and 3. Next, they completed additional measures for each voucher (one voucher at a time), including WTP for one unit of the service and estimates of how much they and a typical person would use the voucher. The two usage items were standardized within each voucher and then averaged (r = .42) to create an *anticipated usage* composite.

Results and Discussion

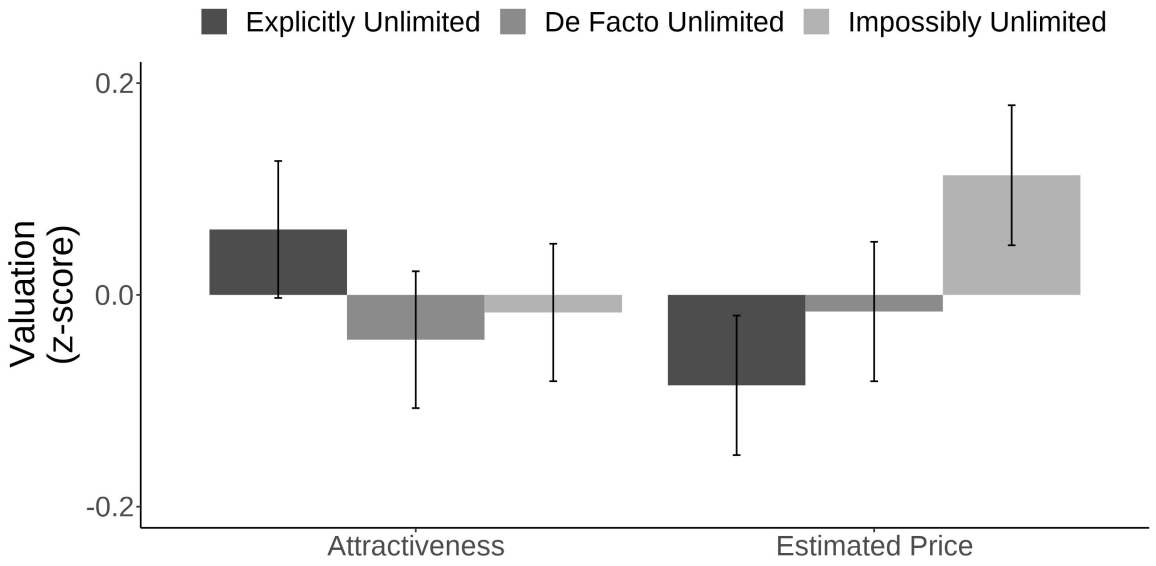
Monetary-subjective valuation dissociation. We began by testing whether the unlimited frames had divergent effects on monetary and subjective evaluations. We calculated a relative valuation difference score for each voucher as in the previous studies. In line with our preregistered exclusion criterion, we excluded the 29 observations for which the log-transformed estimated price was more than 3.5 standard deviations from the mean for that particular offer.

We conducted a linear mixed-effects regression with the relative valuation difference score predicted by unlimited frame (categorical), with random intercepts for both participant and offer category. Compared to explicitly unlimited offers, relative valuation was larger for both de facto, $b = 0.17$, $SE = 0.05$, $t(2960.39) = 3.82$, $p < .001$, and impossibly unlimited offers, $b = 0.28$, $SE = 0.05$, $t(2962.92) = 6.06$, $p < .001$. The first comparison replicates the basic dissociation seen in earlier studies. The second comparison shows that it persisted even when the discrete limit was impossibly high. In fact, the divergence between monetary and subjective valuation grew larger as the discrete usage limit increased from one that was roughly equal to maximum possible usage (de facto unlimited) to one that far exceeded it (impossibly unlimited), $b = 0.10$, $SE = 0.05$, $t(2962.7) = 2.26$, $p = .024$. We decompose these dissociations to understand how each type of valuation contributed to these effects (figure 5).

Attractiveness. Relative to explicitly unlimited offers ($M = 4.47$, $SD = 1.87$), participants rated both de facto unlimited offers ($M = 4.24$, $SD = 1.89$), $b = -0.10$, $SE = 0.03$, $t(2960.26) = -3.04$, $p = .002$, and impossibly unlimited offers ($M = 4.33$, $SD = 1.93$), $b = -0.08$, $SE = 0.03$, $t(2963.47) = 2.28$, $p = .023$, as less attractive. Impossibly unlimited offers were seen as no more

FIGURE 5

MONETARY AND SUBJECTIVE VALUATION AS A FUNCTION OF UNLIMITED FRAME (STUDY 4).



NOTE.—Error bars represent 95% confidence intervals for the model-predicted values.

or less attractive than de facto unlimited offers, $t < 1$. This means that although the presence of a discrete usage limit lowered subjective valuation, the magnitude of this limit was not influential.

Estimated price. Relative to explicitly unlimited offers, estimated prices were higher for both de facto unlimited offers, $b = 0.07$, $SE = 0.03$, $t(2956.65) = 2.11$, $p = .035$, and impossibly unlimited offers, $b = 0.20$, $SE = 0.03$, $t(2959.46) = 6.00$, $p < .001$. Unlike subjective valuation, these price estimates were sensitive to the magnitude of the discrete usage limit: Impossibly unlimited offers elicited higher estimated prices than de facto unlimited offers, $b = 0.13$, $SE = 0.03$, $t(2959.19) = 3.89$, $p < .001$. The representative effect was the monthly meal plan. The average (back-transformed) price estimates were \$115.40 in the explicitly unlimited frame, \$126.19 in the de facto unlimited frame, and \$144.32 in the impossibly unlimited frame. This

suggests that monetary valuation was not merely sensitive to the presence versus absence of a discrete usage limit. Instead, as that discrete usage limit grew, monetary valuation grew as well.

Anticipated usage. If the discrete limits serve as high (and implausibly high) anchors (usage-based anchoring account), then we may find similar effects whereby not only do de facto unlimited offer elevate anticipated usage, but impossibly unlimited offers may do so even more. First, we conducted a similar linear mixed-effects regression with anticipated usage predicted by the unlimited frame. As in previous studies, anticipated usage was greater for de facto unlimited offers than for explicitly unlimited offers, $b = 0.08$, $SE = 0.03$, $t(2858.36) = 2.51$, $p = .012$. Notably, the impossibly unlimited frame increased anticipated usage even further, not simply relative to the explicitly unlimited frame, $b = 0.17$, $SE = 0.03$, $t(2867.20) = 4.93$, $p < .001$, but also relative to the de facto unlimited frame, $b = 0.08$, $SE = 0.03$, $t(2862.34) = 2.44$, $p = .015$. Thus, provision of a discrete limit increased anticipated usage, even (and especially) when the discrete usage limit was so high as to be meaningless.

Second, when we added anticipated usage to the original estimated price model, it was a significant predictor, $b = 0.12$, $SE = 0.02$, $t(3311.14) = 6.81$, $p < .001$. Moreover, the difference in monetary valuation between de facto and explicitly unlimited offers became only marginally significant, $b = 0.06$, $SE = 0.03$, $t(2956.46) = 1.82$, $p = .068$. The difference between impossibly and explicitly unlimited offers, $b = 0.18$, $SE = 0.03$, $t(2961.56) = 5.42$, $p < .001$, and the difference between impossibly and de facto unlimited offers, $b = 0.12$, $SE = 0.03$, $t(2959.00) = 3.62$, $p < .001$, remained significant but were reduced. Sobel tests comparing de facto and explicitly unlimited ($z = 2.35$, $p = .019$), impossibly and explicitly unlimited ($z = 4.00$, $p < .001$), and impossibly and de facto unlimited offers ($z = 2.30$, $p = .022$) were all significant. The effect

of discrete limits on anticipated usage thus helped to explain why de facto and impossibly unlimited offers were so highly monetarily valued.

To test the differential-weighting account, we conducted another regression with monetary valuation predicted by anticipated usage, a variable contrasting the explicitly unlimited frame against the two discrete-limit frames (explicitly unlimited: -0.5, de facto unlimited: +0.25, impossibly unlimited: +0.25), a variable for the orthogonal contrast (explicitly unlimited: 0, de facto unlimited: -0.5, impossibly unlimited: +0.5), and the two-way interactions between anticipated usage and both contrast variables. The interaction between anticipated usage and the contrast between the explicitly unlimited frame and the two discrete-limit frames was not significant, $t < 1$. This indicates that anticipated usage was not a stronger predictor of monetary valuation for offers without discrete usage limits (explicitly unlimited offers) than for offers with discrete limits, which is inconsistent with the differential-weighting account.

STUDY 5

Having shown that de facto unlimited offers in part acquire perceived value by elevating anticipated usage, we turn our attention to the reference-offer account. Specifically, we theorized that consumers are more likely to call to mind (and rely on) *reference offers* when formulating monetary valuations for de facto (vs. explicitly) unlimited offers. By quantifying a discrete usage limit, the de facto unlimited frame should encourage recruitment of comparable reference offers that can serve as a foundation for monetarily valuing de facto unlimited offers. Because such reference offers would necessarily be smaller, using their prices as a basis for proportionally

scaling up to the assumed price of an unlimited offer should make them seem especially large and valuable.

Study 5 used a thought-listing protocol as an initial test of this idea. After participants estimated the prices of various unlimited offers, they explained how they formulated their estimates. Research assistants blind to hypotheses coded these responses for evidence of spontaneous use of a reference offer. From these, we could test two possibilities. First, we tested whether participants were more likely to call to mind a reference offer when consider a de facto (vs. an explicitly) unlimited offer. Second, we assessed whether use of a reference offer predicted higher monetary valuations for those considering de facto (but less so those evaluating explicitly) unlimited offers.

Method

This study was not preregistered before data collection. However, we did preregister our coding guidelines on AsPredicted before beginning the coding procedure (and thus before we were able to conduct most of the primary analyses).

Participants and design. One-hundred ninety-nine participants who were undergraduates at an American university took part in the study as part of an hour-long session for which they received either marketing course credit or $15. Excluding the 20 participants who failed an attention check left us with a final sample of 179 participants.

Procedure. Participants considered a set of six vouchers from the same categories as those used in studies 1 and 3. For each participant, we randomly varied which three vouchers were presented as *explicitly* unlimited and which three were presented as *de facto* unlimited.

After considering each voucher, participants completed the estimated price measure used previously. And after estimating the prices of all six vouchers, participants completed a free-response task that asked them to describe the process they used to formulate each price estimate:

> "Now we would like to better understand just *how* you formulated an estimate of each voucher's price. Perhaps you simply came up with a price *intuitively*, with the price coming to you out of thin air. Instead, perhaps you drew on certain information that you had (or at least thought you knew) that helped you to formulate the specific price you estimated."

Participants then saw the following prompt: "For each voucher, please describe specifically what was going through your head, including any specific information you thought about or relied upon when forming the price estimate." They provided a response for each voucher they had seen earlier. The prompt for each voucher reminded them of their earlier response: "Describe how you went about estimating that the price set by the company was most likely [$X]."

Finally, participants completed additional measures about each voucher (one voucher at a time; see web appendix), including their willingness to pay for a single unit of the service.

Results and Discussion

Estimated price. We began by testing for an effect of the unlimited offer frame on monetary valuation. As in previous studies, we log-transformed estimated price and partialed out the effect of unit WTP for each voucher. We excluded the 9 observations for which the log-transformed estimated price was more than 3.5 standard deviations from the mean for that particular offer. We then conducted a linear mixed-effects regression with estimated price

predicted by unlimited frame, including random intercepts for both participant and voucher. As in previous studies, estimated prices were higher for de facto unlimited offers than for explicitly unlimited offers, $b = 0.26$, $SE = .05$, $t(885.06) = 5.15$, $p < .001$. The representative effect was the three-day international data plan, which was priced at $37.00 when framed as de facto unlimited and $27.72 when framed as explicitly unlimited (back-transformed means).

Thought protocol. We proceeded to test whether participants considering de facto versus explicitly unlimited offers differed in their likelihood of calling to mind a reference offer, and whether they were differentially influenced by this reference offer when they did call one to mind. We first had four research assistants (who were blind to participants' conditions and our hypotheses) code participants' free responses. Coders were trained to look for evidence that participants had called to mind the price of a reference offer to help with formulating the estimated price of the target offer. See the web appendix for more details on the coding procedure and sample coded responses.

To test the first possibility, we conducted a mixed-effects logistic regression with use of a reference offer (1 = yes, 0 = no) predicted by unlimited frame, with random intercepts for participant and voucher. Participants were more likely to spontaneously recruit a reference offer when they were estimating the price of de facto unlimited offers (29.8%) compared to explicitly unlimited offers (20.7%), $b = 0.80$, $SE = 0.17$, $z = 4.71$, $p < .001$.

To test the second possibility, we assessed whether use of a reference offer was associated with higher estimated prices for those considering de facto (vs. explicitly) unlimited offers. We conducted a linear mixed-effects regression with estimated price predicted by unlimited frame (-0.5 = explicitly, +0.5 = de facto), an indicator for whether the participant recruited a reference offer (-0.5 = no, +0.5 = yes), and the two-way interaction between these

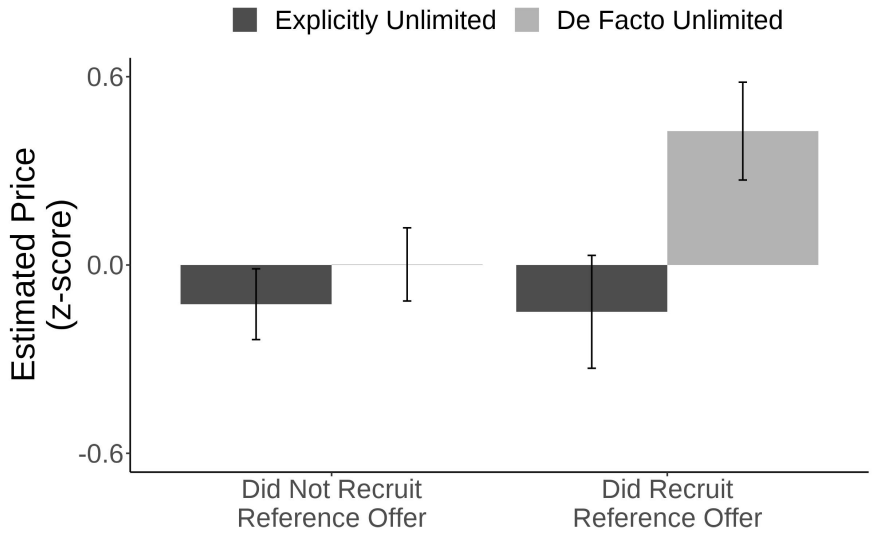
variables. Random intercepts for participant and voucher were included. The interaction between the use of a reference offer and the unlimited frame was significant, $b = 0.45$, $SE = 0.12$, $t(975.33) = 3.60$, $p < .001$ (figure 6). We decomposed this interaction in two ways.

First, we examined the effect of the unlimited frame on valuation among those who did versus did not consult a reference offer. When participants did not show evidence of using a reference offer, they estimated somewhat higher prices for de facto unlimited offers than explicitly unlimited offers, $b = 0.13$, $SE = 0.06$, $t(662.84) = 2.20$, $p = .028$. But when they did recruit a reference offer, the effect of the unlimited frame was even larger, $b = 0.59$, $SE = 0.12$, $t(240.61) = 4.96$, $p < .001$.

Second, we examined the association between the use of a reference offer and monetary valuation among those considering each unlimited offer frame. Among participants considering

FIGURE 6

MONETARY VALUATION AS A FUNCTION OF UNLIMITED FRAME AND WHETHER PARTICIPANTS RECRUITED A REFERENCE OFFER (STUDY 5).



NOTE.—Error bars represent 95% confidence intervals for the model-predicted values.

de facto unlimited offers, those who showed evidence of recruiting a reference offer made significantly higher price estimates than those who did not, $b = 0.45$, $SE = 0.09$, $t(492.55) = 4.89$, $p < .001$. But among participants considering explicitly unlimited offers, those who did and did not show evidence of reference offer recruitment did not differ in their price estimates, $t < 1$.

Summary. This study provides initial support for our reference-offer account. Participants seemed not only more likely to call to mind reference offers when considering de facto unlimited offers than when considering explicitly unlimited offers, but the identified use of such reference offers was predictive of higher monetary valuations only for de facto unlimited offers.

STUDY 6

Study 6 built on the previous study in two ways to further test our reference-offer account. First, whereas study 5 suggested that consumers are more likely to spontaneously recruit reference offers when evaluating de facto unlimited offers, it used a correlational approach to infer the differential influence of reference offers across unlimited frames. Study 6 instead allowed for a causal test of whether considering a reference offer price elevates consumers' monetary valuation of de facto unlimited offers more so than explicitly unlimited offers. We varied whether participants were provided with the price of a reference offer and tested whether this information had a larger effect on valuation of de facto unlimited offers. Second, we measured subjective valuation to examine whether consideration of a reference price uniquely affects monetary valuation. That is, our theoretical logic predicts that the reference-offer account will apply only to monetary valuation. Measuring both types of valuation allows us to test whether this account helps to explain the monetary-subjective valuation dissociation.

Method

Participants and design. We requested 400 U.S.-based MTurk participants via CloudResearch. After applying preregistered exclusions, we were left with a final sample of 398 participants. Participants were randomly assigned to one of two *reference price* conditions: present or absent.

Procedure. Participants considered the same six vouchers used in studies 1 and 3. For each participant, three were randomly selected to be presented as *explicitly* unlimited, whereas the other three took the *de facto* unlimited frame. Participants were told for each offer that the firm had historically only charged per use, but it recently began to supplement pay-per-use offers with another voucher. Those six target offers were presented in a random order.

When the reference price was *present*, participants were provided with information about the pay-per-use price of the service (e.g., "The price for 2-week access to one audiobook is $5."). These reference offer prices were based on the median unit WTP responses from previous studies. When the reference price was *absent*, participants were not provided with the pay-per-use price (but were still informed that the pay-per-use option existed).

For each voucher, participants completed the estimated price and attractiveness measures used in previous studies. Next, participants responded to additional items about each voucher (one voucher at a time), including WTP for one unit of the service and estimates of how much they and a typical person would use the voucher. The two usage items were standardized within each voucher and then averaged to create an *anticipated usage* composite (r = .75).

Results and Discussion

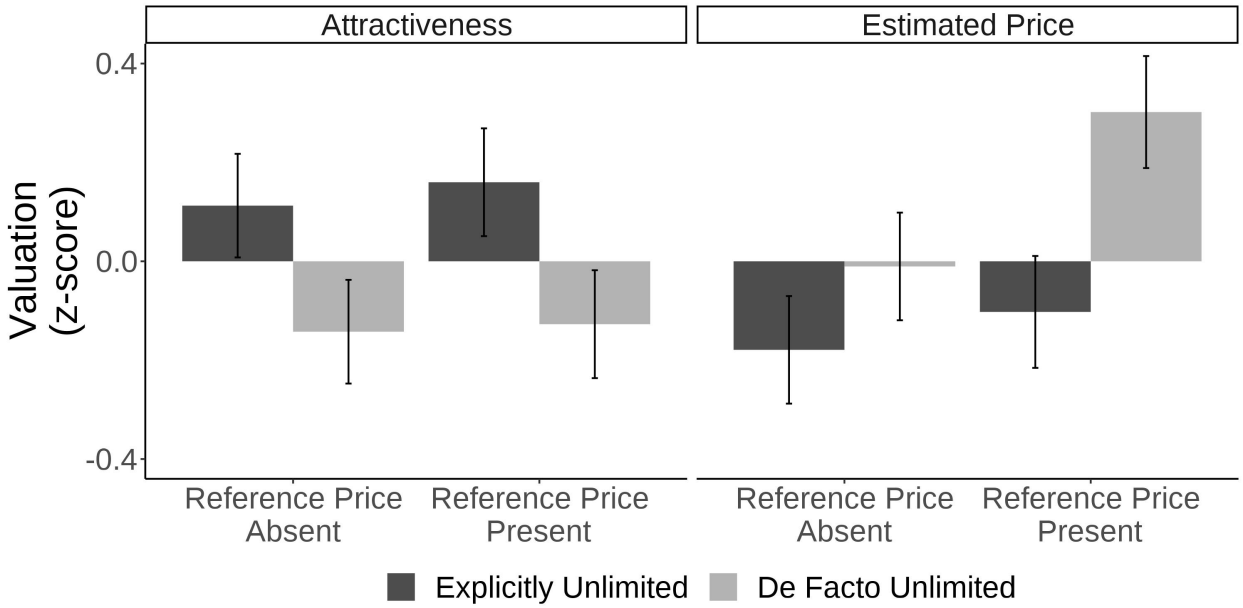
Monetary-subjective valuation dissociation. To test for a dissociation between monetary and subjective valuation, we used a similar approach to that used in previous studies. We calculated a difference score between estimated price and perceived attractiveness (both standardized) for each voucher (after partialing out the effect of unit WTP). In line with our preregistration, we excluded the 16 observations for which the log-transformed estimated price was more than 3.5 standard deviations from the mean for that particular voucher. We conducted a linear mixed-effects regression with the relative valuation difference score predicted by unlimited frame (-0.5 = explicit, 0.5 = de facto), presence of a reference price (-0.5 = absent, 0.5 = present), and their interaction. Random intercepts for participant and voucher were included. The main effect of unlimited frame was significant, $b = 0.56$, $SE = 0.04$, $t(1968.11) = 13.24$, $p < .001$, but the size of this effect grew when a reference price was present, $b = 0.27$, $SE = 0.08$, $t(1968.11) = 3.19$, $p = .001$ (figure 7). We unpack this interaction below.

Attractiveness. Explicitly unlimited offers were rated as more attractive ($M = 4.44$, $SD = 1.90$) than de facto unlimited offers ($M = 3.96$, $SD = 1.90$), $b = -0.27$, $SE = 0.03$, $t(1972.85) = -8.57$, $p < .001$. This effect did not depend on the presence of a reference price, $t < 1$.

Estimated price. Overall, participants estimated higher prices for de facto unlimited offers than explicitly unlimited offers, $b = 0.29$, $SE = 0.03$, $t(1968.04) = 9.70$, $p < .001$. The magnitude of this effect depended on whether a reference price was present, $b = 0.24$, $SE = 0.06$, $t(1968.04) = 3.99$, $p < .001$. In the absence of a reference price, and replicating the results of previous studies, de facto unlimited offers elicited higher price estimates than explicitly unlimited offers, $b = 0.17$, $SE = 0.04$, $t(1968.89) = 4.12$, $p < .001$. But once a reference price was

FIGURE 7

MONETARY AND SUBJECTIVE VALUATION AS A FUNCTION OF UNLIMITED FRAME AND REFERENCE PRICE PROVISION (STUDY 6).



NOTE.—Error bars represent 95% confidence intervals for the model-predicted values.

provided—thereby guaranteeing that everyone had access to it—the effect of the unlimited frame more than doubled: De facto unlimited offers were expected to be priced much higher than explicitly unlimited offers, $b = 0.40$, $SE = 0.04$, $t(1967.26) = 9.50$, $p < .001$.

We also decomposed the interaction in a complementary way. For de facto unlimited offers, the presence of a reference price significantly increased price estimates, $b = 0.31$, $SE = 0.08$, $t(521.33) = 3.90$, $p < .001$. But for explicitly unlimited offers, the introduction of a reference price had no effect, $t < 1$. As foreshadowed by the previous study, which found that participants considering de facto unlimited offers who spontaneously recruited a reference price put a particularly high monetary valuation on the offer, this study identifies a causal relationship.

Summary. These results provide complementary support for our second process account (the reference-offer account). By providing participants with the price of the reference offer, the monetary valuation (but not the subjective valuation) of de facto unlimited offers increased. The same was not true for explicitly unlimited offers. In other words, providing a reference offer price heightened the subjective-monetary valuation dissociation for de facto versus explicitly unlimited offers.

STUDY 7

In our final study, we examined downstream consequences of the monetary-subjective valuation dissociation for consumers' interest in and engagement with a real unlimited offer. Specifically, participants reported their interest in an unlimited coffee and tea subscription offered by a fast-casual chain that is found in every state of the continental U.S. A digital ad was edited to use an explicitly or de facto unlimited frame. Participants then chose whether to receive a link to the offer, and we tracked clicks as a behavioral measure of engagement.

We also varied whether the ad included pricing information. This allowed us to examine whether the appeal of each frame depends on the presence of pricing information. Given that consumers' choices—at least when price is not an issue—tend to be better predicted by subjective than monetary valuation (Hascher et al. 2021), we expected explicitly unlimited offers to evoke more interest. But because consumers expect de facto unlimited offers to be priced higher, we predicted that providing pricing information would counteract (or even eliminate) the advantage of explicitly unlimited offers. To further buttress this explanation, we attempt to trace

these effects to a shift in how much consumers base their interest on subjective valuation (when a price is not supplied) as opposed to monetary valuation (especially when a price is supplied).

Method

Participants and design. We requested 800 U.S.-based MTurk participants via CloudResearch. After applying preregistered exclusion criteria, we were left with 798 participants. Participants were randomly assigned to one of four conditions in a 2 (unlimited frame: explicitly vs. de facto) X 2 (price: present vs. absent) full-factorial design.

Procedure. All participants considered a voucher that was actually being offered at the time the study was run by a well-known fast-casual restaurant chain: unlimited coffee and tea for a month. For some participants, this offer was *explicitly* unlimited (i.e., "Unlimited beverages per month"). But the unlimited offer came with a catch: It could only be redeemed once every two hours. This allowed us to create an equivalent *de facto* unlimited offer ("200 beverages per month"), with a usage limit that was based on this chain's locations' typical business hours.

Before seeing the target voucher, participants indicated how often they personally "consume" and "purchase" coffee and tea compared to the average person (1 = "Much less," 4 = "About the same," 7 = "Much more"). We averaged these two items to create a *baseline consumption* composite for each participant (r = .87). Participants were then exposed to the focal offer. They completed the attractiveness and estimated price measures used in previous studies.

Next, participants saw a social media advertisement for the same voucher. For participants in the price *present* condition, the ad stated the (true) price of the coffee and tea subscription, which was $8.99. For those in the price *absent* condition, the voucher's price was

not mentioned. Participants indicated their personal interest in the advertised offer using two items: “How good do you think this offer is?” (1 = “Not very good”, 7 = “Very good”) and “How interested are you in this offer?” (1 = “Not at all”, 7 = “Very much”). We averaged the two responses to create an *interest-in-offer* composite (r = .69). Next, participants indicated how many beverages they would personally redeem the voucher for per month and how many beverages a typical consumer would redeem per month, which were averaged to create an *anticipated usage* composite (r = .54; usage results are reported in the web appendix).

Finally, participants were truthfully informed that the voucher was actually available at a fast-causal restaurant chain in the U.S. They indicated whether they wanted to receive a link to the offer (“Yes” or “No”). Those who indicated “Yes” were supplied a link that would allow them to access the offer. Unbeknownst to participants, we were able to track whether participants actually did click on the link, which served as a behavioral measure of interest. Because the link redirected participants to an external site, we were not able to track ultimate conversions.

Results

Monetary-subjective valuation dissociation. We first tested whether the unlimited frame had divergent effects on monetary and subjective valuation. We created a relative valuation difference score for each participant by subtracting their attractiveness rating from their log-transformed price estimate (after partialing out the effect of baseline consumption on each valuation measure in the same way as in previous studies). Replicating the repeatedly observed dissociation, the difference score was larger for de facto unlimited offers than for explicitly

unlimited offers, β = 0.29, *b* = 0.91, *SE* = 0.11, *t*(796) = 8.56, *p* < .001. Next, we decompose this effect.

Attractiveness. As predicted, the de facto unlimited offer was rated as less attractive (*M* = 3.56, *SD* = 1.99) than the explicitly unlimited offer (*M* = 4.17, *SD* = 1.96), β = -0.15, *b* = -0.30, *SE* = 0.07, *t*(796) = -4.25, *p* < .001.

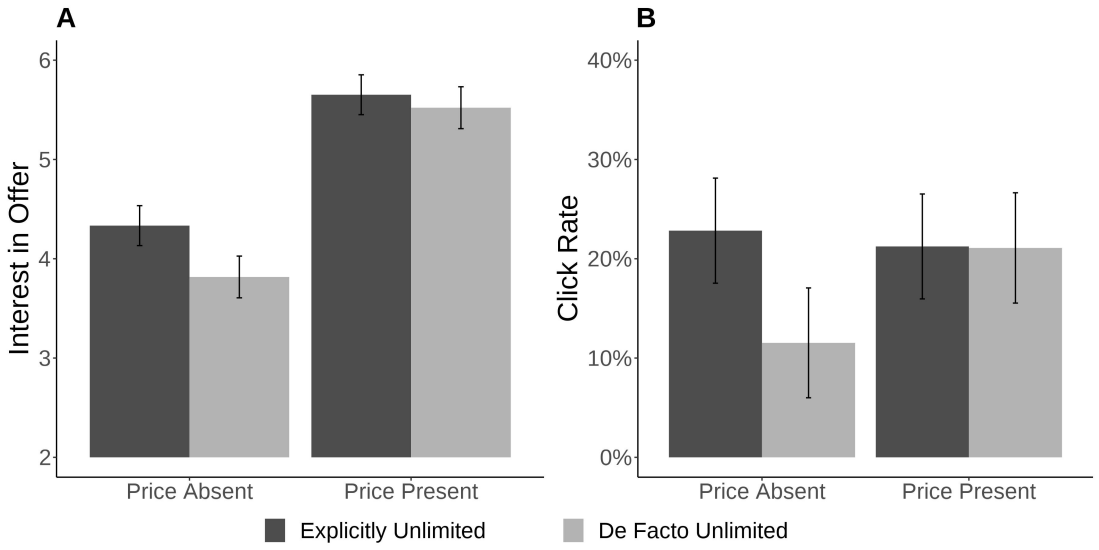
Estimated price. By contrast, participants provided significantly higher price estimates for the de facto unlimited offer than for the explicitly unlimited offer, β = 0.30, *b* = 0.61, *SE* = 0.07, *t*(796) = 9.00, *p* < .001. Whereas the explicitly unlimited offer was expected to cost $32.56, the de facto unlimited offer was expected to cost $63.53 (back-transformed means).

Interest in offer. We then tested whether consumers' interest in the offer depended on whether the advertisement mentioned the offer's price. We regressed the interest-in-offer composite on unlimited frame (-0.5 = explicit, 0.5 = de facto), presence of pricing information (-0.5 = absent, 0.5 = present), and the two-way interaction of these variables, controlling for the baseline consumption composite. We observed significant main effects of both the unlimited frame, β = -0.09, *b* = -0.32, *SE* = 0.11, *t*(793) = -3.08, *p* = .002, and the presence of pricing information, β = 0.43, *b* = 1.51, *SE* = 0.10, *t*(793) = 14.41, *p* < .001. The predicted interaction between these two factors was marginally significant, β = 0.05, *b* = 0.39, *SE* = 0.21, *t*(793) = 1.84, *p* = .066 (figure 8).

In the absence of pricing information, participants were significantly more interested in the explicitly unlimited offer (M_{est} = 4.33, *SE* = 0.10) than the de facto unlimited offer (M_{est} = 3.82, *SE* = 0.11), *t*(793) = 3.48, *p* < .001. After all, the explicitly unlimited offer was seen as the more attractive one, and expressing interest in the offer—without knowing its price—should be sensitive to subjective valuation. But once the offer's price was provided, this difference

FIGURE 8

SELF-REPORTED INTEREST AND CLICK-THROUGH RATE AS A FUNCTION OF UNLIMITED FRAME AND PRICING INFORMATION (STUDY 7).



NOTE.—Error bars represent 95% confidence intervals for the model-predicted values.

disappeared; the de facto unlimited offer received no less interest (M_{est} = 5.52, SE = 0.11) than the explicitly unlimited offer (M_{est} = 5.65, SE = 0.10), $t(793) = 0.88$, $p = .380$. Once the offer could also be assessed in terms of its monetary valuation, the de facto unlimited offer—which participants assumed to be priced substantially higher—became much more appealing.

Why did our manipulations affect interest in the offer? One possibility is merely that pricing information trumped the influence of other cues. Instead, we have argued that our core effect—the subjective-monetary valuation dissociation—explains these interest shifts because the absence or inclusion of pricing information changes the type of valuation that drives interest in the offer. To test this more directly, we added eight terms to the model: main effects of attractiveness and estimated price, as well as the interactions between each of these variables and our manipulations—both individually (thereby creating four two-way interaction terms) and

together (thereby creating two three-way interaction terms). When pricing information was included, interest in the offer became more predicted by its estimated price (b = .11 to b = .38), β = 0.08, b = 0.26, SE = 0.08, $t(785)$ = 3.15, p = .002, and less predicted by its perceived attractiveness (b = 1.25 to b = .78), β = -0.13, b = -0.47, SE = 0.08, $t(785)$ = -6.02, $p < .001$. Given each unlimited frame fares better on a different valuation measure, these shifts whereby subjective valuation decreased in importance and monetary valuation increased in importance explained why the interest gap disappeared once pricing information was added.

Behavioral interest. Finally, we conducted a logistic regression to test for a similar pattern on participants' actual click-through rates, a behavioral indicator of interest in the offer. We again observed a main effect of the unlimited frame, indicating that participants clicked on the link to the de facto unlimited offer less often than the link to the explicitly unlimited offer, b = -0.43, SE = 0.19, z = -2.27, p = .023. Of greater interest, this effect depended on the presence of the offer's price, b = 0.83, SE = 0.38, z = 2.18, p = .029 (figure 8). When the price was absent, participants were significantly more likely to click on a link to the explicitly unlimited offer (23.4%) than the de facto unlimited offer (11.0%), z = 2.95, p = .003. But once the pricing information was present, the click rate for the de facto unlimited offer increased (21.2%) to match that of the explicitly unlimited offer (21.1%), z = 0.06, p = .950.

Summary. Study 7 showed that the monetary-subjective valuation dissociation can affect consumer behavior. It also uncovered an important factor that determines which type of valuation drives interest: whether pricing information is provided. Participants who saw an advertisement that did *not* include the offer's price were more interested in the explicitly unlimited offer, leaning more on their intuitive sense of how attractive it seemed. In contrast, participants who saw an advertisement that *did* feature the offer's price were just as interested in

the offer whether it was framed in de facto unlimited or explicitly unlimited terms, presumably because the de facto unlimited offer—despite being less subjectively valuable—was priced *much* below expectation. More generally, interest in explicitly and de facto unlimited offers should depend on factors that change reliance on subjective and monetary valuations.

GENERAL DISCUSSION

Seven experiments demonstrated a robust dissociation between consumers' *subjective* and *monetary* valuation of unlimited offers. Across a range of consumer contexts, unlimited offers were consistently rated as more attractive when they were *explicitly* labeled as "unlimited" relative to when they included a discrete usage limit that made them *de facto* unlimited (studies 1-4, 6-7). De facto unlimited offers were instead seen as more monetarily valuable, both in terms of consumers' WTP (studies 1-2) and price estimates (studies 2-7). Reframing an offer as explicitly unlimited elevated subjective valuation, whereas reframing an offer as de facto unlimited elevated monetary valuation, even when these alternate frames were not used by the firms themselves (study 3). This suggests that our results are attributable to cues in the frames themselves, not inferences about firms that select one frame over the other.

Although explicitly unlimited offers are clearly valuable based on their superficial promise of infinite use, de facto unlimited offers acquired a unique value advantage for two reasons. First, consumers expect to use de facto unlimited offers more. Their discrete usage limits serve as high anchors that elevate estimates of how much the offers would be used (studies 1-7)—even when the limit is impossibly high (study 4). This usage-based anchoring in turn anticipates increased valuation of de facto unlimited offers. Second, de facto unlimited offers are

unique in being comparable to other (necessarily more limited) discrete offers. Especially when considering de facto unlimited offers, consumers call to mind these smaller reference offers and their monetary value spontaneously (study 5). Considering the price of such offers leads consumers to scale up and place larger monetary values on de facto unlimited offers in particular (study 6). This reference-offer process is unique to monetary valuation, and thus it helps fuel the monetary-subjective valuation dissociation. And indeed, consumers were more interested in and engaged more with an ad for an actual unlimited offer when it was framed in explicitly unlimited terms, but only when it lacked pricing information. Once pricing information was added, the de facto unlimited offer received just as much engagement, as its surprisingly good price counteracted the advantage that explicitly unlimited offers hold in subjective valuation (study 7).

Theoretical and Practical Implications

This research contributes to the literature on unlimited offers, coming from both marketing (Lambrecht and Skiera 2006; Nunes 2000) and economics (DellaVigna and Malmendier 2006; Kridel et al. 1993; Train 1991). In contrast to previous work, which typically compares unlimited offers to pay-per-use offers, the present work focus on the *framing* of unlimited offers. To our knowledge, no past work has appreciated that most unlimited offers can be presented in two different (but, in practice, equivalent) ways. We show consumers do not value offers in each frame equivalently. Moreover, we find that the two frames influence valuation in part through their effects on consumers' usage estimates. We are not the first to identify a link between usage and valuation of unlimited offers: Past work has repeatedly suggested that a key reason consumers value unlimited offers so highly is that they overestimate

how much they will use such offers (DellaVigna and Malmendier 2006; Lambrecht and Skiera 2006; Nunes 2000). We instead show and explain why the framing of the offer itself—and not simply consumers' optimism—can bolster such estimates and make an offer even more enticing.

By showing that consumers respond to an unlimited offer differently depending on how it is framed, we add to a large body of work in judgment and decision making on framing effects (Levin 1987; Levin, Schneider and Gaeth 1998; Sher and McKenzie 2006; Tversky and Kahneman 1981). According to the principle of description invariance, different descriptions of the same option should yield the same preferences (Tversky and Kahneman 1989). Because explicitly and de facto unlimited offers are objectively equivalent, consumers should perceive both as equally valuable. For example, given that there are 120 hours in every 5-day period, consumers should be willing to pay just as much for a 5-day voucher offering unlimited hours of internet access as they are willing to pay for one offering 120 hours of internet access. We find not only that these frames have different effects on valuation, in violation of description invariance, but also that they lead to different preference orderings altogether (with explicitly unlimited offers favored in *subjective* valuation and de facto unlimited offers favored in *monetary* valuation). Thus, we not only observe a novel framing effect on each valuation measure in isolation, but identify two such framing effects that combine to yield a strong preference reversal. Furthermore, our work distinguishes itself from most demonstrations of preference reversals, which compare two distinct options (e.g., a digital vs. physical newspaper subscription), by instead uncovering a reversal between two ways of framing the *same* option.

Beyond demonstrating that subjective and monetary valuation produce different patterns of preferences, we also offer insight into when and why each type of valuation might matter in the marketplace. Based on recent work showing that subjective liking more reliably predicts

choices than does WTP (Hascher et al. 2021), one might assume that real-world consumer decisions are largely a reflection of consumers' subjective preferences. However, our findings suggest that this conclusion may be too simple. Past work has typically examined choices between options without considering what each option would cost (e.g., Catapano et al. 2022), and therefore may have neglected the importance of monetary valuation. Indeed, when participants in study 7 were provided with pricing information, they appeared to lean more heavily on their initial monetary valuation and less on their subjective valuation. Thus, those who were considering a de facto unlimited offer expressed and demonstrated much more interest in the offer after learning its (for them) unexpectedly low price. This suggests that marketers may be able to shift the extent to which consumers rely on holistic subjective assessments versus estimates of monetary value depending on how prominently they convey pricing information.

In practice, whether consumers will indicate a stronger preference for explicitly or de facto unlimited offers should depend on the context. On one end of a continuum are choices that consumers make in the absence of prices (e.g., a loyal customer selecting which free gift offer they prefer). Here consumers should prioritize subjective valuation, and explicitly unlimited offers should be particularly enticing. On the other end of the continuum are contexts like auctions, in which consumers are invited to directly supply a monetary valuation. Here, de facto unlimited offers should prevail. Many other marketplace contexts fall in between. Here, two factors are likely relevant. First, if pricing information appears later in the buying process (e.g., after a consumer clicks on an ad), explicitly unlimited offers may encourage initial engagement. But once pricing information is available, de facto unlimited offers may help to close the sale. This relates to the second factor: how aggressively an offer is priced. If, like in study 7, the price is below what consumers would expect based on the explicitly or de facto unlimited frame, it

should encourage interest regardless of the frame. If instead the price is higher than what those confronting an explicitly unlimited offer expect, but lower than what those seeing a de facto unlimited offer expect, then de facto unlimited offers may attain an absolute advantage. Thinking further down the road, because de facto unlimited offers also seem to be valued highly due to their effects on anticipated usage, it is an open question how consumers will respond if their anticipated usage falls short of expectation. Of course, one realistic possibility is that consumers will fail to accurately track their usage or recall their initial usage expectations, which may reduce this potential threat to repeat purchasing.

Finally, it is worth emphasizing that the benefits of each unlimited frame are not counteracted by the addition of the other frame. Study 3 showed that adding an "unlimited" label to a de facto unlimited offer increased subjective valuation, and adding a discrete limit to an explicitly unlimited offer increased monetary valuation, with no negative effects on the other type of valuation. Marketers may thus do best by using both frames where possible, or by piquing initial interest with an "unlimited" label and then adding a de facto unlimited frame when the offer's price is presented. These promising managerial implications await direct test.

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WEB APPENDIX

The Limits of "Unlimited" Offers:

How Quantifying Constraints Can Increase Valuation

TABLE OF CONTENTS

Table S1: Context and Manipulations for Each Voucher

Voucher	Context	Explicitly unlimited frame description	De facto unlimited frame description	Impossibly unlimited frame description	Studies
Two-week audiobook subscription	“Imagine you are considering buying a two-week subscription to an audiobook service. The average length of an audiobook is 5 hours long, and this service requires that you finish one audiobook before starting another. You will not be able to download or listen to any of the audiobooks after the two weeks are over.” (1-4, 6) “… The audiobook service’s library includes thousands of audiobooks.” (4)	"Access to unlimited audiobooks, for use over two weeks"	"Access to up to 75 audiobooks, for use over two weeks" (1-3, 6) “Access to 68 audiobooks, for use over two weeks” (4)	“Access to 999 audiobooks, for use over two weeks”	1-4, 6
Monthly audiobook subscription	“Imagine that as a new month is approaching, you are considering buying a voucher for a new audio book service. When using the service, you will select an audiobook to listen to from thousands of titles available. Once you start listening to an audiobook, you cannot start another audiobook until the one you selected is finished playing. The audiobooks do not contain any advertisements. Vouchers can be used over the course of one calendar month. The voucher allows you to listen to [X] audiobooks, from a large selection of titles. On average, each audio book is 5 hours long.”	“Unlimited audiobooks for use in the next month”	“150 audiobooks for use in the next month”		5
One-week shuttle service	“Imagine that you are considering purchasing a voucher for a shuttle bus service while on a week-long vacation. The shuttle service goes back and forth from the hotel to the city center once every hour.”	"Unlimited shuttle rides, for use over one week"	"Up to 170 shuttle rides, for use over one week"		1, 3, 6
3-day shuttle service	“Imagine that you are considering purchasing a voucher for a shuttle bus service while taking a 3-day vacation. The shuttle service goes back and forth, from the hotel to the city center, once every hour. The voucher allows you to use the shuttle [X] times.”	"Unlimited shuttle rides for use over 3 days"	"72 shuttle rides for use over 3 days"		5
3-day cellular data plan	“Imagine you are traveling for three days and plan to take an iPad on the trip. You are looking to purchase a voucher that will allow you internet access during the three-day trip. You review your previous usage and see that you’ve never used more than 1.8 GB of data per hour.” (1-3)	"Unlimited data, for use over three days." (1-3) “Unlimited GB of data for use over 3 days” (5)	"150 GB of data, for use over three days" (1, 6) "130 GB of data, for use over three days" (2-3)		1-3, 5-6

	“Imagine that you are traveling internationally for 3 days, and plan to take an iPad with you on the trip. You look to your own past data usage and see you use between 0.2 GB and 1.8GB per hour. You are looking to purchase a data plan that will allow you to access the internet on your iPad while on your trip. One plan your data provider offers is for [X] GB of data usage while in the country you are visiting.” (5)		“100 GB of data for use over 3 days” (5)		
5-day internet access	“Imagine that you are staying at a hotel for 5 days. Internet access is not included for free with your hotel booking, so you are considering purchasing a voucher for internet access.”	"Unlimited hours of internet access, for use over 5 days"	"120 hours of internet access, for use over 5 days"		1, 3, 6
7-day internet access	“Imagine that you are staying at a hotel for the next 7 nights and are looking into getting wireless internet access. The hotel sells a voucher that offers internet access. The voucher offers [X] hours of internet access.”	"Unlimited hours of internet access for use over 7 days"	"168 hours of internet access for use over 7 days"		5
One-week cell-phone minute plan	“Imagine that you are taking a week-long vacation in another country and looking to purchase cell phone minutes to make international voice calls during the trip.”	"Unlimited voice minutes, for use over one week"	"11,000 voice minutes, for use over one week" (1-3, 6) “10,080 voice minutes, for use over one week” (4)	“999,999 voice minutes, for use over one week”	1-4, 6
One-month cell-phone minute plan	“Imagine that as a new month is approaching, you are looking to purchase a new monthly voice-calling plan for your cell-phone. The monthly plan includes [X] minutes of talk time to any number nationwide.”	"Unlimited cell minutes for use in the next month"	"30,000 cell minutes for use in the next month"		5
In-flight movies	“Imagine that you are about to take a 10-hour international flight. The airline offers vouchers that will allow you to watch movies on the flight. Each movie is on average 2 hours long, and you must finish one movie before starting another.” (1, 3-4, 6) “… The airline’s movie library includes thousands of movies.” (4) “Imagine that you are about to take a 10-hour international plane ride. You are given the option to purchase a voucher for in-flight movies. The in-flight entertainment will be available for the full duration of this flight. Please note, once you select a particular movie, you will be unable to watch something else until it is finished. The movies do not contain any commercials. The voucher offers [X] movies from a selection of popular movies released last year. On average, movies are two hours long.” (5)	"Watch unlimited movies, for use on this flight" (1, 3-4, 6) “Unlimited movies on your current flight” (5)	"Watch up to 5 movies, for use on this flight" (1, 3-4, 6) “5 movies on your current flight” (5)	“Watch up to 999 movies, for use on this flight”	1, 3-6

Coffee subscription	"Imagine that your local coffee shop is offering a voucher that provides free coffee and tea before noon within a specified time period. The voucher is redeemable between February 8 and April 23 of this year and can be used at most once per day."	"Unlimited free drinks, for use between 2/8 and 4/23"	"75 free drinks, for use between 2/8 and 4/23"	"999 free drinks, for use between 2/8 and 4/23"	2, 4
In-flight TV episodes	"Imagine that you are about to take a 10.5-hour international flight. The airline offers vouchers that will allow you to watch TV episodes during the flight. Each episode is on average 21 minutes long, and you must finish one episode before starting another. The airline's TV library includes hundreds of popular shows."	"Watch unlimited TV episodes, for use on this flight"	"Watch 30 TV episodes, for use on this flight"		2
Monthly train pass	"Imagine that you are about to start a new job that requires you to commute via train to and from work each day. The train runs each way in the morning (when people commute to work) and again in the afternoon (when people commute from work). You are looking to purchase a monthly train pass, so you download the local transportation system's mobile app."	"Unlimited one-way trips, for use over one month."	"62 one-way trips, for use over one month."	"999 one-way trips, for use over one month."	2, 4
Monthly meal plan	"Imagine that you are looking to purchase a meal plan (e.g., at a place of employment, a building where you live) that offers three buffet-style meals a day. You can load a meal plan on an ID card, which you swipe upon entering the cafeteria. You visit the cafeteria's website to select a meal plan for the upcoming month."	"Unlimited meal swipes, for use over one month."	"93 meal swipes, for use over one month."	"999 meal swipes, for use over one month."	4
Real monthly coffee subscription	"Please consider the following monthly coffee subscription."	"Unlimited beverages per month. Redeemable once every two hours."	"200 beverages per month. Redeemable once every two hours."		7

Note. This table provides details on all of the vouchers included in our studies. For each voucher, we include the context provided to participants, the description of the voucher in each unlimited frame, and the studies in which it appeared. In all studies, the context was described immediately above an image of the voucher (which included the unlimited frame description). The context often provides information that makes clear why the de facto unlimited offer does not impose actual constraints. In studies 1-4 and 6-7, a nearly identical description of the unlimited frame also appeared in text above the image (see materials on ResearchBox). In study 5, this description was embedded in the context (so we include it in this table, with an [X] indicating the limit, which varied by unlimited frame). For some voucher categories, there were minor differences in the context and/or unlimited frame descriptions across studies. When vouchers in the same category used different timeframes across studies (e.g., 5-day vs. 7-day internet access), we include a separate row for each timeframe; when only minor contextual information (e.g., whether the voucher was for domestic vs. international travel) or details of the unlimited frames themselves (e.g., a limit of 10,080 vs. 11,000 voice minutes) differed across studies, we combine them into one row and indicate in parentheses (following the relevant information) to which study the information applies.

FRAMING EFFECTS BY VOUCHER AND STUDY

Tables S2 and S3 summarize the subjective and monetary valuation results, respectively, for each voucher across studies. For each voucher in each study, we report the average valuations in the explicitly unlimited frame and in the de facto unlimited frame, as well as the regression coefficient, standard error, and significance level for the difference in valuation between the two frames (-0.5 = explicitly unlimited, +0.5 = de-facto unlimited or impossibly unlimited). The final column of each table presents the sample-size-weighted average effect of the unlimited frame manipulation for each voucher across all studies in which it appeared. This offers a simple summary statistic to allow readers to discern any patterns in which vouchers tended to be more or less susceptible to the influence of the unlimited frame manipulation.

In calculating the average effect of the unlimited frame manipulation, we included the effects from every condition in every study except for the dual-frame-present condition of study 3. This is because the dual-frame manipulation served to eliminate the effects of the unlimited frame manipulation for both types of valuation. Study 4 added a third (impossibly) unlimited frame that, like the de facto unlimited frame, also supplied a discrete usage limit, though this limit was higher. Because our theoretical logic predicts similar effects on valuation for both the de facto unlimited and impossibly unlimited frames, we included both effects in the average-effect calculation, each weighted by half of the overall sample size. For study 6, which varied between-subjects whether a reference price was supplied, we included the separate simple effects of the unlimited frame manipulation within the reference-price-absent and reference-price-present conditions, weighted by each condition's sample size. Especially in light of the inclusion of these non-standard conditions, the summary statistic should not be used to characterize the

average effect size that emerges in the basic de facto vs. explicitly unlimited comparisons. We hope that providing this full information will permit comparisons across vouchers that allow readers to observe how the effects of our unlimited frame manipulation—when predicted and observed in the aggregate analyses—emerge across different voucher categories.

Subjective Valuation

In Table S2, negative [positive] regression coefficients reflect that the explicitly [de facto] unlimited frame elicited greater subjective valuation.

Dependent variable construction. As reported in the main text, the subjective valuation measure originated from the rated attractiveness (1-7) of each voucher. We first conducted separate OLS regressions for each voucher to partial out the effect of unit WTP (to account for baseline variation in personal valuation across vouchers and participants). We extracted the standardized residuals from these analyses and used them as the subjective valuation dependent measure. Because these residuals are standardized, the regression coefficients reported in Table S1 are comparable across vouchers and studies.

Variation in effects across vouchers. Although the overall effect of unlimited frame on subjective valuation was in the expected direction for every voucher (i.e., the explicitly unlimited frame elicited higher subjective valuations than the de facto unlimited frame), we considered whether we could identify and speculate on any systematic heterogeneity observed in the effects. The largest effects emerged for the shuttle service, cell phone minutes, and hotel internet vouchers. Meanwhile, the smallest effects emerged for the airplane TV episodes, train pass, and

audiobook vouchers. Although we proceed to speculate on what might drive this heterogeneity, we mostly detail these effects in case it aids future researchers who wish to build on our work.

One possible explanation is that differences in subjective valuation are smaller when consumers are more likely to spontaneously reframe the de facto unlimited offer's discrete limit as "unlimited." For example, when purchasing TV episodes to watch during a flight, a traveler may not find the promise of "unlimited TV episodes" any more appealing than "30 TV episodes" if they immediately recognize that a 30-episode limit will pose no constraints. In contrast, when considering a cell phone plan for a weeklong vacation, someone may find a voucher offering "unlimited voice minutes" more attractive than one offering "11,000 voice minutes" if they do not immediately recognize that it is impossible to use 11,000 minutes. This possibility could be directly probed in future research by post-study measures that assess whether participants had recognized certain de facto unlimited offers (but not others) as explicitly unlimited.

Another possible explanation is that differences in subjective valuation are larger for services that are more subjectively appealing to begin with. For services that are less attractive to consumers at baseline, there may be smaller psychological benefits from removing constraints. In contrast, for services that consumers already find highly appealing, there may be especially large benefits of providing unconstrained access. This logic is consistent with the notion that subjective valuation is driven by easily accessible, intuitive cues of how good an offer is: The intuitive appeal of the "unlimited" label may have a greater impact on subjective valuation in domains that consumers find intuitively appealing already. Although this possibility was intuitively compelling to us, it was not supported in the data: The correlation between the mean (sample-size-weighted) attractiveness of each voucher in the de facto unlimited frame and the average effect of unlimited frame for that voucher (shown in the last column of table S2) was $r =$

-.01. This reflects that across vouchers, there was essentially no relationship between the baseline attractiveness of a de facto unlimited voucher and the increase in attractiveness when it was framed as explicitly (rather than de facto) unlimited.

Table S2: Subjective Valuation by Voucher and Study

	Study 1 (N = 193)			Study 2 (N = 593)			Study 3 Dual frame absent (n = 292)			Study 4 (N = 598)					Study 6 Reference price absent (n = 207)			Study 6 Reference price present (n = 191)			Study 7 (N = 798)			Average effect across studies (sample-size-weighted)
Voucher	**Explicit mean (SD)**	**De facto mean (SD)**	**Reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**Reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**Reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**Impossible raw mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	**Impossible vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**Reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**Reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**Reg. coefficient (SE)**	
Audiobook	2.63 (1.35)	2.57 (1.39)	-0.03 (0.144)	2.93 (1.75)	3.00 (1.77)	0.06 (0.082)	3.85 (2.00)	3.37 (1.99)	-0.25* (0.117)	3.21 (1.70)	3.32 (1.74)	3.23 (1.71)	0.05 (0.099)	-0.00 (0.103)	3.59 (1.85)	3.12 (1.85)	-0.22 (0.138)	3.94 (1.84)	3.49 (1.98)	-0.25† (0.144)				**-0.06**
Shuttle	5.28 (1.25)	4.77 (1.45)	-0.38** (0.143)				5.28 (1.54)	4.89 (1.80)	-0.23* (0.117)						5.18 (1.53)	4.64 (1.83)	-0.27† (0.141)	5.33 (1.60)	4.42 (1.87)	-0.49*** (0.144)				**-0.33**
Data	4.41 (1.53)	3.89 (1.73)	-0.3* (0.144)	4.52 (1.86)	3.86 (1.86)	-0.30*** (0.082)	4.62 (1.91)	4.42 (1.89)	-0.10 (0.117)						4.42 (1.88)	4.11 (1.92)	-0.16 (0.139)	4.38 (2.05)	3.82 (1.97)	-0.28† (0.144)				**-0.24**
Internet	5.16 (1.50)	4.54 (1.66)	-0.37* (0.143)				5.20 (1.65)	4.61 (1.85)	-0.37** (0.117)						4.97 (1.87)	4.27 (1.83)	-0.40** (0.139)	4.52 (1.97)	4.51 (1.71)	-0.03 (0.144)				**-0.30**
Cell-phone minutes	4.38 (1.79)	3.59 (1.69)	-0.43** (0.144)	4.07 (1.94)	3.53 (1.80)	-0.29*** (0.082)	4.62 (1.99)	3.97 (1.95)	-0.29* (0.117)	4.28 (1.93)	3.71 (1.89)	4.06 (1.86)	-0.3** (0.101)	-0.11 (0.100)	4.38 (1.92)	3.57 (1.80)	-0.43** (0.139)	4.26 (1.84)	3.60 (1.96)	-0.34* (0.145)				**-0.30**
Airplane movies	3.81 (1.78)	3.75 (1.72)	0.02 (0.144)				4.49 (1.67)	4.49 (1.94)	0.05 (0.117)	4.55 (1.72)	4.12 (1.79)	3.96 (1.98)	-0.2* (0.100)	-0.29** (0.100)	4.26 (1.88)	3.97 (1.83)	-0.10 (0.139)	4.70 (1.72)	4.09 (1.84)	-0.31* (0.144)				**-0.14**
Coffee subscription				4.41 (1.88)	4.21 (1.92)	-0.05 (0.082)				4.62 (1.81)	4.52 (1.86)	4.39 (1.93)	-0.04 (0.100)	-0.12 (0.100)										**-0.07**
Airplane TV				3.78 (1.91)	3.76 (1.84)	-0.04 (0.082)																		**-0.04**
Train pass				4.83 (1.78)	4.57 (1.87)	-0.14† (0.082)				4.93 (1.81)	4.97 (1.65)	5.01 (1.69)	0.02 (0.100)	0.04 (0.101)										**-0.05**
Meal plan										5.23 (1.58)	4.93 (1.81)	5.17 (1.75)	-0.18† (0.103)	-0.02 (0.100)										**-0.10**
Real coffee subscription																					4.17 (1.96)	3.56 (1.99)	-0.30*** (0.070)	**-0.30**

Note. This table shows the raw means and standard deviations of subjective valuation for each unlimited frame, by voucher, and by study, as well as the regression coefficient, standard error, and significance level for the effect of the unlimited frame manipulation on subjective valuation. The regression coefficients estimate the effect of the unlimited frame manipulation (explicitly unlimited: -0.5, de facto unlimited: +0.5; study 4 only: explicitly unlimited: -0.5, de facto or impossibly unlimited: +0.5) on the subjective valuation dependent variable. The final column shows a sample-size-weighted average effect of the unlimited frame for each voucher across all studies in which it appeared. For study 4, we include both the de facto unlimited and the impossibly unlimited effects, each weighted by half of the overall sample size for that study (i.e., each coefficient was weighted by

598/2). This is to avoid double-counting the explicitly unlimited participants who were used in both simple effects comparisons. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Monetary Valuation

In table S3, positive [negative] regression coefficients reflect that the de facto [explicitly] frame elicited greater monetary valuation.

Dependent variable construction. As reported in the main text, the monetary valuation measure originated from participants' willingness to pay (WTP) for or estimated price of each voucher. We first (natural) log-transformed these values (after adding 1 to them, to avoid the undefined ln-transformation of 0), then conducted separate OLS regressions for each voucher to partial out the effect of unit WTP (to account for baseline variation in personal valuation across vouchers and participants). We extracted the standardized residuals from these models and used them as the monetary valuation dependent measure. Because these residuals are standardized, the regression coefficients reported in table S3 are comparable across vouchers and studies.

Variation in effects across vouchers. As with subjective valuation, we considered potential sources of variation between vouchers in the overall effect of the unlimited frame manipulation on monetary valuation. The largest differences in monetary valuation seemed to emerge for the real coffee subscription, the shuttle service, and the hypothetical coffee subscription. Meanwhile, the smallest effects seemed to emerge for the internet, train pass, and airplane movie vouchers. (For all vouchers, the direction of the effect was consistent with our hypotheses.)

One possible explanation is that differences between explicitly and de facto unlimited offers are largest for services that consumers highly monetarily value to begin with. That is, both the anchoring and scaling-up process we focused on might lead to especially strong framing effects in contexts in which higher prices already seem intuitively plausible. Note that this idea is

distinct from the notion that the absolute gap (in dollars) between the two unlimited frame conditions may be higher for more expensive items simply because the same percentage bump in monetary valuation would produce a larger dollar gap. The standardization of the valuation measures makes such an explanation inapplicable. We found only weak support for this speculation: The correlation between the mean (sample-size-weighted) monetary valuation of each voucher in the explicitly unlimited frame and the average effect of unlimited frame for that voucher (shown in the last column of table S3) was $r = .17$. The p value at this small sample size is only .610, and it is thus ambiguous whether this correlation would emerge as significant if the number of vouchers we tested were greater or if this merely reflects random noise.

A second possible explanation—and one that is more firmly rooted in our empirically supported reference-offer account—is that such effects are larger for services that encourage greater recruitment and use of reference prices, especially when different consumers recruit the same reference prices (thereby minimizing a source of extraneous variation). For example, consumers may use more consistent reference prices while formulating monetary valuations (in line with our reference price account) when they are more familiar with the unit price or are more able to estimate such reference prices given their familiarity with close substitutes in the category. For instance, the coffee subscription may have elicited such a strong effect on monetary valuations when it was framed in de facto unlimited terms because coffee and tea are commonly sold on a per-unit basis; thus, many consumers are likely familiar with their unit prices (e.g., “I know I pay $2.95 for a tall coffee at Starbucks…”). As a result, using this unit price to scale up to the de facto unlimited offer’s limit (e.g., “200 beverages per month”) may have had an especially large effect on their estimated price relative to other vouchers (for which

there would be lower likelihoods of using a reference price and more variability in the reference price used when one *was* recruited).

As an initial test of the plausibility of this account, we added the interaction between unlimited frame and baseline consumption to the monetary valuation model in study 7. The premise behind this test is that more frequent coffee and tea drinkers may be more familiar with the unit price of coffee and tea, thereby leaving them more susceptible to the unlimited frame effect. The interaction term was directionally consistent with the basic idea but did not reach significance, $b = 0.05$, $SE = 0.04$, $t(794) = 1.18$, $p = .240$, which reflects that those who consume and purchase coffee and tea more frequently were directionally but not significantly more influenced by the de facto unlimited frame. Nevertheless, it is possible that even infrequent coffee and tea drinkers are still familiar with their typical prices (or the prices of other beverages), and thus still incorporated this knowledge into their monetary valuation responses.

Similarly, the monetary valuation effect may have been especially large for the shuttle service voucher because many consumers are familiar with the unit price of transportation services generally (thus encouraging and allowing them to mentally access a reference price), even if they have not personally taken such a shuttle and are unfamiliar with the price of a shuttle ride specifically. By contrast, consumers may not be as familiar with reference prices for services that are less commonly sold on a per-unit basis or do not have close substitutes that permit the simple formulation of such reference prices, such as hours of internet access or movies to watch on an airplane. Naturally, in such domains different consumers would also be less likely to access and apply a consistent reference price when scaling up to value the de facto unlimited offer. Note that by this understanding, the reference price manipulation in study 6 not only ensured that all participants had access to a reference price, but also made certain that

participants were focused on the *same* reference price (thus constraining the amount of variability in the prices from which participants scaled up). Not only did these conditions allow for a valid test of our theoretical account, but they were also particularly useful ones for observing this mechanism (if it is indeed operating, as our data suggest it is).

Table S3: Monetary Valuation by Voucher and Study

	Study 1 WTP (*N* = 193)			Study 2 WTP (*N* = 593)			Study 2 Estimated Price (*N* = 593)			Study 3 Dual frame absent Estimated Price (*n* = 292)			Study 4 Estimated Price (*N* = 598)					Study 6 Reference price absent Estimated Price (*n* = 207)			Study 6 Reference price present Estimated Price (*n* = 191)			Study 7 Estimated Price (*N* = 798)			Average effect across studies (sample-size-weighted)
Voucher	**Explicit mean**	**De facto mean**	**De facto vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**Impossible mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	**Impossible vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	**Explicit mean (SD)**	**De facto mean (SD)**	**De facto vs. explicit reg. coefficient (SE)**	
Audiobook	7.24	8.45	0.18 (0.145)	8.73	11.72	0.31*** (0.082)	18.83	22.62	0.22** (0.082)	20.30	22.78	0.13 (0.118)	20.13	21.61	21.60	0.06 (0.099)	0.06 (0.103)	19.83	22.75	0.18 (0.136)	18.16	29.22	0.49*** (0.142)				**0.19**
Shuttle	29.42	41.08	0.45** (0.144)							37.91	55.64	0.43*** (0.118)						34.62	50.14	0.41** (0.139)	35.86	63.51	0.59*** (0.142)				**0.46**
Data	20.07	19.57	0.05 (0.145)	20.59	17.69	-0.05 (0.082)	31.17	29.00	0.02 (0.082)	27.83	31.26	0.14 (0.117)						22.12	29.58	0.27† (0.138)	32.43	60.75	0.59*** (0.142)				**0.14**
Internet	25.56	28.62	0.20 (0.144)							30.06	32.38	0.05 (0.117)						29.06	27.88	-0.07 (0.137)	29.91	31.83	0.07 (0.143)				**0.06**
Cell-phone minutes	23.35	22.25	-0.04 (0.145)	22.28	24.36	0.07 (0.082)	33.73	41.33	0.19* (0.082)	33.49	38.63	0.18 (0.117)	36.84	42.92	52.37	0.16 (0.101)	0.35*** (0.100)	35.66	37.86	0.06 (0.137)	43.43	59.89	0.34* (0.143)				**0.17**
Airplane movies	9.69	8.48	-0.07 (0.145)							20.32	19.46	0.04 (0.118)	19.33	16.73	21.43	-0.06 (0.100)	0.20† (0.100)	17.93	18.79	0.16 (0.137)	15.31	18.17	0.30* (0.142)				**0.09**
Coffee subscription				22.51	30.54	0.32*** (0.082)	38.20	54.41	0.37*** (0.082)				42.02	52.89	55.44	0.25* (0.100)	0.28** (0.100)										**0.30**
Airplane TV				10.81	12.86	0.10 (0.082)	18.72	23.41	0.20* (0.082)																		**0.15**
Train pass				51.91	62.15	0.21* (0.082)	69.25	82.84	0.22** (0.082)				86.98	76.79	84.34	-0.08 (0.100)	0.02 (0.101)										**0.09**
Meal plan													115.40	126.19	144.32	0.09 (0.100)	0.23* (0.100)										**0.16**
Real coffee subscription																								32.56	63.53	0.61*** (0.068)	**0.61**

Note. This table shows the back-(ln)-transformed means of monetary valuation for each unlimited frame, by voucher, and by study, as well as the regression coefficient, standard error, and significance level for the effect of the unlimited frame on monetary valuation for each voucher in each study. Whereas the means themselves do not partial out unit WTP, the regression coefficients come from models predicting the standardized residuals that do partial out this extraneous source of variability. The regression coefficients estimate the effect of unlimited frame manipulation (explicitly unlimited: -0.5, de facto unlimited: +0.5; study 4 only: explicitly unlimited: -0.5, de facto or impossibly unlimited: +0.5) on the monetary valuation dependent variable (which was constructed by ln-transforming WTP or estimated price and extracting the standardized residuals from separate OLS regressions with this variable predicted by unit WTP). The final column shows a sample-size-weighted average effect for each voucher across all studies in which it appeared. For study 4, we included both the de facto unlimited and the impossibly unlimited effect sizes in this average,

each weighted by half of the overall sample size for that study (i.e., each coefficient was weighted by 598/2). This is to avoid double-counting the explicitly unlimited participants who were used in both simple-effects comparisons. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

ADDITIONAL ANTICIPATED USAGE ANALYSES

For all studies, we investigated two possible usage-based explanations for the effect of the unlimited frame manipulation on monetary valuation (i.e., that de facto unlimited offers elicited higher monetary valuation than explicitly unlimited offers). First, we examined whether the unlimited frame's effect on monetary valuation could be statistically explained via anticipated usage (the *usage-based anchoring* account). According to this account, consumers value de facto unlimited offers more than explicitly unlimited offers in part because de facto unlimited offers' (high) discrete limits elevate anticipated usage. And second, we tested whether monetary valuation was more strongly predicted by anticipated usage in the explicitly unlimited frame than the de facto unlimited frame (the *differential-weighting* account). According to this account, consumers value de facto unlimited offers more than explicitly unlimited offers because they rely on their actual anticipated usage—instead of a (higher) provided discrete usage limit—when considering offers that do not provide this discrete usage limit (i.e., explicitly unlimited offers).

Overall, as summarized in table S4, we saw stronger support for the usage-based anchoring account than for the differential-weighting account. In every study, the de facto unlimited frame significantly increased anticipated usage relative to the explicitly unlimited frame. In study 4, the impossibly unlimited frame increased anticipated usage even further, despite the fact that its stated limit was so high as to be meaningless. When anticipated usage was added to the original monetary valuation models, its effect was significant ($p < .05$) in five studies (including, in study 2, on both monetary valuation measures), marginally significant ($p < .10$) in one study, and non-significant in one study. In that one study in which anticipated usage

was not a significant predictor of monetary valuation, the study measured anticipated usage only as anticipated *personal* usage and not anticipated usage of a typical consumer. For every other study, the anticipated usage composite averaged across anticipated personal and typical usage. The Sobel test—which is simply a function of the a-paths and the b-paths described above—achieved significance ($p < .05$) in four studies (including, in study 2, for both mediation models given there were two monetary valuation measures), marginal significance ($p < .10$) in one study, and was not significant in two studies. Overall, the studies provide substantial evidence for the usage-based anchoring account.

In contrast, we found no support for the differential-weighting account. We tested this account by allowing anticipated usage to interact with the unlimited frame manipulation in the models predicting monetary valuation. The key interaction term achieved significance in only one of the seven studies, and it was in the direction *opposite* of that predicted by the differential-weighting account. Overall, consumers' greater monetary valuation of de facto (vs. explicitly) unlimited offers is unlikely to be explained by their differential reliance on anticipated usage.

In addition to examining the effects of anticipated usage on monetary valuation, we also tested for parallel effects on subjective valuation. After all, the theoretical logic of the usage-based anchoring account does not uniquely apply to monetary valuation. As discussed in the main text, anticipated usage may serve as a suppressor of the subjective valuation effects our paper focused on. That is, we tested whether greater anticipated usage is also associated with greater subjective valuation. And indeed, as summarized in table S5, anticipated usage was typically associated with greater subjective valuation. Of the six studies in which subjective valuation was measured, this effect was significant ($p < .05$) in four studies, marginally significant ($p < .10$) in one study, and non-significant in one study. The interaction between

Table S4: Considering the Predictive Role of Anticipated Usage on Monetary Valuation by Study

			Usage-Based Anchoring Account				Differential-Weighting Account
Study	**Valuation DV**	**Unlimited frame IV**	**Effect of unlimited frame on usage**	**Effect of usage on valuation**	**Effect of unlimited frame on valuation**	**Mediation test output**	**Unlimited frame X usage interaction on valuation**
Study 1	WTP	De facto (+0.5) vs. explicit (-0.5)	0.146** (0.054)	0.074* (0.030)	0.115* (0.050)	Sobel z = 1.84†	-0.052 (0.058)
Study 2	WTP	De facto (+0.5) vs. explicit (-0.5)	0.283*** (0.030)	0.132*** (0.019)	0.123*** (0.030)	Sobel z = 5.71***	-0.030 (0.036)
	Estimated price			0.094*** (0.018)	0.177*** (0.028)	Sobel z = 4.62***	0.032 (0.034)
Study 3	Estimated price	De facto (+0.5) vs. explicit (-0.5)	0.074** (0.027)	0.036† (0.019)	0.076** (0.026)	Sobel z = 1.58	-0.053 (0.033)
Study 4	Estimated price	De facto (+1.0) vs. explicit (0)	0.084* (0.033)	0.120*** (0.018)	0.060† (0.033)	Sobel z = 2.35*	
		Impossible (+1.0) vs. explicit (0)	0.165*** (0.033)		0.179*** (0.033)	Sobel z = 4.00***	
		Impossible (+1.0) vs. de facto (0)	0.082* (0.033)		0.119*** (0.033)	Sobel z = 2.30*	
	Estimated price	De facto (+0.25) and impossible (+0.25) vs. explicit (-0.5)	0.166*** (0.039)	0.143*** (0.022)	0.157* (0.038)	Sobel z = 3.57***	-0.017 (0.062)
		Impossible (+0.5) vs. de facto (-0.5) vs. explicit (0)	0.082* (0.033)		0.121*** (0.033)	Sobel z = 2.28*	-0.075 (0.050)
Study 5	Estimated price	De facto (+0.5) vs. explicit (-0.5)	0.151** (0.058)	0.031 (0.028)	0.264*** (0.050)	Sobel z = 1.02	-0.034 (0.054)
Study 6	Estimated price	De facto (+0.5) vs. explicit (-0.5)	0.204*** (0.037)	0.080*** (0.021)	0.273*** (0.030)	Sobel z = 3.09**	-0.062 (0.042)

Study 7	Estimated price	De facto (+0.5) vs. explicit (-0.5)	0.579*** (0.038)	0.193*** (0.043)	0.500*** (0.071)	95% CI for indirect effect: [0.05, 0.29]	-0.244** (0.085)

Note. This table shows the regression-estimated effect of the unlimited frame manipulation on anticipated usage, the effect of anticipated usage on monetary valuation (either WTP or estimated price), the effect of the unlimited frame manipulation on monetary valuation controlling for anticipated usage, the mediation test output for the indirect effect of the unlimited frame manipulation on valuation through anticipated usage, and the interaction between anticipated usage and the unlimited frame manipulation predicting monetary valuation for every study. The regressions used to estimate the effect of the unlimited frame manipulation on anticipated usage included as predictors a variable for the unlimited frame (shown in the third column) and a covariate for unit WTP. The regressions used to predict monetary valuation included as predictors a variable for the unlimited frame manipulation, a variable for the additional manipulation (for studies 3 and 6), the anticipated usage composite, and all possible two-way and three-way (for studies 3 and 6) interactions between these variables. The regressions predicting monetary valuation did not include unit WTP as a covariate because the monetary valuation dependent variable already has the effect of unit WTP partialed out. † $p <$ .10, * $p < .05$, ** $p < .01$, *** $p < .001$

anticipated usage and the unlimited frame manipulation was significant in only one study, indicating that anticipated usage was less predictive of valuation for de facto unlimited offers than for explicitly unlimited offers. Although these findings provide further support for the usage-based anchoring account, we have not focused on them in the presentation of our results given that they could only reflect a suppressor effect, not an explanation of the positive effects of unlimited frame on subjective valuation that we consistently documented.

Study 1

In addition to the analyses reported in the main text, we also examined how anticipated usage predicted subjective valuation. We added the anticipated usage composite and its interaction with unlimited frame to the original subjective valuation model. Anticipated usage was a significant positive predictor of an offer's rated attractiveness, $b = 0.13$, $SE = 0.03$,

Table S5: Considering the Predictive Role of Anticipated Usage on Subjective Valuation by Study

Study	Valuation DV	Unlimited frame IV	Effect of unlimited frame on valuation	Effect of usage on valuation	Unlimited frame X usage interaction on valuation
Study 1	Attractiveness	De facto (+0.5) vs. explicit (-0.5)	-0.267*** (0.052)	0.129*** (0.031)	-0.039 (0.060)
Study 2	Attractiveness	De facto (+0.5) vs. explicit (-0.5)	-0.163*** (0.029)	0.138*** (0.018)	-0.102** (0.036)
Study 3	Attractiveness	De facto (+0.5) vs. explicit (-0.5)	-0.109*** (0.029)	0.034† (0.020)	-0.021 (0.035)
Study 4	Attractiveness	De facto (+0.5) vs. explicit (-0.5)	-0.110** (0.034)	0.072*** (0.018)	
	Attractiveness	Impossible (+0.5) vs. explicit (-0.5)	-0.090** (0.034)		
Study 5					
Study 6	Attractiveness	De facto (+0.5) vs. explicit (-0.5)	-0.280*** (0.032)	0.048* (0.023)	-0.043 (0.045)
Study 7	Attractiveness	De facto (+0.5) vs. explicit (-0.5)	-0.307*** (0.069)	0.054 (0.041)	0.050 (0.083)

Note. This table shows the regression-estimated effect of the unlimited frame on anticipated usage, the effect of anticipated usage on subjective valuation, the effect of the unlimited frame manipulation on subjective valuation controlling for anticipated usage, and the interaction between anticipated usage and the unlimited frame manipulation predicting subjective valuation for every study. The regressions used to estimate the effect of the unlimited frame manipulation on anticipated usage included as predictors a variable for the unlimited frame manipulation (shown in the third column) and a covariate for unit WTP. The regressions used to predict subjective valuation included as predictors a variable for the unlimited frame manipulation, a variable for the additional manipulation (for studies 3 and 6), the anticipated usage composite, and all possible two-way and three-way (for studies 3 and 6) interactions that can be created from these variables. The regressions predicting subjective valuation did not include unit WTP as a covariate because the subjective valuation dependent variable already has the effect of unit WTP partialed out. † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

$t(1113.11) = 4.21$, $p < .001$. Consistent with anticipated usage being a suppressor, the effect of unlimited frame on attractiveness was even stronger once anticipated usage was added to the model, $b = -0.27$, $SE = 0.05$, $t(961.71) = -5.10$, $p < .001$. Thus, it appears that despite greater

anticipated usage predicting higher valuation overall, this effect may counteract the effect of the unlimited frame in the case of subjective valuation. The interaction between anticipated usage and the unlimited frame manipulation was not significant, $t < 1$.

Study 2

To examine the usage-based anchoring account, we first conducted a linear mixed-effects regression with the anticipated usage composite predicted by unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited) and (log-transformed and standardized) unit WTP, with random intercepts for participant and voucher. As in study 1, participants expected to use de facto unlimited offers more than explicitly unlimited offers, $b = 0.28$, $SE = 0.03$, $t(2552) = 9.49$, $p < .001$.

Second, we added the anticipated usage composite and its interaction with unlimited frame to the models predicting estimated price and WTP. We observed significant main effects of anticipated usage on both estimated price, $b = 0.09$, $SE = 0.02$, $t(3426.11) = 5.29$, $p < .001$, and WTP, $b = 0.13$, $SE = 0.02$, $t(3484.18) = 7.15$, $p < .001$. The effect of unlimited frame remained a significant, albeit slightly weaker, predictor of both estimated price, $b = 0.18$, $SE = 0.03$, $t(2964.38) = 6.32$, $p < .001$, and WTP, $b = 0.12$, $SE = 0.03$, $t(2968.21) = 4.14$, $p < .001$. Significant Sobel tests provided evidence consistent with mediation for both estimated price, $z = 4.62$, $p < .001$, and WTP, $z = 5.71$, $p < .001$. This suggests that, in support of the usage-based anchoring account, the greater monetary valuation of de facto unlimited (relative to explicitly unlimited) offers may be explained in part by their effects on anticipated usage.

In contrast to the predictions of the differential-weighting account, in neither model was the interaction between anticipated usage and unlimited frame a significant predictor of monetary

valuation, *t*s < 1. In other words, there was no evidence that participants drew upon their beliefs about anticipated usage more when considering the explicitly unlimited frame than when considering the de facto unlimited frame.

We also examined whether anticipated usage was a potential suppressor of the effect of unlimited frame on subjective valuation by adding the anticipated usage composite and its interaction with unlimited frame to the original subjective valuation model. The main effect of anticipated usage on attractiveness was significant and positive, $b = 0.14$, $SE = 0.02$, $t(3472.21) = 7.47$, $p < .001$. As in study 1, the effect of unlimited frame on attractiveness remained significant and grew even stronger when anticipated usage was added to the model, $b = -0.16$, $SE = 0.03$, $t(2968.84) = 5.55$, $p < .001$. This result is consistent with the positive effect of anticipated usage on subjective valuation acting as a suppressor on the greater subjective valuation of explicitly unlimited offers relative to de facto unlimited offers. In contrast to study 1, the interaction between anticipated usage and the unlimited frame manipulation was significant, $b = -0.10$, $SE = 0.04$, $t(3369.20) = 2.83$, $p = .005$. This reflects that anticipated usage was a stronger predictor of attractiveness for explicitly unlimited offers. This was the only study in which this pattern emerged.

Study 3

To probe the usage-based anchoring account, we first conducted a linear mixed-effects regression with the anticipated usage composite predicted by unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited), dual frame (-0.5 = absent, +0.5 = present), their two-way interaction, and (ln-transformed and standardized within each voucher category) unit WTP, with

random intercepts for participant and voucher. This model revealed that anticipated usage was greater for de facto unlimited offers than for explicitly unlimited offers, $b = 0.07$, $SE = 0.03$, $t(2746.51) = 2.77$, $p = .006$. The main effect of the dual frame was not significant, $b = 0.06$, $SE = 0.05$, $t(399.20) = 1.29$, $p = .198$, nor did it interact with unlimited frame, $b = 0.06$, $SE = 0.05$, $t(2746.23) = 1.10$, $p = .271$. Notably, this suggests that the moderating effect of the dual frame on valuation did not emerge on anticipated usage itself. That is, whereas the difference in monetary valuation between explicitly and de facto unlimited offers was diminished when both frames were present, we did not find evidence for the same pattern in anticipated usage. One explanation for this result is that participants who saw both frames were not later reminded of the alternate frame when they completed the anticipated usage measures. In subsequent studies, we instead reminded participants of the relevant manipulations just before they completed the anticipated usage measures, which should offer more insight into what anticipated usage participants were likely considering when actually evaluating the offers.

Second, to examine the effect of anticipated usage on monetary valuation, we conducted another model with estimated price predicted by unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited), dual frame (-0.5 = absent, +0.5 = present), the anticipated usage composite, and the two-way and three-way interactions that could be constructed from these variables. Somewhat supporting the usage-based anchoring account, the main effect of anticipated usage on monetary valuation was marginally significant, $b = 0.04$, $SE = 0.02$, $t(3175.75) = 1.93$, $p = .054$. With anticipated usage added to the model, the effect of unlimited frame on estimated price was nearly unchanged and remained significant, $b = 0.08$, $SE = 0.03$, $t(2717.70) = 2.87$, $p = .004$. The Sobel test—which is simply a function of the two tests just reported—did not reach significance, $z = 1.58$, $p = .114$.

To test the differential-weighting account, we used the same model and examined both the two-way interaction between anticipated usage and unlimited frame, and the three-way interaction between anticipated usage, unlimited frame, and dual frame. The two-way interaction between anticipated usage and unlimited frame was not significant, $b = -0.05$, $SE = 0.03$, $t(2839.59) = -1.64$, $p = .102$, nor was the three-way interaction, $t < 1$. Both of these null interactions are inconsistent with the differential-weighting account, which would predict a stronger effect of anticipated usage for explicitly unlimited offers (perhaps especially in the dual-frame-absent condition).

Finally, we examined how the unlimited frame influenced subjective valuation. When the anticipated usage composite and its interaction with unlimited frame were added to the original subjective valuation model, the main effect of anticipated usage on attractiveness was marginally significant, $b = 0.03$, $SE = 0.02$, $t(3259.68) = 1.69$, $p = .092$. The main effect of unlimited frame on attractiveness was preserved, $b = -0.11$, $SE = 0.03$, $t(2729.16) = -3.77$, $p < .001$. The interaction between anticipated usage and unlimited frame was not significant, $t < 1$.

Study 4

In addition to the analyses of monetary valuation reported in the main text, we also explored the relationship between anticipated usage and subjective valuation by adding the anticipated usage composite to the original subjective valuation model. Anticipated usage was a significant positive predictor of attractiveness, $b = 0.07$, $SE = 0.02$, $t(3364.82) = 3.93$, $p < .001$. With anticipated usage added to the model, the effects of the de facto unlimited frame, $b = -0.11$, $SE = 0.03$, $t(2960.24) = 3.21$, $p = .001$, and the impossibly unlimited frame, $b = -0.09$, $SE = 0.03$,

$t(2966.11) = 2.61$, $p = .009$, relative to the explicitly unlimited frame, remained significant. Both effects appear to be slightly larger than in the original model, consistent with the anticipated usage effect acting as a suppressor on the benefits of the explicitly unlimited frame. As in the original model, the effect of the impossibly unlimited frame relative to the de facto unlimited frame was not significant, $t < 1$.

Note that this study's pattern of subjective valuation results is somewhat inconsistent with the predictions of our usage-based anchoring account. Although anticipated usage was greater for impossibly unlimited offers than for de facto unlimited offers and was a positive predictor of subjective valuation, impossibly unlimited offers were rated as no more attractive than de facto unlimited offers. That is, the magnitude of the discrete limit did not influence subjective valuation in the same way that it seemed to influence monetary valuation (and anticipated usage). We conducted another regression with subjective valuation predicted by anticipated usage, a variable contrasting the explicitly unlimited frame against the two discrete-limit frames (explicitly unlimited: -0.5, de facto unlimited: +0.25, impossibly unlimited: +0.25), a variable for the orthogonal contrast (explicitly unlimited: 0, de facto unlimited: -0.5, impossibly unlimited: +0.5), and the two two-way interactions between anticipated usage and each contrast variable. The interaction between anticipated usage and the contrast between the explicitly unlimited frame and the two discrete-limit frames was not significant, $t < 1$. This indicates that anticipated usage was no more or less predictive of subjective valuation for offers without discrete usage limits (explicitly unlimited offers) than for offers with discrete limits. However, anticipated usage *was* less predictive of subjective valuation for impossibly unlimited offers than for de facto unlimited offers, as indicated by a significant orthogonal contrast, $b = -0.16$, $SE = 0.05$, $t(3244.86) = 3.13$, $p = .002$. In fact, anticipated usage was uncorrelated with

subjective valuation for impossibly unlimited offers, $t(1138.14) = 1.46$, $p = .145$. We do not know why anticipated usage was uniquely non-predictive of subjective valuation for impossibly unlimited offers, but presumably this is also why the boost in anticipated usage for impossibly unlimited offers does not lead to a significant increase in subjective valuation.

Study 5

To examine the usage-based anchoring account, we first conducted a linear mixed-effects regression with (standardized) anticipated personal usage predicted by unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited) and (ln-transformed and standardized) unit WTP, with random intercepts for participant and voucher. As in all studies, anticipated personal usage was greater for de facto unlimited offers than for explicitly unlimited offers, $b = 0.15$, $SE = 0.06$, $t(866.313) = 2.62$, $p = .009$.

Second, we added anticipated personal usage and its interaction with unlimited frame to the model predicting estimated price. In this model, the effect of anticipated personal usage was not significant, $b = 0.03$, $SE = 0.03$, $t(997.54) = 1.11$, $p = .266$. Moreover, the unlimited frame remained a significant predictor of estimated price, $b = 0.26$, $SE = 0.05$, $t(874.31) = 5.26$, $p < .001$. As foreshadowed by the non-significant a-path, the Sobel test was not significant, $z = 1.02$, $p = .305$. This study clearly provided the weakest support for the usage-based anchoring account. We of course do not know whether this is simply due to chance or due to a unique feature of this study. One such unique feature is that in this study, we included a measure of anticipated *personal* usage only (i.e., participants' beliefs about how much they themselves would expect to use each voucher); that is, we did not include the measure of anticipated typical usage that we

included in all other studies (i.e., beliefs about how much a typical consumer would use each voucher).

Inconsistent with the differential-weighting account, the interaction between anticipated personal usage and the unlimited frame manipulation in the model predicting estimated price was not significant, b = -0.03, SE = 0.05, t(952.971) = 0.63, p = .528. This is inconsistent with the possibility that participants leaned on anticipated usage more for vouchers in the explicitly unlimited frame than the de facto unlimited frame.

Study 6

To examine the usage-based anchoring account, we first conducted a linear mixed-effects regression with the anticipated usage composite predicted by the unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited), provision of the reference price (-0.5 = absent, +0.5 = present), their two-way interaction, and (ln-transformed and standardized) unit WTP, with random intercepts for participant and voucher. This model revealed that anticipated usage was greater for de facto unlimited offers than for explicitly unlimited offers, b = 0.20, SE = 0.04, t(1883) = 5.47, p < .001. This effect did not depend on the provision of the reference price, t < 1.

Second, to examine how anticipated usage influenced monetary valuation, we conducted another linear mixed-effects regression with estimated price predicted by unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited), provision of the reference price (-0.5 = absent, +0.5 = present), the anticipated usage composite, and the two-way and three-way interactions that could be constructed from these variables. In support of the usage-based anchoring account, the main effect of anticipated usage on estimated price was significant, b = 0.08, SE = 0.02,

$t(2128.17) = 3.75$, $p < .001$. That is, greater anticipated usage was again associated with higher monetary valuation. With anticipated usage in the model, the unlimited frame remained a significant, albeit somewhat weaker, predictor of estimated price, $b = 0.27$, $SE = 0.03$, $t(1966.94) = 9.18$, $p < .001$. A significant Sobel test provided evidence consistent with mediation, $z = 3.09$, $p = .002$. This finding provides support for the usage-based anchoring account.

Suggesting a lack of support for the differential-weighting account, the two-way interaction between unlimited frame and anticipated usage was not significant, $b = -0.06$, $SE = 0.04$, $t(2081.83) = 1.48$, $p = .138$. This means that, overall, monetary valuation was predicted no more strongly by anticipated usage in one frame than another. But the three-way interaction between unlimited frame, provision of the reference price, and anticipated usage was significant, $b = -0.35$, $SE = 0.08$, $t(2081.83) = 4.20$, $p < .001$. To unpack this interaction, we ran separate regressions to examine the simple effects within the reference-price-absent and reference-price-present conditions separately. In the reference-price-absent condition, the two-way interaction between anticipated usage and the unlimited frame manipulation was significant and positive, $b = 0.11$, $SE = 0.05$, $t(2074.78) = 2.20$, $p = .028$. This reflects that monetary valuation was more strongly predicted by anticipated usage for de facto unlimited offers than for explicitly unlimited offers, which is inconsistent with the differential-weighting account. However, in the reference-price-present condition, the two-way interaction between anticipated usage and the unlimited frame manipulation was significant in the opposite direction, $b = 0.24$, $SE = 0.07$, $t(2086.12) = 3.61$, $p < .001$. This reflects that when reference prices were supplied, monetary valuation was more strongly predicted by anticipated usage for explicitly unlimited offers than for de facto unlimited offers, consistent with the differential-weighting account. Overall, because these critical two-way interactions went in opposite directions (and there is no obvious reason for the

differential-weighting process to depend on the presence of an externally offered reference price), these findings do not provide support for the differential-weighting account.

Finally, we examined whether anticipated usage was a plausible suppressor of the effect of unlimited frame on subjective valuation. When the anticipated usage composite and its interaction with unlimited frame were added to the original subjective valuation model, the main effect of anticipated usage on attractiveness was significant and positive, $b = 0.05$, $SE = 0.02$, $t(2169.80) = 2.10$, $p = .036$. The main effect of unlimited frame on attractiveness remained significant, $b = -0.28$, $SE = 0.03$, $t(1972.90) = 8.78$, $p < .001$. This effect is larger than the effect without anticipated usage in the model, consistent with anticipated usage counteracting the subjective benefits of the explicitly unlimited frame. Again, the interaction between anticipated usage and unlimited frame was not significant, $t < 1$.

Study 7

To examine the usage-based anchoring account, we first conducted an OLS regression with the anticipated usage composite predicted by the unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited) and the typical consumption composite. As in previous studies, anticipated usage was greater for the de facto unlimited offer than for the explicitly unlimited offer, $b = 0.58$, $SE = 0.06$, $t(795) = 9.87$, $p < .001$.

Second, we added anticipated usage and its interaction with the unlimited frame (-0.5 = explicitly unlimited, +0.5 = de facto unlimited) to the model predicting estimated price. The main effect of anticipated usage was significant, $b = 0.19$, $SE = 0.04$, $t(794) = 4.54$, $p < .001$, reflecting that greater anticipated usage was associated with a higher monetary valuation. With

anticipated usage added to the model, the effect of the unlimited frame manipulation on estimated price remained significant but was smaller, $b = 0.50$, $SE = 0.07$, $t(794) = 7.05$, $p < .001$. To test for mediation, we used the PROCESS macro (model 4) to conduct a bootstrapped mediation analysis with 10,000 samples (Hayes 2017). The 95% confidence interval for the indirect effect of anticipated usage on monetary valuation did not contain zero (95% CI: [0.05, 0.29]), providing evidence consistent with mediation.

We used the same model to examine the differential-weighting account. This was the first case in which the interaction between unlimited frame and anticipated usage was a significant predictor of monetary valuation, $b = -0.24$, $SE = 0.09$, $t(794) = 2.86$, $p = .004$. However, the direction of this effect was inconsistent with the differential-weighting account. Specifically, anticipated usage was a stronger predictor of monetary valuation in the de facto unlimited frame than in the explicitly unlimited frame. This pattern is thus not consistent with the differential-weighting account.

Finally, we examined the potential role of anticipated usage in explaining the effect of the unlimited frame on subjective valuation. In contrast to the previous studies, the main effect of anticipated usage on attractiveness was not significant, $b = 0.06$, $SE = 0.04$, $t(794) = 1.28$, $p = .202$. In this model, the main effect of the unlimited frame manipulation on attractiveness remained significant, $b = -0.33$, $SE = 0.07$, $t(794) = 4.45$, $p < .001$. Study 7 thus provided the weakest evidence that anticipated usage may play a role in suppressing the effect of unlimited frame on subjective valuation. The interaction between anticipated usage and the unlimited frame manipulation was not significant, $t < 1$.

DEVIATIONS FROM PREREGISTRATIONS

Studies 1, 3, 6, and 7: The Timing of Partialing Out a Covariate

Our preregistrations for studies 1, 3, 6, and 7 (available on ResearchBox) specified that we would include unit willingness to pay as a covariate in all models, including the analyses on relative valuation, monetary valuation, and subjective valuation. We later recognized that for the purpose of our main analyses, this order of operations was flawed. The procedure as specified in the preregistration for study 1 was:

> ***5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.***
>
> *"We will conduct a linear mixed-effects regression of the relative valuation DV on a variable for framing condition (de facto vs. explicit) and unit WTP (log-transformed and standardized within each offer category), with random intercepts for participant and offer category. We will follow up with separate models regressing WTP and attractiveness DVs on framing condition and unit WTP (log-transformed and standardized within each offer category), with random intercepts for participant and offer category."*

Although this approach would be fine once we decomposed the relative valuation difference score into separate models predicting monetary and subjective valuation, it does not make sense to introduce unit WTP as a covariate in predicting their difference score. This is because the

covariate would operate in opposite directions for each component of the difference score. That said, we did still want to fulfill our original goal of accounting for baseline variation between participants in their personal valuation of each voucher. We also wanted our analyses on the difference score to parallel the analyses on each decomposed component of the difference score. We could do this by partialing out the effect of unit WTP for each valuation measure separately *before* subtracting those standardized residuals to create the relative valuation difference score.

After this realization, we preregistered a slightly different set of analyses for studies 2 and 4, which involved running separate OLS regressions for each individual voucher and each valuation measure separately, and extracting the standardized residuals from these models to use in constructing the relative valuation measure. To ensure that the separate monetary and subjective analyses lined up perfectly with the relative valuation analysis, we used the standardized residuals in all three models. For consistency across studies, we used the same procedure for studies 1, 3, 6, and 7. This minor change does not change the direction or significance of any of the reported results, likely because the difference score itself helps to account for the extraneous baseline variance.

The procedure we consistently followed—as specified, for example, in the preregistration for study 2—was:

> ***3) Describe the key dependent variable(s) specifying how they will be measured.***
>
> *"Each participant will provide six observations for each dependent variable (one for each offer). Our main DV for each offer is a difference score measuring the relative valuation of the offer, one calculated by subtracting (C) from (A) and one calculated by subtracting (C) from (B). (A) logged estimated price of the offer (in dollars) (B) logged WTP for the offer (in*

dollars), (C) attractiveness of the offer (1=Not at all attractive, 7=Very attractive). Before analyzing or including A, B, or C in these calculations, we will first partial out the effect of unit WTP by conducting separate OLS regressions with each DV predicted by unit WTP for each voucher and using the standardized residuals from these models."

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

"We will first conduct a linear mixed-effects regression of each relative valuation DV (one for estimated price, one for WTP) on a variable for the unlimited frame manipulation (0.5 = de facto, -0.5 = explicit), with random intercepts for participant and offer category. We will follow up with separate models predicting estimated price, WTP, and attractiveness with the same predictor."

Study 5: Data Issues

In most studies, we used a setting in Qualtrics that prevented participants from entering non-numeric characters in their open-ended monetary valuation responses. However, study 5 unfortunately omitted this response-validation setting. As a result, we unexpectedly received three responses that contained non-numeric characters. Specifically, one unit WTP response was "25 cents," another unit WTP response was ".01 cents," and one estimated price response was "1O." We reasoned that these three responses were intended to be $0.25, $0.01, and $10, respectively, so we used these values instead of excluding the responses entirely. However,

excluding these three responses does not change the direction or significance level of any results we report.

ADDITIONAL MEASURES NOT DISCUSSED IN MAIN TEXT

Studies 1, 3, 5, and 7 included additional exploratory measures that are not reported in the main text. Below, we list each measure and comment on it. Nevertheless, all measures that we collected are included in our raw data files (available on ResearchBox).

Studies 1 and 3

Estimated firm costs (measured for each voucher). Question text for in-flight movie voucher (text that varied across vouchers is in [brackets]): "In U.S. dollars, what do you think is the **cost to the [airline]** of [showing one movie during a flight]?" (open-ended text box permitting numeric responses greater than or equal to zero).

We included this measure to test an alternative explanation that participants place a higher monetary valuation on de facto unlimited offers because they thought that an explicitly unlimited offer signaled it was cheap for the firm to supply the good. We did not find support for this possibility.

Study 5

Self-reported use of reference value. We had participants write out their thought processes that went into their monetary valuations, because we assumed that we would need expert, trained coders to read these to determine whether participants made use of a reference value. This training, and subsequent discussions, took hours to get the coders to understand the

core construct (see "Coding Protocol and Procedure for Study 5" below). That said, we did want to see whether participants themselves might be able to identify use of reference values in their own thinking. It was unrealistic to train each participant for hours, so we were curious to see how closely self-codings based on the following brief explanation aligned with the assessments of expert coders:

> "When a person estimates the price of a good, they might employ a '<u>reference value</u>' to make the process of estimating easier.
>
> That is, people may first call to mind or estimate the price of a smaller offering (e.g., 'I know that a banana costs about 70 cents') when estimating the price of a larger offering (e.g., 'So I suppose a bunch of bananas should cost around $4 or $5.')
>
> For which, if any, of the vouchers you priced earlier did you first generate a smaller "reference value" when formulating your price estimate for that voucher?"

Participants then indicated, for each voucher, whether or not they had employed a reference value [Yes/No].

Participants' self-codings were only weakly correlated with those of the team of expert coders ($r = 0.23$). Given the amount of training that research assistants needed to fully understand the key construct, we suspect that participants themselves had trouble learning what we mean by reference offers and likely varied in their understanding of what we were asking them to do. Although self-codings are less costly, we recommend that future researchers employ expert coders to determine the use of reference values.

CODING PROTOCOL AND PROCEDURE FOR STUDY 5

Coding Guidelines

Values:

- 1 = participant used a smaller reference price to estimate the price of the target offer.
- 0 = participant did not use a smaller reference price.

What counts as a reference price? (i.e. coded as 1)

- Using the cost of a smaller reference offer to estimate the price of the target offer. Reference offers can be based on a single unit of the service (e.g. the price of one movie, one audiobook) or another quantity of the service (e.g., 2 GB of data, round-trip shuttle ride, 1,000 cell minutes). The key thing is that the participant explicitly called to mind or tried to estimate the price of a smaller quantity than the target offer.
- The reference quantity that they call to mind must be the quantity that is "unlimited" in the unlimited offer. For example, calling to mind the price of one day of unlimited data doesn't count because the quantity that is "unlimited" in the unlimited data voucher is the number of GB of data, not the number of days.
- The reference offer can be in the same domain or in a related domain that the participant is clearly using to inform the reference price in the target domain. For example, calling to mind the price of an Uber ride to inform the price of a voucher for unlimited shuttle rides counts (even if the participant doesn't imply that the price of an Uber is necessarily the same as the price of one shuttle ride).

- If participants merely say or imply they are thinking of a unit price, this counts – even if they don't tell us the price they are thinking of or detail all of the steps of their reasoning.
- If they just provide numbers/a calculation and it's clear they were multiplying a reference price by a number of units to estimate the price of the target offer, this counts.

What doesn't count as a reference price? (i.e., coded as 0)

- If they use the price of another unlimited offer as a reference offer, even if it is in the same domain as the target offer (e.g., using the price that they've paid for unlimited data in the past to estimate the cost of unlimited data now).
- If they call to mind a smaller reference offer but the quantity that is being used as a reference is not the quantity that is the subject of the "unlimited" label. When they use a smaller time frame and not a smaller number of units as a reference point (e.g. unlimited data is probably $10 per day so I'll guess $50 for 5 days). The quantity that is unlimited is not time, but GB of data. Note that for some offers (e.g., cell phone minutes), the "unlimited" quantity is a unit of time – code responses as a 0 if they seem to focus on time as the unlimited quantity and not the *usage* of voice minutes.

Offers:

- Unlimited [5] movies on a 10-hour flight
- Unlimited [150] audiobooks for use over a month
- Unlimited [1000] GB of data for use on an iPad on a 3-day trip
- Unlimited [30,000] cell phone minutes for use over a month
- Unlimited [72] shuttle rides for use on a 3-day vacation

- Unlimited [168] hours of internet access for use during a 7-day hotel stay

Coding Procedure

First round. Four undergraduate research assistants blind to our hypotheses were provided with the above coding guidelines and coded participants' explanations of their monetary valuation responses for each voucher (n = 1,074).

Second round. After the first round of individual coding, we flagged any response for which the coders' ratings were split (i.e., an explanation that received a 1 from two coders and a 0 from the other two coders). Fifty-seven total explanations were flagged (5.3% of all explanations). Three of the original coders then met with the first author to resolve disagreements on these 57 explanations. After a one-hour meeting, eighteen explanations remained, so the three coders re-coded them individually.

Third round. Explanations that were not fully resolved during the meeting (n = 3) or that all three coders did not agree on during the second round of individual coding (n = 4) were flagged, leaving seven unresolved responses for the third round of coding (0.7% of all explanations). The fourth coder, who had not been present at the second-round coding meeting, re-coded these seven explanations. The fourth coder's ratings determined the final group rating.

Sample Coded Responses

Explanations of monetary valuation responses for participants who were identified as having recruited a reference offer (a random subset of the 269 responses coded as 1):

- “I thought about the cost of a bus ride, which is around $2 and then considered how many times the people might be using the shuttle for it to be worth buying.”
- “$10 per day pass seems reasonable. People take the bus several times a day. If each time costs $2, $10 a day gives him 5 rides. Make it unlimited seems like a better deal.”
- “One of the most important factors in this scenario was the fact that it was an international trip. Most companies still charge a premium to use data abroad and I've seen plans with 5GB of data cost $20 so I imagined that $50 for unlimited would be fair”
- “Assuming a person would go to the city center everyday for the 3 days, it will be 6 trips total back and forth, probably cost $20 total for the company, including the wage of the driver, the depreciation of the bus, and the gas cost.”
- “NO one would use the shuttle 72 times. The shuttle would probably be used two times a day and a bus ride is typically 1.5-2 dollars with a return voucher. Therefore the actual cost would only be about 10 dollars for all three days on average. Mark up the price by 5$ to get 15$ for this amount of rides over the course of 3 days.”
- “i based it off how much a movie ticket is and how many movies can someone really watch, so for a 10 hour flight i would assume at max someone could watch 3 movies”
- “Intuitively thought that shuttle prices would be around a $1 each, but calculated for a discount because they offer it for 3 days meaning that it is likely that are incentivizing you to buy this package instead of paying for each shuttle. Factoring in unknown distances between each place, I estimated to about $50.”
- “Because I was not sure of the distance between the hotel and the city center, I erred on the side that it would be quite far (obviously the shuttle service is offered so it's likely not within walking distance}. I estimated that the average guest would use the service about 5

times in a 3-day stay as they may take a different mode of transport than the shuttle to get to the airport (if they flew to the destination). This I figured would be about $2/trip and thus have a value of $10."

- "Often, pay per view movies are priced at $1.99 to $4.99 depending on the popularity, genre, and release dates. On the flight, you can watch an average of 5 movies, but since it is unlikely that you won't stay up and watch the entire time, it is not worth more than say the cost of 3 movies. However, the cost cannot be high than the passengers' perceived value of the voucher"
- "Used Audible - the Amazon for Audiobooks and it was around 14.99 for 2 books / month, I believe, so I estimated for unlimited audiobooks for only one month, it would be around $20."

Explanations of monetary valuation responses for participants who were identified as *not* recruiting a reference offer (a random subset of the 769 responses coded as 0):

- "3 days is too little to care about unlimited data. Only few people will use it and will need to use it so intensively."
- "intuitive"
- "Attempt to remember from commercials."
- "Literally no idea"
- "Most hotel internet is free, if charge more than $20 for the staying of hotel, I wound not purchase."
- "I guessed and came up with a number"

- “Since audiobooks aren't very popular now and a user can probably only go through a couple in a month, I thought the price would be on the lower end”
- “The 5 movies a month each lasting 2 hours would be charger a lower price, making it seem like a great deal to consumers, when in reality, most people on long flights typically only watch 2 movies throughout the flight because more likely than not, the people fall asleep midway during a movie and stay asleep, only really picking to watch around 2 movies on average. The lower price will appeal to consumers because it is such a low price but in reality the company will be making a better deal”
- “Unlimited cell minutes is a lot, especially when traveling which is why this went from $0 to $10 in my eyes. However, it is not worth more than that because there is a lot of brand loyalty in data providers so people might be price sensitive.”
- “from experience people are willing to pay a lot of money for unlimited data”

REFERENCES

Hayes, Andrew F (2017), *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, Guilford publications.