Research Article

Nailing Down the Perceptual Explanation of the Date/Delay Effect in Temporal Discounting

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Abstract: The term temporal discounting describes people's often-observed preference for smaller, but sooner (SS) rewards over larger, but later (LL) rewards. This discounting effect is reduced when the time period to wait for the LL is expressed as an end date (e.g., April 3) rather than a delay (e.g., 80 days). Several explanations of this Date/Delay Effect have been put forward, one of which is the differential time estimation hypothesis claiming that the duration expressed as an end date is perceived as shorter. The few empirical demonstrations in favor of this view used rating scales for subjective duration judgments that have some methodological shortcomings. To achieve a more comprehensive approach, an objective psychophysical discrimination task was used in the current study. In two online experiments (N = 140 and N = 80), participants made timed decisions comparing which of two periods (one expressed as a date, one expressed as a delay in days) was shorter (or longer). The psychometric functions not only showed a clear bias to view the dates as shorter than the delays, but it could be quantified by estimating the point of subjective equality (PSE) which conformed to a delay-to-date ratio of about 83% and 93% in Studies 1 and 2, respectively. Data and analysis scripts are available at https://osf.io/gmkaj/.

Keywords: delay discounting, time perception, discrimination task, date/delay effect

Humans' tendency to prefer smaller but sooner (SS) to larger but later (LL) rewards is referred to as *temporal discounting*. It has been a target of behavioral and economic research for a long time (Samuelson, 1937), and a large-scale international study including 61 countries shows its generality (Ruggeri et al., 2022). Whereas the phenomenon itself may be reconciled eventually with rational principles (i.e., by factoring in the increasing risk of not getting the reward with time passing), some "anomalies" are harder to square with rational principles (Ortiz Fernández et al., 2025), for example, the *Date/Delay Effect* first reported by Read et al. (2005). The discount rate is lower when a time period is expressed as an end date (e.g., August 31) rather than a delay (e.g., 25 days), even if the periods referred to are identical. This differential impact of time depending on the way it is expressed violates the principle of *descriptive invariance* according to which the manner of describing options should not affect preferences among them (see Fisher, 2024, for a discussion). The Date/Delay Effect is quite robust for different amounts of gains (Read et al., 2005), units in which delays are expressed (LeBoeuf, 2006), and it has been replicated multiple times (see reviews in Keidel et al., 2024; Ortiz Fernández et al., 2025). Curiously, the effect is increased for patients diagnosed with substance use disorders (Klapproth, 2012) and participants high on the subscale "unusual experiences" of a schizotypy questionnaire (Keidel, Murawski, Pantelis, & Ettinger, 2025).

Cognitive-motivational explanations of the effect refer to differences in the representation of both time formats, such as higher concreteness of an end date which may be associated with episodic retrieval. In line with this reasoning, evidence suggesting different representations and strategies was gathered in eye-tracking studies showing longer fixations on the time information in the date condition than in the delay condition and more direct comparisons between the options (Keidel et al., 2024, Keidel, Murawski, Ettinger et al., 2025). The behavioral effects were accompanied by a stronger involvement of brain structures typically associated with episodic processing (Keidel et al., 2024). Since the classic choice paradigm involves time periods *and* rewards, it always contains motivational and cognitive components, potentially complicating the separation of their respective effects.

Another explanation of the Date/Delay Effect focuses on the assumed differential time perception according to which time periods marked by end dates may appear shorter than those expressed as delays. Although it has been shown that incorporating the subjective representation of time according to a Weber-Fechner function in computational models improves temporal discounting models (Takahashi et al., 2008), direct tests of comparing time perception for dates and delays have been rare. Authors in this domain typically refer to Zauberman et al. (2009) and Jiang and Dai (2021) as the relevant studies. Zauberman et al. (2009) had participants judge time periods on a Likert scale from "very short" to "very long" and showed a Fechner-like compression of the time scale in several experiments. However, only a briefly reported pilot study (N = 28) at the end of their article directly compared duration judgments in a date condition with judgments elicited in a delay condition, finding lower average duration judgments for the former. A comparable result was obtained in a similar design (using a slider) by Jiang and Dai (2021) in their Experiment 3 (N = 108). Both studies used a between-subjects design. Although both studies are in agreement with the differential time estimation hypothesis, we do not consider them conclusive. The reason is that the comparison of judgments of different stimuli between subjects may yield paradoxical results: In a simple, but enlightening study, Birnbaum (1999) showed that there is a severe danger to elicit spurious results in between-subjects comparisons of rating scales with ambiguous anchors (end points). Hence, it is possible that the construction of a reference frame for what is seen as "very short" or "very long" may change with the display format (e.g., date vs. delay), for example, due to conversational conventions. If the reference frames people construct for the rating scales differed between the groups, different ratings might not necessarily reflect actual differences in perceived duration, but rather conversational conventions.

In an own simple illustrative study (N = 98) using a randomized between-subjects design and a 10-point-rating scale anchored from "very short" to "very long," we found that participants gave a period of "3 h and 50 min" significantly *higher* ratings than a period of "2 and a half days," $t(96) = 7.42$, $p < .001$, with a large Cohen's $d = 1.49$ (all data, analysis files, and a detailed description of the study can be found on https://osf.io/gmkaj/). Although extreme stimuli were chosen in this illustration, it demonstrates that comparing judgment scales across groups must be interpreted with great care.

The goal of the current study is therefore to test the hypothesis that time periods expressed as end dates are perceived as shorter than equivalent periods expressed as delays in a more conclusive manner: First, we focus on the time perception part (without motivational confound of preferential choice) and second, we employ a proper psychophysical discrimination task that avoids potential ambiguities of between-subjects Likert scale comparisons.

A proper method of constant stimuli to elicit a difference threshold typically requires a standard stimulus (or a set of these) that is repeatedly compared to comparison stimuli (e.g., Gescheider, 1997). The stimuli in these basic discrimination tasks are typically not memorable and are perceptually noisy. However, with dates and delays, we cannot expect independent judgments in such a case, as the stimuli are easily memorable and semantically defined. Remembering that one had responded "date shorter" to the stimulus pair "April 3" and "80 days" would certainly affect the judgment of pair "April 3" and "90 days." Hence, in the studies reported herein, we adapted the classical psychophysical method and presented a different standard stimulus (delay) in each trial.

Study 1

The aim of the studies was to test the differential time perception hypothesis by using an objective discrimination task between stimuli describing time periods, either as a delay or as an end date. This approach avoids subjective rating scale use as a potential nuisance variable and eliminates further motivational complexities potentially induced by choosing between monetary rewards. A psychophysical task using an adaptation of the method of constant stimuli allows for assessing a psychometric function which plots the probability of a response (here: p ("date shorter")) as a function of the actual stimulus difference (here: expressed as "delay-to-date-ratio," see below). The inflection point of a psychometric function at p ("date shorter") = 50% is also known as the "point of subjective equality" (PSE, Coren et al., 2004; Gescheider, 1997). A PSE that deviates from the point of objective equivalence denotes a perceptual bias and thus allows for testing the differential perception hypothesis. Furthermore, the size of the bias can be quantified which is not possible using subjective rating scales.

Method

All data and analysis files are available on the Open Science Framework (https://osf.io/gmkaj/).

Design

The independent variable *delay* was varied within participants in 90 steps from 17 to 284 with a step width of three days. Furthermore, the *delay-to-date-ratio* (DDR) was manipulated and comprised the six within-participant conditions 85%, 90%, 95%, 105%, 110%, and 115%. These

DDRs were chosen by the rule of thumb based on Weber fractions reported in Teghtsoonian (1971) that typically range from roughly 2% (heaviness, length, finger span) to 8% (taste, brightness). Psychophysical time perception experiments usually employ very short intervals, ranging at most up to a few seconds. Since time perception is noisy and different from the semantically labelled stimuli in our task, the results are not directly relevant. For standard tasks between 1s and 2s, the Weber fractions roughly range about 5–10% (Getty, 1975; Grondin, 2012). Based on these results as a rule of thumb, our choice of 5%, 10%, and 15% stimulus differences as reflected in our chosen DDRs therefore seemed reasonable.[1]

A counterbalancing factor was created by assigning six consecutive delays to the respective DDRs randomly and by varying the assignments in a Latin square. Each participant judged 90 delay-date-pairs with 15 in each DDR condition, evenly spread across the delays, presented in a random order. For each trial, the computer generated the corresponding end date (as the comparison stimulus to the delay in days) by calculating it relative to the participation date, adding the number of days (rounded to the next integer) as determined by the trial's DDR. For example, when a person participated on January 5, the delay in the trial was 21 days, and the DDR was 85%, the corresponding time as a date would be *round (21 + 0.15*21) = 24* days which resulted in the displayed date of January 29. Hence, the trial would demand which of the following periods was shorter: "21 days" or "January 29."

Participants

A total of 194 participants were recruited from the Mannheim University participant pool and via the recruitment platform https://www.surveycircle.com/. Of these, 54 were excluded for incomplete data (35), self-reported distraction (1), or pressing the same key 9 times in a row (18), leaving a final sample of N = 140 (mean age 28.2, range 18 to 71, 70% female, 89% with at least a high school degree).

Procedure

The studies were programmed in *lab.js* (Henninger et al., 2022) and hosted on a JATOS server (Lange et al., 2015). Participants started the program with a link posted to the recruitment platform. Participants were informed about the study and its potential duration, and they provided explicit consent to participate before providing some demographics. After an explanation of the task, they worked through two example decisions without time limit. They responded by pressing the "y" key (corresponding to "z" on English keyboards) for choosing the left stimulus or "m" for the right stimulus. In each experimental trial, a date and a delay (number of days) were presented on the left and right sides of the screen, respectively. Positions were determined randomly in each trial. Participants had six seconds to respond which period was shorter. Each trial started with a brief fixation cross and a subsequent presentation of the stimulus pair. If no response was recorded within six seconds, a screen appeared with the following text (translated): "You are too slow. Please try to respond faster." They proceeded with the space bar. After choices were finished, participants were asked whether there were reasons not to consider their data (distraction or technical problems). Finally, they were thanked and debriefed.

Results

Descriptives

Altogether 182 trials (1.4%) were removed due to timeout. The percentage of "date shorter" responses for each delay-to-date-ratio is shown in Table 1.

Pre-Registered Hypothesis Test: Analysis of "Date Shorter" Decisions

The mean proportions of "date shorter" choices were 63.7%. A multilevel logistic regression analysis including only the participants' random effect revealed that the average random intercept was significantly larger than

Table 1. Percentage of "date shorter" responses for each delay-to-date ratio (DDR)

Experiment 1		Experiment 2	
DDR	% Date shorter	DDR	% Date shorter
85	50.7	55	16.7
90	57.1	70	26.7
95	58.9	80	31.5
105	69.5	90	40.6
110	72.0	110	76.0
115	73.8	120	80.4
		130	83.9
		145	87.8
Average	63.7		55.5

Note. In the "longer" condition of Experiment 2, responses were properly recoded to reflect "date shorter" choices.

[1] Although one could argue that a DDR = 100% condition (both stimuli equal) would reflect such a bias best, we deliberately refrained from including it since we strove for a verifiably correct answer in each trial and did not want to run the risk of participants detecting an equivalence and loosing compliance with the task.

Table 2. Results of multilevel logistic regressions predicting "date shorter" responses from the delay-to-date ratio (DDR) and the delay

	Experiment 1			Experiment 2		
Predictor	β	*z*	*p*	β	*z*	*p*
Intercept	0.63	12.22	< .001	0.33	5.18	< .001
DDR	0.16	7.81	< .001	1.41	47.57	< .001
Delay	0.41	20.29	< .001	0.16	6.41	< .001
DDR*delay	0.14	7.23	< .001	−0.12	4.13	< .001

zero, $\beta_0 = 0.596$, $z = 12.2$, $p < .001$.[2] The intercept coefficient estimates the log odds. Hence, this conforms to probabilities significantly above 0.5. Since qua design, longer and shorter delays displayed in date format were equally frequent, this demonstrates a clear bias to perceive dates as shorter than corresponding delays.

Further Analyses

To evaluate the effects of DDR and the delay, we included them as z-transformed fixed effects in a multilevel logistic regression along with their interaction and participant random intercepts. The predictors were *z*-transformed for this analysis. The result is documented in Table 2 and shows highly significant effects of both predictors and the interaction. "Date shorter" choices increased with DDR, and they also increased with the delay. The DDR effect is certainly expected, given that participants can discriminate the time periods better than chance. The significant impact of delay reflects that the Date/Delay Effect tends to increase with the length of the time interval, i.e., longer delays produce a larger effect. No effects of gender or age were found when added to the model (both $p > .25$).

Further Exploratory Analyses: Response Times

Response times may serve as an additional validation of a perceptual bias, although the measurement precision may be impeded by the variation in devices used and the speed of participants' internet connections. Nevertheless, we reasoned that a perceptual bias to see dates as shorter than delays would lead to an interaction of the actual status of a trial (date shorter vs. date longer) and the correctness of the decision: Correct decisions should be slowed for trials in which the date is longer, whereas false decisions should be slowed for trials in which it is shorter. To test the prediction, we ran a multilevel regression on response times with the predictors "status" and "correctness of decision" as well as their interaction. The absolute value of the DDR and the delay were included, too. The analysis including random intercepts for participants revealed somewhat longer RTs for correct decisions, $\beta = 0.26$, $t(12{,}333) = 5.25$, $p < .001$ and for status "date shorter," $\beta = 0.095$, $t(12{,}249) = 3.37$, $p < .001$. Most notably, however, the interaction was also significant, $\beta = -0.35$, $t(12{,}263) = -9.36$, $p < .001$, and it follows the predicted pattern as visualized in Panel A of Figure 2. No other effects reached significance.

Quantifying the Perceptual Bias With Psychometric Functions

In comparison to earlier judgment studies with subjective scales, the current psychophysical approach also allows for a quantification of the bias by assessing the *point of subjective equality* (PSE) in the psychometric function. Figure 1 (left) presents the probability of "date shorter" responses as a function of the DDR, along with the best-fitting logistic curve. The PSE is at p("date shorter" = .50) and denotes the indifference point where date and delay formats are probably perceived as equally long. The estimate is 83.2%, showing that on average, an end date is perceived as 16.8% shorter than the same time period expressed in days.

The psychometric function also allows for estimating an aggregated *just noticeable difference* (JND) for this task, which is half the interval between DDRs at $p = .25$ and $p = .75$.[3] This JND is also expressed in terms of differences in percent, and with 31.8%, it is quite substantial. Hence, discrimination is not very good in this task, and it is much larger than the Weber fractions in other psychophysical tasks.

Discussion

To our knowledge, this is the first study using an objective discrimination task to test whether time periods expressed as end dates are perceived as shorter than equivalent periods expressed as delays. Our results suggest that such a perceptual bias exists, and the PSE quantifies it at 16.8%. The pattern of response times tended to corroborate the perceptual bias, although the interpretation must be treated with caution, since variations in devices used and speed of the internet connections may have introduced additional noise.

[2] The analysis was conducted with the R package *lme4* (Bates et al., 2015). We used this analysis to take into account the nested structure of the data (that violates the iid assumptions of a Chi-squared-test) and the use of proportions (violating the assumptions of a t-test). However, both these analyses lead to the same conclusion of a highly significant bias, $\chi^2(1) = 992.0$ and $\chi^2(1) = 115.0$, or $t(139) = 13.00$ and $t(79) = 5.00$, all $p < .001$ in Experiments 1 and 2, respectively.

[3] Note that the small number of stimuli does not allow for proper estimation of individual JNDs, so only an aggregate JND across participants and different standard stimuli is reported here.

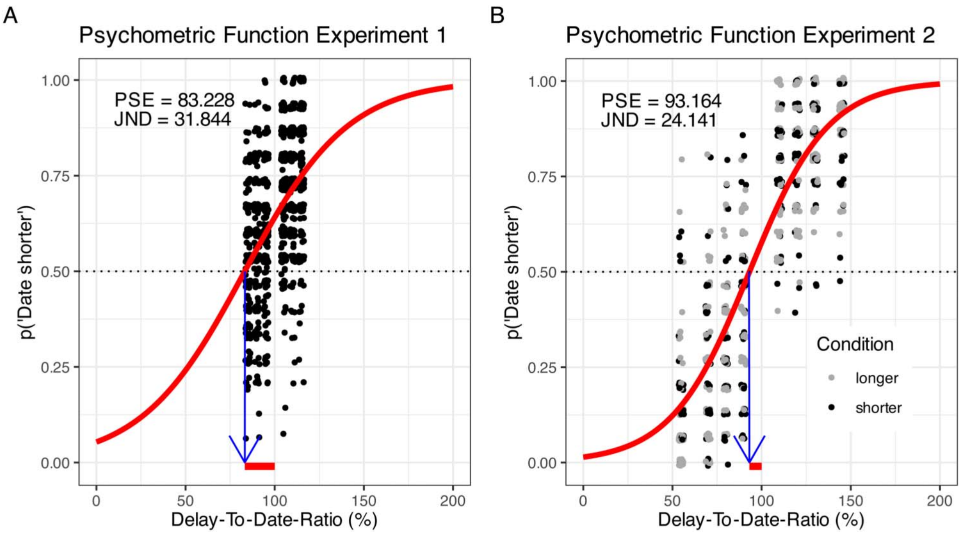

Figure 1. Psychometric functions: Percentage of "Date shorter" responses as a function of the Delay-To-Date-Ratio. Red curve estimated from the binomial logistic regression. PSE = Point of Subjective Equality at $p = .5$; JND = Just Noticeable Difference.

However, in addition to the general requirement to replicate new empirical results, two methodological limitations must be mentioned as a caveat: First, it turned out that the DDR range chosen was too narrow with respect to the difficulty of the task and the large Weber fraction. Therefore, the estimation of the psychometric function may be very unstable, and the quantification of the PSE may be compromised. Second, we only realized one experimental condition in which the "shorter" time period had to be chosen. Strictly speaking, we cannot state that the observed bias is a perceptual bias, but it could also be a response bias to just pick the date in the majority of cases.

Study 2

The aim of Study 2 was to replicate the results and to mitigate the methodological limitations of the first experiment. First, we used two more DDR conditions, and we spread them more widely to clearly cover the PSE and the JND. This would make the task easier for the participants and allow for a more stable estimation of the psychometric function. Second, we realized two counterbalancing conditions in which either "shorter" choices or "longer" choices were requested to control for a potential "pick-the-date" tendency. In addition, we recruited participants from a professional panel and incentivized them properly to achieve higher data quality and fewer exclusions than in Study 1.

Method

All data and analysis files are available on the Open Science Framework (https://osf.io/gmkaj/). Experiment 2 was pre-registered at https://osf.io/qhkmg.

Design

The independent variable *delay* was varied within participants in 120 steps from 10 to 129 with a step width of 1 day. The DDRs were manipulated in eight steps as 55%, 70%, 80%, 90%, 110%, 120%, 130%, and 145%. A counterbalancing factor was created by assigning eight consecutive delays to the respective DDRs randomly and by varying the assignments in a Latin square. Each participant judged 120 delay-date-pairs with 15 in each DDR condition, evenly spread across the delays, presented in a random order. In Experiment 2, we counterbalanced between participants whether they made "shorter" versus "longer" decisions to rule out that "date shorter" responses in Experiment 1 reflected a priming effect by emphasizing the current participation date in the instructions or by a mere response preference to choose the date in any required judgment.

Participants

Altogether 80 German residents with German as their primary language were recruited via www.prolific.com for a compensation of 3 GBP.[4] No participant had to be excluded according to pre-registered criteria. The mean age was

[4] For Study 1, we collected the maximum available sample size during the data acquisition period. For study 2, the sample size calculation was done based on the effect size estimate of Cohen's $d = .33$. This corresponds to a percentage of 55% "date shorter" responses and a standard deviation of .15 as estimated from Study 1, documented in the preregistration. For $\alpha = .05$, and a target statistical power of $(1-\beta) = .90$ in a one-tailed one-sample t-test, the required sample size is $N = 79$ (calculated with G-Power, see Faul et al., 2007).

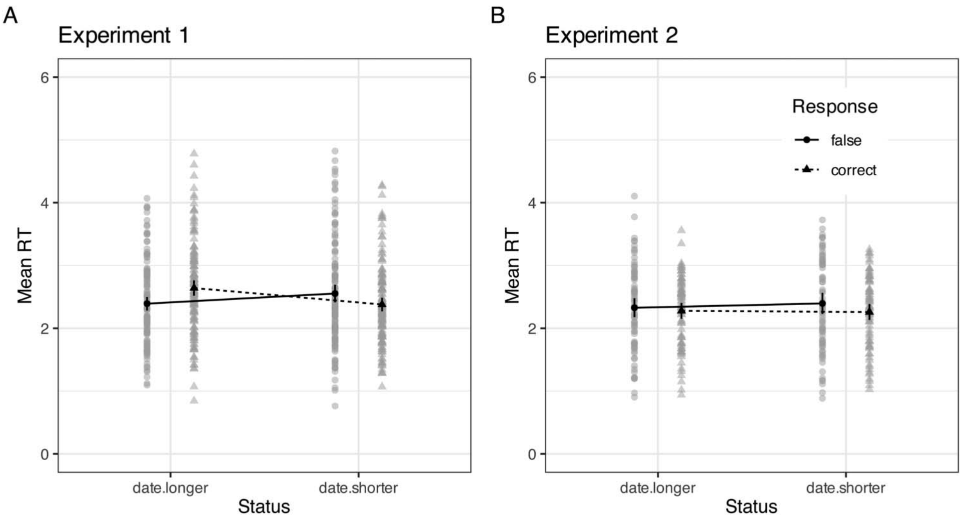

Figure 2. Mean response times in seconds as a function of trial status and correctness of the response in both experiments.

33.4 years (*SD* = 8.33, range 19–59), 61 persons identified as male, 18 as female, and 1 as other. In total, 65 had at least a high school degree. Due to a programming error that led to one missing data point, the program was corrected after checking data integrity after five participants.

Procedure

The procedure was identical to Experiment 1 with the exception that half of the participants had to choose the longer period of the presented options.

Results

Descriptives

Forty trials (0.4%) were removed due to timeout. We recoded the choices in the "longer" condition to reflect "date shorter" choices. The percentage of "date shorter" responses for each delay-to-date-ratio is shown in the right half of Table 1.

Pre-Registered Hypothesis Test: Analysis of "Date Shorter" Decisions

The mean proportion of "date shorter" choices was 55.5%. The multilevel logistic regression analysis including only the participants' random effect revealed a significant random intercept, $\beta_0 = 0.23$, $z = 5.29$, $p < .001$. This again demonstrates a clear bias to perceive dates as shorter than corresponding delays.

Further Analyses

To evaluate the effects of DDR and the delay, we included them as z-transformed fixed effects in a multilevel logistic regression along with their interaction and participant random intercepts. The result is documented in Table 2 and shows highly significant effects of both predictors and the interaction, mirroring Experiment 1: "Date shorter" choices increased with DDR, and they also increased with the delay. Adding age and gender to the model showed a significant gender effect this time, with female participants showing a somewhat larger inclination to choose the date as shorter (61.9%) than males (53.8%, $\beta = .49$, $p < .001$).[5]

Further Exploratory Analyses: Response Times

Following the same rationale and multilevel analysis as in Experiment 1, we analyzed response times as a function of the trial's status, decision correctness, and their interaction by also including the absolute value of the DDR and the delay in the model. Again, correct responses took longer than false ones, $\beta = 0.11$, $t(9{,}594) = 2.50$, $p = .01$, as did trials with the date being shorter, $\beta = 0.08$, $t(9{,}599) = 2.29$, $p = .02$. The main effects were qualified by an interaction, $\beta = -0.09$, $t(9{,}602) = -2.33$, $p = .03$, as visualized in Panel B of Figure 2. This time, correctness also showed an interaction with the amount of the difference in a trial, $\beta = -0.003$, $t(9{,}593) = -2.57$, $p = .01$. Hence, the interaction pattern again matched the predictions expected from a bias to perceive dates as shorter than delays.

Quantifying the Perceptual Bias With Psychometric Functions

Panel B of Figure 1 presents the probability of "date shorter" responses as a function of the DDR, along with the best-fitting logistic curve. The estimate of the PSE is 93.2%, showing that on average, an end date is perceived

[5] These values result when the one nonbinary person is removed. The values do not change significantly if this person is either assigned to males or to females.

as 6.8% shorter than the time period expressed in days. The JND is also expressed in terms of differences in percent, and with 26.6%, it is again quite substantial.

General Discussion

In this paper, we tackled the perceptual explanation of the Date/Delay Effect in temporal discounting research with a proper psychophysical approach, implementing an objective discrimination rather than a subjective judgment task. In our view, the main results are (1) a clear demonstration of the perceptual bias to perceive dates as shorter, (2) the establishment of a psychometric function, allowing for (3) a first attempt to quantify this effect, and (4) the estimation of a quite large JND. We will discuss these results in turn. The demonstration of a bias to perceive dates as shorter was shown in choices as well as response times. Hence, our conclusions are in line with the studies using subjective judgments (Jiang & Dai, 2021; Zauberman et al., 2009) and extend them at the same time.

The demonstration of a perceptual effect by using an objective discrimination task is more conclusive than earlier attempts to demonstrate the effect in subjective judgments. We discussed several shortcomings in the introduction. As an extension to Experiment 1, we established two counterbalanced groups of "longer" versus "shorter" judgments in Experiment 2. In both conditions, we found the preference for seeing the date as shorter relative to the delay, thus ruling out a simple priming effect or a preference to choose the date irrespective of the question asked. The descriptive bias was smaller in Experiment 2 than in Experiment 1. This was expected since we included delay-to-date ratios that were much easier to discriminate than those in Experiment 1. The latter had been chosen by rule of thumb using usual ranges of JNDs reported in the literature and proved to be quite demanding (with only 58.2% correct choices on average). The inclusion of easier DDRs in Experiment 2 consequently resulted in a higher rate of correct decisions (76.7%), leaving less room for bias.

Another advantage of the psychophysical approach is the PSE, a standard procedure to assess perceptual biases (e.g., Coren et al., 2004; Ernst & Bülthoff, 2004; Gescheider, 1997). According to this analysis, Experiment 1 suggested that a delay in days must be reduced by approximately 17% to appear the same length as a period marked by a corresponding end date. This estimate was only about 7% in Experiment 2. These estimates are unfortunately quite discrepant. However, we tend to give more weight to the results from Experiment 2 since we used a broader range of DDRs, which probably led to a more stable estimation of the logistic discrimination curve. As Panel A of Figure 1 shows, the PSE was even slightly outside the manipulated DDR range in Experiment 1. Hence, we argue that the conservative estimate of a PSE at a DDR of 93% in Experiment 2 is more trustworthy.

Note, however, that our primary goal was to demonstrate the perceptual bias rather than to measure its exact size. The latter can probably be accomplished by more controlled laboratory experiments optimized for this purpose. We demonstrated here as a proof of concept that such a measurement should be possible in principle. Furthermore, we encourage computational modelers of temporal discounting effects to check whether a perceptual bias of the order of magnitude demonstrated here is able to fully explain the Date/Delay Effect.

Our psychometric functions from both experiments allowed us to estimate an aggregated "just noticeable difference" expressed in percent stimulus change. By convention, this is half the uncertainty interval between DDRs at p("date shorter") = .25 and .75. In both experiments, the JND was quite substantial, amounting to 31.84% and 24.14%, respectively. Hence, discriminating between time delays expressed in different ways seems to be quite a challenging task. Note, however, that we prevented explicit calculations by speeding up the responses. We do not doubt that participants could do better (or even perfectly) when allowed to calculate the correct response. In this case, results would probably look quite different, and the JND might approach zero. For intuitive judgments, however, the discriminability is quite weak.

A further investigation into JNDs can be seen in Table 3. Here, we report separate PSEs and JNDs for the shortest, medium, and longest delays (33.33% percentiles). As one can see, the PSEs are fairly constant in both experiments, whereas the JNDs decrease with delay in Experiment 1. In Experiment 2, in contrast, the JND is relatively constant which is expected according to Weber's Law (Fechner, 1860) when the JND is expressed as a percentage. Since Weber's law has some approximate validity for various sensory modalities (Coren et al., 2004), it may be seen as a benchmark to judge data quality and yields another argument to trust the numerical estimates from Experiment 2 more.

Next to these accomplishments, there are of course some caveats and limitations of our studies: First, our samples were convenience online samples, and participants were quite highly educated on average. Also, the gender distribution was different in both experiments. One might further argue that a psychophysical approach would require more rigorous experimental control. This would be recommended if the goal is a precise estimation of the PSE. Second, we deliberately avoided including nuisance variables that may be at work in standard delay discounting

Table 3. Just noticeable differences (JNDs) and points of subjective equality (PSEs) for short, medium, and long delays

	Experiment 1		Experiment 2	
Delay category	PSE	JND	PSE	JND
Short	83.1	48.7	96.6	22.3
Medium	81.5	34.2	93.7	23.4
Long	84.7	21.3	89.0	26.7

Note. In both studies, the 33% shortest, medium, and longest delays were analyzed separately.

tasks: For example, we collected data early in the year (first half of 2025) and chose delays in a way to avoid crossing the year boundary. Also, we stuck to expressing the delays as the number of days. This may be somewhat unnatural since longer delays are often expressed as months or weeks instead (e.g., "2 months and 9 days" instead of "70 days"). This is also the case in many delay discounting experiments. Hence, our current results are confined to the day format, and it remains to be seen if the relationships hold for delays expressed in other time units as well.

Finally, we do not claim that this demonstration of differential time perception is the only mechanism at work in the Date/Delay Effect. It remains to be seen whether the size of the bias documented here is sufficient to explain the full amount of discounting differences between the formats. It may therefore be worthwhile in future studies to assess both the perceptual bias and its size (as we have done here) and the individual discounting rates. As Keidel et al.'s (2024, Keidel, Murawski, Ettinger et al., 2025) research has shown, there are other processing differences in a typical discounting task as shown by eye movements and fMRI data. Whether these are mere consequences of differential perception or constitute other genuine mechanisms remains to be explored. Like other phenomena in psychology, multiple causes may certainly be at work. However, according to our results we are confident to claim that the perceptual difference between the formats is one of those.

Even outside temporal discounting research, our results may have practical consequences for the efficient communication of time frames. For example, if certain outcomes are desirable, such as compliance with medical or dietary advice, motivation to study etc., it may be preferable to frame the period as a date rather than a delay. For example, patients may be more compliant to the advice "no sports before March 15th" rather than "no sports in the next six weeks." Conversely, an upcoming stressful event may sound less threatening when framed as a delay than a concrete date.

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Conflict of Interest

We have no conflict of interest to disclose.

Publication Ethics

Participants were treated in accordance with the APA ethical guidelines. None of the studies involved methods that required explicit ethics approval from the Mannheim University IRB. No deception was used, and participants were fully informed that they could terminate participation at any time without disadvantages for them. All participants gave explicit consent to participate after being informed about the study and data protection measures.

Authorship

Arndt Bröder, writing – original draft, writing – review and editing, conceptualization, data analysis, data curation; Selina Krauß, writing – review and editing, data analysis, data curation. All authors approved the final version of this article.

Open Science

To the best of our ability and knowledge, we have provided all original materials and clear references to all other materials via a stable online repository.

- Open Data: Data and analysis scripts are available at the project's Open Science Framework page (https://osf.io/gmkaj/; Bröder & Krauß, 2026).
- Open Materials: Data and analysis scripts are available at the project's Open Science Framework page (https://osf.io/gmkaj/; Bröder & Krauß, 2026).
- Preregistration: My manuscript contains at least one experiment with a completely executed preregistration or explicit notes on any deviation from the preregistration. Study 2 was preregistered at https://osf.io/qhkmg (Bröder & Krauß, 2025).

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