EXAMINING THE EFFECTS OF AFFECTIVE EPISODIC FUTURE THINKING ON DELAY DISCOUNTING OF REWARDS IN YOUNGER AND OLDER ADULTS

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Abstract

There is a tendency to devalue delayed outcomes as a function of increasing delay and immediate reward amounts, known as delay discounting (DD). Episodic future thinking (EFT) of specific, personal events is shown to reduce DD for rewards in younger and older adults. The role of imagined emotional content remains unclear, especially in older adults, where the influence of EFT on DD may be weaker. The effects of pre-experimentally normed positive and negative EFT cues on DD, relative to a non-EFT control condition, were examined in two experiments. In Experiment 1, positive EFT significantly reduced DD relative to a control condition in 183 younger adults. In Experiment 2, positive and negative EFT significantly reduced DD relative to a control condition in 217 older adults and 220 younger adults, and this effect was comparable across age groups. These findings may be leveraged to support individuals at risk for suboptimal decision-making.

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Examining the effects of affective episodic future thinking on delay discounting of rewards in younger and older adults

Many real-world decisions involve evaluating choices between immediate gratification and longer-term gains. These decisions can be influenced by the value of expected outcomes and various time-based factors, such as choosing between smaller, immediate rewards (family vacation in 1 month) or larger, delayed rewards (home renovation in 9 months). Increasing the delay to a future reward decreases its subjective value, a phenomenon known as delay discounting (DD; Green & Myerson, 2004; Kwan et al., 2012, 2013). Greater DD reflects the tendency to choose smaller, more immediate rewards, which often comes at the expense of larger, more optimal future outcomes and is associated with various maladaptive health and financial consequences (Alessi et al., 2003; Bailey et al., 2018; Daugherty et al., 2010; Halilova et al., 2022; Mena-Moreno et al., 2022; Pinger et al., 2024; Wang et al., 2022).

Given the link between DD and real-world outcomes, researchers have examined strategies to reduce discounting to optimize decisions by promoting more future-oriented choices. One well-supported strategy is episodic future thinking (EFT), which involves cueing individuals to simulate possible, personal future events (Schacter et al., 2008; Kwan et al., 2015; Palombo et al., 2015). EFT has been shown to enhance emotional engagement with the goals of one's future self, improving self-control and promoting goal-directed decisions and behaviours (Boyer, 2008; Gamble et al., 2021). EFT may result in experiencing anticipatory emotions related to decisions or future outcomes (Boyer, 2008), allowing the temporally distal events to appear more present and concrete (Trope & Liberman, 2010). This may increase valuation of imagined rewards, allowing for better consideration of options and more patient, future-optimizing decisions (Boyer, 2008; Cheng et al., 2011). If prospective or anticipatory emotions are a potential mechanism underlying the influence of EFT on DD, then cueing affective EFT may enhance this effect, similar to how affective EFT has been shown to influence the overall memorability and richness of imagined events (Acevedo-Molina et al., 2020; Puig et al., 2020). The main objective of the present study was to consider how affective EFT, particularly imagining cued positive and negative future events, influences DD.

Although EFT has been consistently shown to reduce DD, the specific affective qualities of EFT that influence discounting are still unclear. Studies examining how the valence of EFT affects DD indicate that positive EFT reduces DD for rewards in young adults (Ballance, et al.,

2022; Bulley et al., 2019; Calluso et al., 2019; Liu et al., 2013; Rösch et al., 2022; Ye et al., 2022; Zhang et al., 2018), but findings for negative EFT are limited and inconsistent (see Rösch et al., 2022 or Ye et al., 2022 for review). Some studies report that negative EFT reduces DD, reflected in a greater selection of larger, later choices (Ballance et al., 2022; Bulley et al., 2019; Calluso et al. 2019; Fan et al., 2024), while others report that negative EFT increases DD and the preference for smaller, sooner rewards (Liu et al., 2013; Zhang et al., 2018). Moreover, some studies reporting an effect of negative EFT have used participant-generated cues (Ballance et al., 2022; Calluso et al. 2019). However, these individualized cues may vary systematically in emotional valence and intensity as well as other phenomenological factors across trials within individuals and between individuals, and this variability may influence DD. For example, vividness of EFT may further reduce DD by eliciting stronger affective responses, increasing the perceived plausibility of the imagined event (see Rösch et al., 2022 for review). Although statistical control can account for some variation in phenomenology of participant-generated cues (Ballance et al., 2022), it cannot account for unmeasured aspects of cue content or the possibility that emotional valence may influence phenomenological characteristics themselves (e.g., vividness, imagined perspective), and, in turn, DD (Bulley & Suddendorf., 2016; Rösch et al., 2022). Further, because phenomenological characteristics of EFT are often intercorrelated, statistical adjustment or covariate control may obscure the unique effects of emotional valence. *A priori* matching or norming of cues can allow for increased phenomenological comparability across affective conditions, allowing for greater experimental control and isolation of the unique effect of EFT emotional valence on DD.

Beyond an unclear understanding of the influence of affective EFT on DD, few studies examining DD involve older adult participants. Of those studies, some indicate that older and younger adults differ in their general discounting patterns (Bagaïni et al., 2023; Eppinger et al., 2012; Halpin et al., 2024; Li et al., 2013; Löckenhoff et al., 2011; Mok et al., 2020; Wan et al., 2024; Whelan & McHugh, 2009). Other findings indicate age-related differences captured by a U-shape discounting trend showing that discounting decreases from childhood into mid-life, hits a low near age 50, and then increases in older age, resulting in steeper discounting in older compared to younger adults (Liu et al., 2025; Lu et al., 2023). Yet others find no age effects in DD for rewards (Chao et al., 2009; Seaman et al., 2022). Even fewer studies have investigated the effects of EFT on DD in younger vs. older adults. Mok and colleagues (2020) found that

although older adults showed less discounting than younger adults overall, they still exhibited a reduction in DD following EFT. Mok and colleagues' (2020) findings highlight that, despite mixed findings regarding age-related differences in discounting, a common mechanism may underlie the efficacy of EFT in younger and older adults. Whether EFT is influenced by positive and/or negative emotion in older adults remains to be determined, as research on the valence of EFT has primarily focused on younger adults (Ballance et al., 2022; Bulley & Gullo, 2017; Calluso et al., 2019; Zhang et al., 2018). The finding of similar effects of EFT on DD in younger and older adults for both positive and negative EFT would provide further support for a common mechanism underlying EFT effects in the two groups.

Mechanisms to bolster the phenomenological experience or quality of EFT, such as manipulating emotional valence, may be especially important for older adults who experience age-related cognitive changes that may affect decision-making (e.g., in financial domains; Spreng et al., 2016) and EFT ability in relation to diminished episodic detail (Schacter et al., 2013). These age-related changes highlight the importance of identifying factors that could support EFT effectiveness and phenomenological quality in older adults. This may be particularly important because greater perceptual richness during autobiographical memory recall (i.e., memories of personal, past events), a process closely related to EFT, has been associated with reduced DD in this population (Lempert et al., 2020).

The utility of EFT in older adults is further complicated by age-related changes in emotional processing and motivation. Approach and avoidance motivation refer to motivational systems involved in seeking or approaching favourable outcomes and avoiding undesirable outcomes, respectively (Spielberg et al., 2012; Zhang et al., 2016). These motivational tendencies may influence intertemporal choices (i.e., decisions involving trade-offs between outcomes that occur at different times), such that individuals with greater approach motivation may favour approaching larger, future gains, whereas those with avoidance motivation may prefer avoiding future loss or negative outcomes leading to more delaying of gratification reflecting less DD. Approach and avoidance motivation have been found to change as individuals get older, with reduced approach and increased avoidance motivation (see Freund et al., 2012 for overview; Nikitin et al., 2014; Penningroth & Scott, 2019; Wolfe et al., 2022). Older adults tend to prioritize emotionally salient information with a positivity bias (Carstensen et al., 2000; Charles & Carstensen, 2010; Wolfe et al., 2022). To this end, older adults preferentially

use negativity-avoidance strategies, while younger adults prefer positivity-seeking tactics in line with approach motivation (Wolfe et al., 2022). Together, these age-related differences in motivation and emotional processing suggest that the effects of EFT – particularly the influence of cue valence – may differ between age groups. To date, however, there has been little consideration of approach and avoidance motivation within the context of the influence of affective EFT on DD.

A common framework used to assess approach and avoidance motivation is Reinforcement Sensitivity Theory (Corr, 2016) highlighting two key systems: 1. the Behavioral Activation System (BAS), which reflects sensitivity to reward and approach related behaviour, and 2. the Behavioral Inhibition System (BIS), which reflects a sensitivity to punishment, conflict, and avoidance-related behaviour. Scales measuring these systems, such as the BIS/BAS scales, collectively known as the Behavioral Activation Index (BAI; Carver & White, 1994), are commonly used to measures approach and avoidance motivation. These scales have also been applied to measure how such motivation may predict DD. The BAS has been found to negatively correlate with discounting, with a higher BAS associated with less DD (Veldhoven et al., 2020), although the opposite finding has also been observed (Zhang et al., 2016). Results are more consistent for avoidance motivation, with a higher BIS predicting less DD (Jarmolowicz et al., 2014; Tuk et al., 2011; Zhao et al., 2015). It is possible that these motivational differences are associated with more or less extreme DD at various ages. Importantly, individuals with lower BAS scores reflecting greater approach motivation have been shown to experience lower DD for rewards following EFT (Daniel et al., 2013). This leads to the prediction that motivational shifts may influence the efficacy of affective EFT in reducing DD. To date, previous work has not considered how changes in approach and avoidance motivation in aging influence EFT on DD, let alone DD without EFT. Understanding aging (Eppinger et al., 2012; Mok et al., 2020) and motivational influences (Sparrow et al., 2019) on DD for rewards, including corrective strategies such as EFT, is important for promoting optimal decision-making across the lifespan.

The present study examined age-related differences in DD and how these differences are influenced by affective EFT. A set of cues were developed and normed to confirm that they would be likely to elicit imagined future events high in phenomenological qualities (e.g., vividness, importance, and emotionality) to maximize the effectiveness of the EFT cueing conditions. It was also ensured that cues were matched across the positive and negative EFT

cueing conditions in these dimensions, except for emotional valence. Two experiments tested the influence of emotionally valenced EFT cueing conditions (positive and negative) compared to a control condition (typing task without EFT), first in a sample of younger adults to examine the influence of positive and negative EFT on DD (Experiment 1) and then in a sample of both younger and older adults (Experiment 2). In Experiment 2, phenomenological factors of EFT (e.g., vividness, detail, and first-person perspective) were examined to consider how they relate to DD and future thinking and whether emotional cue valence moderates these relationships as an approach to deepen the understanding of how EFT acts as a mechanism to reduce DD. As a secondary goal for Experiment 2, there was a consideration of whether approach and avoidance motivation mediated the relationship between positive and negative EFT and DD, given that these motivational tendencies change across adulthood. Understanding the role of these motivational processes may inform interventions to support better decision-making across adulthood.

For both experiments it was predicted that positive EFT would reduce DD to a greater extent than would negative EFT and the control task (Rösch et al., 2022). For Experiment 2, the following hypotheses were made: 1. Older adults would discount rewards less than younger adults overall, but the differential effect of positive EFT vs. negative EFT and the control condition on DD would be smaller in older adults given their reduced sensitivity to EFT manipulations (Mok et al., 2020); and 2. Imagining a positive event would promote approach motivation (i.e., an orientation towards a larger overall gain), reflected in reduced DD (Daniel et al., 2013). Specifically, it was predicted that the level of approach orientation, as measured with the BAS, would mediate the effect of positive EFT on DD of rewards.

Methods, Results, and Interim Discussions

Transparency and openness

This project was approved by the Baycrest and York University Research Ethics Boards (REB #19–07) for research with human participants, and all research was conducted in accordance with the Declaration of Helsinki. All participants provided informed consent online prior to their participation in the study. Experiment 2 was pre-registered on the Open Science Framework (OSF) prior to data collection (https://osf.io/67rbh). Participants were compensated

with either course credit (Experiment 1) or monetary compensation (Experiment 2) for their time.

Experiment 1

1.1. Methods

1.1.1. Stimuli. A set of affective event cues were developed such that, through a norming procedure, they were highly effective in cueing affective EFT and matched across EFT cueing conditions in terms of phenomenology and EFT quality. To this end, an online sample of 75 younger adults (aged 18-30 years) was recruited through Prolific.com and the York University Undergraduate Research Participant Pool. Two participants were excluded due to failing the attention check, one due to a history of traumatic brain injury, and two for being aged over 30 years old, leaving a final sample of 70 young adults (M_{age} = 21.73, SD_{age} = 3.77). Using a Qualtrics survey, a total of 32 EFT cues were normed that referenced positive or negative events (16 of each valence) likely to be experienced by younger adults (e.g., you go on a fun date). Cues were randomly presented and for each, participants were instructed to imagine the cued event for 30 seconds before completing a series of phenomenological ratings using a sliding scale bar. For most ratings, 1 indicated the event was low in the quality and 7 indicated it was high, including ratings of: imagined event detail, vividness, the importance of the event, the likelihood of the event happening, and the frequency with which they had already experienced the event. Additionally, participants rated how emotional they felt while imagining the event and how emotional the content of event itself was (1 = very negative, 7 = very positive), the perspective they imagined the event from (1 = mostly their own perspective, 7 = mostly from an outside perspective), and when they imagined the event taking place (1 week, 1 month, 3 months, 6 months, 1 year, 3 years, or 10 years from the present). A single attention check item required responding with the value of "4".

Seven cues for each EFT cueing condition (i.e., positive and negative) were selected using a set of criteria designed to maximize the strength of the imagining experience, and to ensure the imagined events were of the intended valence of the condition (i.e., positive or negative). The list of key selection criteria is presented in Table 1. This selection process also involved ensuring that the variance of ratings across the event cues was minimal (positive:

SD values < 1.29; negative: SD values < 1.19) and that ratings were matched across positive and negative valence conditions on dimensions other than valence. The final set included one event cue per temporal distance or imagined delay that, based on the temporal distance ratings for the imagined events, could be reasonably assigned to that imagined delay. See Table 2 for the selected cues and the median ratings of the key selection criteria reflecting EFT phenomenological qualities. The final set of cues was evaluated by averaging cue ratings across the selected positive, and negative cues for phenomenological dimensions of interest and paired-samples *t*-tests were conducted to compare whether the two valence conditions were matched on the phenomenological EFT characteristics. *p*-values were corrected using False Discovery Rate (FDR) to address multiple comparison concerns. Positive and negative cues did not significantly differ in perspective, $t(69) = 0.27$, $P_{FDR} = .784$, detail, $t(69) = 1.47$, $P_{FDR} = .344$ or vividness, $t(69) = 0.64$, $P_{FDR} = .525$, suggesting cues were matched on these characteristics. However, a significant difference was observed for ratings of the event's importance with positive cues rated as more important than negative cues, $t(69) = 2.65$, $P_{FDR} = .034$.

Table 1.

Affective EFT Cue Stimuli Selection Criteria

Phenomenological Quality	**Criterion***	**Purpose**
Personal emotion (experienced during EFT)		
Positive EFT cues	≥ 4	Moderate level of positive emotion
Negative EFT cues	≤ 4	Moderate level of negative emotion
Event emotion (content of event)		
Positive EFT cues	≥ 4	Moderate level of positive emotion
Negative EFT cues	≤ 4	Moderate level of negative emotion
Perspective event imagined from	< 3	Imagined from first person perspective
Level of detail imagined	≥ 4	Moderate to high levels of detail
Vividness of imagined event	≥ 5	High levels of vividness
Importance of event	≥ 5	Highly important events

Likelihood of future occurrence	≥ 5	Highly likely and plausible events
Frequency of past occurrence	< 4	Plausible events but not highly predictable based on past exposure

Note. *All scales were from 1 to 7. EFT = episodic future thinking.

Table 2

Phenomenological Ratings Set of Event Cues Selected for Younger Adults (Experiment 1)

Event Cue	Phenomenological Ratings (Median)*						
	Temporal Distance	**Perspv.**	**Detail**	**Vivid**	**Pers. Emotion**	**Event Emotion**	**Import.**
Positive Event Cues							
You go out for a nice dinner	1 week	2.0	5.0	6.0	5.5	5.0	5.0
You receive a gift	1 month	1.5	5.0	5.0	5.0	5.0	5.0
You go on a fun date	3 months	2.0	5.0	5.0	6.0	6.0	5.0
You get hired for a new job	6 months	1.0	4.5	4.0	6.0	5.0	6.0
You attend a graduation	1 year	2.0	5.0	5.0	5.0	6.0	6.0
You get a sizeable bonus	3 years	2.0	4.0	4.0	5.0	5.0	5.0
You get a promotion	10 years	2.0	4.0	4.0	5.0	5.0	6.0
Negative Event Cues							
You lose a game	1 week	2.0	4.0	4.0	3.0	3.0	3.0
You receive negative feedback on your work	1 month	2.0	4.0	4.0	3.0	3.0	4.0
You miss an important deadline	3 months	1.0	4.0	4.0	2.0	3.0	5.0
You have a fight with your friend	6 months	2.0	4.0	5.0	3.0	2.5	5.0
You say goodbye to a loved one	1 year	2.0	5.0	5.0	3.0	2.5	6.0

You visit a loved one at the hospital	3 years	2.0	5.0	5.0	3.0	3.0	5.0
You attend a funeral	10 years	2.0	5.0	5.0	2.0	2.0	5.0

Note. Cues were selected based on the best available match to the outlined criteria. *Higher ratings of each phenomenological quality represent greater presence of that quality (range 1 to 7) except for: perspective (1 = mostly first-person perspective, 7 = mostly third-person perspective), and emotionality (1 = very negative, 7 = very positive) and temporal distance/imagined delay (categorical rating). Pers. = Personal; Perspv. = Perspective; Import. = Importance.

1.1.2. Participants. Recruitment for Experiment 1 was conducted online through the York University Undergraduate Research Participant Pool. Inclusion criteria consisted of: being between 18 to 30 years old, fluent in English, and being free of neurological impairment or ongoing psychiatric conditions. G*Power (Version 3.1.9.7; Faul et al., 2007) was used to conduct a power analysis to determine sample size a priori. The analyses revealed that at least 177 participants per study (59 per valence condition) were required to detect a small-to-medium effect size (Cohen's $f = 0.20$) for a linear multiple regression analysis with 3 predictors, an alpha level of .05 and power of .80. The a priori effect size is based on what is typically observed in studies of the effects of EFT on DD of rewards (Rösch et al., 2022). Oversampling occurred to account for potential random responses, recruiting a total of 190 participants. Of these, 7 participants were removed due to not being within the required age limit. This resulted in a final total sample size of 183 participants with 63 assigned to the control condition (M_{age} = 19.46 years; SD_{age} = 1.83; 79.36% female), 61 to the negative condition (M_{age} = 19.77 years; SD_{age} = 2.62; 88.52% female), and 59 to the positive condition (M_{age} = 19.42 years; SD_{age} = 1.93; 81.36% female).

1.1.3. Demographic Questionnaire. Participants provided responses to a demographic questionnaire including: their age, gender, country of residence, ethnicity, education, employment status and occupation, perception of income, substance use and gambling tendencies, and general health related questionnaires including questions related to brain trauma, current medication, perception of their general health, and psychiatric history.

1.1.4. EFT-DD Task. For the EFT-DD task, participants were randomly assigned to one of three conditions (see Figure 1): positive EFT (imagining positive personal future events), negative EFT (imagining negative personal future events), or control (EFT is not cued). In the EFT cueing conditions, participants were presented with each of the seven normed event cues. They were instructed to imagine the cued event at the specified temporal distance and to type a description of what they imagined for 60 seconds in as much detail as possible, including details of "Who? What? When? Where? Why?" for their imagined event. In the control condition, participants were presented with a paragraph of nonsensical text and instructed to type as much of the nonsensical text as they could for the entire 60 seconds. If participants finished typing the text before the time was up, they were instructed to type the same text a second time.

DD was measured using a well-established amount-adjusting intertemporal choice procedure (Halilova et al., 2022, 2025; Mok et al., 2020) where participants chose between a series of smaller, immediate rewards (e.g., $1250) and a larger, future reward ($2000) to be received at different imagined delays (e.g., 1 month, 3 months, or 1 year from now). The immediate reward amount was adjusted across trials based on the participant's previous choice, with the aim to find the value that was subjectively equivalent to the delayed reward at each temporal distance or imagined delay. The first adjustment was half the difference between the delayed and immediate amounts (e.g., choosing $2000 over $1000 leads to a $1500 immediate offer on the next trial). Each subsequent adjustment was half the size of the previous one. After six intertemporal choices were made, a subjective value was obtained at the temporal distance for which the choices were made (e.g., subjective value of $984 for a $2000 reward received after 10 years). Steepness of DD rewards was measured by computing Area-under-the-Curve (AuC; Myerson et al., 2001).

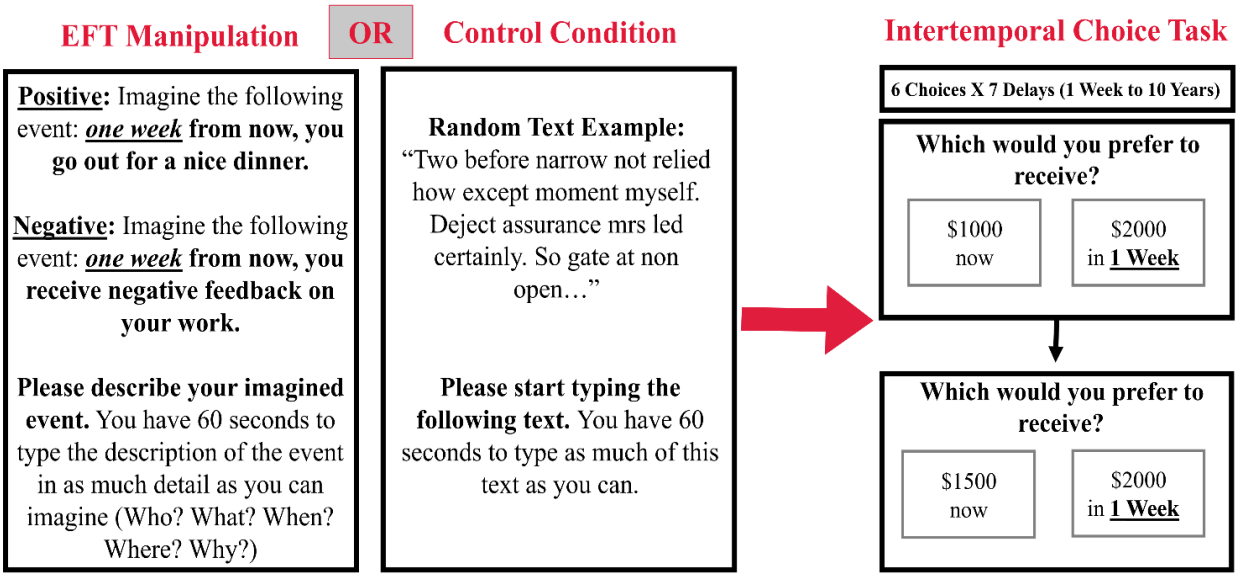
The DD task was combined with the cueing procedure such that participants completed blocks comprising 60 seconds of EFT, followed by six intertemporal choice trials of a particular delay. Importantly, in any given block in the EFT cueing conditions, the cued event was to be imagined at a time in the future (e.g., one month from now) that matched the delay of the subsequent six intertemporal choice decisions (e.g., $1500 now

or $2000 in one month?). The blocks were presented randomly across participants. Note that the control typing condition was presented a single time prior to the intertemporal decision task.

Immediately before starting the EFT-DD task, participants were asked to rate the extent to which they were thinking about the future, present and typing on a 10-point scale (1 = not at all; 10 = a lot). Participants then completed the EFT-DD task blocks, followed by a second round of rating the extent to which they were thinking about the future, present and typing; this latter rating was analyzed as a manipulation check. Participants in the negative and positive conditions also completed a series of 7-point ratings about the EFT phase (event perspective; personal importance of the event; intensity of negative or positive emotion; level of detail imagined; degree of vividness of imagined event), like those used in the cue norming.

Figure 1

Episodic Future Thinking and Delay Discounting Task Procedure



Note. An example of the Episodic Future Thinking and Delay Discounting (EFT-DD) task procedure. Each participant in the positive or negative EFT conditions completed seven EFT cueing conditions per each imagined temporal delay matched to each reward delay, with delays ranging from 1 week to 10 years. Pre-selected positive and negative cues were presented, depending on the participants' condition at the start of each trial and followed by six

intertemporal choice decisions per each delay. The example displays the 1-week cue and matching intertemporal choice task. The control typing task was only displayed once prior to all the intertemporal choice task blocks in Experiment 1. However, in Experiment 2, the control condition typing task was presented seven times, prior to each intertemporal choice task block for the seven imagined delays.

1.1.5. Psychological Distress Index. Psychological distress was assessed based on the presence and severity of depressive or anxiety symptoms with the General Anxiety Disorder 7-item, (GAD-7) scale (Spitzer et al., 2006) and Patient Health Questionnaire 9-item (PHQ-9) scale (Kroenke et al., 2001). The scales ask participants to rate the frequency of symptoms experienced over the past two weeks using a 4-point scale (1 = not at all; 4 = nearly every day). A total score was calculated for each scale with higher scores reflecting greater symptom severity. A psychological distress index was created by standardizing the total scores for the GAD-7 and PHQ-9 and then summing the standardized scores. Scores ranged from -3.03 to 4.76. This index was used to control for depressive and anxiety symptoms that have been shown to influence DD (Bickel et al., 2019).

1.1.6. Positive and Negative Affect Schedule. Experiences of affect or emotion over the past week were assessed using the Positive and Negative Affect Schedule (PANAS) scale (Watson et al., 1988). PANAS presents a series of emotions (e.g., enthusiastic) with 10 items assessing positive affect and 10 items assessing negative affect. The scale asks participants to rate the extent they have felt that way over the past week on a 5-point scale (1 = very slightly or not at all; 5 = extremely). Positive and negative affect scores were computed with higher scores representing greater positive or negative affect. Both positive and negative affect scores ranged from 10 to 50.

1.1.7. Behavioral Activation and Inhibition Systems Scales. Approach and avoidance orientations were measured using the Behavioral Activation and Inhibition Systems [BAS/BIS] scales (Carver & White., 1994). The BAS scale includes three subscales measuring approach orientation: BAS Reward Responsiveness reflects positive responses

to anticipation of reward, BAS Drive reflects the pursuit of goals, and BAS Fun Seeking reflects desire for new rewards and how willing an individual is to approach potentially rewarding situations. Higher scores on these subscales reflect greater reported presence of behavioral activation or approach motivation within the relevant domains described. The BAS Reward Responsiveness scale contains five items with participant scores ranging from 5 to 20. The BAS Drive scale contains four items with participants scores ranging from 4 to 16. The BAS Fun Seeking scale contains four items with scores ranging from 4 to 16. A BAS total score was calculated by summing the three BAS subscales with scores ranging from 13 to 52.

The BIS scale is a single scale that measures punishment sensitivity or reactions to the anticipation of punishment or losses as a reflection of avoidance orientation. Participants provided ratings on how much they agree with each of seven specific statements (e.g., “If I think something unpleasant is going to happen, I usually get pretty "worked up”) on a four-point scale (1 = strongly disagree; 4 = strongly agree). A total score was calculated for each subscale, with higher scores indicating greater presence of the subscale quality. Scores range from 7 to 28.

1.1.8. Loss Aversion Scale. The Loss Aversion Scale (LAS; Li et al., 2021) measured individuals’ loss aversion tendency. For eight items, the scale uses a 7-point rating scale (1 = strongly disagree, 7 = strongly agree) to indicate agreement with statements regarding loss aversion (e.g., “I feel nervous when I have to make a decision that may lead to loss”). The total score was calculated, with higher scores reflecting greater loss aversion. Scores ranged from 8 to 56.

1.1.9. Intolerance of Uncertainty Scale. Participants’ ability to tolerate uncertain situations was measured using the Intolerance of Uncertainty 12-item (IUS-12) scale (Carleton et al., 2007). The scale uses a 5-point rating (1 = not at all characteristic of me; 5 = entirely characteristic of me), with items measuring aspects of uncertainty intolerance, including prospective anxiety (the tendency to worry about future events) and inhibitory anxiety (the tendency to avoid uncertainty and related situations). Total scores were calculated, ranging from 12 to 60, with higher scores reflecting greater intolerance of uncertainty.

1.1.10. Vividness of Visual Imagery Questionnaire. Visual imagery ability is related to EFT richness and quality (Aydin, 2018; D'Argembeau & Van der Linden, 2006) as well as DD behaviour (Parthasarathi et al., 2017) and thus, the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973) was used to explore visual mental imagery ability and the vividness of visual imagination and to ensure vividness of imagining was comparable across the EFT conditions. For the VVIQ, participants are asked to imagine and rate how vivid their experience is on a 5-point scale (1 = No image at all, you only "know" that you are thinking of an object; 5 = perfectly clear and vivid as real seeing). The scale contains 16 items. A total score was summed, with scores ranging from 16 to 80 (a higher score reflects greater mental visual imagery ability).

1.1.11. Attention Checks. Three attention check items from the Conscientious Responder Scale (CRS; Marjanovic et al., 2014) were used to identify participants who are randomly responding. Participants were asked to select a specific answer in response to a questionnaire item (e.g., "Please select option 'several days' in response to this question"). Participants who failed two or more attention checks were removed from the sample.

1.1.12. Procedure. The study was conducted on a survey created using Qualtrics. Informed consent was obtained online prior to starting the study. The study took approximately 30 minutes to complete. Participants first completed the questionnaires described above. The attention check items were placed at random points within these questionnaires. Immediately before starting the EFT-DD task, participants were asked to rate separately the extent to which they were thinking about the present, future, and typing on a 10-point scale (1 = not at all; 10 = a lot). Participants completed the EFT-DD task blocks, followed by rating for the second time, of the extent to which they were thinking about the present, future or typing.

1.1.13. Statistical Analyses. Statistical analyses were performed using R (Version 4.3.0). Statistical analyses were performed to ensure that participants assigned to the three EFT

conditions were matched on demographic variables (e.g., age, gender, education) using linear regression analyses, Fisher's Exact Test of Independence, and Chi-squared tests as appropriate. Linear regression models, equivalent to one-way analysis of variance (ANOVA), were also conducted to determine whether the participants assigned to the EFT cueing conditions differed on the administered questionnaires measuring factors related to DD (e.g., psychological distress index, BIS/BAS, etc.)

To assess the effectiveness of the EFT cueing condition in promoting future orientation and thoughts about the future relative to the control condition, analyses were conducted on participant ratings after the EFT-DD task which indicate the extent to which they were thinking about the present, future and typing. For each rating, a simple linear model was computed with EFT cueing condition as the predictor variable and the non-EFT control condition as the reference group. Steepness of DD rewards was measured by computing Area-under-the-Curve (AuC; Myerson et al., 2001). A linear regression model equivalent to a one-way ANOVA examined whether AuC differed across EFT cueing conditions with participants in the control group being the reference group. Cohen's *d* was computed to quantify the magnitude of AuC differences for each EFT condition pairwise comparison. Group mean differences were divided by pooled standard deviations. Follow-up analyses using FDR-corrected pairwise comparisons were used to interrogate any main effects of condition.

1.2. Results

Simple linear regression analyses were conducted to determine whether the participants in the EFT cueing conditions were matched on key demographics. There was no significant main effect of condition for age, $F(2, 180) = 0.48$, $p = .622$. Fisher's exact test revealed no significant differences in gender distribution, $p = .328$ (two-tailed). Similarly, Chi-square analyses revealed no significant differences in obtained education level across EFT conditions, χ^2 (4, $N = 183$) = 0.96, $p = .619$. Simple linear regression models demonstrated no significant differences in the questionnaire measures (p values > .228) as shown in Table 3. Although these questionnaires are not central to the main analyses, they were considered to ensure EFT conditions were balanced to account for variables that could potentially influence the results such as anxiety and depressive

symptoms which are shown to affect DD (Bickel et al., 2019) or mental imagery ability which could influence EFT abilities and quality (e.g., vividness).

Table 3

Descriptive Statistics for Questionnaire Measures

Measure	**Control *M* *(SD)***	**Positive *M* *(SD)***	**Negative *M* *(SD)***	***F*(*df1, df2*)**	***p***
Psychological Distress Index	0.06 (1.87)	0.09 (1.93)	-0.16 (1.83)	0.31 (2, 178)	.736
IUS	37.35 (9.22)	35.53 (10.70)	39.82 (7.04)	1.22 (2, 180)	.299
LAS	40.58 (6.45)	39.42 (8.74)	43.82 (7.04)	0.38 (2, 178)	.686
BIS/BAS	59.37 (6.64)	59.36 (6.14)	58.95 (5.07)	0.09 (2, 168)	.914
PANAS – Positive Affect	28.08 (8.05)	30.44 (7.63)	29.28 (6.37)	1.49 (2, 174)	.228
PANAS – Negative Affect	24.92 (8.22)	26.79 (8.45)	25.64 (8.10)	0.78 (2, 175)	.461
VVIQ	58.06 (15.00)	60.17 (13.18)	56.80 (13.98)	0.86 (2, 176)	.425

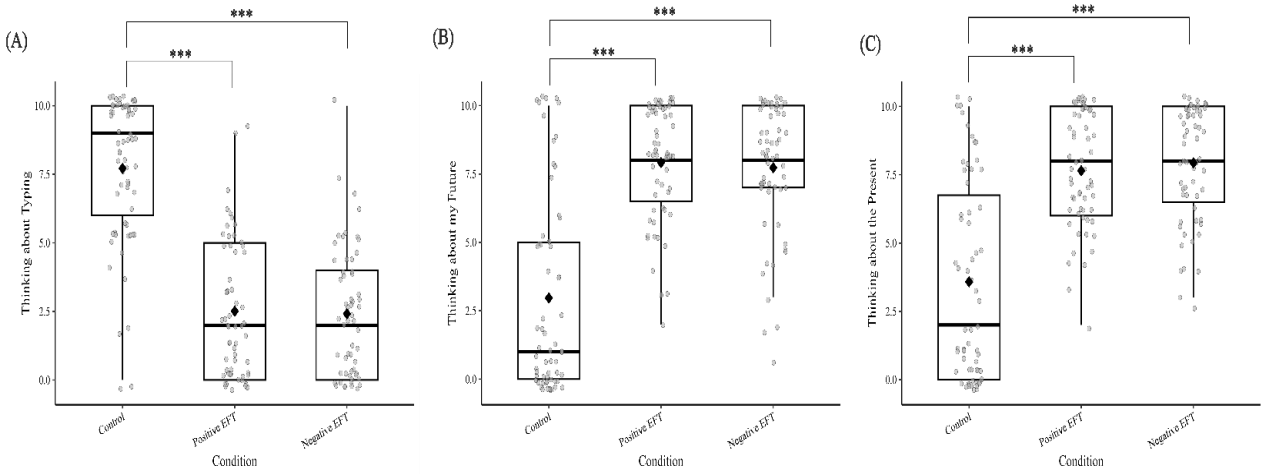
Note. Simple linear regression models tested whether differences existed between EFT conditions on the administered self-report measures. The Psychological Distress Index comprises GAD-7 and PHQ-9. A BIS/BAS composite score, rather than subscales, was used to consider condition differences given that the BIS/BAS was not a main variable within the main analyses. Participants with missing questionnaire data were excluded. GAD-7 = Generalized Anxiety Disorder 7-item; PHQ-9 = Patient Health Questionnaire 9-item; IUS = Intolerance of Uncertainty Scale; LAS = Loss Aversion Scale; BIS/BAS = Behavioral Inhibition Scale/Behavioral Activation Scale; PANAS = Positive and Negative Affect Schedule; VVIQ = Vividness of Visual Imagery Questionnaire.

Next, linear regression models evaluated whether the EFT cueing conditions elicited greater future thinking relative to the non-EFT control condition (see Figure 2). The simple linear model on ratings for thinking about the future indicated that there was a significant effect of condition, $F(2, 177) = 61.75$, $p < .001$, $R^2 = 0.41$, with participants in the positive ($M = 7.92$, $SD = 2.14$),

$t(177) = 9.76$, $P_{FDR} < .001$, and negative ($M = 7.73$, $SD = 2.34$), $t(177) = 9.40$, $P_{FDR} < .001$, EFT cueing conditions reporting greater future-oriented thinking than participants in the control condition ($M = 2.97$, $SD = 3.60$). There was no significant difference between the extent of future thinking in the positive and negative conditions, $t(177) = 0.36$, $P_{FDR} = .718$. Unexpectedly, there was a significant effect of condition for the extent of thinking about the present, $F(2, 177) = 48.25$, $p < .001$, $R^2 = .35$. Relative to participants in the control condition ($M = 3.58$, $SD = 3.65$), those in the positive ($M = 7.64$, $SD = 2.10$), $t(177) = 8.17$, $P_{FDR} < .001$, and negative ($M = 7.93$, $SD = 2.11$), $t(177) = 8.75$, $P_{FDR} < .001$, conditions reported greater present-focused thinking. The positive and negative conditions did not differ, $t(177) = 0.57$, $P_{FDR} = .568$. Finally, there was a significant effect of condition on the degree to which participants thought about typing, $F(2, 177) = 91.45$, $p < .001$, $R^2 = .51$, with those in the control condition having significantly higher ratings ($M = 7.71$, $SD = 2.64$), relative to participants in the positive ($M = 2.51$, $SD = 2.49$), $t(177) = -11.56$, $P_{FDR} < .001$, and negative ($M = 2.41$, $SD = 2.30$), $t(177) = -11.72$, $P_{FDR} < .001$, conditions. Positive and negative conditions did not differ significantly, $t(177) = 0.21$, $P_{FDR} = .837$. Overall, these results indicate that the EFT cueing procedure successfully elicited more thinking about the future.

Figure 2

Experiment 1: EFT-DD Manipulation Check



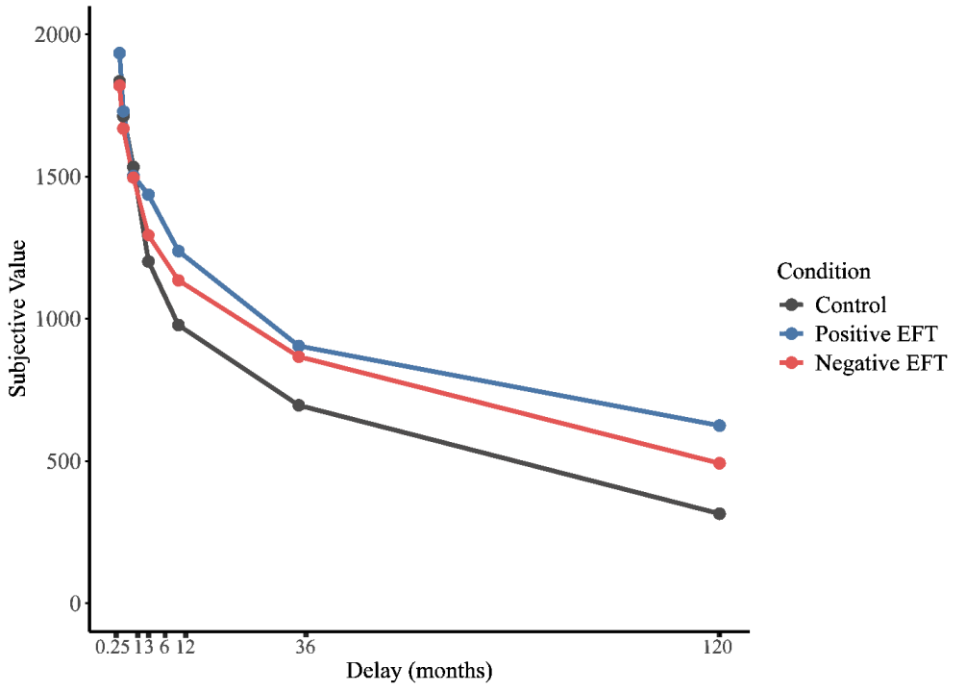
Note. Figure 2 presents a boxplot displaying manipulation check ratings across conditions. Panels display ratings of (A) thinking about typing, (B) thinking about the future, and (C) thinking about the present. Light grey circles represent individual participant responses. Boxes

indicate interquartile range (25th to 75th percentiles), the bold horizontal line indicates the median, whiskers extend to the most extreme values within 1.5 interquartile ranges. The black diamond indicates the mean. *** represents $p < .001$.

Finally, the effect of EFT cueing on DD as reflected by AuC was examined (see Figure 3). A simple linear regression revealed a significant effect of EFT condition on AuC, $F(2, 180) = 3.70$, $p = .027$, $R^2 = .04$. Relative to the control condition ($M = 0.32$, $SD = 0.21$), participants in the positive condition ($M = 0.45$, $SD = 0.25$) demonstrated significantly higher AuC reflecting less DD, $b = .12$, $SE = 0.04$, $t(180) = 2.66$, $P_{FDR} = .025$, $d = 0.48$. Although participants in the negative condition exhibited AuC values ($M = 0.40$, $SD = 0.29$) that were numerically higher than the those in the control condition, this difference did not reach significance, $b = 0.08$, $SE = 0.04$, $t(180) = 1.78$, $P_{FDR} = .116$, $d = 0.32$. Positive and negative EFT conditions did not significantly differ from one another, $t(180) = 0.90$, $P_{FDR} = .372$, $d = 0.16$. Together, these results indicate that positive EFT reduces DD and promotes more patient, larger-later choices, with a similar, albeit weaker, effect for negative EFT.

Figure 3

Experiment 1: Delay Discounting Curves by EFT Condition



Note. Figure 3 displays discounting curves for Experiment 1 for the younger adult sample by plotting subjective value (mean indifference point) of the $2000 delayed reward as a function of the delay (imagined temporal distance) to it being received (1 week = 0.25 months to 10 years = 120 months). Individuals demonstrating greater DD have steeper discounting curves indicated by smaller AuC values.

1.3. Interim Discussion

In line with previous findings (Ballance, et al., 2022; Bulley et al., 2019; Calluso et al., 2019; Liu et al., 2013; Rösch et al., 2022; Ye et al., 2022 ; Zhang et al., 2018), the results suggest that positive EFT effectively reduced DD. Although the negative EFT cueing condition did not significantly differ from the non-EFT control condition, an increase in DD was not observed contrary to some previous findings (Liu et al., 2013; Zhang et al., 2018). These findings are in line with the robust effect of positive EFT (Rösch et al., 2022) and highlight emotional valence as an important factor to consider when trying to promote patient, future-oriented decisions. This effect was further supported by the finding that affective EFT (positive and negative) promoted more future-oriented thinking relative to a control condition that did not cue EFT. It was also observed that EFT elicited an increase in present-oriented thinking relative to the control condition, which might reflect participants connecting their present with potential future circumstances when imagining their future. The findings also demonstrate the effectiveness of general, non-personalized cues in reducing DD. The use of non-personalized EFT cues results in simpler intervention approaches and research paradigms that do not require participant generation measures for researchers and clinicians using EFT-DD based applications. Even with careful selection of participant-level cues (Ballance et al., 2022; Calluso et al. 2019), these cues may not be matched phenomenologically to other participants' cues and may reflect personal goal-relevant monetary choices (O'Donnell et al., 2017) which may influence their efficacy.

In Experiment 2, the relationship between affective (positive and negative) EFT cues and DD was further probed by considering the effects of aging given the reported age-related changes in DD (Bagaïni et al., 2023; Eppinger et al., 2012; Halpin et al., 2024; Li et al., 2013; Löckenhoff et al., 2011; Mok et al., 2020; Wan et al., 2024; Whelan & McHugh, 2009) motivational factors (Wolfe et al., 2022), emotional processing (Carstensen et al., 2000; Charles & Carstensen, 2010), and the phenomenological experience and quality of EFT (Schacter et al., 2013). In Experiment

2, there was an exploration of how EFT phenomenological ratings were associated with DD and future thinking to better understand the potential mechanisms that may support the EFT-DD effect. Similarly, approach and avoidance motivation, which are known to change across aging (Wolfe et al., 2022), were considered as potential mediators of the affective EFT-DD effect.

Importantly, in Experiment 2, methodological refinements were conducted to ensure that the control condition was presented in a balanced and comparable manner to the affective EFT cueing conditions. Potential order effects in Experiment 1 were also considered by having participants complete questionnaires after the EFT-DD task in Experiment 2.

Experiment 2

2.1. Methods

2.1.1. Stimuli. For younger adults, the same set of event cues were used as those developed for Experiment 1. For older adults, a set of 32 event cues (16 per valence) were designed such that they would be meaningful to this population. To norm these stimuli, a sample of 100 older adults (aged 60-85 years) were recruited through Prolific.com using inclusion and exclusion criteria identical to Experiment 1. Three participants were excluded due to failing the attention check, with a final sample of 97 older adults (M_{age} = 65.69, SD_{age} = 5.66). Using the same selection procedure described earlier, seven positive and seven negative cues were chosen according to the specific criteria used in Experiment 1 (see Table 1), with each matched to a specific temporal distance based on the imagined time point ratings for each event. These cues were all highly effective in cueing affective EFT, with minimal variance of ratings across event cues (positive: SD values < 1.74; negative: SD values < 1.75), and the resulting imagined events were matched across EFT cueing conditions in terms of EFT phenomenological characteristics. Paired samples *t*-tests revealed that positive and negative cues did not differ significantly in detail $t(96) = 1.24$, $P_{FDR} = .280$, vividness, $t(96) = 0.83$, $P_{FDR} = .457$ or importance, $t(96) = 0.59$, $P_{FDR} = .556$. However positive cues were rated higher than negative cues in perspective, $t(96) = 2.32$, $P_{FDR} = .034$ indicating more of an outside perspective. See Table 4 for the cues selected for older adults and the median ratings.

Table 4

Phenomenological Ratings Set of Event Cues Selected for Older Adults (Experiment 2)

Event Cue	Phenomenological Ratings (median)*						
	Temporal Distance	**Perspv.**	**Detail**	**Vivid**	**Pers. Emotion**	**Event Emotion**	**Import.**
Positive Event Cues							
You spend time with a loved one	1 week	2.0	5.0	5.0	6.0	5.0	6.0
You go out for a nice dinner	1 month	2.0	5.0	5.0	5.0	5.0	5.0
You go on a holiday	3 months	2.0	5.0	6.0	6.0	5.0	6.0
You receive a clean bill of health	6 months	1.0	5.0	5.0	5.0	5.0	7.0
You meet a friend after a long time	1 year	2.0	5.0	5.0	5.0	5.0	5.0
You attend a celebration	3 years	2.0	4.0	4.0	5.0	5.0	4.0
You win an award	10 years	1.0	4.0	4.0	5.0	5.0	5.0
Negative Event Cues							
You receive an expensive bill	1 week	1.0	5.0	5.0	2.0	3.0	5.0
You misplace something valuable	1 month	1.0	4.0	4.0	3.0	3.0	6.0
You miss an important appointment	3 months	2.0	4.0	4.0	3.0	4.0	5.0
You make an embarrassing mistake in public	6 months	1.0	4.0	5.0	2.0	3.0	4.0
You visit a loved one in the hospital.	1 year	3.0	5.0	6.0	3.0	3.0	6.0
You receive bad news about your health	3 years	1.0	5.0	5.0	3.0	3.0	6.0
You attend a funeral	10 years	2.0	5.0	5.0	2.0	2.0	6.0

Note. Cues were selected based on the best available match to the criteria outlined in Table 1. Higher ratings of each phenomenological quality represent greater presence of that quality (range 1 to 7), apart from perspective, where lower ratings reflect greater first-person perspective whereas higher ratings reflect greater third-person perspective. Pers. = Personal; Perspv. = Perspective; Import. = Importance.

2.1.2. Participants. Recruitment for Experiment 2 was conducted online through Prolific.com. Inclusion criteria included: being aged 18 to 30 or 65 to 85 years, fluent in English, free of neurological impairment or ongoing psychiatric conditions, and residing in the United Kingdom, United States, Ireland, Australia, Canada, or New Zealand (to ensure relevance of the EFT cues). A power analysis conducted using G*Power (Version 3.1.9.7; Faul et al., 2007) revealed that at least 390 participants (65 per age x EFT cueing condition) were required to detect a small-to-medium effect size (Cohen's $f = 0.20$; Rösch et al., 2022) for a multiple linear regression analysis with 4 predictors at an alpha level of .05 and power of .8. As in Experiment 1, oversampling occurred to account for potential random responses and thus recruitment of a total of 604 participants occurred. Of these, 38 participants were excluded due to a brain injury, 32 due to reporting ongoing psychiatric illness, 3 due to having low levels of education (primary school or lower), and 89 due to not meeting age criteria. The final sample ($N = 437$) comprised 217 older adults (M_{age} = 71.12 years; $SD_{age} = 4.47$; 58.52% female) and 219 younger adults (M_{age} = 219 years; $SD_{age} = 24.75$; 57.53% female). For the breakdown across conditions, see Table 5.

Table 5

Demographics by Age Group and EFT Condition

Demographic Characteristic	**Control Older (*n* = 72)**	**Control Younger (*n* = 73)**	**Negative Older (*n* = 70)**	**Negative Younger (*n* = 74)**	**Positive Older (*n* = 75)**	**Positive Younger (*n* = 72)**
Age, M (SD)	71.29 (4.51)	25.18 (3.33)	70.43 (3.92)	24.90 (3.34)	71.60 (4.88)	24.15 (3.59)
Female, *n* (%)	44 (20.28)	46 (21.00)	44 (20.28)	39 (17.81)	39 (17.97)	41 (18.72)

Note. Table 4 displays the age and gender demographics by age group and EFT condition. Values for age are reported as means with standard deviations in parentheses. Values for females are reported as frequencies with percentages in parentheses.

2.1.3. Materials. Materials and questionnaires for Experiment 2 were identical to Experiment 1, with the exception of the following changes to the EFT-DD task. In Experiment 1, ratings about the emotion experienced while imagining the event and the emotion of the event itself used a rating scale that opposed negative and positive emotions (i.e., How emotional did you feel when imagining this event? 1 = very negative, 7 = very positive). However, emotional experiences can involve both positive and negative components at the same time (Mattek et al., 2017; Souders & Yu, 2025). Thus, to better capture the complexity of emotional future imagining, there was an inclusion of four ratings of emotion (e.g., How negative did you feel when imagining this event? 1 = not negative at all, 7 = very negative; How positive did you feel while imagining this event? 1 = not positive at all, 7 = very positive; How negative was the event itself? 1 = not negative at all, 7 = very negative; How positive was the event itself, 1 = not positive at all, 7 = very positive). In Experiment 1, the control typing condition was presented a single time prior to completing all intertemporal choice trials. To better match the structure of the EFT cueing conditions, in Experiment 2 the control typing task was presented during each delay block prior to the participant making six intertemporal choices, for a total of 7 times.

2.1.4. Procedure. Experiment 2 had an identical procedure to Experiment 1 with the exception that the control typing task was now presented prior to each intertemporal choice block (seven times) and all the questionnaires, except for demographics, were collected *after* the EFT-DD task. For the questionnaires, it was reasoned that there was a possibility that the completion of the psychological questionnaires might influence responses on the EFT-DD task by influencing affect and future orientation. The manipulation checks measuring the extent to which participants were thinking about the present, future, and typing were also modified to be on a 7-point scale (1 = not at all; 7 = a lot) consistent with phenomenological EFT ratings.

2.1.5. Statistical Analyses. As in Experiment 1, to ensure group equivalence, demographic variables (age, education, gender) were compared across EFT conditions. Unlike Experiment 1, group equivalence was considered by including both condition and age group as predictors in a multiple linear regression model to account for the study's 6 condition groups (i.e., young and older adults per each EFT condition). Any significant differences were later controlled for by adding the relevant scores as covariates to analyses. For all analyses examining the effect of EFT condition on AuC, a linear regression model was computed which tested the main effects of age group and EFT condition. Next, an interaction model was estimated to test for an age x EFT condition interaction. Follow-up FDR-corrected pairwise comparisons were computed to consider differences between the positive and negative EFT cueing conditions. Cohen's *d* was computed to quantify the magnitude of AuC differences for each EFT condition pairwise comparison. Group mean differences were divided by pooled standard deviations.

To extend on the analyses conducted in Experiment 1, the relationship between phenomenological qualities of EFT and AuC was examined, and it was considered whether this differed between positive and negative EFT cueing condition. To this end, phenomenological ratings reflecting subjective EFT quality were averaged across the seven future events imagined during the EFT-DD task (i.e., one at each temporal distance). Missing phenomenological ratings were handled using available case averaging. For each phenomenological variable, participant-level scores were calculated as the mean of the available cue ratings. Standard linear regression models were then used to examine whether a rated phenomenological quality was associated with AuC. Separate models were fit for each phenomenological predictor (vividness, detail, perspective, experienced and event emotionality, and importance). Moderation models examined whether positive or negative EFT cueing conditions influenced the relationship between phenomenological qualities and AuC with the positive condition being the reference group. Simple slopes analyses probed any significant EFT condition by AuC interactions, and FDR correction was used to control for multiple comparisons.

Linear regression models were also conducted to examine whether phenomenological qualities were associated with the degree of future-oriented thinking.

The models were identical to the ones described for considering the relationship between phenomenological EFT characteristics and AuC, with the exception that instead of AuC, the outcome variable was ratings of future-oriented thinking after the EFT-DD task.

Mediation analyses explored whether individual differences in motivation – specifically approach (BAS total and subscales: Reward responsiveness, Drive, Fun-Seeking) and avoidance (BIS) traits – mediate the relationship between EFT condition and AuC. Prior to conducting mediation analyses for avoidance, a Pearson correlation was conducted to examine the association between the BIS and LAS scores to determine whether they reflected a common avoidance motivation construct. A significant correlation resulted in the generation of an avoidance motivation index. The index was generated by standardizing BIS and LAS scores and then averaging the *z*-scores for each participant to generate a score where higher, positive values reflect greater avoidance motivation.

Mediation analyses were conducted using the Lavaan (version 0.6-16; Rosseel, 2012; Rosseel et al., 2026) package. Cue condition was dummy coded, with the control condition serving as the reference group (positive = 1 vs. control = 0; negative = 1 vs. control = 0). Separate mediation models were estimated for BAS Reward Responsiveness, BAS Drive, BAS Fun Seeking, BAS Total, and BIS. Additionally, LAS and BIS scores were correlated and included as a composite avoidance motivation score in a separate mediation model. In each model, EFT condition was specified as the predictor, the motivational trait was specified as the mediator, and AuC was the outcome variable. Direct effects of condition on AuC, indirect effects through the mediation (a x b), and total effects were estimated. Statistical significance of indirect effects was done through bias-corrected bootstrap confidence intervals based on 5,000 bootstrap samples.

2.2. Results

Demographic comparisons of age were conducted to determine if age, gender, and education differed across EFT conditions. A simple linear regression revealed that there was no significant effect of condition on age, $F(2, 433) = 0.13$, $p = .881$, $R^2 < .001$. Fisher's exact test revealed that gender distribution did not differ across conditions, $p = .297$ (two-sided). Chi-square analyses also revealed a non-significant difference in obtained education χ^2 (4, $N = 436$) =

4.07, $p = .396$. Linear models were conducted to examine differences across age groups and EFT conditions for the remaining administered measures (BAI, VVIQ, etc.) Models indicating significant differences across EFT conditions were integrated as covariates in AuC analyses. Descriptive statistics for self-report measures by condition and age group are presented in Table 6.

For psychological distress, age differences were observed, with younger adults exhibiting higher scores than older adults, $b = 1.66$, $SE = 0.16$, $t(432) = 10.23$, $p < .001$. Participants in the positive condition had significantly lower scores relative to controls, $b = -0.48$, $SE = 0.20$, $t(432) = -2.40$, $p = .017$, while no significant difference was observed between the negative and control conditions, $p = .363$. These findings indicate that younger adults reported greater psychological distress relative to older adults, although participants in the positive condition reported less distress relative to those in the control condition. Similarly, younger adults demonstrated higher intolerance of uncertainty relative to older adults, $b = 5.90$, $SE = 0.88$, $t(432) = 6.70$, $p < .001$, and lower scores in the positive relative to the control condition, $b = -4.15$, $SE = 1.08$, $t(432) = -3.85$, $p < .001$, with no differences between neutral and control conditions, $p = .059$. These findings indicate greater intolerance of uncertainty in younger adults relative to older adults, but to a lesser extent in the positive condition relative to control condition. Despite differences in psychological distress and intolerance of uncertainty, PANAS positive affect did not significantly differ across EFT conditions ($ps > .05$), although younger adults reported significantly lower positive affect relative to older adults, $b = -3.25$, SE = 0.84, t(422) = -3.88, $p < .001$. Similarly, PANAS negative affect did not differ across EFT conditions ($ps > .05$), but younger adults reported significantly higher negative affect relative to older adults, $b = 5.34$, SE = 0.62, $t(424) = 8.54$, $p < .001$. Loss aversion was also higher in younger than older adults, $b = 4.34$, $SE = 0.85$, $t(428) = 5.09$, $p < .001$, and lower in the positive than the control condition, $b = -2.59$, $SE = 1.04$, $t(428) = -2.49$, $p = 0.13$, with no significant difference between the negative and control condition, $p = .230$. For the BAI subscales, no EFT condition differences were observed for BAS Reward Responsiveness, BAS Fun Seeking, or BAS Drive (all $ps > .05$), however younger adults demonstrated consistently greater behavioral activation (approach motivation) relative to older adults and greater behavioral inhibition (all $ps < .05$). Behavioral inhibition, which reflects avoidance motivation, was also significantly lower in the positive

relative to the control condition, b = -1.18, SE = 0.43, $t(425)$ = -2.72, p = .007. Visual imagery did not significantly differ across EFT conditions or between age groups (all ps > .05).

Table 6

Descriptive Statistics for Experiment 2

Measure	Control *M (SD)*	Positive *M (SD)*	Negative *M (SD)*	*F*(df1, df2)	*p*
Younger Adults					
Psychological Distress Index	1.02 (2.09)	0.51 (1.87)	0.95 (2.35)	37.08 (3, 432)	< .001
IUS	35.55 (10.40)	40.78 (9.55)	33.18 (10.32)	20.09 (3, 432)	< .001
LAS	38.75 (7.64)	37.35 (9.09)	38.47 (9.46)	10.74 (3, 428)	< .001
BAS Reward Responsiveness	16.04 (2.22)	15.76 (2.93)	15.86 (2.33)	2.61 (3, 416)	.051
BAS Fun Seeking	10.97 (2.21)	10.58 (2.12)	10.91 (2.12)	4.97 (3, 430)	.002
BAS Drive	10.9 (2.34)	10.51 (2.46)	10.51 (2.23)	2.80 (3, 426)	.04
BAS Total	37.84 (5.44)	37.01 (6.19)	37.35 (5.07)	4.95 (3, 411)	.002
BIS	20.69 (3.60)	20.04 (4.17)	20.20 (3.82)	9.44 (3, 425)	< .001
PANAS – Positive Affect	29.94 (9.68)	30.71 (8.96)	29.52 (9.79)	5.34 (3, 422)	< .001
PANAS – Negative Affect	18.45 (7.49)	18.21 (7.40)	19.12 (8.87)	25.07 (3, 424)	< .001
VVIQ	54.24 (11.44)	59.15 (12.00)	55.00 (13.49)	1.72 (3, 421)	.163
Older Adults					
Psychological Distress Index	-0.59 (1.48)	-1.03 (0.90)	-0.89 (0.93)	37.08 (3, 432)	< .001
IUS	29.01 (9.76)	25.48 (7.31)	27.29(7.44)	20.09 (3, 432)	< .001
LAS	35.86 (9.11)	32.08 (8.58)	33.61 (9.16)	10.74 (3, 428)	< .001
BAS Total	35.82 (5.67)	35.28 (4.71)	35.27 (4.90)	4.95 (3, 411)	.002
BAS Reward Responsiveness	15.65 (2.20)	15.11 (1.89)	15.37 (1.80)	2.61 (3, 416)	.051
BAS Fun Seeking	10.01 (2.17)	10.13 (2.01)	10.00 (1.97)	4.97 (3, 430)	.002

BAS Drive	10.10 (2.10)	10.17 (2.10)	9.90 (2.28)	2.80 (3, 426)	.04
BIS	19.54 (3.73)	17.85 (3.21)	18.71 (3.46)	9.44 (3, 425)	< .001
PANAS – Positive Affect	33.16 (7.48)	33.96 (8.18)	32.81 (7.49)	5.34 (3, 422)	< .001
PANAS – Negative Affect	14.30 (5.62)	12.51 (3.27)	12.96 (4.27)	25.07 (3, 424)	< .001
VVIQ	57.42 (10.72)	57.79 (12.75)	57.07 (13.55)	1.72 (3, 421)	.163

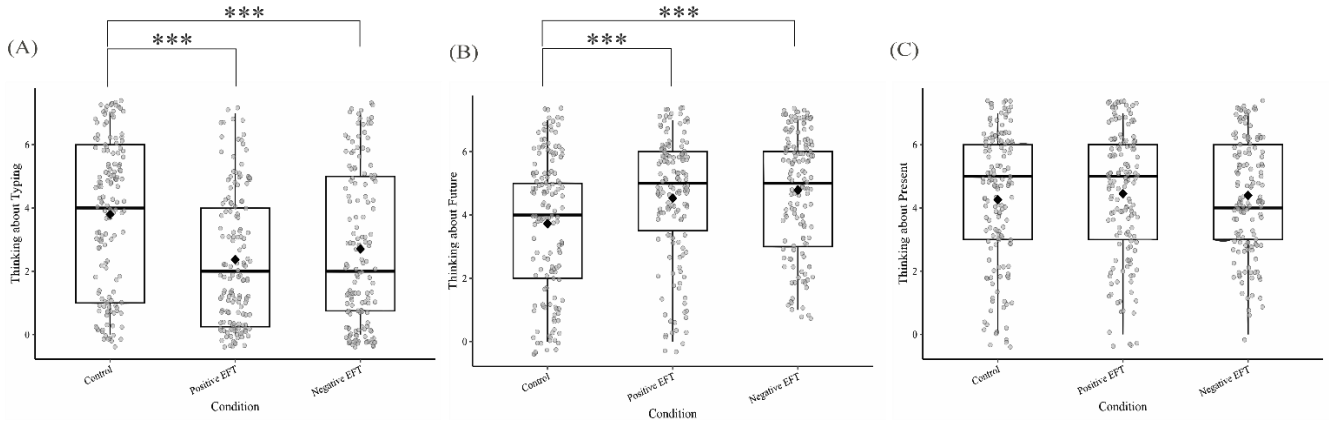
Note. Multiple regression models tested differences across EFT and control conditions and age groups on the self-report measures. The Psychological Distress Index comprises GAD-7 and PHQ-9. *F* values indicate model significance and are duplicated for younger and older adults given that age group was included as a predictor in the same model. Variables with significant main effects of condition were integrated as covariates in AuC analyses. Participants with missing data were excluded. GAD-7 = Generalized Anxiety Disorder 7 item; PHQ-9 = Patient Health Questionnaire 9 item; IUS = Intolerance of Uncertainty Scale; LAS = Loss Aversion Scale; BIS/BAS = Behavioral Inhibition Scale/Behavioral Activation Scale; PANAS = Positive and Negative Affect Schedule; VVIQ = Vividness of Visual Imagery Questionnaire.

Similar to Experiment 1, there was a consideration of whether the EFT cueing conditions elicited greater future thinking relative to the non-EFT control condition (see Figure 4). The simple linear model for thinking about the future indicated that there was a significant effect of condition, $F(2, 433) = 10.74$, $p < .001$, $R^2 = .05$. Relative to participants in the control condition ($M = 3.72$, $SD = 2.23$), participants in the positive condition ($M = 4.53$, $SD = 1.97$), t(433) = 3.39, $P_{FDR} = .001$, and the negative condition ($M = 4.78$, $SD = 1.88$), $t(433) = 4.43$, $P_{FDR} < .001$, reported thinking more about the future. The positive and negative conditions did not differ, $t(433) = -1.07$, $P_{FDR} = .287$. Regarding thinking about the present, there was a non-significant effect of condition, $F(2, 433) = 0.36$, $p = .7$,$R^2 = < .01$, indicating no differences between participants in the control condition ($M = 4.26$, $SD = 2.08$) compared to participants in the positive condition ($M = 4.45$, $SD = 1.99$) and negative condition ($M = 4.40$, $SD = 1.75$) after the EFT-DD task, all *p*s > .05. For thinking about typing, a significant effect of condition was observed, $F(2, 432) = 15.41$, $p < .001$, $R^2 = .07$. Participants in the control condition ($M = 3.80$, $SD = 2.33$) reported that they were thinking about typing to a greater extent than those in the

positive condition (M = 2.37, SD = 2.14), t(432) = 4.04, P_{FDR} < .001, and negative condition (M = 2.71, SD = 2.41), t(432) = 4.04, P_{FDR} < .001. The positive and negative conditions did not differ from each other, t(432) = -1.26, P_{FDR} = .210. Overall, these results indicate that the EFT cueing procedure successfully elicited greater thinking about the future.

Figure 4

Experiment 2: EFT-DD Manipulation Check



Note. Figure 4 presents a boxplot displaying manipulation check ratings across conditions. Panels display ratings of (A) thinking about typing, (B) thinking about the future, and (C) thinking about the present. Light grey circles represent individual participant responses. Boxes indicate interquartile range (25th to 75th percentiles), the bold horizontal line indicates the median, and whiskers extend to the most extreme values within 1.5 interquartile ranges. The black diamond indicates the mean. *** represents $p \leq .001$.

Next, the effect of EFT cueing on DD was examined while considering age group (see Figure 5). The linear main effect model for age-group-only revealed no significant main effect on AuC, F(1, 434) = 0.20, p = .654, R^2 < .001, d = -0.04, indicating similar DD for younger (M = 0.37, SD = 0.27) and older adults (M = 0.36, SD = 0.24). In the condition-only model, a main effect of condition was observed, F(2, 433) = 4.76, p = .009, R^2 = .02, such that participants in the positive condition (M = 0.38, SD = 0.23), b = 0.07, SE = 0.03, t(433) = 2.40, P_{FDR} = .025, d = -0.29 and the negative condition (M = 0.40, SD = 0.27) b = 0.09, SE = 0.03, t(433) = 2.88, P_{FDR} = .0126, d = -0.34, showed higher AuC values than participants in the control condition (M = 0.31, SD = 0.23). Follow-up estimated marginal means comparisons averaged across age group

and adjusted using FDR revealed that the positive and negative conditions did not significantly differ from one another, $t(433) = -0.49$, $P_{FDR} = .625$, $d = 0.06$.

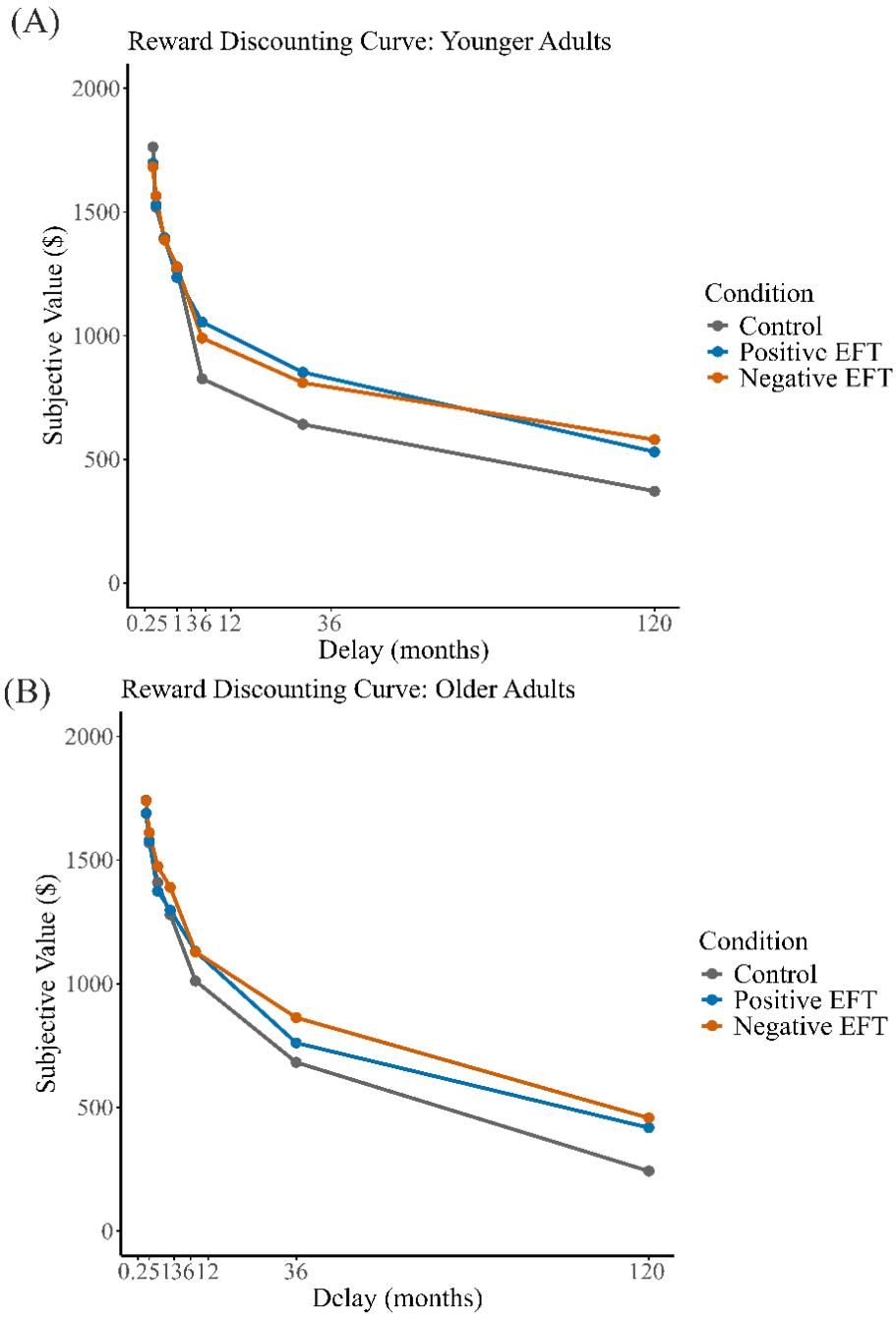
The full factorial model including the condition by age group interaction was not significant, $F(5, 430) = 2.02$, $p = .074$, $R^2 = .02$. There was no significant main effect of age group, $b = 0$, $SE = .04$, $t(430) = 0.02$, $p = .981$, and neither a condition by group interaction for the positive, $b = 0.03$, $SE = 0.06$, $t(430) = 0.55$, $p = .582$, or negative conditions, $b = 0.00$, $SE = 0.06$, $t(430) = -0.06$, $p = .951$. Within this model, participants in the negative condition still demonstrated significantly higher AuC values relative to the control condition, $b = 0.09$, $SE = 0.04$, $t(430) = 2.06$, $p = 0.04$, $d = -0.34$, where the positive condition did not significantly differ from the control condition, $b = 0.06$, $SE = 0.04$, $t(430) = 1.32$, $p = .189$. Follow-up estimated marginal means comparisons revealed that the positive and negative conditions did not significantly differ from one another, $t(430) = -0.48$, $P_{FDR} = .633$, $d = 0.06$. Given that a significant effect of age was not observed, all follow-up analyses considering EFT phenomenology and mediation models did not include age-group as a model predictor.

A supplementary linear regression model was conducted looking at relationship between EFT condition and reward DD including relevant covariates. Covariates were variables that differed significantly by condition (Psychological Index, IUS, LAS, and BIS scales). This model was conducted to consider whether the findings would remain consistent while accounting for condition level differences that may influence DD. Variables that differed between age-groups alone were not included as covariates as a main effect of age-group was not observed in the non-covariate models. Consistent with the unadjusted, primary model, a main effect of EFT condition was observed with participants in the positive condition ($b = 0.08$, $SE = 0.03$, $t(418) = 2.64$, $P_{FDR} = .013$), and negative condition ($b = 0.09$, $SE = 0.03$, $t(418) = 3.05$, $P_{FDR} = .007$) exhibiting higher AuC (less DD) values compared to participants in the control condition. FDR-corrected estimated marginal means analyses revealed that positive and negative conditions did not differ from one another ($P_{FDR} = .695$). Among the covariates, BIS was a significant, positive predictor of AuC ($b = 0.01$, $SE = 0.00$, $t(418) = 2.93$, $p = .004$), indicating that greater behavioral inhibition or avoidance motivation was associated with less DD. In contrast, the other covariates were non-significantly associated with AuC: psychological distress ($b = -0.01$, $p = .132$), IUS ($b = 0.00$, $p = .619$), and LAS ($b < .001$, $p = .974$). These results are highly consistent with the

unadjusted model suggesting that the influence of EFT on DD is robust when accounting for the condition level differences in affective and motivational variables.

Figure 5

Experiment 2: Discounting Curves for EFT and Control Conditions in Younger and Older Adults



Note. Discounting curves for Experiment 2 for both younger adults (A) and older adults (B), displayed by plotting subjective value (mean indifference point) of the $2000 delayed reward as a function of the delay (imagined temporal distance) to it being received (1 week = 0.25 months to 10 years = 120 months). Steeper DD indicated by smaller AuC values.

Descriptive statistics for phenomenological factors and future thinking ratings are reported in Table 7. Across all simple linear models, no phenomenological factors were significantly associated with AuC (all *ps* > .018; R^2 < .01; see Table 8).

Table 7

Summary Statistics for Phenomenological EFT Variables for Positive and Negative Conditions

Phenomenological EFT Variable	**Positive *M***	**Positive *SD***	**Negative *M***	**Negative *SD***
Vividness	4.41	1.23	4.31	1.30
Perspective	2.66	1.21	2.48	1.22
Detail	4.17	1.14	4.15	1.26
Negative Emotion while Imagining	1.65	0.77	4.60	1.09
Positive Emotion While Imagining	5.80	0.95	2.37	1.12
Event Positivity	5.95	0.87	2.14	1.01
Event Negativity	1.49	0.65	4.66	1.11
Event Importance	5.10	1.13	4.69	1.06
Future Thinking	4.55	1.96	4.78	1.88

Note. Control participants did not complete phenomenological EFT ratings due to lack of future imagining. Phenomenological factors and future thinking ratings ranged from 1 to 7 on a Likert scale, with higher values reflecting greater presence of the phenomenon, other than perspective, where lower values (1) reflect greater personal perspective, whereas larger values (7) reflect greater other-focused perspective.

Table 8

Phenomenological Ratings Predicting AuC

Predictor	***b***	***SE***	***t***	***p***	***R²***
Vividness	-0.02	0.01	-1.34	.181	.01
Perspective	-0.01	0.01	-0.60	.550	< .001
Detail	-0.02	0.01	-1.22	.222	< .01
Negative Emotion while Imagining	0.01	0.01	0.76	.447	< .01
Positive Emotion While Imagining	-0.01	0.01	-0.91	.365	< .01
Event Positivity	-0.00	0.01	-0.44	.660	<.001
Event Negativity	0.01	0.01	0.76	.448	< .01
Event Importance	-0.01	0.01	-0.91	.363	< .01

Note. Table 8 presents the results from the simple linear regression models examining whether phenomenological EFT cue ratings were associated with AuC. All reported *p*-values are uncorrected due to non-significance.

To extend the considerations of the relationship between EFT phenomenology and AuC, analyses examined whether cue valence may influence these associations. No interaction effects survived FDR correction (P_{FDR}s > .05; see Table 9).

Table 9

Influence of EFT Cue Valence on The Relationship Between Phenomenological Ratings and AuC

Predictor	***b***	***SE***	***t***	***p***	***R²***
Vividness * Valence	< .001	0.02	0.04	.971	.01
Perspective * Valence	0.01	0.02	0.47	.639	< .001
Detail * Valence	-0.01	0.03	-0.52	.605	.01
Negative Emotion while Imagining * Valence	0.05	0.04	1.50	.135	.01

Positive Emotion While Imagining * Valence	-0.04	0.03	-1.33	.185	.01
Event Positivity * Valence	-0.07	0.03	-2.12	.035	.02
Event Negativity * Valence	0.07	0.04	1.83	.068	.01
Event Importance * Valence	0.01	0.03	0.04	.97	< .001

Note. Interaction terms reflect moderation by cue valence (positive vs. negative). *p*-values are uncorrected; no effects remained significant following FDR correction. Conditions were coded with the positive group as the reference.

Next, the relationship between EFT phenomenology and the extent to which participants in the EFT conditions reported thinking about the future was considered. The findings indicated various significant associations between post-EFT manipulation ratings of future thinking and phenomenological aspects of EFT (see Table 7 for descriptive statistics). The simple linear models demonstrated that increased future thinking was significantly associated with: vividness, $b = 0.27$, $SE = 0.09$, $t(288) = 3.06$, $P_{FDR} = .007$, $R^2 = .03$, detail, $b = 0.34$, $SE = 0.09$, $t(288) = 3.71$, $P_{FDR} = .002$, $R^2 = .05$, and importance, $b = 0.32$, $SE = 0.1$, $t(288) = 3.22$, $P_{FDR} = .006$, $R^2 = .04$.

Perspective was not significantly associated with future thinking, $b = 0.16$, $SE = 0.09$, $t(288) = 1.77$, $p = .078$, $R^2 = .011$, $P_{FDR} = .126$. Neither were negative emotional experience while imagining, $b = 0.13$, $SE = 0.06$, $t(288) = 1.99$, $p = .048$, $R^2 = .01$, $P_{FDR} = .096$, or positive emotional experience during imagining, $b = 0.04$, $SE = 0.06$, $t(288) = 0.74$, $p = .459$, $P_{FDR} = .524$, $R^2 = < .001$. Similarly, event positivity, $b = 0.03$, $SE = 0.05$, $t(288) = 0.03$, $p = .615$, $P_{FDR} = .615$, $R^2 = < .001$, and event negativity, $b = 0.09$, $SE = 0.06$, $t(288) = 1.47$, $p = .142$, $P_{FDR} = .190$, $R^2 = .01$, were also not significantly associated with future thinking.

Moderation analyses examined whether EFT cue valence conditions influenced the relationship between EFT phenomenology and future thinking. Cue condition was coded with the positive condition as the reference group. After applying FDR correction, no interaction effects remained significant (P_{FDR}s > .05;), indicating that condition did not reliably moderate the association between EFT phenomenological quality and future thinking (see Table 10).

Table 10

Influence of EFT Cue Valence on The Relationship Between Phenomenological Ratings and Future Thinking

Predictor	***b***	***SE***	***t***	P_{FDR}
Vividness * Valence	0.10	0.18	0.56	.772
Perspective * Valence	-0.04	0.19	-0.21	.838
Detail * Valence	< .001	0.19	-0.04	.966
Negative Emotion while Imagining * Valence	0.42	0.25	1.66	.263
Positive Emotion While Imagining * Valence	-0.46	0.22	-2.14	.132
Event Positivity * Valence	-0.57	0.24	-2.40	.132
Event Negativity * Valence	0.38	0.28	1.33	.295
Event Importance * Valence	-0.30	0.20	-1.46	.290

Note. Interaction terms reflect moderation by cue valence (positive vs. negative). *p*-values are uncorrected; no effects remained significant following FDR correction. Conditions were coded with the positive group as the reference.

Prior to conducting mediation analyses, the association between the BIS and LAS scores was examined to determine if they reflect a common avoidance motivation construct. A Pearson correlation indicated a strong, positive relationship between BIS and LAS scores, $r(423) = .63$, 95% CI [.57, .68], $p < .001$, indicating that as behavioral inhibition increases so does loss aversion. In line with the preregistration plan, BIS and LAS scores were combined into an avoidance motivation index to reflect avoidance motivation in a subsequent mediation analysis.

Mediation analyses were conducted using Lavaan (version 0.6-16) using maximum likelihood estimation and 5,000 bootstrap samples in order to test whether approach (BAS motivation: BAS drive, BAS fun seeking, BAS reward responsiveness; BAS total, and avoidance motivation (BIS) mediated the relationship between EFT condition and DD. Condition was dummy coded with the control group as the reference category. Separate models were used to estimate BAS Reward Responsiveness, BAS Drive, BAS Fun Seeking, BAS total, BIS, and the avoidance motivation index. Age group was initially considered as a central factor, however,

given that a primary analyses examining age-related differences in the relationship between EFT condition and AuC were non-significant, age-specific mediation models were not warranted. Instead, mediation models probed the significant effect of EFT conditions on AuC and how they may be mediated by approach and avoidance tendencies.

Across all models, the positive and negative EFT cueing conditions were consistently associated with higher AuC values indicating less DD relative to controls and in line with the main model. None of the BAS subscales significantly mediated the relationship between EFT condition and AuC. There was no significant evidence that BAS Reward Responsiveness mediated the effect of the EFT conditions on AuC. EFT condition did not significantly predict BAS Reward Responsiveness, (positive: b = -0.42, p = .129; negative: b = -0.22, p =.399), and BAS Reward Responsiveness did not predict AuC (b = < .001, p = .997). In line with these findings, the indirect effects were not significant (positive: b = < .001, p = .994; negative: b = < .001, p = .994) while direct effects remained significant (positive: b = 0.07, p = .014; negative: b = 0.08, p = .009). BAS drive was similarly non-significant, indicating a lack of mediation of the relationship between EFT condition and AuC. EFT condition did not predict BAS Drive (positive: b = -0.26, p = .547; negative: b = -0.28, p = .291), and BAS Drive was not associated with AuC (b = < .001, p = .992). Indirect effects were not significant (positive: b = < .001, p = .996; negative: b = < .001, p = .994). Direct effects maintained significance (positive: b = 0.07, p = .014; negative: b = 0.08, p = .009). A mediation was not observed for BAS Fun Seeking as well. Condition did not predict BAS Fun Seeking (positive: b = -0.14, p = .578; negative: b = -0.03, p = .923), and BAS Fun Seeking was not associated with AuC (b = -< .001, p =.845). Indirect effects were not significant (positive: b = < .001, p = .924; negative: b = < .001, p = .986), but direct effects remained significant (positive: b = 0.07, p =.013; negative: b = 0.08, p = .005). The BAS total scores did not mediate the relationship between EFT condition and AuC. EFT condition did not significantly predict BAS total (positive: b = -0.70, p = .286; negative: b = -0.46, p = .474), and BAS total was not associated with AuC (b = -< .001, p = .869). Consequently, the indirect effects were not significant (positive: b = < .001p = .904; negative: b = < .001, p = .924). Direct effects remained significant for both the positive (b = 0.08, p = .009) and negative (b = 0.08, p = .01) EFT cueing conditions. These results suggest that BAS reflecting approach motivation does not mediate the relationship between EFT condition and DD.

There was evidence of partial mediation through avoidance motivation based on BIS. The positive condition was associated with lower BIS scores relative to control (b = -1.20, p = .007), while the negative condition was not (b = -0.62, p = .148). Higher BIS scores were associated with higher AuC (b = 0.01, p = .001). The indirect effect of the positive condition was significant, b = -0.01, p = .043, indicating that reduced avoidance motivation partially accounted for the effect of positive EFT on AuC. This indirect effect indicates that, although the mediation was significant, the effect operated in the opposite direction with reductions in BIS associated with a weaker effect or suppression of positive EFT effect on AuC and DD. The negative condition had a non-significant indirect effect (b = 0.09, p = .196). Direct effects of the condition remained significant (positive: b = 0.08, p = .004; negative: b = 0.09, p = .003) indicating a partial rather than full mediation. Similarly, the avoidance motivation index showed a similar pattern to BIS that did not reach significance. The positive condition was associated with lower avoidance motivation (b = -0.30, p = .004), while the negative condition was not (b = -0.16, p = .137). High avoidance motivation was associated with higher AuC (b = 0.04, p = .006). The indirect effect of the positive condition approached significance (b = -0.012, p = .052), while the negative condition was not significant (b = -< .001, p = .187). Direct effects of condition remained significant (positive: b = 0.08, p = .004; negative: b = 0.09, p = .002).

2.3. Interim Discussion

Experiment 2 results partially replicated those of Experiment 1, with the EFT manipulation promoting greater future thinking and positive EFT significantly reducing DD. In contrast to Experiment 1, negative EFT also resulted in significantly less DD compared to the non-EFT control condition. This finding is in line with previous findings that affective EFT cues, whether positive or negative, can promote more patient, intertemporal choices (Ballance et al., 2022; Bulley et al, 2019; Calluso et al., 2019). Extending the findings from Experiment 1, the results indicated that like younger adults, older adults demonstrated similar levels of DD when collapsing across conditions, and the affective EFT effect on DD appeared to be consistent given the lack of EFT condition by age-group interaction. These results are consistent with recent meta-analyses indicating that older adults demonstrate similar DD tendencies to those observed in younger adults (Chao et al., 2009; Seaman et al., 2022). The results also suggest that affective EFT has comparable effects regardless of age despite previous findings of a weakened general,

non-affective EFT effect found in older adults (Mok et al., 2020). It is important to note that, although Experiment 1 and Experiment 2 had very similar findings, the negative EFT condition did not reach significance in Experiment 1. This could potentially be due to methodological differences between the experiments (e.g., one control task in Experiment 1 versus seven control tasks in Experiment 2).

The findings were further extended from Experiment 1 as it was considered how phenomenological qualities of EFT are associated with DD. This pattern did not differ as a function of cue valence. These results indicate that the phenomenological factors of affective EFT (e.g., vividness, perspective, importance) may not be directly associated with DD and may not be the underlying mechanism through which affective EFT influences DD. This contrasts with previous suggestions that factors such as increased EFT vividness (Ciaramelli et al., 2019; Lee et al., 2022; Palombo et al., 2015; see Rösch et al., 2022 for a review) are associated with reduced DD. However, Ballance et al. (2022) found that, even after accounting for personal relevance and vividness, the positive EFT effect persisted. Thus, vividness might moderate the effect of DD to some extent, but it might not reflect the more fundamental mechanism that underlies the affective EFT influence on DD.

Despite not observing a significant association between phenomenological qualities of affective EFT cues and DD, several significant relationships were observed between these experiential EFT qualities and reported future thinking, including EFT vividness, detail, and importance. However, these factors did not reliably vary due to EFT emotional valence. Thus, even though EFT phenomenology did not predict DD, it was associated with greater future thinking.

Other considerations included potential mediation of the affective EFT-DD relationship through trait-level motivational factors reflecting approach (BAS) and avoidance (BIS) motivation. Although no significant association or mediation was found with approach motivation, avoidance motivation appeared to significantly predict AuC, with greater avoidance motivation (BIS) predicting reduced DD. This is in line with previous findings that BIS is associated with reduced DD (Jarmolowicz et al., 2014; Tuk et al., 2011; Zhao et al., 2015). However, the results suggested that avoidance motivation partially mediated the relationship between the affective EFT condition and DD, specifically through positive EFT, by suppressing

its effect in reducing DD. These findings indicate that positive EFT may reduce avoidance motivation and result in increased immediate, less patient choice selections.

It is important to note that condition level differences were observed for the questionnaires in Experiment 2 indicating a potential order effect due to the EFT-DD task preceding those measures. Potential effects were accounted for in the covariate model, but this order effect of administering questionnaires after an affective EFT manipulation and DD task should be considered in future research.

General Discussion

Across two experiments, the effects of positive and negative EFT on DD were examined relative to a non-affective control condition, first in a sample of younger adults and then in a sample of younger and older adults to consider potential age differences. Partially in line with the pre-registered hypotheses, positive EFT reduced DD relative to the control condition across both experiments. Negative EFT also reduced DD in Experiment 2, although this effect did not reach significance in Experiment 1. Contrary to the hypotheses, there were no age-group differences in overall DD or in the effect of affective EFT on DD. The findings indicate that positive and negative affectively valenced EFT appear to promote more patient, future oriented intertemporal choices in younger and older adults. It was additionally considered whether phenomenological qualities of EFT and approach or avoidance motivation contributed to these effects. Approach motivation, as indexed by the BAS, was not found to be associated with DD or to mediate the relationship between affective EFT and DD. In contrast, greater avoidance motivation, indexed by the BIS, was associated with reduced DD. Thus, trait-level motivational factors such as the BIS and BAS do not appear to explain how affective EFT influences DD. Additionally, phenomenological qualities of EFT were not found to be associated with DD or to moderate the relationship between EFT cueing condition and DD. However, greater imagined vividness, detail, and importance, were all associated with higher self-reported future thinking. Overall, these findings indicate that, although affective EFT, specifically positive and negative EFT, reduces DD in both younger and older adults, this effect is not explained by differences in approach and avoidance motivation or by phenomenological qualities of imagined future events. These findings are discussed in the context of whether affective processing itself may act as a mechanism underlying EFT related changes during intertemporal decision-making.

Positive vs. Negative EFT and DD

The finding that positive EFT reduces DD has been consistently reported in the EFT-DD research literature (Ballance et al., 2022; Bulley et al., 2019; Calluso et al., 2019; Liu et al., 2013; Zhang et al., 2018; see Rösch et al., 2021 and Ye et al., 2022 for a review). In line with what appears to be a robust effect, these results further support the efficacy of positive EFT in reducing DD. This study extended this finding to show that the effect of positive EFT on DD holds for older adults (Carstensen et al., 2000; Charles & Carstensen, 2010).

However, the effect of negative EFT is much less consistent, with some studies reporting increased DD relative to neutral conditions (Liu et al., 2013; Zhang et al., 2018) and others reporting reduced DD (Ballance et al., 2022; Bulley et al., 2019; Calluso et al., 2019), but with a weaker effect relative to positive EFT (Ballance et al., 2022; Calluso et al., 2019). The findings are aligned with those of Ballance et al. (2022), Bulley et al. (2019), and Calluso et al. (2019), further supporting the view that affective EFT, specifically EFT of positive and negative valence, promotes more patient intertemporal choices. With respect to negative EFT specifically, previous work has highlighted a potential role of preparatory motivational processes to explain the negative EFT effect on reducing DD (Ballance et al., 2022; Bulley et al., 2016; Bulley et al., 2019). Negative EFT can act by simulating future threats, resulting in individuals anticipating future needs and adjusting their behaviour to maximize resources and their capacity to deal with perceived threats and adversity (Bulley et al., 2019; Miloyan & Suddendorf, 2015). These effects may be reliant on the perception and appraisal of a threat, including perceived controllability (Fan et al., 2024), with a threat-related motivational component that may operate in addition to shifts in temporal construal. Future consideration of threat perception and perceived controllability of negative events is still needed when examining the effect of affective EFT on DD.

Findings that both positive and negative EFT influence DD suggest that emotional engagement itself may underlie the EFT effect during intertemporal decision-making. Taking a Construal Level Theory perspective (Trope & Liberman, 2010; Yi et al., 2017), EFT may influence how future outcomes are mentally represented or temporally construed (Ballance et al., 2022; Bulley et al., 2019; Lempert & Phelps, 2016), allowing future rewards and perceived temporal distances to be altered by making temporally distant events or outcomes appear more concrete and psychologically proximal. This increases their salience and promotes future-

optimizing outcomes (Boyer, 2008), reducing DD (Yi et al., 2017). Within this framework, affective engagement may play a supporting role. Boyer (2008) describes how emotions are adaptive-motivation devices that can counter natural tendencies to be impulsive. However, the current study shows that experiencing prospective emotions that are goal-relevant or reward-relevant do not appear to be necessary for EFT to reduce impatient intertemporal choices, as the cues provided to participants related to general future-oriented events that were not reward-specific.

In line with Construal Level Theory, the results support the view that affective future imagining promotes future thinking, but the quality of EFT overall (i.e., phenomenological EFT ratings) was not associated with DD. The present study used normed emotional cues rather than participant-generated events, which reduced the variability in cue content based on phenomenological qualities of EFT. This allowed for greater experimental control over differences in cue content across DD conditions to better isolate the effect of EFT valence on DD. At the same time, building on previous work (Ballance et al., 2022), the relationship between EFT phenomenological ratings and both DD and reported future thinking was examined to consider whether EFT phenomenology is a potential mechanism underlying the effect of affective EFT on DD. No significant associations were observed between DD and imagined perspective, detail, vividness, importance, and emotionality. At first glance, this result appears to obscure the understanding of the qualities of EFT that influence DD. However, several of these EFT qualities were associated with higher ratings of future thinking, suggesting that richer future simulations increased participants' engagement with the future even though it did not influence DD. It may be that processes supporting future-oriented thought do not reflect the underlying mechanism supporting the EFT-DD effect entirely. Consistent with this interpretation, Ballance et al. (2022) found that the positive EFT effect on DD persisted even after accounting for personal relevance and vividness, suggesting that these phenomenological qualities are unlikely to represent the primary mechanism through which affective EFT influences DD.

Methodologically, participants' phenomenological ratings were averaged across seven temporal distances to derive a person-level index of EFT experience. This differs from Ballance et al. (2022) who examined cue-level variability in phenomenological ratings. By aggregating cues, the present analysis captured individual differences in engagement with EFT rather than variability tied to specific imagined events. This distinction may help explain why

phenomenological ratings were associated with future thinking but not DD. Together, these findings suggest that the effectiveness of EFT in reducing DD may depend less on the subjective quality of imagined events and more on increasing the salience of future outcomes, potentially through emotional processes that have not been considered within the EFT-DD context. Rather than emotional valence and EFT quality being the central focus, an alternative explanation is that an optimal level of arousal may be associated with the affective EFT effect by enhancing the salience of the future and its representation. This may be in addition to allocating increased attentional resources and goal prioritization to the future, thus optimizing future-oriented choices. According to arousal-biased competition models (Mather & Sutherland, 2011), arousal can increase prioritization of attention and memory strength, amplifying the processing of motivationally relevant information. From the EFT context, emotional arousal, either from positive or negative EFT, may heighten the salience and perception of the future and, in turn, future outcomes, influencing valuation of future reward. Future investigations of the influence of EFT on DD should dissociate the effect of arousal from emotional valence.

Consistent with a focus on emotional processing rather than EFT quality, converging evidence suggests that rich episodic simulation may not be necessary for EFT to influence DD. Importantly, many of these studies have used future cues that were emotionally neutral or only mildly positive rather than explicit affective EFT manipulations. Previous findings show that cueing the future can still reduce DD in individuals with episodic amnesia in relation to medial temporal lobe damage, as long residual tissue and/or episodic memory and future imagining ability remain (Kwan et al., 2015). Similarly, the EFT effect is also present in individuals with damage to the ventromedial prefrontal cortex, another brain region associated with EFT and prospective imagination integrity (Ciaramelli et al., 2021; Verfaellie et al., 2019). More recent findings further illustrate that other future-oriented biases seen in healthy young and older adults, such as the tendency to construe near-future events in detailed, concrete terms and distant-future events in more abstract terms (i.e., temporal construal; Halilova et al., 2026) are exhibited by individuals with hippocampal lesions and some individuals with vmPFC lesions (Rosenbaum et al., 2023). This suggests that the ability to represent future outcomes in more concrete terms may be supported by non-episodic mechanisms or require less substantial prospection ability to create a concrete future construal. These findings could be taken to suggest that the richness of EFT facilitates engagement and future orientation, but this is not sufficient to account for EFT-DD

effects. Instead, other factors may underlie this influence, such as a more general capacity to orient towards the future – potentially supported by semantic or narrative representations of future events. Thus, EFT may exert its influence on DD, not through general phenomenological qualities of EFT, but through a promotion of future-oriented thinking made more salient by emotional content and through alterations in future construal. In this way, emotionally salient future cues may support future-oriented decision-making even when episodic simulation abilities are reduced, raising the possibly that more emotional forms of EFT could benefit individuals with milder episodic memory compromise, such as in healthy aging.

Approach and Avoidance Motivation

Despite theoretical suggestions of threat-minimizing motivation, the present findings do not support a motivational mediation framework based on approach and avoidance tendencies. Although higher BAS has been previously associated with larger reductions in DD following EFT (Daniel et al., 2013), the findings did not demonstrate a similar effect. Indeed, none of the BAS subscales were associated with DD generally, a finding contradicting the pre-registered hypotheses. Instead, approach motivation appears to have an unreliable association with DD, with no indication from the present findings that it mediates the relationship between affective EFT condition and DD. The findings are nonetheless in line with previous work indicating that avoidance motivation, as reflected by BIS, is associated with less DD (Jarmolowicz et al., 2014; Tuk et al., 2011; Zhao et al., 2015), further supporting greater avoidance motivation as predicting an increased willingness to choose larger, later rewards to avoid future reward losses. This suggests that individuals with higher avoidance sensitivity may be more inclined toward future-oriented preparatory decision-making. However, BIS itself does not capture state-level motivational processes that may have been promoted by affective EFT cueing conditions given the lack of mediation with the negative EFT condition. Instead, preparatory motivation may reflect a more transient, context-dependent response to anticipated future demands that cannot be captured by trait-level motivational processes like BIS/BAS (Carver & White, 1994; Corr, 2016). More broadly, the absence of clear mediation by BIS or BAS may reflect a mismatch in analysis level due to the relative stability of approach and avoidance motivation despite a shift across aging (Nikitin et al., 2014; Wolfe et al., 2022). More proximal, state-based mechanisms may be

engaged to influence temporal representation, salience of future outcomes, and reward valuation during intertemporal decision-making.

Aging and the Affective EFT Effect on DD

In this study, differences were not observed in DD between younger and older adults with affective EFT reducing DD similarly in younger and older adults regardless of emotional valence. Although the effect of EFT on DD has not been studied extensively in older adults (Mok et al., 2020; Sasse et al., 2017; Yu et al., 2026), findings regarding age-related differences in DD and the efficacy of EFT have been inconsistent, with some studies reporting greater DD in older adults (Sasse et al., 2017; Yu et al., 2026) and others reporting less DD in older than younger adults, though DD was still attenuated by EFT (Mok et al., 2020).

Although no age-group differences were observed, this finding is noteworthy given evidence that older adults often show reduced episodic detail during episodic future simulation (Schacter et al., 2013), which may contribute to weaker EFT-related reduction in DD (Mok et al., 2020). Based on these previous findings, one might expect the EFT cueing effect to be attenuated in older adults. However, the present study suggests that the mechanisms supporting EFT-related reductions in DD may be relatively preserved despite age-related changes in episodic simulation ability. This may further support that EFT quality and phenomenological factors may not be the underlying mechanism of the EFT-DD effect. This is paired with the finding in this study that EFT quality and phenomenology were not associated with DD.

The absence of age-group differences is also notable in light of age-related changes in motivation. Older adults have been reported to show reduced approach motivation and greater avoidance motivation tendencies relative to younger adults (Nikitin et al., 2014; Penningroth & Scott, 2019; Wolfe et al., 2022) and differentially prioritize emotional information (Carstensen et al., 2000; Charles & Carstensen, 2010; Wolfe et al., 2022) leading to predictions that positive and negative EFT may differentially influence DD by influencing these motivational orientations. However, neither age nor approach and avoidance motivation appeared as significant factors when considering the effect of affective EFT on DD. This finding suggests that age-related difference in motivational orientation may be less important for EFT-related reductions in DD than expected.

Given the mixed findings on age-related moderation, it is possible that additional factors beyond age may influence the EFT-DD relationship. Cognitive ability may serve as a potential factor that explains variable findings across studies and participant samples (Eppinger et al., 2018; James et al., 2015; Lin & Epstein, 2014; Sasse et al., 2017). It might be that factors related to overall cognitive ability and EFT function may need to be considered. Cognitive decline has been suggested to predict greater DD (James et al., 2015; Lempert et al., 2020), with greater working memory demands resulting in greater DD in older adults despite observations of the opposite pattern in younger adults (James et al., 2015). Sasse and colleagues (2017) found that older adults did not uniformly benefit from EFT cueing and that this effect was primarily observed in older adults with greater attentional control capacity, likely allowing them to better generate simulations and integrate episodic information into their value-based decisions. These findings suggest that cognitive ability may underlie variability in EFT findings and suggest the importance of considering cognitive function in EFT-DD related aging research.

Limitations and Future Directions

The present study has several limitations that should be considered. It is important to note that various condition-level differences were observed for the administered self-report measures in Experiment 2 relative to Experiment 1, indicating a potential order effect when administering questionnaires after the EFT-DD task rather than before. The order of the self-report questionnaires from Experiment 1 and Experiment 2 was changed from being administered prior to the EFT-DD task (Experiment 1) to after (Experiment 2). In Experiment 2, various EFT condition differences were observed that may reflect this change (see Table 6). Additionally, the use of a non-EFT control condition limits the ability to disentangle the general effects of engaging in non-emotionally salient episodic simulation compared to having a neutral EFT condition (Ballance et al., 2022; Calluso et al., 2019). Including a neutral EFT condition in future work will better help to determine the efficacy of affective EFT as opposed to general, non-emotionally salient, but nonetheless future-oriented, EFT. This study was also conducted using an online, older adult sample on a crowdsourced platform (Prolific). There is recent evidence that cognitive performance is typically higher in such samples, with higher-functioning older adults registered as participants (Cohen et al., 2026). It is possible that the EFT-DD effect may have differed in community-dwelling older adults. Future work should determine if community-based

recruitment and/or in-person testing yield results that are like those reported here. Although it is possible that the present findings relate to emotional arousal and salience, arousal was not directly measured. As such, it remains unclear whether differences in emotional engagement during EFT influenced DD through such mechanisms. Future work should incorporate measures of arousal to better isolate this process. Similarly, the use of trait-level motivational measures limited the ability to understand motivational mechanisms. Future work should incorporate both state and trait level measures to better understand the role of motivation processes and how they may be influenced or underlie the affective EFT effect on DD during intertemporal decision-making.

Conclusion

The findings of reduced DD in relation to positive and negative EFT relative to a control condition encourage the use of affective EFT to promote future oriented decision making and to reduce impulsivity during intertemporal decision-making. This effect appeared in both younger and older adults and did not appear to be mediated by trait-level approach and avoidance motivation. This effect was not found to be associated with different phenomenological aspects of EFT, suggesting that the reduction in DD following affective EFT is likely supported by factors beyond subjective EFT quality. Instead, affective EFT may operate via broader future-oriented and affective or arousal-based processes occurring during simulation, however this requires further investigation. Regardless, imagining an affective positive or negative future, even with pre-selected cues, appears to modify behaviour to promote patience. These findings may inform EFT-based interventions for behaviour modification to promote more optimal decision-making in vulnerable populations, such as individuals with problematic substance (Chen et al., 2026) and alcohol use (Mellis et al., 2019), and weight loss difficulty (Ding et al., 2024). More broadly, the findings support the role of emotional future simulation in promoting patient intertemporal choices in both younger and older adults and prompts further consideration of the mechanisms underlying the effect of affective EFT on DD.

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