Supplemental Materials

S1: Brief description of methods implemented in larger study design

A. Initial Laboratory Visit (Day 1):

1) Structured Clinical Interview for DSM-IV (SCID) to assess current and lifetime history of Axis I disorders (First et al., 2004)
2) The Wechsler Test of Adult Reading (WTAR)an estimate of premobid IQ. (Wechsler, 2001)
3) Structured clinical interviews assessing negative symptoms using the Clinical Assessment for Negative Symptoms (CAINS; Kring et al., 2013)
4) Basic demographic form (e.g., age, gender, parental education, occupation, medication, etc).
5) The Emotional Verbal Learning Test (EVLT) a measure of emotional learning and memory (Strauss et al., 2013)
6) Anticipation Gambling Task (Forbes et al., 2006). On each trial participants will be presented with digits, one at a time on the computer screen. Prior to the digits, they will be asked to guess by computer press whether the digit is above or below 5. After a choice is made, the trial type will be presented (up arrow to indicate a reward trial, down arrow to indicate a loss trial) along with an indication of potential monetary outcome (+50¢, +$1, -25¢, -50¢). After learning trial type, participants will be asked to answer the question: How do you predict the outcome of this trial will make you feel, from unhappy to happy. Participants will be presented with a Likert Scale from 1 to 5, from unhappy to happy. Next, the digit between 1-10 will be presented with the feedback of results (up arrow for win; down arrow for loss, and circle for no loss or gain) and the dollar amount won or lost. Finally, participants will be asked to rate "How the outcome of the trial made you feel, from unhappy to happy" using the same 5-point Likert scale. On 70% of the trials, the cues will accurately predict the outcome, and on 30% of the trials, the neutral outcome will occur ($0). Thus, participants will earn $5.25 over the course of the experiment.

7) Treadway EEfRT Task: One each trial of the EEfRT task, participants choose between two different task difficulty levels to obtain monetary rewards. For all trials, participants will make repeated manual button presses within a short period of time. Each button press will raise the level of a virtual ‘‘bar’’ viewed onscreen by the participant. Participants are eligible to win the money allotted for each trial if they raise the bar to the ‘‘top’’ within the prescribed time period. On each trial, subjects choose between two levels of task difficulty, a ‘hard task’ and an ‘easy task’. Successful completion of hardtask trials will require the subject to make 100 button presses, using the nondominant little finger within 21 seconds, while successful completion of easytask trials will require the subject to make 30 button presses, using the dominant index finger within 7 seconds. For easytask trials, subjects win $1.00 on each trial if they successfully complete the task. For hardtask choices, subjects win higher amounts that vary per trial within a range of $1.24 – $4.30 (‘‘reward magnitude’’). Subjects will not be guaranteed to win the reward if they complete the task; some trials are ‘‘win’’ trials (50%), in which the subject receives the stated reward amount, while others are

‘‘no win’’ trials, in which the subject received no money for that trial. Subjects will receive $9 for completion of this task.

In addition, individuals will be asked to complete the following self-report scales:
8) Motivation and Pleasure Scale-Self Report (MAP-SR) a self-report measure of negative symptoms (Llerena et al., 2013).
9) Beck Depression Inventory (BDI; Beck & Steere, 1987) a well validated self-report measure of depression.

10) Finally, the experimenter will provide instructions on the EMA portion of the study: The experimenter will provide the participant with the mobile phone for the Ecological Momentary Assessment (EMA) portion of the study. The investigator will train participants on how to use the EMA Easy M App and phone, including instruction on how to charge and care for the phone. Participants will complete one assessment with the experimenter to ensure understanding. Experimenter will answer any questions the participant has about the smartphone, app, or interview questions.

B. Seven Days of Ecological Momentary Assessment reports (days 2-8):
Participants will be randomly paged four-times per day at quasi-random times within 4 epochs each day between 10 am- 7 pm (for a total of 28 trials across the 7 days). Participants will be asked about their current emotion, who they are spending time with and what they plan on doing in the future (see Daily Interview). Participants will be paged, via a ring tone through the study-provided mobile phone. At that time, participants are asked to fill out the questionnaires through the qualtrics within 15 minutes. If they are unable to do so, the app will alert them that they are past the 15 minute testing window. Each interview is expected to take up to 5 minutes. Participants will be asked to answer 5 questionnaires a day (4 daily interviews and 1 nightly interview) for a total of 25 minutes per day of surveys.

C. Second Laboratory Visit (day 9):
At the end of the one-week period, participants will return to the lab and return their study provided phone. This visit is expected to take between 2 to 3 hours. Participants will be paid $40 for completing this session. During this session, individuals will be administered the following by a trained research staff member:
1) Brief Psychiatric Rating Scale (BPRS; Ventura et al., 1993) a measure of a broad ranging of psychiatric symptoms including psychosis and mood symptoms.
2) Structured clinical interviews assessing negative symptoms over the prior week using the Clinical Assessment for Negative Symptoms (CAINS).
3) Recall and Recognition Memory from Emotion Verbal Learning Test (EVLT) completed in Visit 1.
4)Participants will complete the Brief UCSD-Performance Based Skills Assessment (UPSA-B).
5) The Screen for Cognitive Impairment in Psychiatry (SCIP), which is a researcher-administered screen of cognitive ability in the domains of memory, processing speed, and verbal fluency.

In addition, individuals will be asked to complete the following self-report scales:

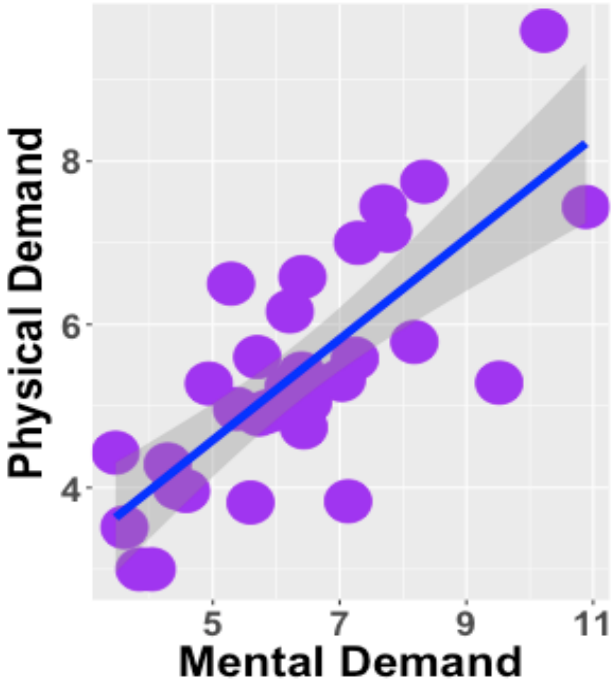
8) Temporal Experience of Pleasure Scale (TEPS; Gard et al., 2006) a scale that measures anticipatory and consummatory pleasure.
9) Savoring Beliefs Inventory (SBI; Bryant, 2003) a measure of anticipation and savoring pleasure.
10) Specific Levels of Functioning Scale (SLOF) a well validated scale of community function.
11) EMA Feedback Form (attached) a self-report form created to assess participants time and ease of use for EMA portion of study.
12) Need for Cognition Scale (Cacioppo & Petty, 1983)

D) fMRI Session:
Participants will complete an approximately 1.5 hour-long fMRI scan, which will take place at either the Siemens SKYRA 3T scanner at Bay 2, East Building, or the Siemens Trio in Bay 3 East Building, or at the Siemens Trio at the CCIR. Both structural and functional images will be acquired during each scan session. During this scan, participants will complete three cognitive tasks, all of which will require participant's response via a button-box within the scanner:
1) Rapid Instructed-Based Learning Task: during this task, participants will view simple black and white images (stars, suns, squares), and be asked to learn whether the response to each stimulus should be a button press with their right hand or left hand. Feedback (correct, incorrect, too slow) will be provided after each trial to facilitate learning.

2) Explicit Reinforcement Learning Task: For explicit RL, we will optimize a probabilistic paradigm developed by Pessiglione and Kim in which participants are asked to learn which image in a pair of images is either more associated with winning (e.g., potential gains), or with not losing (potential loses). A different pair of images is used for potential wins and loses, counterbalanced across participants. We will administer a total of between 100 to 300 trials, with each pair type presented an equal number of times. Trials will be presented in blocks of trials, with win and loss trials pseudo-randomly interleaved. As dependent measures we will compute both model based learning rates for achieving gain and avoiding loss, and accuracy in the last block. Importantly, we will develop parallel versions with different stimuli types so that they can be used in longitudinal studies. Participants will be given the amount of money they win on the task, which will be in the range of $1-$5.

3) Cognitive effort task: Outside of the scanner, participants will be instructed how to complete cognitive effort task and they will practice rounds of the task. This task involves remembering a series of letters in sequence. Then, in the scanner, they will complete a single round of discounting decision-making to ascertain the subjective value of cognitive effort for each level of the task. Discounting consists of asking participants to identify which levels of the task they would be willing to repeat based on amounts of money offered to repeat them. After completion of the scanning task, they will complete one of their randomly selected choice levels, and paid up to $5 based on their choices. Participants will then complete the post-working memory (N-back) task questionnaire and post-decision-making questionnaire.

S2: Correlation between Mental and Physical Demand (r-value = 0.76; p-value < 0.001)



S3: Models Separating Current, Past, and Future Motivational Experience

| Dependent Variable: Current EMA Effort | | | |
|---|---|---|---|
| | **Beta** | **SE** | **p-value** |
| Intercept | 1.63 | 1.17 | 0.17 |
| Time of Day | 0.03 | 0.04 | 0.45 |
| Day of Survey | -0.13 | 0.05 | 0.02 |
| EMA Enjoyment | -0.05 | 0.04 | 0.21 |
| COGED Average | 2.11 | 0.66 | <0.01 |
| EEfRT Average | -0.67 | 0.54 | 0.22 |
| Need for Cognition | 0.02 | 0.01 | 0.32 |
| EMA Completion Rate | 1.03 | 0.82 | 0.21 |

| Dependent Variable: Past EMA Effort | | | |
|---|---|---|---|
| | **Beta** | **SE** | **p-value** |
| Intercept | 3.09 | 1.35 | 0.03 |
| Time of Day | -0.02 | 0.03 | 0.54 |
| Day of Survey | -0.01 | 0.04 | 0.82 |
| EMA Enjoyment | 0.03 | 0.03 | 0.30 |
| COGED Average | 0.89 | 0.84 | 0.30 |
| EEfRT Average | 0.09 | 0.72 | 0.90 |
| Need for Cognition | 0.01 | 0.02 | 0.58 |
| EMA Completion Rate | -0.20 | 1.04 | 0.85 |

| Dependent Variable: Future EMA Effort | | | |
|---|---|---|---|
| | **Beta** | **SE** | **p-value** |
| Intercept | 4.04 | 1.48 | 0.01 |
| Time of Day | -0.03 | 0.04 | 0.42 |
| Day of Survey | -0.28 | 0.05 | <0.01 |
| EMA Enjoyment | -0.01 | 0.03 | 0.72 |
| COGED Average | 1.73 | 0.93 | 0.07 |
| EEfRT Average | -0.79 | 0.79 | 0.33 |
| Need for Cognition | 0.00 | 0.02 | 0.84 |

S4: *Associations between task performance and EMA mental/physical demand*

*A.)*

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 4.97 | 1.60 | 3.11 | <0.01 |
| Time of Day | -0.19 | 0.06 | -3.31 | <0.01 |
| Day of Survey | 0.01 | 0.06 | 0.14 | 0.89 |
| COGED Average | 1.63 | 1.20 | 1.36 | 0.17 |
| EMA Completion Rate | 0.04 | 0.05 | 0.84 | 0.40 |

*B.)*

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 6.39 | 1.33 | 4.79 | <0.01 |
| Time of Day | -0.19 | 0.06 | -3.29 | <0.01 |
| Day of Survey | 0.01 | 0.06 | 0.15 | 0.88 |
| EEfRT Average | -0.04 | 1.15 | -0.03 | 0.97 |
| EMA Completion Rate | 0.02 | 0.05 | 0.40 | 0.69 |

*C.)*

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 3.89 | 1.33 | 2.94 | 0.01 |
| Time of Day | -0.23 | 0.07 | -3.34 | <0.01 |
| Day of Survey | 0.01 | 0.04 | 0.15 | 0.89 |
| COGED Average | 2.76 | 0.99 | 2.79 | 0.01 |
| EMA Completion Rate | 0.03 | 0.04 | 0.71 | 0.48 |

*D.)*

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 6.05 | 1.19 | 5.09 | <0.01 |
| Time of Day | -0.23 | 0.07 | -3.31 | <0.01 |
| Day of Survey | 0.01 | 0.04 | 0.16 | 0.87 |
| EEfRT Average | 0.60 | 1.03 | 0.58 | 0.56 |
| EMA Completion Rate | -0.02 | 0.04 | -0.37 | 0.71 |

Table Caption: (A & B): HLMs predicting mental demand. (C & D): HLMs predicting physical demand

S5: Task Completion and Performance Metrics

| | N-Back performance (d-prime) | | | |
|---|---|---|---|---|
| **EEfRT Completion Rate** | **1back** | **2back** | **3back** | **4back** |
| 98.7% (0.02%) | 3.11 (0.82) | 1.89 (0.81) | 1.33 (0.62) | 1.16 (0.51) |

*Table Caption:* Participants were required to make a decision for each trial of both the COGED and EEfRT tasks. Thus, there were no trials in which the task "timed out" before the participant was able to make a choice. For EEfRT, participants completed 98.7% of trials on average. Given the high rate of successful task completion all trials were included. For COGED, there is some concern that effort-based choice behavior may be influenced by n-back performance. D-prime is provided for each n-back level above.

S6: Models predicting EMA Effort from COGED including participant n-back performance as an additional predictor

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 4.27 | 1.40 | 3.06 | <0.01 |
| Time of Day | -0.21 | 0.05 | -3.94 | <0.01 |
| Day of Survey | -0.02 | 0.04 | -0.35 | 0.73 |
| EMA Enjoyment | -0.01 | 0.05 | -0.28 | 0.78 |
| COGED Average | 2.80 | 0.91 | 3.07 | <0.01 |
| N-back (d-prime mean) | -0.06 | 0.44 | -0.12 | 0.90 |
| EMA Completion Rate | 1.36 | 1.27 | 1.08 | 0.28 |

S7: Models predicting EMA enjoyment from effort-based decision-making task performance

*A.)*

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 6.28 | 1.69 | 3.71 | 0.00 |
| Time of Day | 0.30 | 0.07 | 4.40 | 0.00 |
| Day of Survey | -0.02 | 0.06 | -0.33 | 0.74 |
| COGED Average | 1.18 | 1.28 | 0.91 | 0.37 |
| EMA Completion Rate | 0.05 | 0.05 | 1.13 | 0.27 |

*B.)*

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 7.27 | 1.37 | 5.32 | 0.00 |
| Time of Day | 0.30 | 0.07 | 4.40 | 0.00 |
| Day of Survey | -0.02 | 0.06 | -0.31 | 0.76 |
| EEfRT Average | 0.06 | 1.19 | 0.05 | 0.96 |
| EMA Completion Rate | 0.04 | 0.05 | 0.81 | 0.42 |

S8: Below we provide models, which test for moderation of EEfRT and COGED by NCS. In these models, we did not observe significant interactions (NCS x COGED or NCS x EEfRT).

| **COGED** | | | | |
|---|---|---|---|---|
| Parameter | Estimate | SE | t-value | p-value |
| Intercept | 3.88 | 3.27 | 1.18 | 0.24 |
| Time of Day | -0.21 | 0.06 | -3.80 | <0.001 |
| Day of Survey | 0.01 | 0.05 | 0.17 | 0.86 |
| COGED Average | 1.28 | 8.62 | 0.15 | 0.88 |
| Need for Cognition | 0.01 | 0.06 | 0.18 | 0.86 |
| EMA Completion Rate | 1.06 | 1.42 | 0.75 | 0.45 |
| COGED x NFC | 0.01 | 0.15 | 0.09 | 0.93 |
| **EEfRT** | | | | |
| Parameter | Estimate | SE | t-value | p-value |
| Intercept | 8.11 | 5.15 | 1.57 | 0.12 |
| Time of Day | -0.21 | 0.06 | -3.76 | <0.001 |
| Day of Survey | 0.01 | 0.05 | 0.17 | 0.86 |
| EEfRT Average | -5.09 | 6.97 | -0.73 | 0.47 |
| Need for Cognition | -0.04 | 0.09 | -0.41 | 0.68 |
| EMA Completion Rate | 0.16 | 1.44 | 0.11 | 0.91 |
| EEfRT x NFC | 0.10 | 0.12 | 0.80 | 0.42 |

S9: Analyses after removing individuals who solely preferred one option.

COGED Model

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 9.96 | 2.81 | 3.55 | 0.00 |
| Time of Day | -0.38 | 0.10 | -3.64 | 0.00 |
| Day of Survey | 0.01 | 0.08 | 0.13 | 0.90 |
| COGED Average | 3.29 | 2.27 | 1.45 | 0.15 |
| EMA Completion Rate | 1.21 | 2.82 | 0.43 | 0.67 |

EEfRT Model

| Parameter | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 14.26 | 2.54 | 5.62 | < 0.01 |
| Time of Day | -0.42 | 0.12 | -3.42 | < 0.01 |
| Day of Survey | -0.06 | 0.09 | -0.67 | 0.50 |
| EEfRT Average | -0.79 | 2.41 | -0.33 | 0.74 |
| EMA Completion Rate | -1.20 | 2.83 | -0.43 | 0.67 |