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Development and validation of a contextual behavioral distress intolerance task in cigarette smokers

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HIGHLIGHTS

- C-FiTT is a new task that considers the impact of contextual factors on DI
- C-FiTT produces increases in negative affect and smoking urges
- DI is increased when smokers are exposed to a high versus low-difficulty task
- DI is highest when smokers are primed for withdrawal paired with high-difficulty task

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ABSTRACT

Introduction: Distress intolerance, an individual's perceived or actual inability to withstand negative emotional or physical distress, contributes to the maintenance of smoking. However, there is limited understanding of the contextual factors that impact distress intolerance in general or among smokers specifically. This study aimed to adapt and test a computerized behavioral persistence task that requires re-typing a passage while adhering to specific instructions (Contextual-Frustration Intolerance Typing Task [C-FiTT]). C-FiTT was designed to model contextual factors that influence distress intolerance, negative affect, and smoking urges.
Method: Daily smokers (n = 550) were recruited through the use of Qualtrics Panels. Using a 2 × 2 + 1 experimental design, participants were randomly assigned to one of four C-FiTT conditions that crossed task difficulty (low or high difficulty) with passage content (neutral or tobacco withdrawal text), or a neutral control group.
Results: C-FiTT produced an average persistence time of 94.1 ± 114.3 s and 64.7% of participants self-terminated the task. C-FiTT also produced small to medium sized-increases in negative affect and smoking urges. Between-condition comparisons indicated that the high-difficulty C-FiTT produced shorter behavioral persistence, greater self-termination likelihood, and larger increases in negative affect and smoking urges. The combination of high-difficulty and withdrawal content resulted in the shortest persistence time, 100% self-termination rate, and largest increases in negative affect and smoking urges, compared to other conditions
Conclusions: Findings provide initial evidence for the validity of C-FiTT in smokers within the context of tobacco withdrawal at low and high levels of task difficulty. Avenues for refinement and use of C-FiTT are discussed.

1. Introduction

Distress intolerance (DI) reflects one's perceived or behavioral incapacity to withstand negative emotional or physical distress states (Leyro, Zvolensky, & Bernstein, 2010; Zvolensky, Leyro, Bernstein, & Vujanovic, 2010). DI is linked to the persistence of smoking (Leventhal & Zvolensky, 2015) including more severe tobacco dependence (Leyro, Bernstein, Vujanovic, McLeish, & Zvolensky, 2011), smoking to

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alleviate negative affect (Trujillo et al., 2017), and greater nicotine consumption following nicotine deprivation (Bold, Yoon, Chapman, & McCarthy, 2013; Perkins, Karelitz, Giedgowd, Conklin, & Sayette, 2010). Certain aspects of DI, like intolerance for physical distress, are associated with poor smoking cessation outcomes (e.g., Kahler, McHugh, Metrik, Spillane, & Rohsenow, 2013), perhaps due to increased sensitivity to nicotine deprivation and heightened withdrawal severity (Farris, Zvolensky, Otto, & Leyro, 2015).

DI is a higher order construct including intolerance for negative emotional states (e.g., frustration, anxiety) or physical sensations (e.g., pain, bodily discomfort; Zvolensky et al., 2010). One's *perceived* intolerance for distress can be evaluated with self-report measures that tap intolerance for general (Corstorphine, Mountford, Tomlinson, Waller, & Meyer, 2007; McHugh & Otto, 2012) or specific emotional distress (Buhr & Dugas, 2002; Harrington, 2005) and physical discomfort (Schmidt, Richey, & Fitzpatrick, 2006). Measures of *behavioral* intolerance for distress involve evaluating the duration of an individual's capacity to withstand an aversive task or stimulus, with shorter persistence being indicative of higher behavioral DI (Leyro et al., 2010). Several tasks have been developed and used to index behavioral DI, including persistence during exposure to thermal pain (Neufeld & Thomas, 1977; Rhudy & Meagher, 2003) or respiratory distress (Brown, Lejuez, Kahler, & Strong, 2002; Hajek, Belcher, & Stapleton, 1987; Marshall et al., 2008). Exposure to stressful/frustrating mental tasks (Lejuez, Kahler, & Brown, 2003; Quinn, Brandon, & Copeland, 1996; Strong et al., 2003) or to negative emotional pictures (Veilleux, Pollert, Zielinski, Shaver, & Hill, 2017) are used to measure intolerance for mental and emotional distress, respectively.

Notably, the convergent validity of self-repot and behavioral indices of DI is typically low (McHugh et al., 2011) and DI (especially behavioral indices) can be influenced by contextual factors (e.g., Szuhany & Otto, 2015) including acute nicotine deprivation (Bernstein, Trafton, Ilgen, & Zvolensky, 2008) and task-difficulty (Daughters et al., 2005; MacPherson, Stipelman, Duplinsky, Brown, & Lejuez, 2008). Moreover, DI indices have discrepant predictive validity in terms of smoking-relevant outcomes, like short-term abstinence and puff topography (Farris et al., 2015; Perkins, Giedgowd, Karelitz, Conklin, & Lerman, 2012). Measures of DI that are specific to smoking (relative to general) are posited to have increased predictive validity of smoking-relevant outcomes. For example, one self-report measure taps perceived DI for distress experienced during smoking abstinence (e.g., withdrawal; Sirota et al., 2010). However, no smoking-specific behavioral measures of DI have been developed.

To address these limitations, we developed the Contextual–Frustration Intolerance Typing Task (C-FiTT) to model contextual influences on persistence of goal-directed behavior, an index of DI. This task was developed based on theoretical principles of self-regulation and self-control (Baumeister, Bratslavsky, Muraven, & Tice, 1998). Self-regulation can be defined as goal-directed behavior that, in part, affords individuals the capacity to reduce discrepancy between standards and actual states, including thoughts, feelings, and behaviors (Hofmann, Schmeichel, & Baddeley, 2012). Self-regulation is posited to be a resource that can be depleted or conserved, much like physical energy (Muraven, Shmueli, & Burkley, 2006); thus demands on self-regulation resources (e.g., a challenging task) will limit availability for subsequent goal-direct behavior which can increase vulnerability for failure in self-regulation (Baumeister et al., 1998; Baumeister & Vonasch, 2015; Heatherton & Wagner, 2011). Failure of self-regulation is linked to the persistence of a wide range of health behaviors, including cigarette smoking (Baumeister & Vonasch, 2015). Self-regulation has been modeled utilizing a computer based re-typing task that requires individuals to retype a passage under conditions that are mentally taxing (instruction to type without use of letters “a” or “n” or spaces) which depletes self-regulation resources (Muraven et al., 2006). Similarly, behavioral DI marks one's inability to persist in goal-directed activity in the face of distress, and is commonly assessed with a challenging task requiring persistence to complete a goal (e.g., complete task). Drawing upon this work, we modified the previously developed computer based re-typing task (Muraven et al., 2006) and adapted it to assess DI, such that an individual with higher DI would experience greater frustration in response to the mental demand of the typing task, and be less capable of persisting and completing the task relative to someone lower in DI.

In the current study, we tested the feasibility and initial validity of the C-FiTT in two different contexts – task difficulty (omitting frequent and infrequent letters: low versus high difficulty) and content (typing tobacco withdrawal versus neutral text). In order to evaluate construct validity, we examined the association between the C-FiTT persistence with an established measure of DI, the Distress Tolerance Scale (DTS; Simons & Gaher, 2005). Additionally, we evaluated persistence time and DTS in terms of negative affect reactivity to the task, where evidence for DI as an individual difference variable would be seen if (a) persistence time accounted for significant variance in negative affect reactivity and (b) both DI measures performed consistently in predicting negative affect reactivity. Finally, we tested the effect of C-FiTT versions (i.e., the contextual manipulation) on behavioral DI and task responding. There were three specific hypotheses regarding predictive validity: (1) Exposure to the high-difficulty task would produce higher DI (shorter persistence time; greater likelihood self-terminating task) and greater task responding (increases in negative affect and smoking urges), relative to the low-difficulty task; (2) Exposure to the withdrawal content would produce higher DI and greater task responding, relative to the neutral content; and (3) Exposure to the high-difficulty task with withdrawal content would produce the highest DI and greatest task responding, relative to other conditions.

2. Material and methods

2.1. Participants

Participants (N = 550; M_{age} = 44.6, SD = 13.5; 52.2% female) were daily smokers recruited from all 50 states in the United States for an anonymous study on smoking and health. Data were collected online and participants were recruited through the Qualtrics Panels service in July of 2015. Potential participants were targeted based on the following pre-selected eligibility criteria: ≥18 years of age; a qualifying rate of ≥80% (satisfactory completion of ≥80% of surveys in which they participated); and a daily smoker. Interested individuals completed a study screening assessment and were eligible if they met the following criteria: (a) daily smoking for ≥1 year, (b) smoking ≥5 cigarettes/day, and (c) cigarettes were primary tobacco product of use. Participants were excluded if they reported having reduced their smoking rate by more than half in the past 1 month. See Table 1 for sample characteristics.

2.2. Measures

Items from the *Smoking History Questionnaire* (SHQ; Brown et al., 2002) were used to describe the sample in terms of smoking characteristics. Two additional items were used to assess same-day smoking (cigarettes smoked today and minutes since last cigarette). The *Fagerström Test for Cigarette Dependence* (FTCD; Fagerström, 2012) was used to assess level of tobacco dependence, with higher scores reflecting higher dependence (possible range 0–10). Internal consistency was low in the current sample (α = 0.55), which is consistently found with this measure (Korte, Capron, Zvolensky, & Schmidt, 2013). The *Patient Health Questionnaire* (PHQ; Spitzer, Kroenke, & Williams, 1999) is a self-report assessment that was used to assess the severity of current depressive (α = 0.92) and anxiety symptoms (α = 0.88). The 14-item version of the *Distress Tolerance Scale* (DTS; Simons & Gaher, 2005) is a self-report measure used to assess perceived tolerance for emotional distress. Items are rated on a 5-point Likert-type scales ranging from 1

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