**Psychometric Evaluation of an Episodic Future Thinking Variant of the Autobiographical Memory Test
(Episodic Future Thinking - Test; EFT-T)**

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Abstract

Future-oriented variants of the Autobiographical Memory Test (AMT) are often used to assess the generation of specific episodic future thoughts, however, as yet the underlying factor structure of items in this modified test has not been examined. Therefore, over two studies we examined the factor structure and validity of an episodic future thinking variant of the Autobiographical Memory Test (Episodic Future Thinking - Test; EFT-T). In Study 1, exploratory factor analysis ($N = 466$) showed a one-factor structure underlying responses to positive, negative, and concrete noun cue words on the EFT-T. In Study 2, confirmatory factor analysis with a different sample ($N = 304$) and using different cue words showed a good fit for a single factor structure. In both studies, good convergent validity was found with scores on the EFT-T correlating with autobiographical memory specificity scores, with support for divergent factors also. Mixed support was found for associations with measures of mental imagery, and the implications for measurement are discussed. These studies provide the first evidence that the EFT-T uni-dimensionally assesses specificity in episodic future thinking across two cue word sets.

Keywords: Episodic future thinking; episodic future thinking specificity; episodic future thinking test; autobiographical memory test; autobiographical memory specificity; factor analysis

The Autobiographical Memory Test (AMT) is a widely used measure of autobiographical memory (AM). As a method originally pioneered by Galton (1879), and developed further by Crovitz and Schiffman (1974), the AMT involves the verbal or written presentation of a series of cues (typically words, but sometimes sentences or pictures), to which respondents are asked to describe personally-experienced events from their past. The use of the AMT greatly increased following Williams and Broadbent's (1986) seminal study into individuals who had recently attempted suicide, in which they focused on responses to the AMT that were specific in nature, defined as an event that had occurred within the space of 24 hours. This was defined relative to longer-spanning extended events, repeated categoric events, or simple semantic word associations that would be considered non-specific. Their finding that suicide attempters showed a lower proportion of specific memories, relative to their control groups, sparked decades of research into the role of specific AM in clinical and non-clinical populations. For example, reduced AM specificity has been found to be common in those with clinical depression (Liu, Li, Xiao, Yang, & Jiang, 2013) and PTSD (Ono, Devilly, & Shum, 2015), and is associated with deficits in cognitive processes such as planning, emotion regulation, and problem-solving (Dalgleish & Werner-Seidler, 2014). Readers are referred elsewhere for a description of processes that might cause deficits in AM specificity (Williams et al., 2007)

More recently, the AMT has also been increasingly used to assess specificity in episodic future thinking (EFT; e.g., Addis, Hach, & Tippett, 2016; Brown et al., 2013; Maccallum & Bryant, 2011; Raffard, Esposito, Boulenger, & Van der Linden, 2013). In this form, individuals are required to mentally generate and describe events that could be personally experienced in the future, and responses are typically coded for the proportion of future events that are specific. This assessment, therefore, differs to other assessments of EFT, such as the modified Autobiographical Interview (Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002) which focuses more on episodic and semantic detail of future thinking and requires in-person administration, or the Prospective Imagery Test (Stöber, 2000), which provides pre-specified events for respondents to imagine.

Use of these future-focused variants of the AMT has increased in concert with an overall interest in research on EFT in general. Substantial evidence indicates that the ability to simulate EFT is reliant on autobiographical memory (see Schachter, Addis & Buckner, 2007), whereby the contents of memories of experienced events are flexibly recombined in order to mentally simulate novel events. Although EFT is intimately linked with

autobiographical memory, it is conceptualized as a more recently evolved cognitive capacity in humans (Suddendorf & Corballis, 1997), and involves neural substrates that are both common and distinct from those of remembering (Addis, Wong, & Schacter, 2007). It has unique functions through simulating the outcomes and consequences of possible events. This is closely tied with intention (Neroni, Gamboz, & Brandimonte, 2014) and anticipated emotional states (Baumgartner, Pieters, & Bagozzi, 2008), such as lower EFT specificity linked with apathy in individuals with schizophrenia (Raffard et al., 2013), and ultimately contributes to goal-motivated behaviour (Szpunar, 2010). Further, prospecting one's future affects decision-making, such as increasing the tendency to delay current for future rewards in a manner distinct from recalling past experience (Schacter, Benoit, & Szpunar, 2017), and contributes to planning, problem-solving, coping (Brown MacLeod, Tata, & Goddard, 2002; Taylor, Pham, Rivkin, & Armor, 1988), and emotion regulation (Schacter et al., 2017; Taylor & Schnieder, 1989).

Other characteristics of EFT, relative to remembering, are that it is more cognitively demanding. This may be one of the reasons why individuals generate less detailed or specific events than when recalling memories (D'Argembeau & Van der Linden, 2004, 2006). They are also more goal-oriented in a nature (D'Argembeau, Lardi, & Van der Linden, 2010; D'Argembeau & Van der Linden, 2004, 2006), and the content of EFT has been found to be more positively-valenced relative to memories in both non-clinical (D'Argembeau & Van der Linden, 2006) and psychiatric groups (MacLeod & Byrne, 1996). Meta-analytic evidence also shows that deficits in EFT are common in a range of psychiatric disorders, such as clinical depression, schizophrenia spectrum disorders, and bipolar disorder (Hallford, Austin, Takano, & Raes, 2018), and may precipitate or contribute to the maintenance of these illnesses.

The uptake of this modified, future version of the AMT in research has clearly borne fruitful information, however, to the authors' knowledge no study to date has examined its factor structure to ascertain if the items assess a common underlying latent variable of EFT specificity. This is crucial for studies on EFT and related constructs that use this methodology, as having specified sets of cue words assess a common latent variable and have good internal reliability will increase precision in measurement. Further, cue words of different valence are often used within studies (and analyzed separately; e.g., Kleim, Graham, Fihosy, Stott, & Ehlers, 2014; Maccallum & Bryant, 2011), which may give rise to multi-factor models based on cue-word valence. In this

context, we examine this modified future version of the AMT, henceforth referred to as the Episodic Future Thinking-Test (EFT-T), through two studies assessing its construct validity with exploratory and confirmatory factor analysis, and its divergent and convergent validity.

Study 1

Exploratory factor analysis (EFA) was used to examine whether items on the EFT-T clustered into one single factor of specificity, or whether a different factor structure might be found due to cue word characteristics. In addition to positive and negatively-valenced cue words, we also included a set of neutral, concrete noun cue words. Based on previous AMT factor analytic results (Griffith, Kleim, Sumner, & Ehlers 2012; Griffith et al., 2009) we predicted that a one-factor solution would fit the data best. We administered the standard AMT and predicted that these items would load onto a different factor than the EFT-T items, but would still strongly correlate. We also predicted that there would be fewer overall specific responses to the EFT-T relative to the AMT. For exploratory purposes, we assessed whether the number of specific responses on the EFT-T differed between positive, negative, and neutral cue words.

Methods

Participants and Procedure

A total of 477 participants, all living in the U.S., were recruited from Amazon Mechanical Turk, allowing for a large case-to-item ratio to reduce the risk of errors of inference. After 10 cases were removed due to responding multiple times, and one case was removed due to erroneous responses to all items (e.g., entering dictionary definitions, or giving the exact same answer to each item). The remaining cases provided intelligible responses, and all took over three minutes to complete the items, which we perceived to be a reasonable indication of non-careless responding, albeit still quick (Niessen, Meijer, & Tendeiro, 2016). The final sample used for analysis was $N = 466$ (63.1% women). The participants reported a mean age of 36.6 years ($SD = 12.1$, range 19 - 71). The majority reported, using pre-specified categories, as having either a bachelor (49.0%) or postgraduate degree (18.8%), and the remaining had a diploma or certificate (17.5%), or finished high school (14.7%) as their highest educational achievement.

Following ethics approval, the study was posted on the Mechanical Turk website. Interested participants were taken to an external website, presented with the plain language statement, and prompted to complete the

study questionnaires. The EFT-T was completed prior to the AMT. Informed consent was implied by completion and submission of the questionnaire. Participants were compensated with a nominal sum of US\$1.

Materials

Episodic Future Thinking Test (EFT-T). We chose 15 cue words with which to construct the EFT-T. Five negative and five positive words were chosen using Bradley and Lang's (1999) affective norms for English words and balanced in their valence, arousal, and frequency of occurrence: *happy, lost, strong, trouble, beautiful, failure, easy, fear, hope, stress*. The remaining five items were commonly occurring concrete nouns taken from the Corpus of Contemporary American English (<https://corpus.byu.edu/coca/>): *book, money, hand, house, and water*. Participants were asked to provide an event that either would happen or hypothetically could happen in their future, occurring in the space of one day, that was directly related to or inspired by the cue word, and that they would be personally involved in. They were asked to provide as many details about the future event that they could, and provide a different event for each cue word. No restriction in terms of the timeframe for the event was specified. Two examples of specific EFT's were then provided for the words *pleasure* and *table* on a separate webpage to the instructions (see Appendix A for the full instructions). The 15 cue words were then shown one at a time on separate webpages in the same order for all participants. No time limit was given, but in order to reduce the number of one word or erroneous answers participants were required to provide responses of at least 20 characters long before the survey would progress to the next page.

For this study, we coded the responses to the EFT-T as 1 = a specific event that could occur in the future, and would be temporally contained within 24 hours, and 0 = a non-specific future event. Examples of specific and non-specific events are provided in Supplementary Table 1. Authors ?? and ?? collaboratively developed a scoring guide for the EFT-T (available upon request from the corresponding author). Using this scoring guide on 1000 EFT-T responses from data not reported here, they found an intraclass correlation (ICC) of .73, and total agreement of 86.4%. Author ?? and another researcher independent to the study then scored 350 responses from the sample used in the current study using dichotomous coding, with a resulting Cohen's kappa of .82. The first author scored the remaining responses. The responses to the items were summed and then divided by 15 to create a proportional score (0% to 100%), and subscales for positive, negative, and neutral items were computed (range 1 -5) to test for differences in specificity based on valence.

Autobiographical memory test (AMT). For the AMT, participants were given instructions that were replicated verbatim with the EFT-T instructions, but specified that they were to provide descriptions of events they had experienced in their past. Again, examples were given of specific memories to two words (*upset* and *peace*). Ten cue words were presented in the same order to participants, using a different set of words, five positive and five negative: *excited, bored, happy, failure, lucky, hopeless, relaxed, lonely, relieved, and sad*. The responses were coded as specific or non-specific AM. Only a subsample completed the AMT ($n = 361$), as an initial smaller proportion of the full sample was recruited to only complete the EFT-T to assess the inter-rater reliability of the related coding scheme. A subset of 350 AMT responses were coded by the first author and another researcher not associated with the study, with a Cohen's kappa = .83. The first author coded the remaining responses. The scores were summed and reported as the proportion of specific responses (range 0% to 100%). The internal reliability for these 10 items was good (McDonald's $\omega = .79$).

Data Analytic Approach

All data were analyzed using the psych package version 1.8.12 (Revelle, 2018) in R version 3.5.1 (R Core Team, 2018) and SPSS 24.0. Parallel analysis (Horn, 1965) with 5000 iterations was conducted on the EFT-T items to determine the number of factors to extract. The factor analysis function was used, therefore only common variance was analyzed (i.e., the reduced correlation matrix). Parallel analysis indicates how many factors there are likely to be that correspond to eigenvalues greater than those obtained from a simulated dataset generated, using the same number of sample size and number of variables. Ordinary least squares with Pearson correlations was used as the estimator to extract the factors, as one method recommended for ordinal data (Gaskin & Happell, 2014). We also used parallel analysis on the items from the EFT-T and AMT together to assess whether they clustered onto two different factors, and therefore to determine if they could be discriminated from one another. Descriptive statistics were generated, and the internal reliability amongst the items was assessed using McDonald's omega. Pearson correlations were used to assess for associations between the EFT-T and the AMT scales and demographic variables. A repeated measures ANOVA was used to assess for differences between the mean scores of the differently-valenced cue word subsets. Paired sample t -tests were used to assess differences in number of specific responses between the EFT-T and AMT.

Results

The EFT-T data appeared to be suitable for factor analysis, given the high score on the Kaiser-Meyer-Olkin measure of sampling adequacy (.934, $p < .001$), significant results of Barlett's Test of Sphericity ($p < .001$), and all the diagonal elements on the anti-image correlation matrix were $> .9$. The average of the 105 correlations between the EFT-T items was .45 (all $p < .001$), and amongst these only three were $< .30$. Parallel analysis indicated that eigenvalues subsequent to those of the first factor were below the 95% confidence interval line, and therefore lower than eigenvalues generated randomly in simulated data, and well below an eigenvalue of 1.

Factor analysis was conducted specifying one factor for all 15 items (see Table 1 for factor loadings and descriptive statistics). This factor had an eigenvalue of 4.5, explaining 30% of the variance amongst the items¹. All items had factor loadings of at least .43 (range .43–.61), and the fit indices showed the model was a good fit to the data, RMSR = .03, TLI = 0.98, RMSEA = .02 (95%CI = 0 – 0.03). The items showed good internal reliability (McDonald's $\omega = .88$). The EFT-T total score ($M = .49$, $SD = .29$) was not found to be skewed on inspection of the histogram and related statistics (skewness statistics/error = 1.04), but was platykurtic (kurtosis statistic/error = -4.63).

The results from parallel analysis of the combined EFT-T and AMT data showed evidence of two eigenvalues that were more likely to occur than by chance in the simulated and resampled data. A two factor solution was then extracted, along with a one factor solution to contrast with it. The two factor solution with oblimin rotation had a good fit to the data, RMSR = .04, TLI = 0.96, RMSEA = .02 (95%CI = 0.01 – 0.03; eigenvalues of 4.86 and 2.31), which was superior to a one factor solution, RMSR = .05, TLI = 0.91, RMSEA = .04 (95%CI = 0.03 – 0.04; eigenvalue of 6.29)². In the two factor solution, all 15 EFT-T items loaded onto the first factor, with all loadings ≥ 0.44 and no cross-loadings above .18. The AMT items cleanly loaded onto the second factor except for one item (*lonely*) that did not appear to load onto either factor (.23 and .25). The two factors correlated at $r = .65$, $p < .001$. The superior two factor solution when EFT-T and AMT items were combined, and the correlation between them (indicating there was 58% unshared variance between the two set of items), provided evidence of discriminant validity between these past and future-oriented items.

¹When specifying three factors, the eigenvalues were 3.72, 1.07, and 1.02, and 13 of the 15 items loaded on to the first factor.

²When specifying three factors, the eigenvalues were 4.93, 1.49, and 1.29, with only three AMT items loading cleanly onto the third factor

With respect to cue word valence, a repeated measures ANOVA across the three differently-valenced cue word subsets was significant, $F(2,456)=26.8$, $p<.001$, and within-subjects contrasts showed that there were a higher frequency of specific EFT provided to positive cue words ($M=2.7$, $SD=1.5$) relative to negative cue words ($M=2.3$, $SD=1.6$, $d_z=.33$, $p<.001$) and neutral cue words ($M=2.4$, $SD=1.7$, $d_z=.23$, $p<.001$), but no statistically significant difference between negative and neutral ($p=.176$).

Identifying as a woman was weakly correlated with higher scores on the EFT-T ($r=.14$, $p=.003$), but no significant association was found with age ($r=.05$, $p=.291$) or education level ($r=.03$, $p=.536$). The EFT-T scores correlated strongly with scores on the AMT ($r=.62$, $p<.001$). To examine whether the proportion of specific responses on the EFT-T was higher or lower than the AMT, a paired samples t -test showed a small to moderate difference, with less responses on the EFT-T ($M=.49$, $SD=.29$) than the AMT ($M=.59$, $SD=.26$), $t(360) = 7.2$, $p<.001$, $d_z=.38$.

Discussion

The results showed the 15 EFT-T items loaded onto a single factor, despite incorporating three cue word sets with different characteristics. All items had significant and strong loadings on this factor and overall the EFA provided good evidence that the responses to the EFT-T items were assessing one latent trait of EFT specificity. As expected, responses to the EFT-T were found to be strongly correlated with those on the AMT, but their respective items loaded onto two discernable factors. A greater proportion of specific responses were provided when recalling memories on the AMT relative to generating future events on the EFT-T. Responses were more specific for positive cue words on the EFT-T relative to negative and neutral cues.

Study 2

Having established the one-factor structure of the EFT-T in Study 1, we then sought to test the model using confirmatory factor analysis (CFA) in a separate sample. We administered the AMT again to replicate convergent validity, and to examine whether differences in proportion of specificity would again be found. In Study 2 we used a different word set to assess if the EFT-T items would still operate as a one-factor model with different cues. We used this same word set for the EFT-T and AMT to assess whether differences in proportion of specific responses were replicable, or might be related to differences in cue words. Again, the EFT-T was completed prior to the AMT. To further assess convergent validity, we administered measures of mental

imagery. We hypothesized that a higher proportion of specific responses on the EFT-T would indicate more frequent use of mental constructions of possible future events populated with contextual details, and therefore would be positively correlated with vivid mental imagery.

Methods

Participants and Procedure

To statistically power the CFA we aimed to recruit at least 300 participants, taking into account likely number of latent factors, that there were a large number of indicators, and that factor loadings and inter-correlations of the EFT-T items were generally moderate to strong in Study 1 (Wolf, Harrington, Clark, & Miller, 2013). A total of 331 participants were recruited using the same strategy as Study 1. In this study we used an instructional manipulation check that has been shown to improve the integrity of responses to online surveys (Oppenheimer, Meyvis, & Davidenko, 2009). Participants could not advance past the first item until they had provided the correct response to a question relating to a favorite sporting activity, which was embedded in a paragraph of text instructions. This approach has been shown to reduce careless responding, whereby if participants fail the item and are then required to repeat it they then tend to respond to subsequent items in the same manner as those that pass it the first time (Oppenheimer et al., 2009). Data were removed for 12 participants who completed the survey multiple times, and another 15 sets were removed if they gave erroneous answers to all EFT-T items as per the first study, with the final sample used for analysis being $N = 304$ (64.1% women). The participants reported a mean age of 37.7 years ($SD = 12.5$, range 18 - 81), and most had obtained a bachelor (47.2%) or postgraduate degree (19.1%), while the remaining had a diploma or certificate (21.8%), or finished high school (11.9%) as their highest educational achievement.

Materials

EFT-T and AMT. We administered the EFT-T and AMT using the same methodology in Study 1. The only difference was the cue word set, which was selected using the same procedure as Study 1, including matching positive and negative cues on valence, arousal, and frequency, and the same positive and negative cues were used for both the EFT-T and AMT: *truth, pressure, agreement, pain, respect, danger, freedom, cold, success, evil, door, room, face, eye, and computer*). The internal reliability for the AMT items was good (McDonald's $\omega = .80$).

Spontaneous Use of Imagery Scale (SUIS; Reisberg, Pearson, & Kosslyn, 2013). The SUIS is a self-report measure of the tendency to use visual mental imagery in daily life. The original SUIS consists of 12-items, however, we removed three items following recommendations based on poor factor loadings in CFA studies of the SUIS (Nelis, Holmes, Griffith, & Raes, 2014). Participants responded to statements relating to the use of mental imagery in various situations in daily life (e.g., “*When I think about a series of errands I must do, I visualize the stores I will visit*”). A five-point scale was provided for participants to indicate how applicable these statements were to them ranging from 1 (*never applies to me*) to 5 (*always applies to me*). The single-factor structure and validity of the SUIS as a measure of mental imagery has been demonstrated across several datasets (Nelis et al., 2014). To retain the relevance of the scale points, we averaged the responses to items to create a score ranging from 1 – 5 for each participant, whereby higher scores indicated more use of mental imagery. The internal reliability for the nine items was good (McDonald’s $\omega = .85$).

Prospective Imagery Test (PIT; Stöber, 2000). The PIT is a 20-item, self-report measure that uses prescribed scenarios to which individuals generate mental images. Participants are presented with 10 positive future events (e.g., “*People will admire you*”) and 10 negative (e.g., “*You will have health problems*”) taken from a list used by MacLeod (1996) to assess subjective probability of the occurrence of events. Instructions were given to take a few moments to try and briefly form a mental image of each scenario, and then the scenarios were presented one at a time on separate webpages. No time limit was given. For each scenario, the participants answered questions relating to how vivid their mental image of the scenario was, how detailed it was, and how much it seemed like they were experiencing it on a scale from 1 (*not at all*) to 5 (*very much so*). Scores on each of these items were averaged. Consistent with previous research (Stöber, 2000), very high inter-correlations were found between these items ($r = .82 - .90$, all $p < .001$), and so they were averaged together to provide an overall score for the PIT ranging from 1-5. The internal reliability for these items was high (McDonald’s $\omega = .96$).

Data Analytic Approach

The CFA was conducted using the Lavaan package (Rosseel, 2012) in R version 3.5.1 (R Core Team, 2018) using a weighted least squares means with variance adjusted robust estimator (WLSMV) with Pearson correlations to estimate the model. This approach provides less biased and more accurate estimations of factor

loadings in ordinal data compared to maximum likelihood estimation (Li, 2016). To assess model fit we used a range of indices: The chi-square value (CMIN) and corresponding p -value (set at $p < .05$), the relative chi-square statistic (CMIN/DF) using a conservative guide of <2.0 for indicating good fit (Tabachnick & Fidell, 2007), the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the comparative fit index (CFI). The latter three fit indices were assessed relative to guidelines provided by Hu and Bentler (1999): $RMSEA \leq .06$, $SRMR \leq .09$, and $CFI \geq .95$. The remaining data analyses were conducted using the same approach as Study 1. Other analyses were conducted in SPSS 24.0.

Results

The results from the first CFA indicated that the one-factor model was a good fit to the data, $CMIN=122.1$ ($df=90$, $p=.014$), $CMIN/df=1.35$, $RMSEA=.034$ (90%CI .016 - .049), $SRMR=.068$, $CFI=0.98$. As shown in Figure 1, all items loaded significantly onto the latent variable, with an average standardized regression coefficient of .64. Unstandardized factor loadings and other descriptive statistics for the items are shown in Table 2.

The EFT-T items showed good internal reliability (McDonald's $\omega = .85$). The EFT-T total score ($M=.52$, $SD=.26$) was comparable to that found in Study 1 ($M=.49$, $SD=.29$). Although EFT-T scores across Study 1 and 2 were not statistically assessed for difference, the standardized mean difference was very small ($d=.12$). Again, the total scale was not found to be skewed on inspection of the histogram and related statistics (skewness statistics/error=1.15), but was mildly platykurtic (kurtosis statistic/error=-3.06).

A significant difference was found between the three differently-valenced cue word subsets, $F(2, 302) = 50.4$, $p<.001$, and within-subjects contrasts showed that there were more specific responses given to neutral cue words ($M=3.1$, $SD=1.7$) relative to positive cue words ($M=2.3$, $SD=1.5$, $d_z=.56$, $p<.001$) and negative cue words ($M=2.4$, $SD=1.5$, $d_z=.47$, $p<.001$), but no statistically significant difference between positive and negative ($p=.132$).

Identifying as a woman was weakly correlated with higher scores on the EFT-T ($r=.18$, $p=.002$), no significant association was found with age ($r=.04$, $p=.516$), or education level ($r=.10$, $p=.080$). The EFT-T specificity total again correlated with scores on the AMT at a fairly strong magnitude (see Table 3 for correlations and descriptive statistics for Study 2).

To again determine the discriminant validity between the EFT-T and AMT, we estimated a model loading EFT-T and AMT items onto one factor, $CMIN=404.6$ ($df=275$, $p<.001$), $CMIN/df=1.47$, $RMSEA=.039$ (90%CI .031 - .047), $SRMR=.083$, $CFI=0.95$, and compared this with a model loading the EFT-T and AMT items onto separate latent factors, $CMIN=330.3$ ($df=274$, $p=.011$), $CMIN/df=1.20$, $RMSEA=.026$ (90%CI .013 - .036), $SRMR=.073$, $CFI=0.98$. All secondary loadings and inter-correlations amongst items were fixed to zero. The range of completely standardized loadings for the EFT-T items was .51 - .75, and for the AMT items it was .49 - .78. Evidence for discriminant validity was found given that the two factor solution was a better fit to the data ($\Delta RMSEA = -.013$, $\Delta SRMR = -.01$, $\Delta CFI = .03$), and the correlation between the EFT-T and AMT factors ($r = .78$, $p < .001$) indicated there was approximately 40% unshared variance between the two measures.

A paired samples *t*-test showed that participants provided an overall lower proportion of specific responses on the EFT-T ($M=.52$, $SD=.27$) compared to the AMT ($M=.60$, $SD=.27$), $t(303)=5.5$, $p<.001$, $d_z=.31$. Specificity scores on the EFT-T were weakly correlated with a higher use of mental imagery in everyday life as measured by the SUIS, but did not correlate with scores on the PIT (separate analyses with the PIT subscales showed consistent results, r -.05-.01, all $p>.410$). A consistent pattern of correlations was found for AMT specificity also.

General Discussion

In Study 1, a one factor structure for 15 items was found using EFA, and this model was then found to be a good fit to EFT-T items in Study 2 using CFA in a separate sample of participants. The findings provide some confidence that responses to a range of differently-valenced cue words, when balanced in terms of arousal and frequency, cluster around a single latent factor of episodic future thinking specificity. Construct validity was indicated by strong correlations with autobiographical memory specificity, as measured by the AMT.

Participants were found to provide fewer specific responses to the EFT-T relative to the AMT in both studies. This is consistent with previous evidence that future thoughts are less specific and episodically detailed relative to memories (e.g., Addis, Musicaro, Pan, & Schacter, 2010; Anderson & Dewhurst, 2009, D'Argembeau & Mathy, 2011), possibly due to it being a more effortful cognitive process. Regarding whether responses differed dependent on the valence, we found inconsistent results, with more specific responses to

positive cue words in Study 1, and more specific responses to concrete noun cues in Study 2. These differences might be accounted for by characteristics of the cue word sets used in the studies rather than systematic differences, but future research may clarify this. In particular, the self-relevance of cue words in terms of personal goals or self-concept may affect the specificity of responses to the EFT-T, similarly to findings with autobiographical memory specificity (Crane, Barnhofer, & Williams, 2007; Matsumoto & Mochizuki, 2017).

Women were more likely to provide specific responses to the EFT-T relative to men in both studies, consistent with previous research in episodic future thinking (Wang, Hou, Tang, & Wiprovnick, 2011) and autobiographical memory specificity (Herlitz, Nilsson, & Backman, 1997; Pillemer, Wink, & DiDonato, 2003). Heron et al. (2012) suggest this is thought to be due to increased elaboration of parents stories when reminiscing with daughters relative to sons. This might also promote a tendency to produce episodic future thoughts that are more contextually specific in regards to time and space, and episodic details. Another factor may be the increased social bonding that women engage in relative to men (Hays, 1989; Jones, 1991; Oswald, Clark, & Kelly, 2004). This might facilitate communication of specific EFT through personal or shared plans, goals, and future possibilities. Older age has previously been found to be related to reduced EFT specificity (Addis et al., 2010), perhaps due to generalized reductions in executive functioning in older age and associated retrieval of specific autobiographical memory (Ricarte, Ros, Serrano, Martínez-Lorca, & Latorre, 2016; Ros, Latorre, & Serrano, 2009), or difficulties in combining elements to form coherent mental representations (Romero & Moscovitch, 2012). We found no such association, but this may be due to the restricted age range, with few participants in either sample identifying as being in older adulthood (cf. Takano, Mori, Nishiguchi, Moriya, & Raes, 2017 who sampled a wider age range with the AMT). We did not find clear evidence for an association between EFT specificity and education level, which echoes previous research on autobiographical memory specificity showing equivocal results (e.g., Wessel et al., 2001; Birch & Davidson, 2007).

The associations between specificity on the EFT and mental imagery provided only partial support for our hypothesis. We had anticipated that generating more specific future thoughts, relative to non-specific, would reflect an increased tendency to represent episodes of future personal experience through mental imagery. Although generating specific EFT might necessitate responses with more episodic detail (such as the context of time and space, sensory details, and specific thoughts and actions), providing this specific information was only

weakly related to self-report of how commonly vivid mental images are used in everyday life. One explanation is that because participants were not asked to cognize their EFT-T responses in the form of mental imagery, the written response format encouraged a more verbal form of representation in consciousness. The EFT-T involves mentally constructing future episodic thoughts which are necessarily verbal due to the written responses, but not necessarily visually, whereas the SUIS may tap more or only into mental image construction. On the PIT, the number of specific responses to the EFT-T were not correlated at all with mentally simulating the prescribed future events. This may again represent a divergence in verbal and imagery representations. It is also noteworthy that the PIT provides scenarios that are not actually specific in nature (e.g., “*You will have lots of energy and enthusiasm*”), nor does it request them to be imagined in this way. Therefore, our participants may have instead given vividness, detail, and experiencing ratings based on general emotional responses to abstractions of possible experiences, rather than mental representing specific episodes of experience. Other aspects of specific EFT might be related to whether they are represented as mental imagery, such as how vivid they are, their familiarity, the anticipatory and anticipated emotion related to them, the temporal distance/timeframe, and their relevance to one's personal concept and goal (Barsics, Van der Linden, & D'Argembeau, 2016; D'Argembeau & Van der Linden, 2004, 2012; D'Argembeau, Renaud, & Van der Linden, 2011). Future research might assess these dimensions in relation to responses on the EFT-T, with self-reported use of mental imagery on the EFT-T itself.

This study provides evidence of the psychometric validity of the EFT-T when used in an online method of administration using a crowd-sourcing recruitment methodology. Despite possible reservations about low participant motivation and resulting satisficing, we found there were very few cases where participants provided responses that were erroneous or off-task. This was perhaps due to the requirement of providing at least 20 characters in responses to the cue word items. The mean proportion of specific responses in the current studies was similar to those found in previous studies examining spontaneous production of future thoughts or where specificity in responses was not precisely requested, that is, around 50% (e.g., Anderson & Dewhurst, 2009; D'Argembeau, Renaud, & Van der Linden, 2011; D'Argembeau & Mathy, 2011). This is also similar to the average number of specific responses provided in paper and pencil formats of the AMT that are distributed rather than interviewer-administered (Griffiths et al., 2009). In contrast, in studies where participants are

prompted repeatedly to provide specific future events, or when task errors are corrected, the proportion of specific events is closer to 100% (e.g., Addis et al., 2016; Addis et al., 2010). Given the above, this online, crowd-sourcing mode of administering the EFT-T does not seem to differ greatly from comparable methods of assessing episodic specificity using a cue word method without repeated prompts. Of course, future research may usefully compare recruitment and testing methodologies. Further, future research may assess the psychometric validity of the EFT-T in clinical samples. Although previous findings indicate that the emotional valence of word cues does not appear to significantly affect specificity in some clinical samples (Hallford et al., 2018; van Vreeswijk & de Wilde, 2004), factor analyses have not been conducted to date, and particular clinical populations, such as those with posttraumatic stress disorder, obsessive-compulsive disorders, and personality disorders, have not been well studied.

Regarding the number of items on the EFT-T, meta-analytic research on episodic future thinking specificity has not shown clear evidence that the sensitivity of this measurement approach is dependent on the number of cue words (Hallford et al., 2018), which is largely consistent with findings on the AMT (van Vreeswijk & de Wilde, 2004). However, using too few items on the EFT-T may reduce sensitivity. A further note is that there were small differences between the cue word sets in mean number of specific responses. Given this, the counterbalancing of these cue words sets would be essential for use in some study designs.

In conclusion, the findings from these two studies provide evidence of the robustness of the one-factor structure of the EFT-T and its association with specificity on the AMT.

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Table 1.

Factor Loadings and Descriptive Statistics for the EFT-T Items in Study 1.

Item	Cue Word	Factor Loadings	Mean Proportion of Specific Responses (<i>SD</i>)	Item-total correlation
1	Happy	.559	.72 (.45)	.48
2	Lost	.638	.62 (.49)	.56
3	Strong	.610	.44 (.50)	.54
4	Trouble	.685	.49 (.50)	.61
5	Beautiful	.633	.62 (.49)	.56
6	Failure	.754	.35 (.48)	.64
7	Easy	.662	.53 (.50)	.59
8	Fearful	.748	.48 (.50)	.66
9	Hopeful	.630	.39 (.49)	.55
10	Stress	.646	.37 (.48)	.57
11	Book	.690	.50 (.50)	.61
12	Money	.695	.42 (.49)	.61
13	Hand	.689	.52 (.50)	.61
14	House	.722	.43 (.50)	.63
15	Water	.721	.49 (.50)	.63

Note: Item range is 0-100%, and scale range is 1-15. All item-total correlations significant at the $p < .001$ level.

Table 2.

Descriptive Statistics and Unstandardized Factor Loadings From Study 2

Item	Cue	Mean Proportion of Specific Responses (SD)	Item-total correlation	Unstandardized Factor Loadings	Standard Error	z-value
1	Truth	.63 (.48)	.54	1.00	/	
2	Pressure	.46 (.50)	.48	0.85	.13	6.79
3	Agreement	.63 (.48)	.52	0.97	.13	7.51
4	Pain	.62 (.49)	.44	0.77	.13	5.94
5	Respect	.44 (.50)	.62	1.20	.14	8.76
6	Danger	.55 (.50)	.62	1.16	.13	9.30
7	Freedom	.33 (.46)	.55	1.05	.13	8.39
8	Cold	.50 (.50)	.57	1.05	.14	7.70
9	Success	.31 (.46)	.51	0.95	.13	7.61
10	Evil	.31 (.46)	.53	1.06	.14	7.63
11	Door	.69 (.46)	.58	1.15	.13	8.81
12	Room	.58 (.49)	.52	0.96	.13	7.46
13	Face	.61 (.49)	.66	1.31	.15	9.25
14	Eye	.63 (.48)	.56	1.05	.12	8.78
15	Computer	.64 (.48)	.52	0.96	.13	7.55

Note: Item range is 0-100%. First factor loading set to 1. All item-total correlations and factor loadings significant at the $p < .001$ level.

Table 3.

Zero-Order Correlations and Descriptive Statistics for Study 2 Variables

	EFT-T	AMT	PIT	SUIS	Mean (<i>SD</i>)	Possible
	Specificity	Specificity				Range
EFT-T	-				7.9 (4.0)	0 – 15
Specificity						
AMT Specificity	.63***	-			6.0 (2.7)	0 – 10
PIT	-.02	.02	-		3.1 (.62)	1 – 5
SUIS	.13*	.11*	.38***	-	3.4 (.76)	1 – 5

* $p < .05$, *** $p < .001$.

SUIS = Spontaneous Use of Imagery Scale.

Appendix

You will now be presented with a series of 15 words, one at a time. Your task will be to describe **a specific event that could happen in your future**. The event does not have to be directly related to this word, but may be just inspired by it.

Here are some instructions for what type of future event to describe:

- It can be something that either will happen or hypothetically could happen
- It must be something you would be personally involved in
- It must be something that occurs **in a particular place** and **within the space of a day at most**.

Please try and state as many details about this possible future event as you can (e.g. where it happens, who would be there, what would happen, how you might feel, what you might think etc.).

Please describe a different event for each word.

Please click continue for some examples of correct responses to this task

If the cue word was: PLEASURE, then an example of a correct response would be:

"I have a friend's birthday party at their house next month. The house is big, but I would spend most of my time in their kitchen. A lot of other friend's will be there, and there will be dancing and music. It will probably be a late night, and I'll eat too many of the snacks".

If the cue word was TABLE, then an example of a correct response would be:

"I can imagine one day having to stand up on my table at home to fix a light. I'll be a little worried about the height and that I might fall off. I'll change the light and then get down off the table. I'll feel proud that I managed to do it"

Please describe a specific future event related to the word:

Word List A: *happy, lost, strong, trouble, beautiful, failure, easy, fear, hope, stress, book, money, hand, house, water*

Word List B: *truth, pressure, agreement, pain, respect, danger, freedom, cold, success, evil, door, room, face, eye, computer*

Supplementary Table 1.

Examples of Specific and Non-Specific Episodic Future Thoughts

Specific Episodic Future Thoughts	Non-Specific Episodic Future Thoughts
<i>Next month, I might have to drive my friend to an appointment somewhere. I would have the directions written down, but I would get lost on the way there. I would then drive around for a long time before finally finding the place. It would be very frustrating.</i>	<i>I have hope that the health care in this country will get better. So many people need affordable health care and can't get it but I have hope that they will be able to soon.</i>
<i>I will miss my family when I have to leave on Sunday.</i>	<i>I'm not much into books but my daughter is a book worm.</i>
<i>I have travel plans to southern California in a few months. The thought of getting lost on the freeway fills me with worry.</i>	<i>Next year, I have a lot of work to do on my house.</i>
<i>I would see a stranger that lost their wallet and I would have been the one that found it for them.</i>	<i>Someday my children will give birth to their own children and I will finally be a grandmother.</i>
<i>It will be a beautiful sight tomorrow when I see Kylie, my girlfriend tomorrow.</i>	<i>I will own a house in 3 to 5 years with my beautiful and blessed family.</i>
<i>I am going to go to skip school on Monday morning. I learn nothing in the class anyway.</i>	<i>I work out every day and I'm strong</i>
<i>My work day on my first day back after the holiday will probably not be easy.</i>	<i>After finishing my work projects I hope to be free from work for the rest of the year!</i>