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# Thinking About Episodic Future Events as a Way to Reduce Smoking Behavior: An Ecological Momentary Assessment Study

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Thinking About Episodic Future Events as a Way to Reduce Smoking Behavior: An Ecological Momentary Assessment Study

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**Abstract**

With nearly 35 million Americans currently estimated to smoke and an approximate seven out of ten adult smokers wanting to quit, it is clear that there is a need for enhanced smoking cessation techniques. Encouraging people to think about a future smoke-free self may help to encourage and motivate changes in smoking behavior. The present study investigated the role of an episodic future thinking manipulation on the motivation to quit smoking using ecological momentary assessment (EMA). Participants ($N$ = 103) were randomly assigned to either an episodic future thinking (EFT) condition or an episodic recent thinking (ERT) condition, and were asked to write a short paragraph about an EFT or an ERT event from their personal life. Immediately following the writing prompt, participants answered daily questions about mental imagery, mind-wandering, craving, stress, and the motivation to quit smoking. Participants also completed individual differences questionnaires surveying their propensity for holistic thinking, mental imagery, and mind-wandering. It was hypothesized that individuals randomly assigned to the EFT (vs. ERT) condition would report greater motivation to quit smoking. Additionally, participants in the EFT (vs. ERT) condition who reported more holistic thinking were expected to report the strongest motivation to quit smoking. Finally, participants in the EFT group who reported more mental imagery and more frequent mind-wandering (for both the individual differences and daily EMA variables) were expected to report the strongest motivation to quit smoking. None of the hypotheses were supported. However, greater motivation to quit smoking was significantly correlated with greater levels of daily mental imagery and more frequent deliberate daily mind wandering (regardless of the condition). Additionally, daily average deliberate mind-wandering significantly predicted the motivation to quit smoking. Limitations and future directions are discussed.

**Contents**

## Introduction

With nearly 35 million Americans currently estimated to smoke and an approximate seven out of ten adult smokers wanting to quit, it is clear that there is a need for enhanced smoking cessation techniques (Creamer et al., 2019). Current approaches include satisfying a craving (e.g., nicotine gum or patch) or reliance on self-initiated behavior (e.g., call a friend when experiencing a craving or remembering the reasons to quit). Self-initiated behaviors typically rely on prospective memory—the ability to recall information from the past, but still implement the intended behavior in the future—and for those who wish to quit smoking, both recalling their intention to quit and enforcing the intended behavior can be especially difficult (Risko & Gilbert, 2016).

Encouraging people to think about their future, i.e., to engage in episodic future thinking (EFT) may help to encourage the intended motivation and behavior by allowing people to pre-experience a future self that is smoke-free. EFT is the ability to imagine or simulate possible future-oriented personal events (Atance & O'Neill, 2001; Schacter et al., 2017). EFT is considered to be essential for shaping the self and identity, and has been shown to be a meaningful component in daily life activities such as goal attainment, motivational behavior, and decision-making (Schacter et al., 2017; Szpunar, 2010).

The present thesis first examined the effect of EFT (vs. episodic recent thinking) on the motivation to quit smoking using Ecological Momentary Assessment (EMA). Second, it investigated the effect of individual differences in holistic thinking tendency, mental imagery, and mind-wandering in EFT on the motivation to quit smoking. Finally, daily EMA questions related to mental imagery and mind-wandering in EFT as a function of quit motivation were examined. I begin by discussing the effect of EFT on smoking behavior using EMA. From there

I discuss the theoretical background of EFT, obstacles to smoking cessation related to future-oriented cognition, and the constructs of holistic thinking tendency, mental imagery, and mind-wandering during EFT which may impact smoking-related outcomes.

**Episodic Future Thinking and Smoking**

The primary goal of this study was to examine the effect of EFT (vs. episodic recent thinking) on the motivation to quit smoking using ecological momentary assessment (EMA). While EFT is the ability to simulate the future, episodic recent thinking (ERT) is considered to be a control condition where participants think of a past memory during a certain time frame. ERT is considered to be a control condition because both groups incorporate memory as well as an autobiographical component, therefore isolating prospection to the EFT group (Stein, 2016).

While there is little EMA research investigating EFT cues on cigarette smoking behavior, there is literature examining the effectiveness of EFT cues on other health-related behaviors. For instance, research has shown improved decision-making following EFT cues in which caloric intake in overweight individuals was decreased (Dassen et al., 2016) and hypothetical alcohol consumption in alcohol-dependent individuals was lowered (Snider et al., 2016). These results are in line with the prediction that imagining a future smoke-free self may alter cigarette smoking behavior.

**Theoretical Background of Episodic Future Thinking**

The mechanism by which EFT is proposed to have its effects is through the episodic memory system. According to Tulving (2002), mental time travel between the past and the present relies on an individual's sense of subjective time, autonoetic consciousness (i.e., conscious awareness of mental time travel), and an understanding of the self as it exists in subjective time. Schacter and Addis (2007) present a differing viewpoint – the constructive

episodic simulation hypothesis – which emphasizes the atemporal aspect where EFT is a constructive process by which the episodic memory system reconstructs and reassembles past experiences in an effort to engage in novel future-oriented thought. Yet another explanation for episodic future thinking – the scene construction theory – is proposed by Hassabis and Maguire (2007). The scene construction theory focuses primarily on the hippocampus as the construction site for building episodic memories and episodic imaginings. The theory proposes that the hippocampus is a hub of sorts where other areas may be recruited to assist in mental time travel.

**Prospective Memory and Episodic Future Thinking**

One area that may hinder a smoker's ability to quit is through deficits in prospective memory (PM). PM is defined as the ability to carry out intended behavior in the future in the face of ongoing tasks. PM consists of sequential stages, including: intention setting, retaining that intention while going about daily life, initiating the action to perform the intention, and evaluating the outcome of those actions (Terrett et al., 2016). Relapse prevention strategies for smokers typically depend on self-initiated behavior (e.g., call a friend when experiencing a craving; remembering the reasons to quit). These behaviors rely on prospective memory, and for people who wish to quit smoking, recalling their intention to quit, retaining their intention despite constant triggers, and enforcing the intended behavior can be especially difficult.

Research indicates that PM is impaired in people who are addicted to both licit and illicit drugs (Platt et al., 2019). A meta-analysis investigating alcohol and nicotine use on PM tasks showed impaired performance (Platt et al., 2019), including PM deficits in cigarette smokers in a simulated real-world paradigm (Heffernan et al., 2012). In the real-world study, there were 15 location-action PM pairs in which 3 groups (smokers, previous smokers, never smokers) of participants (aged 18-35) were asked to perform as they walked across a college campus. For

example, one location was “When you reach the University shop” and its associated action was “Ask: Do you sell sandwiches?”. Participants were allowed to memorize the location-action list for 1.5 minutes prior to walking around the campus. For each location-action correctly recalled, the participant received 1 point. The higher score represented better PM. Analyses indicated that the never smoker group recalled significantly more location-action pairs than the smoker group, and the previous smoker group recalled significantly more location-pairs than the smoker group. There were no significant differences between the previous smoker and the never smoker groups. At the heart of this study, smokers had a more difficult time following through with the intended actions. Quitting smoking also has sequential steps with intended actions. One must set the intention to quit smoking, retain that intention despite numerous distractions, and follow through with intended actions. One way to enhance smoker’s ability to follow through with their intentions is to think about a future smoke-free self.

Engaging in EFT may help to improve PM and therefore help to reinforce the intention to quit smoking by simulating a future addiction-free self. To my knowledge, there is no literature directly investigating the effect of EFT on prospective memory in smokers. There is evidence, however, showing that imagining future events improves PM in healthy individuals under the influence of alcohol. In one study, participants under the influence of alcohol completed the simulated Virtual Week boardgame (Paraskevaides et al., 2010). The virtual board game included 10 prospective memory (PM) tasks that participants must remember to carry out at specific times in the future (e.g., call the plumber at 4pm; take antibiotics with breakfast). Results indicated that EFT significantly improved PM performance in the alcohol-impaired (vs. control) group. While this is not direct evidence supporting the use of EFT in improving PM in

smokers, it is very likely that similar mechanisms are in place for nicotine dependence as they are for alcohol dependence.

There is additional evidence showing EFT is an effective strategy to improve PM. PM improvement was investigated in a computerized simulation where participants were required to complete the Dresden Breakfast Task. PM tasks were defined as setting the table in a certain way and preparing foods while adhering to certain rules and time restrictions (Altgassen et al., 2015). After hearing the instructions, but prior to completing the task, the experimental group imagined themselves completing the task in the future. Those participants who imagined themselves completing the breakfast task completed more PM tasks (e.g., remembering to set the table with plates before the silverware) than the control group, indicating that future thinking is an effective strategy for improving prospective memory. It is promising that PM was shown to be improved in individuals addicted to a substance so closely related to nicotine, as both alcohol and nicotine dependence have been shown to rely on the neurotransmitter dopamine (Hertling et al., 2005). Extreme impairments in PM in alcohol and nicotine dependence not only have an effect on daily living, but for people who are attempting abstinence from alcohol or smoking, PM impairments are likely interfering with their intentions to quit.

**Decision-Making and Episodic Future Thinking**

Another area that may inhibit smokers' ability to quit is through impaired decision-making. Research on inter-temporal choice—making decisions based on reward options that differ in magnitude and the time until reward—have been shown to be impaired in smokers (Baker et al., 2003; Bickel et al., 2014; Stein, 2016). Some even suggest that decision-making becomes pathological in individuals who struggle with addiction, leading to overvaluation of drug-related rewards and undervaluation of later rewards (Bickel et al., 2014). For instance, in a

study on intertemporal choice, the $1000 monetary reward was replaced with the number of cigarette packs equal to $1000 (Bickel et al., 1999). When delayed by 5 years, smokers devalued $1000 worth of cigarettes by 87.5%, when the $1000 monetary reward was only devalued by 57.5%. The same study also found that ex-smokers discounted monetary and cigarette outcomes less so than current smokers with the discounting rates closer to never-smokers. The authors concluded that increased discounting might be a function of nicotine dependence and that upon cessation, discounting can decrease. With this logic, improved decision-making relies on cessation, but for smokers who are attempting to quit, improving decision-making during the quitting process could help smokers achieve abstinence.

Improvements in decision-making and its associated reduction in cigarette use following EFT cues have been shown in tobacco users. The effects of EFT in cigarette smokers were evaluated with a delayed discounting task and a cigarette self-administration task (Stein, 2016). In the delayed discounting task participants were presented with a question that offered them $1000 later or various smaller amounts immediately. For each question, both the smaller amount of money offered immediately differed and participants were presented with the EFT or an episodic recent thinking (ERT) cue. Results indicated that participants in the EFT condition discounted less at the 3 month and 1-year delay. In the cigarette self-administration task, participants earned cigarette puffs through a fixed-ratio response requirement which led to the EFT group smoking fewer cigarette puffs, showing that they delayed smoking more than the ERT group.

Improved decision-making in people with substance use disorders has also been shown to increase following EFT cues. The effect of EFT cues on intertemporal choice with alcohol-dependent individuals was investigated. Participants generated either EFT events or ERT events,

completed a delayed discounting task and a hypothetical alcohol purchasing task (Snider et al., 2016). Prior to the experimental tasks, participants were prompted with questions to help them elaborate on their EFT or ERT cue (ex. “What will you be doing?”). Once participants elaborated on their event, participants were asked to shorten the cues to end up with sentences such as, “In 1 year from now I will be at my daughter’s birthday party at home with my family eating cake.” The delayed discounting task asked participants questions such as “Would you rather have $50 now or $100 in a year,” while either the shortened EFT or the ERT sentence was above the question on the computer screen (Snider et al., 2016). Results for the delayed discounting task indicated that the EFT group significantly valued monetary rewards delayed by 1 year (the longest delay in the experiment). In the alcohol purchasing task, participants were instructed to imagine themselves in a bar with their friends and were asked how much they would pay for an alcoholic drink when the cost was a specified amount of money (their EFT or ERT cues were above the question). For example, participants would be asked, “How many drinks would you consume if they were $0 each?”, with drink prices increasing for subsequent questions. Results indicated that participants in the EFT group had lower initial purchase behavior (the consumption when the drink was at $0), which indicates that participants in this group had less desire for the hypothetical alcoholic drink when it was free. Thus, based on prior evidence, EFT appears to increase decision-making ability for alcohol-dependent individuals.

In sum, obstacles to quitting smoking, such as PM and decision-making, have been shown to be impaired in smokers, but have likewise been shown to improve after EFT cues. Thus, the aim of the present study was to examine whether engaging in EFT results in greater motivation to quit smoking compared to ERT. Participants were randomly assigned to either an EFT or an ERT group and were engaged in EMA for one week. I hypothesized that after one

week participants in the EFT group would report stronger motivation to quit smoking than participants in the ERT group.

**Holistic Thinking Tendency and Episodic Future Thinking**

Individual differences in holistic (vs. analytic) thinking tendency may play a significant role in the motivation to quit smoking. Thinking styles are thought to be linked with the sociocultural environment in which individuals come from (Miyamoto, 2013). For instance, individuals from North America or Western Europe are not considered to be socially linked with others, which is thought to lead to an analytic thinking style where people attend to individual goals without the influence of others. On the other hand, individuals from Eastern Asia are considered to be fundamentally connected to social relationships, which is thought to lead to a holistic thinking style where individuals attend to relationships, context, and connections. While analytic and holistic thinking styles were originally proposed as between culture differences, studies have also shown within culture differences in thinking styles (Calvo & Beltrán, 2014; Choi et al., 2007; Li et al., 2018). The Analysis-Holism Scale (AHS) was designed to assess cultural thinking styles (analytic vs. holistic) between and within cultures, and is made up of four constructs (Causality; Attitude toward contradictions; Perception of change; Locus of attention) that are central to analytic-holistic thinking styles (Choi et al., 2007).

In one study, two subgroups (students of Oriental Medicine vs. students in other majors) within a culture were given the AHS, and it was shown that the students of Oriental Medicine scored significantly higher on the AHS, indicating that the Oriental Medicine students engaged in more holistic thinking than the other subgroup of students (Choi et al., 2007). In another study investigating the mechanisms behind the role of eye and mouth regions in recognizing emotional faces, participants were shown face stimuli in 3 configurations (whole face, upper half visible,

and lower half visible) while event-related potentials were measured (ERP; Calvo & Beltrán, 2014). When the whole face was shown, expression encoding and emotional assessment elicited greater N170 (wave amplitude occurring at approximately 170ms after stimulus), indicating holistic processing. When showing only the mouth area, processing occurred at approximately 150ms, indicating analytic processing.

The construct of thinking holistically (vs. analytically) may play a significant role in the motivation to quit smoking because EFT is inherently tied to thinking about the self and others, thinking about details surrounding an event, and thinking about the context of the event. The traditional definition of EFT states that it is a form of prospection and refers to the ability to imagine or simulate possible future-oriented *personal* events (Atance & O'Neill, 2001; Schacter et al., 2017). While this definition is clear in that it encompasses all personally-related events, it does not properly delineate between personal events and interpersonal events. Thus, this definition leaves out the nuanced role of the deep interpersonal experience of the *relationship* between the self and others. A close other has been defined as being someone that is emotionally invested in one's life (i.e., parents, siblings, children, friends; Andersen & Chen, 2002). A personal event can include anything that has to do with the self as well as the self and close others. An interpersonal event, however, can only be in relation to the self and close others. Because social relationships and context are embedded within a holistic thinking style, people who spontaneously include close others in their future events may have more motivation to quit smoking.

Because EFT instructions in previous literature have not differentiated between personal and interpersonal events, there is a gap in the literature in which instructions for the EFT

condition combine personal and interpersonal experiences. Examining holistic (vs. analytic) thinking tendencies may help to inform this gap in literature.

**Mental Imagery and Episodic Future Thinking**

In addition to holistic thinking tendency, the ability to imagine may also play a significant role in the effects of EFT on the motivation to quit smoking. The ability to imagine, or mental imagery (MI) has been the topic of discussion throughout history dating back from Greek philosophers to early experimental psychologists and now to contemporary psychologists. Because mental imagery is internally-oriented, it has historically been difficult to define, and there are still debates on whether mental imagery consists of picture-like mental representations or whether it consists of language-like thought (Kosslyn et al., 2003; Pearson, 2019; Pylyshyn, 2003). At the most basic level, mental imagery is typically a way to voluntarily experience a perceptual or sensory experience without the presence of the external stimuli influencing the experience (Thomas, 2020). It has been referred to as “visualizing” or “seeing in the mind’s eye”. While mental imagery can include all of the senses, visual mental imagery has been the primary focus of mental imagery research.

As discussed in a previous section, the system by which EFT works is the episodic memory system (Hassabis & Maguire, 2007; Schacter & Addis, 2007; Tulving, 2002). Evidence that episodic memory is involved in imagining the future comes from studies investigating common neural regions and brain injuries such as amnesia (Addis et al., 2007; Tulving, 1985). Event-related functional magnetic resonance imaging (fMRI) was used to investigate common areas implicated in the construction and elaboration of past and future thought by asking participants to construct a past or a future event when cued by a noun (Addis et al., 2007). Activated regions for construction and elaboration were the same for past events as they were for

future events, but maximal differentiation was shown during event construction. Additional evidence pointing to episodic memory in imagining the future is from patient KC (Tulving, 1985). KC was unable to remember a personal past event nor could he imagine a personal future event, indicating a lack of episodic memory in past and in future thought.

The ability to imagine vivid visual details during mental time travel may lead to positive future outcomes. In one study where participants were asked to remember personal past and imagine personal future events, it was shown that generating vivid visual details led to more sensory and contextual detail (D'Argembeau & Van der Linden, 2006). Additionally, the participants ~~that~~ who visualized more vivid details perceived those events to be more important and reported feeling more emotion surrounding those events. These same authors suggest that the ability to provide more sensory and contextual details during future thinking could lead to more detailed information surrounding personal goals, which may then lead to perceiving their future events as more important. Being able to vividly imagine sensory and contextual details that elicit emotions and help the smoker to value their future smoke-free self could influence smokers to change their smoking behavior.

Additional evidence that vivid visual details in MI lead to desirable outcomes derives from studies investigating episodic specificity inductions. Episodic specificity induction is an experimental procedure that asks participants to focus on the details of a past event (Schacter & Madore, 2016). This procedure has been shown to increase the number of episodic details when remembering a past event and imagining a future event (Schacter & Madore, 2016). It has also been used in studies investigating Means End Problem Solving (MEPS) tasks where participants are asked to provide the steps to solve hypothetical social problems (Schacter & Madore, 2016). In one such study, participants were divided into two groups (an episodic specificity induction

group or a control group) and afterwards were given the MEPS. Participants in the episodic specificity induction group produced more relevant steps to solve the MEPS task (Schacter & Madore, 2016). The increase in details from the episodic specificity induction in solving means ends problems suggests that imagining more details is important for solving future problems. The ability to generate more details, including sensory and contextual details when pre-experiencing a future smoke-free self may motivate smokers to quit smoking.

**Mind-Wandering and Episodic Future Thinking**

In addition to holistic thinking tendency and mental imagery, mind-wandering (MW) may also play a significant role in the effects of EFT on the motivation to quit smoking. MW is similar to MI in the sense that it is an internal, private process that has historically (and currently) been difficult to define. Common definitions include task-unrelated thought and stimulus-independent thought (Antrobus et al., 1966; Giambra, 1989). Other definitions include a dynamic framework in which MW is defined as involving freely moving, unconstrained thoughts (Christoff et al., 2016), and a family resemblances view in which MW is defined as a heterogeneous construct that requires a description of the elements under investigation (Seli et al., 2018). Despite the definitional haze, it is accepted to generally describe MW as an attentional drift from the external environment inward toward one's own mental content (Smallwood & Schooler, 2015).

EFT has been shown to be involved in an extended set of brain regions that overlap with regions that are involved in mind-wandering, which suggests that EFT is a complicated process that requires multiple steps to achieve its end goal, and that MW plays a role in future-oriented cognition (Schacter et al., 2012; Stawarczyk & D'Argembeau, 2015). One such functional network is called the default mode network (DMN). The DMN is a set of brain regions working

in combination that have been implicated in past and future thinking, as well as in mentalizing and simulation (Andrews-Hanna, 2012; Andrews-Hanna et al., 2014).

Engaging in MW has been hypothesized to contribute to personal goal processing with regards to thinking and planning for the future (Stawarczyk & D'Argembeau, 2015). In one study, participants were asked to complete a choice reaction time task with thought sampling probes that asked about the temporal focus (past, present, future), cognitive dimension (self-related, goal-directed), and task focus (on task, off task; Baird et al., 2011). Results regarding task focus indicated that off-task thought was primarily prospective. Additional analyses indicated that goal-directed content was associated with being off-task and was future-oriented, but not past-oriented, which indicates a functional aspect of goal processing in mind-wandering. Furthermore, in another study, participants were asked to complete a sustained attention to response task (SART) with thought sampling probes (Stawarczyk et al., 2011). It was shown that the contents of MW episodes focused on anticipation and future goal planning relating to decision making, planning, or reevaluation of situations. MW may be able to facilitate changes in the motivation to quit smoking due to the propensity for individuals to engage in decision-making and planning aspects of smoking cessation during MW episodes.

**Ecological Momentary Assessment and Future Thinking**

EMA is a mobile application that can be downloaded to a smartphone and is particularly well-suited to collect data on nicotine usage because data is collected in real-time in participant's natural environments (Shiffman et al., 2014). Additionally, the internal (i.e., mood, craving, withdrawal state) and external contextual environments (i.e., social triggers) have been hypothesized to be critical for understanding the mechanisms by which nicotine addiction works (Shiffman, 2009), thus making cigarette smoking a prime area of research using EMA. Indeed,

there is a vast amount of literature that examines cigarette smoking using EMA, including investigating the patterns of craving and relapse in real-time (Shiffman et al., 2007). There is further research investigating the role of cognitive processes, such as attention and emotion, in cigarette smoking behavior (Veilleux & Skinner, 2020; Waters et al., 2014). Although there is an abundance of EMA literature investigating cigarette smoking with the above various topics, EMA research investigating EFT on cigarette smoking behavior is lacking. One study evaluated the use of EFT cues on cigarette smoking behavior in the lab and found that imagining a future smoke-free self reduced the amount of cigarette puffs in a cigarette self-administration task (Stein, 2016). These same authors suggest that continuous use of EFT cues in smokers in context-dependent environments may produce prolonged reductions in smoking consumption (Stein, 2016).

**Present Study and Aims**

The purpose of the present study was to 1) examine the effect of EFT (vs. ERT) on the motivation to quit smoking; 2) investigate the role of individual differences in holistic thinking tendency, mental imagery, and mind wandering as a function of EFT in the motivation to quit smoking; and 3) examine the role of daily EMA mental imagery and mind-wandering variables in the motivation to quit smoking. I hypothesized that participants who were randomly assigned to the EFT (vs. ERT) group would report stronger motivation to quit smoking. Furthermore, I hypothesized that interactions would occur between the experimental manipulation (EFT vs. ERT) and the individual differences constructs, and with the experimental manipulation (EFT vs. ERT) and daily EMA variables. Specifically, it was hypothesized that participants in the EFT group who reported holistic thinking tendencies would report the strongest motivation to quit smoking. Similarly, I hypothesized that participants in the EFT group who have more vivid

mental imagery (both in terms of individual differences and daily EMA) would report the strongest motivation to quit smoking. Finally, I hypothesized that participants in the EFT group who tend to engage in more mind wandering (both in terms of individual differences and daily EMA) would report the strongest motivation to quit smoking.

## Methods

### Participants

A total of 120 participants between the ages of 21-65 were recruited for this study. Participants were recruited through flyers posted in public locations and postings on social media sites (e.g., Craigslist, Facebook, Twitter). Postings were also made at the University of Arkansas for Medical Sciences (UAMS), the University of Arkansas News, and on the local NPR station.

Participants were considered eligible for the study if they 1) smoked at least 5 cigarettes a day for 2 years (only tobacco cigarettes and no E-cigarettes), 2) had no untreated anxiety or depression, 3) had a smartphone on which they could download the LifeData mobile application, and 4) were interested in quitting smoking, but not actively trying to quit (i.e., not using nicotine replacement therapies such as medication, nicotine patches, or cessation therapy).

Four participants were excluded due to data acquisition issues and 13 participants were excluded because they had less than a 30% compliance rate, which left 103 participants for analysis (mean age = 39.63, *SD* = 10.28; 76 female, 27 male). Compliance rate was calculated as a proportion of completed prompt questions to total prompt questions and anything over 20% is considered adequate for analysis (Stone & Shiffman, 2002). Average prompt response for the study sample was 74.93%. Based on an a priori power analysis using EMAtools (Kleiman, 2021), a small effect ($d = 0.2$) can be detected with 80% power at approximately 25 responses per person with 100 participants (25 responses X 100 participants = 2500 observations needed to

detect a small effect). Of the 103 participants, 51 were in the EFT condition and 52 were in the ERT condition. Eighty-three participants identified as white/Caucasian, 11as multi-racial, 7 as Black, African-American, or African, and 2 as Asian or Asian American. On average, participants were low to moderately dependent ($M$ = 4.52, $SD$ = 1.87; Fagerstrom Test for Nicotine Dependence; Kozlowski et al., 1991), smoked approximately fifteen cigarettes per day, and smoked no less than five days a week. Approximately 95% of participants attempted a past quit attempt with 59% reporting 3 or more quit attempts over their lifetime. Additionally, 59% of participants reported their last attempt at quitting smoking more than six months prior to their participation in the current study. Participants were compensated for study completion with two Amazon gift cards. The first $20 Amazon gift card was given for completion of the Qualtrics questionnaire. The second Amazon gift card was prorated so that participants could earn up to $100 based on the percentage of completed EMA prompts. Lower EMA compliance resulted in lower payment. To receive the full $100 dollar gift card participants must have completed at least 85% or more of the total prompts. This payment system is typical for EMA studies (Veilleux et al., 2021). This study was approved by the University of Arkansas Institutional Review Board (IRB; Appendix 1) and all participants provided informed consent prior to participating.

## Measures

### Individual Differences Measures

**Analysis-Holism Scale (AHS).** The AHS is a 24-item measure used to assess individual differences in the degree to which people tend to think holistically or analytically (Choi et al., 2007). Participants used a Likert-type scale to rate items on how much they agreed with the statements using the scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Example

items from the AHS scale are: "*Everything in the world is intertwined in a causal relationship"* and *"It is more desirable to take the middle ground than go to extremes."*

Research on the psychometric properties of the AHS shows good internal consistency ($\alpha$ = .80; Choi et al., 2007). Convergent validity was assessed by calculating correlations for the AHS, Attributional Complexity Scale (ACS; $r = .22$, $p < .01$), the Sternberg-Wagner Self-Assessment Inventory on the Global Style (SWSAI; $r = .34$, $p < .01$), and the Rahim Organizational Conflict Inventory-II (ROCI-II; $r = .28$, $p < .01$). Results indicate good convergent validity (Choi et al., 2007).

**Spontaneous Use of Imagery Scale (SUIS).** The SUIS is a 12-item measure used to assess individual differences in the degree to which people use mental imagery in daily life (Reisberg et al., 2003). Participants used a Likert-type scale to indicate the degree to which the item was appropriate for them with the scale ranging from 1 *(never appropriate)* to 5 *(completely appropriate).* Example items from the SUIS scale are: *"When going to a new place, I prefer directions that include detailed descriptions of landmarks (such as size, shape, and color of a gas station) in addition to their names"* and *"When I think about a series of errands I will do, I visualize the stores I will visit."*

Research on the psychometric qualities of the SUIS shows an acceptable internal consistency among items for an online sample ($\alpha$ = .72; Nelis et al., 2014). Convergent validity was assessed by calculating correlations for the SUIS, the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973), and the Questionnaire upon Mental Imagery (QMI; Sheehan, 1967). The authors report that the SUIS scores were inversely correlated with both the VVIQ ($r = -.35$, $p < .001$) and the QMI ($r = -.38$, $p < .001$).

**Mind Wandering Questionnaire (MWQ).** The MWQ is a 5-item measure used to assess trait levels of task-unrelated thought (Mrazek et al., 2013). Participants used a Likert-type scale ranging from 1 *(almost never)* to 6 *(almost always).* Example items from the MWQ scale are: *"I have difficulty maintaining focus on simple or repetitive work"* and *"I do things without paying full attention"*.

Research on the psychometric qualities of the MWQ shows good internal consistency among items ($\alpha$ = .85; Mrazek et al., 2013), as well as good discriminant validity with the operation span task (OSPAN), ($r$ = -0.283, $p$ = .013; (Mrazek et al., 2013), and working memory capacity (Kane et al., 2007).

**Spontaneous and Deliberate Mind-Wandering Scales (SDMWS).** The SDMWS is an 8-item measure used to assess trait levels of deliberate and spontaneous mind-wandering (Carriere et al., 2013). Participants used a Likert-type scale ranging from 1 *(never)* to 7 *(always).* Example items from the SDMWS are: *"I allow my thoughts to wander on purpose"* and *"I mind wander even when I'm supposed to be doing something else."*

Research on the psychometric properties for the SDMWS shows good internal consistency for the deliberate ($\alpha$ = .86) and the spontaneous items ($\alpha$ = .81; Marcusson-Clavertz & Kjell, 2019). The spontaneous MW subscale shows good convergent validity with the Poor attentional control style on the Short Imaginal Processes Inventory (SIPI), $r$ = .68, $p$ < .001 (Huba et al., 1982). The deliberate MW subscale shows a strong correlation with the Positive-constructive daydreaming style of the SIPI ($r$ = .54, $p$ < .001).

**Ecological Momentary Assessment**

**Episodic future thinking condition (EFT).** In the EFT condition, participants were instructed to type 6-8 sentences about a future-oriented personal event that might occur in the

next 24 hours, 1 week, 1 month, 1 year, and 5 years (depending on the prompt). Participants were told that the event could involve just themselves, or it could include family and/or friends. Participants were also told that the event can be of an actual anticipated future occasion or an imaginary event. Participants were provided with the following prompts to help them generate their episodic future events: *1) What will you be doing? 2) Where will you be? 3) How will you be feeling? 4) What will you be seeing?*

**Episodic recent thinking condition (ERT).** In the ERT condition, participants were instructed to type 6-8 sentences about a personal event that had occurred in the past 24 hours, 1 week, 1 month, 1 year, and 5 years (depending on the prompt). They were told the event could involve just themselves, or they could include family and/or friends. Participants were provided with the following prompts to help them generate their episodic recent events*: 1) What were you doing? 2) Where were you? 3) How were you feeling? 4) What were you seeing?* In both conditions it was emphasized that the events should not involve any discussion about smoking.

**Mental imagery.** Mental imagery was assessed at every prompt after participants wrote their EFT or ERT event. The mental imagery question was: "*Right now, to what degree do your thoughts come with clear or vivid mental imagery?*" The options ranged from 0 *(clear)* to 100 *(vivid)*.

**Mind-wandering.** Mind-wandering was assessed with two questions at every prompt after participants wrote their EFT or ERT event. The first MW question was: "*Right now, how deliberate (under voluntary control) versus spontaneous (thoughts just popped into your head) are your thoughts*?" The options for this question were 0 *(spontaneous)* to 100 *(deliberate)*. The second question was given directly after the first MW question and was: "*Right now, to what*

*degree are you experiencing mind-wandering and daydreams that are unrelated to what you are doing*?" The options for this question ranged from 0 *(a little)* to 100 *(a lot)*.

**Craving.** Craving was assessed at every prompt after participants wrote their EFT or ERT event, and after the mind-wandering and mental imagery questions. This option ranged from 0 (*no craving*) to 100 (*extreme craving*) and is: "*Right now, my craving to smoke is*…"

**Motivation to quit smoking.** The motivation to quit smoking was assessed at every prompt through three questions after participants wrote their EFT or ERT event, and after the mental imagery, mind-wandering, and craving questions. They were: (1) Right now, I want to quit smoking, (2) Right now, I wish I wasn't a smoker, and (3) Right now, I am willing to do whatever it takes to quit smoking. For each question, the options ranged from 1 (*strongly disagree)* to 7 *(strongly agree)*.

**Situational stress.** Stress was assessed at the end of every prompt through one question: *"Have you experienced a significant stressor in the last 15 minutes?"* The options were either no *(0)* or yes *(1)*.

**Procedure**

After meeting inclusion criteria, participants were randomly assigned to either the EFT or the ERT condition. Orientation to the LifeData mobile application was done over the phone, and verbal informed consent was obtained at the beginning of the phone conversation. To ensure that prospective participants were smokers, participants were asked to send a picture of themselves with their cigarettes to the email account associated with the study. Participants were instructed to complete a Qualtrics questionnaire within 3 days of the phone conversation on their own time outside of the laboratory. The Qualtrics questionnaire included the individual differences measures used in the current study, demographics, and several other measures not used in the

current study (See Appendix 2 for the full list of measures). They were instructed to complete the questionnaire within one hour of starting it. See Figure 2 for the visual representation of the study design.

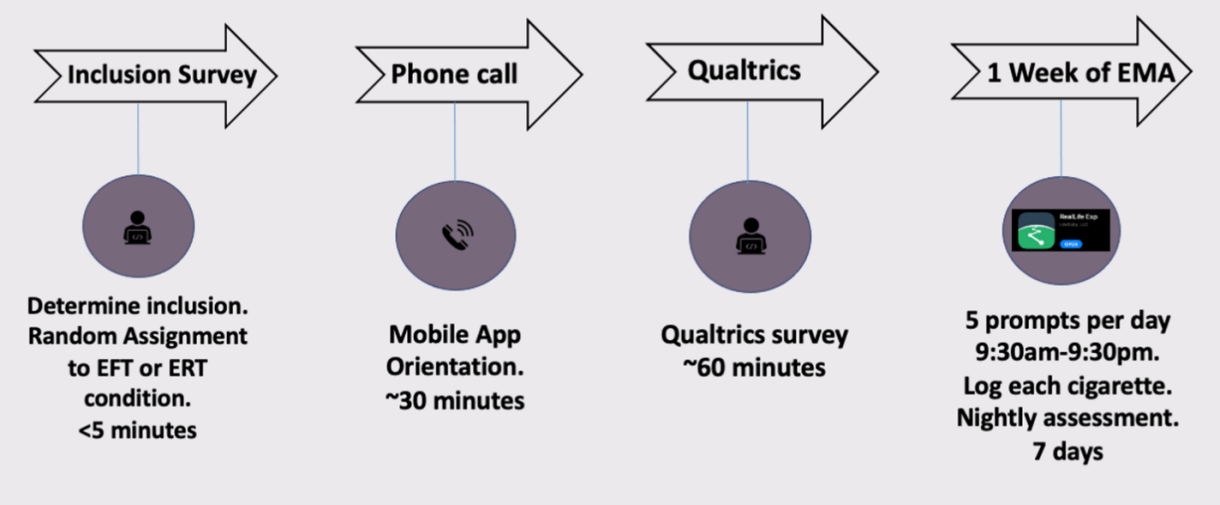


**Figure 2.** Study design by chronological order.

Following completion of the questionnaire, participants completed the EMA portion of the study for one week. During the week of EMA, five notifications were sent per day, between 9:30am and 9:30pm, at random times, but with at least 45 minutes between notifications. Participants had 20 minutes to respond to a prompt if they missed the initial notification (in line with reporting guidelines for EMA studies; Stone & Shiffman, 2002). Participants were instructed to write about events from five mental time periods (24 hours, 1 day, 1 week, 1 month, 5 years) each day. Each mental time event was only given once per day in pseudo-random order. Following the writing prompt, participants answered questions about their momentary mental imagery, mind-wandering, craving, the motivation to quit smoking, and stress levels (See Appendix 3 for the full list of EMA questions).

## Data Analytic Strategy

Because there are repeated assessments nested within individuals, multilevel modeling was used to examine the data. This was accomplished with eight multilevel models: (1) EFT vs. ERT predicting the motivation to quit smoking, (2) the interaction between EFT and ERT and individual differences in holistic thinking predicting the motivation to quit smoking, (3) the interaction between EFT and ERT and individual differences in mental imagery predicting the motivation to quit smoking, (4) the interaction between EFT and ERT and daily momentary mental imagery predicting the motivation to quit smoking, (5) the interaction between EFT and daily person average mental imagery predicting the motivation to quit smoking, (6) the interaction between EFT and ERT and individual differences in mind-wandering predicting the motivation to quit smoking, (7) the interaction between EFT and ERT and daily momentary mind-wandering predicting the motivation to quit smoking, and (8) the interaction between EFT and daily person average mind-wandering predicting the motivation to quit smoking. Both the dependent and independent variables are not separated into each of the five time period events for the current analysis, but are aggregated into an overall total score. Mental imagery and mind-wandering daily variables were centered in two different ways: person mean centering and person average centering. Person mean centering captures momentary states by showing how much an individual differs from their own average (within-person) and person average centering captures individual differences (between-person). The scores for the individual differences in holistic thinking, mental imagery, and mind-wandering were grand-mean centered. I controlled for day of the study, daily craving, and situational stress. For the models with individual differences measures, the predictors, EFT (vs. ERT) manipulation, holistic thinking, mind-wandering, mental imagery, day of the study, craving, and situational stress were entered as fixed

effects. Person mean centered mind-wandering and mental imagery variables were included as random slopes for the momentary models.

## Results

All statistical analyses were carried out in SPSS Version 27 and R Studio (R Core Team, 2021). The condition variable is coded so that the ERT condition is the reference group and there are 2577 total observations for each model. This study uses a $p < .05$ threshold for statistical significance. The situational stress variable is a dichotomous variable coded so that *"no"* is the reference group.

An intercept only model was tested to determine the amount of variation that exists at the within- and between-person levels. The model only consisted of the dependent variable (the motivation to quit smoking) and the grouping variable (participant ID). No predictors were entered. From the intercept only model, the Intraclass Correlation Coefficient (ICC) for the motivation to quit smoking was calculated, which indicated that 83% of the total variance is attributable to between-person variation, whereas 17% is attributable to within-person variation.

Zero-order correlations are reported in Table 1. Between-person correlations are reported below the diagonal while within-person correlations are reported above the diagonal. At the within-person levels, greater motivation to quit smoking was significantly associated with greater levels of daily mental imagery and lower levels of daily craving. Additionally, greater levels of daily mental imagery were significantly associated with increased daily mind-wandering. At the between-person levels, greater motivation to quit smoking was significantly associated with more frequent deliberate daily mind wandering and lower levels of daily cravings. Greater daily cravings were also significantly associated with more daily mind-wandering and increased levels of individual differences in mental imagery. Greater levels of individual differences in mental

imagery were also significantly associated with individual differences in deliberate and spontaneous forms of mind-wandering. And finally, holistic thinking was significantly associated with greater daily deliberate mind-wandering and with greater individual differences in mental imagery.

*Table 1.* Between person and within person correlations among daily and individual differences variables.

| | | *M* (SE) | Min | Max | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Motivation to quit | 4.48 (1.60) | 1 | 7 | -- | 0.04* | .03 | .01 | -0.24*** | n/a | n/a | n/a | n/a |
| 2. | Daily mental imagery | 56.54 (19.31) | 2.42 | 98.18 | .13 | -- | 0.14*** | -.02 | .03 | n/a | n/a | n/a | n/a |
| 3. | Daily mind-wandering | 33.01 (17.79) | 0 | 77.27 | -.09 | .11 | -- | -0.4*** | .03 | n/a | n/a | n/a | n/a |
| 4. | Daily deliberate mind-wandering | 60.79 (15.07) | 13.64 | 97.88 | 0.22* | .06 | -0.76*** | -- | .00 | n/a | n/a | n/a | n/a |
| 5. | Daily craving | 49.57 (15.92) | 4.44 | 81.67 | -0.2* | .18 | 0.24* | -.15 | -- | | | | |
| 6. | Holistic thinking (AHS) | 4.95 (.48) | 3.88 | 6.25 | .04 | .06 | -.11 | 0.2* | -.02 | -- | n/a | n/a | n/a |
| 7. | Mental imagery (SUIS) | 43.33 (7.71) | 27 | 60 | .12 | 0.26** | .10 | .05 | 0.29** | 0.2* | -- | n/a | n/a |
| 8. | Mind-wandering (MWQ) | 3.31 (1.12) | 1 | 6 | -.09 | -.11 | 0.36*** | -0.36*** | .04 | -.15 | .16 | -- | n/a |
| 9. | Deliberate mind-wandering (SDMWS) | 3.62 (1.15) | 1 | 6.5 | -.05 | .05 | .18 | -.09 | .01 | .02 | 0.2* | 0.28** | -- |
| 10. | Spontaneous mind-wandering (SDMWS) | 3.81 (1.3) | 1 | 6.75 | -.08 | .04 | 0.29** | -.19 | .11 | -.01 | 0.29** | 0.68*** | 0.42*** |

*$p < .05$, **$p < .01$, ***$p < .001$

*Note*. Between-person correlations are below the diagonal, and within-person correlations are above the diagonal. AHS = Analysis-Holism Scale; SUIS = Spontaneous Use of Imagery Scale; MWQ = Mind Wandering Questionnaire; SDWMW = Spontaneous and Deliberate Mind-Wandering Scale.

**Episodic Future Thinking vs. Episodic Recent Thinking**

The first multilevel model evaluated if thinking about future events (vs. past events) predicted the motivation to quit smoking. Given that repeated engagement in EFT has shown to improve the ability to carry out tasks over time (i.e., prospective memory; Neroni et al., 2014), the interaction between the EFT (vs. ERT) condition and the day of the study were also entered as a predictor. There was no significant effect of the episodic future thinking (vs. episodic recent thinking) condition on the motivation to quit smoking ($\hat{\beta} = -.377, p = .208$). There was no significant interaction between the EFT (vs. ERT) condition and the day of the study variable on the motivation to quit smoking ($\hat{\beta} = -.004, p = .729$). The effect remained non-significant when controlling for situational stress (in Table 2).

*Table 2.* EFT vs. ERT predicting the motivation to quit smoking.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | EFT condition | -.363 (.300) | -1.22 | .224 |
| | EFT condition x Day of study | -.009 (.013) | -.71 | .476 |
| | Day of Study | .051 (.009) | 5.37 | < .001 |
| | Stress | -361 (.049) | -7.42 | < .001 |

**Holistic Thinking**

The second model tested the interaction between the EFT and ERT condition and holistic thinking. There was no significant interaction between the EFT condition and holistic thinking on the motivation to quit smoking ($\hat{\beta} = .035, p = .245$). The effects remained non-significant after controlling for the day of the study and situational stress (Table 3).

*Table 3.* The interaction between EFT and ERT and holistic cognition.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -0.413 (.299) | -1.38 | .170 |
| | EFT condition x AHS | .037 (.03) | 1.23 | .221 |
| | AHS | -0.02 (.02) | -.98 | .331 |
| | Day of study | .046 (.007) | 6.90 | < .001 |
| | Stress | -.359 (.049) | -7.41 | < .001 |

**Mental Imagery**

The next three models investigated the interaction between EFT and ERT and individual differences in mental imagery as measured by the Spontaneous Use of Imagery Scale (SUIS), the interaction between EFT and ERT and momentary mental imagery, and the interaction between EFT and ERT and person average mental imagery. There was no significant interaction between the EFT condition and the SUIS on the motivation to quit smoking ($\widehat{\beta} = -.002, p = .969$). There was no significant interaction between the EFT condition and momentary mental imagery on the motivation to quit smoking ($\widehat{\beta} = .012, p = .305$). There was no significant interaction between the EFT condition and person average mental imagery on the motivation to quit smoking ($\widehat{\beta} = .206, p = .185$). The effects remained non-significant after controlling for craving, day of the study, and situational stress (Tables 4-6).

*Table 4.* The interaction between EFT and ERT and individual differences in mental imagery.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -.288 (.294) | -.98 | .330 |
| | EFT condition x SUIS | -.006 (.039) | -.15 | .884 |
| | SUIS | .036 (.030) | 1.18 | .241 |
| | Average craving | -.012 (.01) | -2.32 | .027 |
| | Day of study | .046 (.007) | 6.90 | < .001 |
| | Stress | -.351 (.049) | -7.23 | < .001 |

*Note.* SUIS = Spontaneous Use of Imagery Scale.

*Table 5.* The interaction between EFT and ERT and momentary mental imagery.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -.399 (.292) | -1.36 | .176 |
| | EFT condition x Momentary mental imagery | .018 (.018) | 1.01 | .316 |
| | Momentary mental imagery | .004 (.012) | .32 | .751 |
| | Day of study | .046 (.007) | 6.87 | < .001 |
| | Stress | -.357 (.018) | -7.44 | < .001 |

*Table 6.* The interaction between EFT and ERT and person average mental imagery.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -1.581 (1.044) | -1.51 | .133 |
| | EFT condition x Average mental imagery | .194 (.151) | 1.29 | .201 |
| | Average mental imagery | .032 (.106) | .30 | .766 |
| | Day of study | .046 (.007) | 6.90 | < .001 |
| | Stress | -.359 (.049) | -7.39 | < .001 |
| | Average craving | -.011 (.005) | -2.03 | .045 |

**Mind-Wandering**

The final three models investigated the interaction between EFT and ERT and individual differences in mind-wandering as measured by the Mind Wandering Questionnaire (MWQ), the interaction between EFT and ERT and momentary mind-wandering, and the interaction between EFT and ERT and person average mind-wandering. There was no significant interaction between the EFT condition and the MWQ on the motivation to quit smoking ($\widehat{\beta} = -.081, p = .134$). There was no significant interaction between the EFT condition and momentary mind-wandering on the motivation to quit smoking ($\widehat{\beta} = -.007, p = .680$). There was no significant interaction between the EFT condition and person average mind-wandering on the motivation to quit smoking ($\widehat{\beta} = .167, p = .321$). The effects remained non-significant after controlling for the day of the study and situational stress (Tables 7-9).

*Table 7.* The interaction between EFT and ERT and individual differences in mind-wandering.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -.410 (.293) | -1.39 | .165 |
| | EFT condition x MWQ | -.080 (.053) | -1.50 | .138 |
| | MWQ | -.001 (.036) | -.03 | .980 |
| | Day of study | .046 (.007) | 6.90 | < .001 |
| | Stress | -.352 (.049) | -7.24 | < .001 |

*Note.* MWQ = Mind Wandering Questionnaire.

*Table 8.* The interaction between EFT and ERT and momentary mind-wandering.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -.399 (.292) | -1.36 | .176 |
| | EFT condition x Momentary mind-wandering | -.010 (.018) | -.55 | .581 |
| | Momentary mind-wandering | .009 (.012) | .75 | .454 |
| | Day of study | .047 (.007) | 7.03 | < .001 |
| | Stress | -.354 (.048) | -7.35 | < .001 |

*Table 9.* The interaction between EFT and ERT and person average mind-wandering.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -1.032 (.775) | -1.33 | .186 |
| | EFT condition x Average mind-wandering | .155 (.167) | .93 | .355 |
| | Average mind-wandering | -.169 (.115) | -1.47 | .146 |
| | Day of study | .046 (.007) | 6.88 | < .001 |
| | Stress | -.358 (.049) | -7.39 | < .001 |

**Exploratory Mind-Wandering Results**

The Spontaneous and Deliberate Mind Wandering Scale (SDMWS) consists of two separate factors: Deliberate and spontaneous mind wandering. Daily EMA questions also contained questions specific to deliberate and spontaneous mind-wandering. After grand-mean centering the SDMWS and centering the daily deliberate/spontaneous variable into momentary and person average variables, exploratory analyses were thus conducted to examine: (1) The

interaction between EFT and ERT and individual differences in deliberate mind-wandering as measured by the (SDMWS), (2) the interaction between EFT and ERT and individual differences in spontaneous mind-wandering as measured by the SDWMS, the interaction between EFT and ERT and momentary deliberate and spontaneous mind-wandering, and the interaction between EFT and ERT and person average deliberate and spontaneous mind-wandering. There was no significant interaction between the EFT condition and deliberate mind-wandering on the SDWMS on the motivation to quit smoking ($\widehat{\beta} = -.117, p = .089$). There was no significant interaction between the EFT condition and spontaneous mind-wandering on the SDWMS on the motivation to quit smoking ($\widehat{\beta} = -.077, p = .193$). There was no significant interaction between the EFT condition and momentary deliberate/spontaneous mind-wandering on the motivation to quit ($\widehat{\beta} = -.001, p = .943$). There was no significant interaction between EFT and person average deliberate/spontaneous mind-wandering on the motivation to quit smoking ($\widehat{\beta} = -.227 = , p = .244$). However, there was a significant effect of person average deliberate/spontaneous mind-wandering on the motivation to quit smoking ($\widehat{\beta} = .353 = , p = .012$). Craving, day of the study, and situational stress were added to the EFT and ERT and deliberate MW model (Table 10). Day of the study and situational stress were added to the EFT and ERT and spontaneous MW model (Table 11), to the EFT and ERT and momentary deliberate/spontaneous MW model (Table 12), and to the EFT and ERT and person average deliberate/spontaneous MW model (Table 13).

*Table 10.* The interaction between EFT and ERT and individual differences in deliberate mind-wandering.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -.403 (.294) | -1.37 | .174 |
| | EFT condition x Deliberate MW | -.129 (.067) | -1.93 | .057 |
| | Deliberate MW | .028 (.041) | .69 | .494 |
| | Average craving | -.011 (.005) | -2.04 | .044 |
| | Day of study | .046 (.007) | 6.89 | < .001 |
| | Stress | -.351 (.049) | -7.23 | < .001 |

*Note.* Deliberate mind-wandering was assessed using the deliberate sub-factor of the Spontaneous and Deliberate Mind Wandering Scale (SDMWS).

*Table 11.* The interaction between EFT and ERT and individual differences in spontaneous mind-wandering.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -.411 (.295) | -1.39 | .166 |
| | EFT condition x Spontaneous MW | -.076 (.059) | -1.30 | .196 |
| | Spontaneous MW | .003 (.042) | .07 | .943 |
| | Day of study | .046 (.007) | 6.90 | < .001 |
| | Stress | -.352 (.049) | -7.24 | < .001 |

*Note.* Spontaneous mind-wandering was assessed using the spontaneous sub-factor of the Spontaneous and Deliberate Mind Wandering Scale (SDMWS).

*Table 12.* The interaction between EFT and ERT and momentary deliberate/spontaneous mind-wandering.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | -.398 (.292) | -1.36 | .176 |
| | EFT condition x Momentary Deliberate/Spontaneous MW | .009 (.017) | .53 | .597 |
| | Momentary Deliberate/Spontaneous MW | -.003 (.012) | -.26 | .795 |
| | Day of study | .046 (.007) | 6.84 | < .001 |
| | Stress | -.338 (.048) | -7.02 | < .001 |

*Note.* Momentary MW was measured with the question*:* "*Right now, how deliberate (under voluntary control) versus spontaneous (thoughts just popped into your head) are your thoughts*?"

*Table 13.* The interaction between EFT and ERT and person average deliberate/spontaneous mind-wandering.

| Outcome | Predictors | B(*SE*) | *t* | *p* |
|---|---|---|---|---|
| Motivation to quit smoking | Condition EFT | 1.207 (1.398) | .86 | .390 |
| | EFT condition x Average Deliberate/Spontaneous MW | -.212 (.193) | -1.10 | .275 |
| | Average Deliberate/Spontaneous MW | .334 (.137) | 2.43 | .017 |
| | Day of study | .046 (.007) | 6.86 | < .001 |
| | Stress | -.358 (.049) | -7.38 | < .001 |

*Note.* Person average MW was measured with the question*:* "*Right now, how deliberate (under voluntary control) versus spontaneous (thoughts just popped into your head) are your thoughts*?"

## Discussion

This study examined the role of episodic future thinking in the motivation to quit smoking using ecological momentary assessment. Thinking about the future to reduce the motivation to smoke has been examined solely in the laboratory or with retrospective nightly reporting (Chiou & Wu, 2017; Stein et al., 2016), but to my knowledge it has not been examined in the real world, where the urge to smoke might be influenced by contextual factors. Based on the studies showing that EFT reduced cigarette consumption in the lab, and because EFT was shown to reduce other addiction-related substances such as alcohol (Snider et al., 2016), confirming the ecological validity of EFT was the next logical step.

In the present study, participants completed several questionnaires examining individual differences in holistic thinking, mental imagery, and mind-wandering. They were also randomly assigned to an EFT or an ERT condition, and took part in one week of EMA where they wrote about their personal future or past (depending on the condition they were assigned to) and answered follow-up questions about mental imagery, mind-wandering, craving, stress, and the motivation to quit smoking. I hypothesized that participants randomly assigned to the EFT (vs.

ERT) group would report greater motivation to quit smoking. Results indicated that participants assigned to the EFT condition did not show higher motivation to quit smoking compared to the participants assigned to the ERT condition. Previous laboratory studies investigating smoking behavior and episodic future thinking have shown that thinking about the future impacts nicotine intake. For example, in one study participants created audio cues and abbreviated summaries of their EFT and ERT events (depending on condition assignment) and were then presented the summaries and audio cues during a 60-minute cigarette self-administration task where they could choose to smoke as little or as much as they wanted (Stein et al., 2016). The authors found that participants randomly assigned to the EFT group chose to take significantly fewer cigarette puffs than the individuals in the ERT group. In the current study, participants were randomly asked five times per day for seven days to write 6-8 sentences about their EFT or ERT events without being presented with summaries or audios to remind them of their future or past events, which may have been a disadvantage in the current study. In another study investigating the efficacy of EFT (vs. semantic future thinking and control) on cigarette smoking intake, it was found that thinking about positive life events one year into the future led to fewer smoked cigarettes during the final in-lab questionnaire (compared to the semantic and control conditions; Chiou & Wu, 2017). Following the laboratory manipulation, participants were also asked to retrospectively record their daily cigarette intake every evening for a week. The authors found that participants randomly assigned to the EFT condition (compared to the semantic and control conditions) reported smoking fewer cigarettes. In the current study participants were asked to think of a future-oriented event that might occur, while in the Chiou and Wu study participants were asked to think about their event "if you successfully quit smoking now." Chiou and Wu (2017) provided participants with a distinct goal involving a future non-smoking self (i.e., envisioning

the self after *successfully* quitting smoking), which might have artificially enhanced an episodic future thinking event because EFT is already thought to be involved in or to be related to goal attainment (Schacter et al., 2017; Szpunar, 2010). Both of the above described studies were either completed in the laboratory or included a retrospective reporting aspect. The primary reason for using EMA is to examine real-time responses as people go about their daily lives and the atmosphere of laboratory experiments could have a differential impact on the same psychological construct.

Although the first hypothesis was not supported, results further showed that there was a significant correlation between the motivation to quit smoking and daily deliberate mind-wandering. Regardless of the condition, people who reported greater daily deliberate mind-wandering reported the greatest motivation to quit smoking. Additionally, greater daily mind-wandering (not deliberate MW) was associated with greater craving. The significance of the mind-wandering association adds interesting information to already existing literature on cigarette smoking behavior. Previous laboratory research investigating body scanning and mind-wandering in relation to cigarette craving found that body scanning decreased craving while mind-wandering thoughts increased craving both in the body scanning condition and in the mind-wandering condition (May et al., 2012). It appears that daily mind-wandering may be increasing craving, while the deliberate form of mind-wandering helps to increase the motivation to quit smoking. The way the dependent variable is conceptualized may also be important. In the past literature the dependent variable is represented by one's craving for smoking, but the current study's dependent variable is comprised of one's motivation to quit smoking. The motivation to quit smoking in the current study might be related to deliberate mind-wandering through personal goal processing, especially considering that past mind-wandering literature has made a

positive association between goal processing and mind-wandering (Stawarczyk & D'Argembeau, 2015). By contrast, general mind-wandering in the above discussed literature might increase craving because the urge to smoke exploits biological processes related to addiction, which increases thoughts about satisfying the need to smoke (which could be related to or defined as mind-wandering).

Previous literature points to a positive association between the use of mental imagery and reductions in cigarette smoking behavior. For example, one study investigated the effect of abstention from smoking (also called the deprived group), and auditory and visual mental imagery on craving. Results indicated that the individuals in the group that abstained from smoking cigarettes the previous day who also engaged in the neutral mental imagery task (vs. an urge induction imagery task) reported reduced craving for cigarettes (vs. the non-deprived group and the auditory group; May et al., 2010). Future work might investigate the role of mental imagery in the length of abstention from cigarette smoking using EMA.

This study also investigated three individual difference variables (holistic thinking, mental imagery, and mind-wandering) and two daily EMA variables (mental imagery and mind-wandering) as a function of EFT in the motivation to quit smoking. I hypothesized interactions between the manipulation (EFT vs. ERT) and individual differences constructs, and between the manipulation (EFT vs. ERT) and daily EMA variables. I hypothesized that individuals randomly assigned to the EFT condition who reported holistic thinking tendencies would report greater motivation to quit smoking. This interaction was not significant. To my knowledge there is no literature investigating the interaction between EFT and holistic thinking tendencies, however there is literature investigating the role of change and prediction of future behavior in holistic thinking styles. For example, people who think holistically tend to view relationships to objects

as constantly changing and in flux whereas analytic thinkers tend to view relationships to objects as stable and linear (Choi et al., 2007). Viewing the properties of objects in constant change in holistic thinking reflects a potential to see and/or engage in change from day to day (Ferris et al., 2018). On the flip side, viewing the properties of objects as stable and linear in analytic thinking characterizes the changelessness of the properties of objects and the relationship to those objects on a daily basis. The current study only assessed holistic thinking as an individual difference variable. However, it might be more beneficial to investigate holistic thinking tendency momentarily during EMA because of the ever-changing relationship to the properties of objects in holistic thinking. Future research should investigate the value of incorporating holistic thinking into a daily EMA variable in the context of smoking and future thinking.

I also hypothesized that individuals randomly assigned to the EFT condition who reported greater mental imagery would report greater motivation to quit smoking. This hypothesis was for mental imagery as an individual difference variable and for a daily EMA variable. These interactions were not significant. The constructive episodic simulation hypothesis proposes that mental time travel relies on the episodic memory system, but a reconceptualization of this hypothesis suggests that memory and imagination are both by-products of a simulation system (Addis, 2018; Addis, 2020). Understanding this new hypothesis, now called the domain-general simulation system, may be especially important for understanding why the interaction between the EFT condition and mental imagery was not significant. The domain-general simulation system attests that memories and imagination are simulated in much the same way—previously existing knowledge and schematic content are used to construct both the past and the future, however the strength of integrating past memories and recombining future memories vary based on previously associated details. In other words, constructing past and future events is an

associative process by which previous knowledge and schemas build upon each other to provide stronger associations. Based on this framework, past events will most likely have greater associations than future events (Addis, 2020). In the current study participants were asked to remember the past or to think about the future, but to refrain from thinking about anything smoking-related. Both conditions initiated the same constructive process, but the past condition may have yielded a slight advantage over the future condition due to the likelihood of past events featuring stronger associations among details. Future research investigating the effectiveness of EFT on smoking cessation might explore the associative strength of past and future events by centering participant's mental travel on a smoking detail.

Finally, I hypothesized that individuals randomly assigned to the EFT condition who reported greater mind-wandering would report greater motivation to quit smoking. This hypothesis was for mind-wandering as an individual difference variable and for a daily EMA variable. These hypotheses were not supported. There may be several factors associated with mind-wandering that could influence the current findings. One of those factors is that mind-wandering can be differentiated between deliberate and spontaneous forms (Carriere et al., 2013). This led to examining four exploratory models that investigated the interaction between the manipulation (EFT vs. ERT) and individual differences in deliberate and spontaneous MW (models 1 and 2), and the interaction between the manipulation (EFT vs. ERT) and momentary and deliberate MW (models 3 and 4) on the motivation to quit smoking. Because these were exploratory models, there were no specific hypotheses. All interactions were not significant, but person-average deliberate MW was found to significantly increase the motivation to quit smoking (See Table 13), suggesting that individuals who reported greater average levels of daily deliberate MW had the greatest motivation to quit smoking. Additionally, there was a marginal

trend towards significance for the interaction between the EFT condition and deliberate MW (See Table 10), suggesting that individuals who thought about the future and who reported higher levels of deliberate mind-wandering on the SDWMS also reported greater motivation to quit smoking. The SDWMS is an individual differences measure that assesses deliberate and spontaneous MW (Carriere et al., 2013). Mind-wandering has been shown to be oriented towards goal attainment and towards the future (Stawarczyk & D'Argembeau, 2015). Due to both of these factors, it seems likely that both daily and individual differences in deliberate mind-wandering and thinking about a future smoke-free self could overlap. Future work should investigate the complex marginal relationships found between future thinking with daily and individual differences in deliberate MW.

## General Limitations and Future Directions

There are a number of limitations to the present study. The first major limitation concerns the levels of within- and between-group variation found in the dependent variable—the motivation to quit smoking. Between- and within-group variation can be found by calculating the intraclass correlation coefficient (ICC). The ICC is a percentage of the total variance in *Y* that is attributed to between subjects and has values ranging between 0-1 (Bolger & Laurenceau, 2013). EMA studies typically have ICC values between .2-.4 and ICC values closer to 1 indicate greater between-subject variation. In the current study the motivation to quit smoking had an ICC value of .83, indicating that most of the variation was between subjects. Greater between subject variability in the outcome variable suggests that the motivation to quit smoking is somewhat stable between people over time. Another outcome variable that might be better suited to capture differences in smoking cessation within people is the urge to smoke, which can be operationalized as an individual's craving. Regularly smoking cigarettes has pharmacological

characteristics that induce craving and withdrawal symptoms roughly 2 hours after the last smoked cigarette (Miyata & Yanagita, 2001). Considering the affective and somatic issues induced through craving, greater variability in the urge to smoke (i.e., craving) might be more present on a moment-to-moment basis leading to greater understanding of future thinking as a cessation technique.

The second limitation is in regards to the EFT and ERT writing prompts. In the current study, participants were instructed to write 6-8 sentences about either an episodic past or future event. Participant's' responses have not yet been coded for episodic content, and it is possible that some responses are not fully episodic in nature. Examining participants' responses could also point to the need for a better control condition. Some mental time travel literature suggests the use of a control condition that captures semantic knowledge, rather than recent or past memories of oneself, so there is a control standard in the field (Hollis-Hansen et al., 2019). If the current study's prompts include more semantic detail than episodic detail, this might be a clue that an episodic recent thinking condition is not an appropriate control condition.

The third limitation is related to the delivery of protocol and communication with participants. All protocol and communication were delivered either by telephone or by email. Delivering protocol in this manner meant that there was no way to control for distractions in the participants' environments. This may have been particularly relevant during the orientation for the LifeData mobile application when participants were downloading and setting up the mobile application, and getting instructions for answering prompts. Even though researchers communicating with the participants were instructed to ask participants if they had any questions, it's not unreasonable to assume that participants missed study information both because of the distractions in their environments and because the study protocol was detailed. To

mitigate this issue, participants did receive a .pdf document of the study instructions which they could refer to at any time.

Finally, the fourth limitation is related to data collection during the Covid-19 pandemic. The majority of data collection was at the height of the pandemic when restrictions were in place, when community transmission was at an all-time high, and when covid deaths were at the highest over the course of the pandemic. Because of these factors, there may be unknown impacts on the production of future thinking, and processes related to mental time travel such as mind-wandering and mental imagery. Lalla and Sheldon (2021) evaluated the relationship between mental time travel and stress during the Covid-19 pandemic, and found that future events produce less specificity compared to past events (this is consistent with past literature prior to the pandemic; Anderson & Dewhurst, 2009), that perceived stress increased the cognitive demands of mental time travel overall, and that higher perceived stress led to less likelihood of engaging in their future personal events. The current study controlled for momentary situational stress, but there were no questions asking participants if they feel they engaged in thinking about the past or the future. Instructing participants to focus on mental time travel, especially in the real-world, is a cognitively demanding task and asking participants if they were fully focused on the task could be an easy way to assess participant engagement (similar to an attention check in surveys). Additionally, there may be consequences that impact future behavior if stressed people are less likely to simulate future time travel. For example, smokers may still engage in future ideation about quitting smoking, but because of the stress they are experiencing, they may not perform or implement actions related to quitting smoking. An additional concern is that the Covid-19 pandemic saturated individual's lives with uncertainty which could also mean that the psychological connection to our future selves was more tenuous

than it would normally be. A weakened connection between our present selves and a future self has shown to impact decision making (Bartels & Urminsky, 2011). Making a potentially uncomfortable decision (e.g., resisting the urge to smoke) in the present moment for a distal healthy reward has been shown to be difficult for people with addictions (Bickel et al., 2014), but when the connection between the present and the future self is weak, then resisting the urge to smoke can become even more difficult to manage.

Future directions include investigating an alternative dependent variable, such as craving, that has more within-person variation. Additionally, exploring the relationship between EFT and deliberate mind-wandering on the motivation to quit smoking has promise considering that daily deliberate MW significantly predicted the motivation to quit smoking, and that mind-wandering was significantly correlated with the motivation to quit smoking. Future research should investigate this relationship with more nuance, including investigation into the content of mind-wandering thoughts.

## Conclusion

This study is one of the few studies to investigate the role of episodic future thinking on the motivation to quit smoking using ecological momentary assessment. All of the models were not significant, however the relationships between daily deliberate MW, the motivation to quit smoking, and craving warrants future investigation. Additionally, other future directions related to the limitations include an investigation into a new dependent variable with greater within-person variation and a control condition that can be successfully compared to an episodic future thinking condition.

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# Appendices

Appendix 1

UNIVERSITY OF ARKANSAS

| | |
|---|---|
| **To:** | Darya L Zabelina<br>MEMH 311 |
| **From:** | Douglas J Adams, Chair<br>IRB Expedited Review |
| **Date:** | 05/10/2021 |
| **Action:** | **Expedited Approval** |
| **Action Date:** | 05/07/2021 |
| **Protocol #:** | 2006271492A005 |
| **Study Title:** | Thinking About Future Personally Relevant Events as a Way to Reduce Smoking Behavior: An Ecological Momentary Assessment Study |
| **Expiration Date:** | 07/23/2021 |
| **Last Approval Date:** | 05/07/2021 |

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Stephanie J Kane, Investigator

Appendix 2

- Alternate Uses Task (Guilford, 1967) [1 item]
- Analysis-Holism Scale (AHS; Choi et al., 2007) [24 items]
- Anxiety Sensitivity Index (ASI-3; Taylor et al., 2007) [18 items]
- Big 5 (Goldberg, 1992) [50 items]
- Brief Self-Control Scale (BSCS; Tangey, Baumeister, & Boone, 2004) [13 items]
- Challenges to Stopping Smoking (CSS-21; Thomas et al., 20160 [21 items]
- Contemplation Ladder (Biener & Abrams, 1991) [1 item]
- Emotion Regulation Scale (EmotRS; Gross & John, 2003) [10 items]
- Fagerstrom Test of Nicotine Dependence (FTND; Heatherton et al., 1991) [6 items]
- Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) [39 items]
- Four Factor Imagination Scale (FFIS; Zabelina & Condon, 2019) [26 items]
- Implicit Theories Scales [20 items]
- Intolerance for Smoking Abstinence Discomfort (IDQ-S; Sirota et al., 2010) [17 items]
- Mind Wandering Questionnaire (MWQ; Mrazek et al., 2013) [5 items]
- Spontaneous and Deliberate Mind Wandering Scales (SDMWS; Seli, Carriere, Levene, & Smilek, 2013) [8 items]
- Minnesota Nicotine Withdrawal Scale—Revised (MNWSR; Hughes & Hatsukami, 2008) [15 items]
- Motivation to Stop Scale (MTSS; Kotz et al., 2013) [1 item]
- Relapse Situation Efficacy Questionnaire (RSEQ; Gwaltney et al., 2011) [43 items]
- Rumination & Reflection (RumRS; Trapnell & Campbell, 1999) [24 items]
- Questionnaire of Smoking Urges—Brief (QSU-B; Cox et al., 2001) [10 items]

- Scale of Positive and Negative Experience (SPANE; Diener et al., 2010) [12 items]
- Self-Construal Scale (SCS; Singelis, 1994) [26 items]
- Smoking Abstinence Expectancies Questionnaire (SAEQ; Abrams et al., 2011) [28 items]
- Stages of Change and Treatment Readiness Scale (SOCRATES; Miller & Tonigan, 1996) [19 items]
- Short UPPS-P (Cyders et al. 2014) [20 items]
- Spontaneous Use of Imagery Scale (SUIS; Reisberg, Pearson, & Kosslyn, 2003) [12 items]
- Temporal Experience of Pleasure Scale (Gard et al, 2006) [18 items]
- Thought Control Ability Questionnaire (TCAQ; Luciano et al., 2005) [25 items]
- Willpower (Job, Dweck, & Walton, 2010) [12 items]
- White Bear Thought Suppression (WBTS; Wegner & Zanakos, 1994) [15 items]
- White Bear Suppression Inventory – Smoking (WBSI-Smk; Nosen & Woody, 2013) [10 items]
- Wisconsin Inventory of Smoking Dependence Motives (WISDM; Piper et al., 2004) [68 items]
- Demographic questions

Appendix 3

Unique ID: Welcome to the MoCA Lab smoking study! You were given a unique ID number during your phone call with the MoCA lab. Please enter that number here.

Instructions: Over the next week, you will be asked to write 6-8 sentences and answer several additional questions each time you receive a notification (5 times each day). Click OK to see an example of what this will look like.

Example Prompt: In 6-8 sentences please describe your current surroundings.
"What do you see?"
"Where are you?"
"How are you feeling?"

Cig Log Instructions: In addition to answering 5 notifications that we send you each day, we would like you to let us know each time you smoke a cigarette, even if it is just one puff. To do this, every time you smoke, please open this app and click on the notification with the "1" on it. Here you will log the time you started smoking and will be asked some follow-up questions.

Thank you! You will begin getting notifications on this app on the 4th day after you speak with the MoCA lab member. You will get 5 notifications each day for 7 days. If you cannot respond to a notification right away, you will have 20 minutes from the time of the original notification to respond. Thank you for your participation!

## **EMA Daily Notifications** (NIS: Notification-Initiated Session)

*Participants are randomly assigned either to the EFT or the ERT condition. If they are assigned to the EFT condition then they will receive the "EFT prompt" below, and if they are assigned to the ERT condition then they will receive the "ERT prompt" below. In both conditions the same 31 questions follow the initial EFT/ERT prompt question. The questions below are written out in the order in which they are given in LifeData.

*EFT prompt*
Write out an event that could happen in the NEXT 24 HOURS*. This event can involve an actual anticipated future occasion, or it can be something you can potentially see yourself doing. The event should not involve any discussion about smoking. Please use 6-8 sentences to describe this event. Here are some prompts to help you get started:

"What will you be doing?"
"Where will you be?"
"How will you be feeling?"
"What will you be seeing?"

*24 HOURS, ONE WEEK, ONE MONTH, ONE YEAR, FIVE YEARS

*ERT prompt*
Write out an event that has happened in the LAST 24 HOURS*. The event should not involve any discussion about smoking. Please use 6-8 sentences to describe this event. Here are some prompts to help you get started:

"What were you doing?"
"Where were you?"
"How were you feeling?"
"What did you see?"

*24 HOURS, ONE WEEK, ONE MONTH, ONE YEAR, FIVE YEARS

*Questions after EFT or ERT prompts*

How important is this event to you?
*0 (Not important at all) to 100 (very important)*
How positive is this event?
*0 (Not at all positive) to 100 (Very positive)*
How negative is this event?
*0 (Not at all negative) to 100 (Very negative)*
How vivid was this event in your mind's eye?
*0 (Not vivid at all) to 100 (Very vivid)*
How many cigarettes have you smoked since the last message?

*Mind-wandering:*

Right now, how positive are your thoughts?
*0 (not at all positive) to 100 (very positive)*
Right now, how negative are your thoughts?
*0 (not at all negative) to 100 (very negative)*
Right now, is your attention mostly directed OUTWARDS (towards aspects of the external environment) or INWARDS (towards your thoughts, feelings, and/or bodily sensations)?
*0 (outwards or 100 (inwards)*
Right now, how deliberate (under your voluntary control) versus spontaneous (thoughts just popped into your head) are your thoughts?
*0 (spontaneous) to 100 (deliberate)*
Right now, to what degree are you experiencing mind-wandering and daydreams that are unrelated to what you are doing?
*0 (a little) to 100 (a lot)*

*Mental Imagery*

Right now, to what degree do your thoughts come with clear or vivid mental imagery?
0 (clear) to 100 (vivid)

*Emotion*:

Right now, I feel ____?

a. Joyful
b. Delighted
c. Calm
d. Relaxed
e. Nervous
f. Angry
g. Sad

Response choices:
0 = not at all
1 = minimally
2 = slightly
3 = somewhat
4 = moderately
5 = very much
6 = extremely

h. Irritated

*Craving*:

Right now, my craving to smoke is: 0 (no craving) to 100 (extreme craving)

Motivation

1 = strongly disagree
2 = moderately disagree
3 = mildly disagree
4 = agree and disagree equally
5 = mildly agree
6 = moderately agree
7= strongly agree

Right now, I want to quit smoking.
Right now, I wish I wasn't a smoker
Right now, I am willing to do whatever it takes to quit smoking.

Situation/context

| | | | |
|---|---|---|---|
| Situation/Context | Location | Where are you right now? | 0 = Home<br>1 = Work<br>2 = Other's Home<br>3 = Bar or restaurant<br>4 = School<br>5 = In Transit<br>6 = Other |
| Situation/Context | Social | Who are you with right now? | 0 = I am alone<br>1 = Spouse or romantic partner<br>2 = Friend<br>3 = Family members<br>4 = Acquaintance/classmates<br>5 = Coworker<br>6= Other |
| Situation/Context | OthersSmk | Are other people nearby smoking right now? | 0 = No<br>1 = Yes |
| Situation/Context | Alcohol | Have you had any alcohol since the last prompt? | 0 = No<br>1 = Yes |
| Situation/Context | Alc_Drks | How many drinks have you had since the last prompt? [please enter 0 if none] | [numeric response] |
| Situation/Context | Food | Are you currently eating? | 0 = No<br>1 = Yes |

| | | | |
|---|---|---|---|
| Situation/Context | Caffeine | Are you currently drinking caffeine (soda, energy drink, coffee, caffeinated tea)? | 0 = No<br>1 = Yes |
| Situation/Context | Stress | Have you experienced a significant stressor in the last 15 minutes? | 0 = No<br>1 = Yes |