Review

The relationship between distress tolerance and cigarette smoking: A systematic review and synthesis

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HIGHLIGHTS

- This paper synthesizes existing research on distress tolerance (DT) and smoking.
- Measurement issues between self-report and behavioral tasks are considered.
- Evidence reveals an inconsistent relationship between DT and smoking.
- Several key gaps in the research are identified.
- A model of momentary distress tolerance is advanced.

ARTICLE INFO

ABSTRACT

Distress tolerance, the ability to withstand physical or emotional discomfort, is thought to be associated with cigarette smoking behavior and smoking cessation failure. A systematic review evaluated studies that linked distress tolerance to smoking. Central findings suggest that (a) distress tolerance can—but does not always—predict smoking cessation lapse, (b) treatments targeting distress tolerance are promising but need additional research, (c) lower distress tolerance does not seem to be associated with greater smoking frequency or longevity, and (d) limited work evaluates the effect of smoking context on distress tolerance. Gaps in our current knowledge are also identified, most notably the need to evaluate how links between distress tolerance and smoking develop across smoking escalation and maintenance stages, and the need to examine distress tolerance contextually. A model of momentary distress tolerance is proposed, where the key premise is to discuss the factors which could influence state or momentary distress tolerance and how habitual smoking may lower distress tolerance and reinforce the links between heightened distress and smoking behavior. Theoretical and measurement implications are discussed with the aim of extending future research on distress tolerance and smoking.

1. Introduction

Distress tolerance, or the ability to withstand uncomfortable states (Leyro, Zvolensky, & Bernstein, 2010) has been touted as an important individual difference factor in understanding smoking behavior, particularly for explaining early smoking lapse (Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005). Difficulties tolerating the physical discomfort and heightened negative affect associated with withdrawal might be a central reason people fail cessation attempts (Brown et al., 2005). It is arguably also important to understand the role of distress tolerance during smoking escalation and maintenance (Leventhal & Zvolensky, 2015), to begin to ascertain whether distress intolerance is a vulnerability factor for smoking, or if the experience of smoking actually alters distress tolerance abilities. A review of current research linking distress tolerance and smoking behavior can thus help identify where we currently lack knowledge, and subsequently raise additional questions and develop theories to spur further research. Notably, a thorough discussion of distress tolerance and smoking will also require an exploration of how distress tolerance is studied in the general psychological literature, with the clear intention of answering the call to better bridge the basic research on motivation and self-regulation with research in addiction (Köpetz, Lejuez, Wiers, & Kruglanski, 2013; Roos & Witkiewitz, 2017).

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2. Defining and measuring distress tolerance

In the basic psychological literature, the term *distress tolerance* is used to refer to a person's ability to withstand uncomfortable states (Leyro et al., 2010), and is a higher-order umbrella construct that subsumes several facets that are more specific to the nature of the type of distress to be tolerated: tolerance of uncertainty, tolerance of ambiguity, tolerance of frustration, tolerance of negative emotion, and tolerance of physical discomfort (Zvolensky, Vujanovic, Bernstein, & Leyro, 2010). Self-report measures, which assess individuals' perceived capacity to withstand distress, have been developed for all of the lower order distress tolerance facets (Leyro et al., 2010).

Distress tolerance can also be measured via behavioral tasks. Commonly used tasks include those assessing tolerance of physical discomfort, where people have to hold their breath as long as they can (Hajek, 1989), persist at keeping their hand in a vat of ice water as long as they can (i.e., cold pressor task; MacPherson, Stipelman, Duplinsky, Brown, & Lejuez, 2008), or persist inhaling in carbon dioxide enriched air (i.e., CO_2 challenge; Brown, Lejuez, Kahler, & Strong, 2002). Other tasks assess tolerance of frustration, where participants must complete a modified version of the Paced Auditory Serial Addition Test (PASAT; Lejuez, Kahler, & Brown, 2003), trace a star backwards as if in a mirror (Strong et al., 2003), or work on impossible anagrams (see Leyro et al., 2010 for descriptions of all of these tasks). One newer task assesses tolerance of negative emotion (Veilleux, Pollert, Zielinski, Shaver, & Hill, 2017) which assesses persistence in viewing negatively valenced images. All of these behavioral tasks use reaction time to assess time until the participant quits as the index of distress tolerance, and can be construed as persistence tasks. In fact, several older studies using these same tasks explicitly use the term *task persistence* (Brandon et al., 2003; Quinn, Brandon, & Copeland, 1996) to describe the construct assessed instead of *distress tolerance*. Newer conceptualizations differentiate the two by stating that task persistence has a reward component such that there is some desirable outcome from persisting at the task, whereas distress tolerance does not imply reward (Steinberg et al., 2012). Others state that the concepts are overlapping, if not the same (Brandon, Vidrine, & Litvin, 2007). Regardless of the nomonclature, behaviorally indexed distress tolerance tasks *are* tasks of persistence.

Also of note, the behavioral tasks and self-report measures of distress tolerance are rarely correlated at statistically significant levels (Ameral, Palm Reed, Cameron, & Armstrong, 2014; Bernstein, Marshall, & Zvolensky, 2011; Cougle, Bernstein, Zvolensky, Vujanovic, & Macatee, 2012; Kiselica, Rojas, Bornovalova, & Dube, 2015; Schloss & Haaga, 2011), leaving researchers suspicious that these different measurement strategies are actually assessing different constructs (Kiselica et al., 2015; Leventhal & Zvolensky, 2015). The view adopted here is consistent with recent theoretical and empirical work suggesting that self-report and behavioral tasks assess different aspects of distress tolerance (Kiselica et al., 2015; Veilleux et al., 2017). Not different types of distress (Zvolensky et al., 2010) but different psychological features of tolerance, such that the behavioral tasks assess persistence through distress, and the self-report measures assess judgments about abilities to manage distress (see Veilleux et al., 2017 for discussion of this view). These distinctions likely relate to the low and non-significant correlations across measurement methods, and also suggest that the type of measure used to assess distress tolerance may also differentially associate with smoking. Importantly, there are also similarities across behavioral and self-report measures, beyond the fact that both are intended to assess the ability to handle physical and/or emotional discomfort. Namely, distress tolerance is typically considered an individual difference (Farris, Zvolensk, Otto, & Leyro, 2015) that can be assessed at one point in time, with the assumption that a single assessment is indicative of how a person will respond at a different point in time. This assumption allows researchers to evaluate distress tolerance once and assess how well tolerance abilities or perceptions predict later behavior.

3. Differentiating from other constructs

Distress tolerance relates to other emotional constructs but is conceptually distinct (Leyro et al., 2010). Specifically, distress tolerance has been linked to anxiety sensitivity, or the fear of anxiety and physical sensations associated with anxiety (Bernstein, Zvolensky, Vujanovic, & Moos, 2009). It makes logical sense that people who are more sensitive to emotion (including, but not limited to anxiety) experience distress more intensely (Nock, Wedig, Holmberg, & Hooley, 2008) which makes tolerating distress more difficult. Distress tolerance has also been linked to emotion regulation (Simons & Gaher, 2005), and experiential avoidance, or the tendency to avoid or escape from negative affect situations (Chawla & Ostafin, 2007). Experiential avoidance (and avoidant coping; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986) is thought to be a maladaptive emotion strategy that people low in distress tolerance use to manage emotions (Boulanger, Hayes, & Pistorello, 2010). Functionally, low distress tolerance may serve as an intermediary between emotional sensitivity and engagement in avoidance behaviors, though more work on the nomological net of distress tolerance is warranted (Leyro, Bernstein, Vujanovic, McLeish, & Zvolensky, 2011).

4. Theories linking distress tolerance and smoking

Historically, the primary theoretical framework that has been used to connect distress tolerance to smoking is learned industriousness theory (Eisenberger, 1992), which suggests that people who find putting effort toward non-rewarding tasks as aversive are less likely to expend effort on those tasks in the future, choosing instead "low-effort" regulation strategies (e.g., avoidance, escape) rather than more difficult strategies that are often more effective (e.g., reappraisal, problem solving). From this framework, smoking is considered a "low effort" strategy (Brandon et al., 2003; Quinn et al., 1996) and people low in distress tolerance may initiate smoking as a low-effort method of regulation (Leventhal & Zvolensky, 2015). In addition, this theory explains why low distress tolerance smokers may be more likely to fail at cessation, because the effort of managing withdrawal is high and the pull of a low-effort relief method (i.e., returning to smoking) is strong. The theory of learned industriousness is consistent with prominent negative reinforcement models of smoking such as the affective withdrawal model (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004) which posits that both smoking maintenance and relapse occur due to increased negative affect conferred by withdrawal symptoms. This model suggests that people who are more sensitive to negative affect may preconsciously detect signals of negative affect even before they are consciously accessible, which is consistent with findings that smokers tend to be at least more sensitive to anxiety (Leventhal & Zvolensky, 2015). However, the affect withdrawal model suggests that it is heightened affect itself that prompts smoking behavior, whereas the distress tolerance perspective extends this idea to suggest that it is not merely affect but the ability to sit with or persist *through* the affect that prompts smoking (Brown et al., 2005).

Importantly, learned industriousness theory does not drive distress tolerance work in the basic psychological literature. In the basic literature, the predominant theory is that distress tolerance is an important individual difference factor that subsumes tolerance for specific types of distress (e.g., ambiguity, uncertainty, physical discomfort, negative emotion, frustration; Zvolensky et al., 2010), and is a transdiagnostic vulnerability factor across many types of psychopathology (Leyro et al., 2010). However, this conceptualization lacks theory about mechanisms and developmental origins (Bernstein, Vujanovic, Leyro, & Zvolensky, 2011), and the notion that distress tolerance is solely a trait and does not fluctuate across situations has been raised as a deficit in current thinking about distress tolerance (Bernstein, Vujanovic, et al., 2011; Trafton & Gifford, 2011).

5. Systematic review

The intention of the review is to examine work linking distress tolerance and smoking behavior to better understand *how* distress tolerance and smoking have been studied thus far, as well as to describe the state of the literature in terms of what is known about how smoking behavior and distress tolerance influence one another. Due to the desire to include *all* of the work linking distress tolerance and smoking, a meta-analysis was not conducted, because a meta-analysis would have necessarily restricted the included work to fit with predetermined hypotheses. Instead, the corpus of all work on distress tolerance and smoking was evaluated systematically to investigate the research questions, methods, measurement, samples and assumptions in a nuanced fashion that would prompt greater depth of thinking about distress tolerance and smoking. Notably, this review extends a prior review (Leventhal & Zvolensky, 2015) which was included within a paper addressing transdiagnostic vulnerability factors (anhedonia, anxiety sensitivity and distress tolerance) linking smoking and emotion-related psychopathology (i.e., depression, anxiety). The current review provides a more comprehensive (as well as updated) analysis of the literature explicitly focused on smoking and distress tolerance, with the ultimate goal of understanding research issues surrounding distress tolerance in a smoking context and to formulate a model toward generating future research.

5.1. Review methodology

References were located by searching PubMed and PsychInfo using the terms "task persistence" or "distress tolerance" or "distress intolerance" or "discomfort tolerance" or "discomfort intolerance" or "frustration tolerance" along with "cigarettes" or "smoking" or "tobacco" or "nicotine" through early June of 2018. English language papers that were (a) published peer reviewed journal articles, (b) chapters that presented new data, or (c) theses and dissertations were considered for inclusion. These selection methods produced 81 unique articles (see Fig. 1 for flowchart), and an additional 5 articles were mentioned by reviewers. After reviewing titles and abstracts for applicability, 19 articles were excluded, leaving 67 for full text analysis. In reviewing the full-text articles, references sections of those papers were evaluated to see if any papers were missed. Criteria for inclusion were (i) a quantitative study; (ii) human participants; (iii) at least some of the participants were smokers and the smoking groups were clearly identified (which allowed for comparison of smokers versus non-smokers or former smokers); (iv) distress tolerance or task persistence was measured via either behavioral task or self-report, and (v) where at least one reported on the relationship between any smoking variable and any indicator of distress tolerance *or* the paper reported on changes in distress tolerance via an intervention or manipulation for smokers specifically. In total, 60 papers were retained (see Table 1 online appendix)

The articles were then grouped into categories based on the type of research question pursued, though there was significant heterogeneity within each category. Broadly, the work evaluated (a) the links between distress tolerance and cessation behaviors, including both retrospective work on quit history and prospective studies evaluating how distress tolerance predicts lapse, (b) treatments developed to alter distress tolerance, primarily intended to improve smoking outcomes, (c) studies evaluating distress tolerance as a predictor of non-cessation related smoking behavior (e.g., primarily smokers not interested in quitting) and (d) the influence of smoking contexts and behavior as predictors of distress tolerance. Throughout the sections below, results for the behavioral distress tolerance tasks are typically covered separately from the self-report measures, as these may have different associations with smoking behavior.

6. Distress tolerance and cessation

A substantial portion of the theoretical work on distress tolerance and smoking is centered around distress tolerance as a likely predictor of early lapse. Lapse, or smoking a cigarette during a cessation attempt, is distinct from relapse, or return to regular smoking, though lapses tend to precipitate full relapses (Brandon, Tiffany, Obremski, & Baker, 1990; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996). In the context of distress tolerance and early lapse, "early" is important because the majority of smokers who attempt cessation lapse within one week of trying to quit (Brown et al., 2005). It is during this stage where physical withdrawal and negative emotion symptoms are highest (Hughes, 2007), such that the ability to tolerate these symptoms should be central to understanding—and hopefully treating—early lapse (Brown et al., 2005).

6.1. Quit history

Empirically, some of this work examined lapse retrospectively via quit history, with several studies finding that people with a history of delayed lapse had better behavioral persistence on physical tolerance tasks (e.g., breath holding, hyperventilation challenge, cold pressor) compared to people who lapsed early in the cessation process (Brown et al., 2002; Brown et al., 2009; Kahler, McHugh, Metrik, Spillane, & Rohsenow, 2013; Sirota, Rohsenow, Dolan, Martin, & Kahler, 2013; Stipelman, 2008). In addition, a few studies using frustration tasks showed that early lapsers had lower mirror tracing persistence scores (Steinberg, Williams, Gandhi, Foulds, & Brandon, 2010) and PASAT scores (Brown et al., 2002; Stipelman, 2008) compared to those who were able to stay abstinent for three months (Brown et al., 2002), one week (Steinberg et al., 2010) or three days (Stipelman, 2008). However, some of the above studies failed to find any effect of quit history on other assessed tasks, such as lack of effects on the PASAT (Brown et al., 2009) or mirror tracing (Stipelman, 2008). A few other studies (Hogan, Farris, Brandt, Schmidt, & Zvolensky, 2015; Zvolensky, Feldner, Eifert, & Brown, 2001) also did not find differences in behavioral persistence based on number of quit attempts or longevity of a prior quit attempt.

In terms of self-reported distress tolerance, smoking-specific distress intolerance—the self-reported difficulty of being able to tolerate smoking withdrawal symptoms—was associated with fewer prior quit attempts (Sirota et al., 2013) and shorter quit attempts (Sirota et al., 2010), though not in all studies (Germeroth, Baker, & Saladin, 2018). One study with a sample of Mexican daily smokers found that the appraisal component of the Distress Tolerance Scale (DTS; Simons & Gaher, 2005) predicted retrospective reports of early lapse after controlling for negative affectivity (Kauffman et al., 2017), although there appears to be no relationship between global self-reported distress tolerance and past quit attempts (Kauffman et al., 2017; Lubetkin, Guidry, Webb, Ocampo, & Burkhalter, 2018).

6.2. Prospectively predicting lapse

Beyond examination of quit history and distress tolerance, prospective studies examine distress tolerance (measured prior to a quit attempt) as predictors of lapse outcomes. A recent review of distress tolerance as a transdiagnostic risk factor linking smoking to anxiety and depression indicated "robust" findings connecting distress tolerance to early lapse (Leventhal & Zvolensky, 2015). However, their assertions of robustness are overstated, as is revealed by a closer examination of the studies. In some studies, shorter breath holding (Brown et al., 2009; Hajek, Belcher, & Stapleton, 1987), predicted lapse. However, in one of these same studies (Brown et al., 2009), the PASAT did not. In another study, lower tolerance on the PASAT predicted lapse but mirror tracing did not (Cameron, Reed, & Ninnemann, 2013), and two other studies indicated that lower persistence on the mirror tracing task (Brandon et al., 2003; Steinberg et al., 2012) predicted lapse, but in both cases
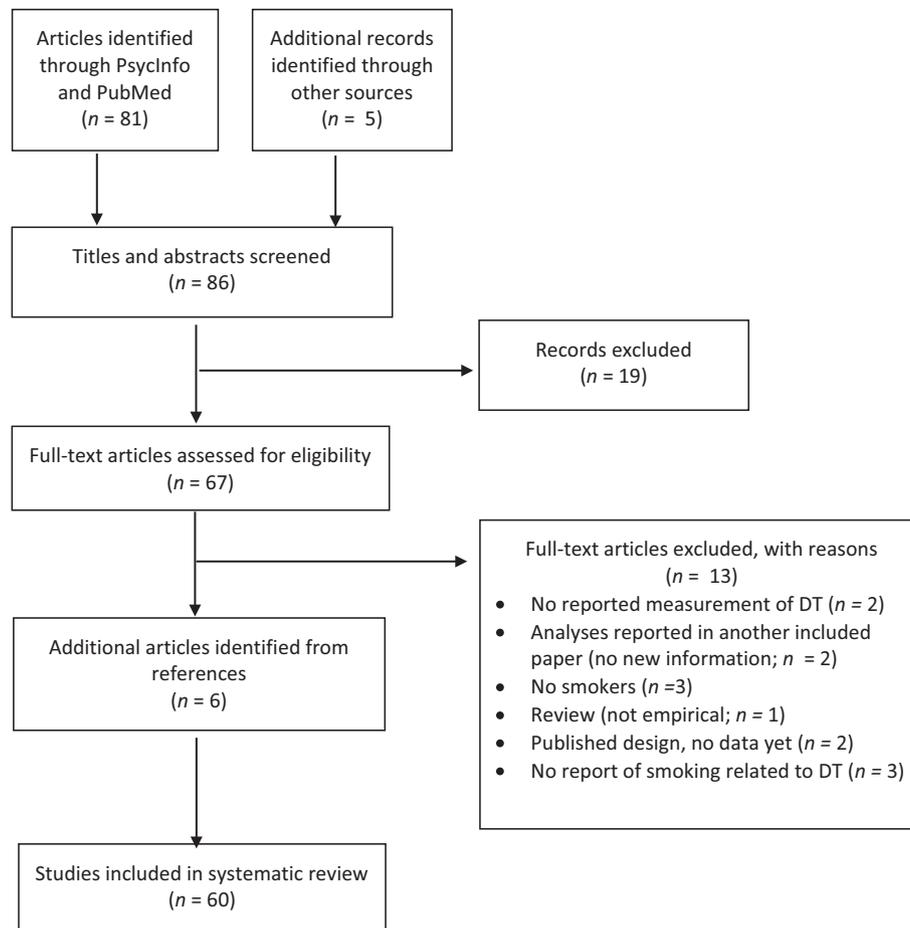
Fig. 1. Flow diagram of identified studies.

other tasks such as an anagram persistence task (Brandon et al., 2003) and breath holding (Steinberg et al., 2012) did not. These latter two studies both had relatively large samples ($Ns > 140$) of high-frequency smokers (at least 10 cigarettes per day), with smokers who were motivated to quit; the similarity of the samples should, in theory, help equate findings. However, in all of the studies reviewed above (some of which had low sample sizes of under 60 people), distress tolerance tasks predicted lapse on some but not all of the assessed measures, with very little consistency between the type of distress task (physical, frustration) and cessation outcome.

In terms of self-reported perceived distress tolerance prospectively predicting lapse, there is less available evidence, with work only demonstrating that self-reported task persistence did not predict either early lapse (24 h post-quit; Kalman, Hoskinson, Sambamoorthi, & Garvey, 2010) nor abstinence rates several months post-quit (Kalman et al., 2010; Steinberg et al., 2012). In addition, smoking specific withdrawal intolerance did not predict 1-month abstinence rates (Germeroth et al., 2018) Other work examined self-reported smoking-specific experiential avoidance, a concept related to distress tolerance such that theoretically, people low in distress tolerance may smoke to avoid negative emotion (Minami, Bloom, Reed, Hayes, & Brown, 2015). This study found that higher smoking specific experiential avoidance moderated the relationship between internal distress (depressive symptoms, negative affect, physical symptoms) and abstinence at about 3 months post-quit (Minami et al., 2015).

6.3. Intentions to quit

Beyond lapse, distress tolerance may actually influence people's

decisions to quit smoking. This is important because we know that quit intentions are relatively strong predictors of quit attempts (Berli et al., 2015; Schwarzer & Luszczynska, 2008). If low distress tolerance predicts lowered motivation to quit or treatment attrition, this speaks to smokers who are not even giving themselves the opportunity to quit. In this domain, adolescent smokers who indicated motivation to quit self-reported greater task persistence than smokers with ambivalence or no plans toward quitting (Steinberg et al., 2007). Other work found lower scores on the PASAT for women who dropped out of a study prior to the treatment period (MacPherson et al., 2008). Interestingly, the same study showed that men who dropped out of the study prior to treatment had lower breath holding and cold pressor persistence compared to men who stayed in the study (MacPherson et al., 2008), suggesting potential gender differences in type of behavioral tolerance tasks.

6.3.1. Summary

It seems more reasonable to say that behavioral distress tolerance *can* predict lapse outcomes rather than asserting that distress tolerance robustly predicts lapse. Understanding the conditions (sample, measure of distress tolerance, length of lapse period) in which distress tolerance does and does not predict lapse may be important in future work. Examination of emotional context is likely useful, such as in a study that found only people with lower mirror-tracing persistence showed increased craving in response to daily hassles experienced during a quit attempt (Volz et al., 2014), and another which that found smokers with low persistence on breath holding and hyperventilation challenge tasks reported higher negative affect on quit day (Abrantes et al., 2008). These studies thus suggest that low distress tolerance may increase vulnerability and reactivity to contextual stressors, and imply that

greater attention to contextual factors in understanding lapse may be important (Roos & Witkiewitz, 2017). Moreover, additional work is needed to understand the relationship between prior quit attempts and quit motivation on distress tolerance, which could be bidirectional. People who know they failed (i.e., lapsed quickly) at a prior quit attempt may view themselves as less capable of withstanding smoking-related distress because they always had low distress tolerance, or perhaps repeated failed attempts change people's self-perceptions, or people's willingness to persist at something difficult, consistent with learned industriousness theory.

7. Altering distress tolerance

If distress tolerance is a predictor of cessation failure, then training people to increase their distress tolerance via treatment may be an important avenue for increasing cessation success. Treatment programs have been developed (Brown et al., 2008) and tested (Brown et al., 2013) using techniques from Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999) focusing on identifying values, accepting thoughts and emotions and defusion (i.e., distancing from thoughts). Initial work suggested this treatment improved cessation outcomes in the short term (4 weeks post-quit) though the same study showed the effect was no longer present at 8 weeks (Brown et al., 2013). In addition, a pilot study focused on women interested in quitting smoking but concerned about weight gain targeted distress tolerance via ACT-based skills and was rated highly by the participants (Bloom et al., 2017).

Other work has looked at changes in distress tolerance as an outcome of smoking cessation treatment, even if treatment was not directly targeted at changing distress tolerance (Farris et al., 2016; Kapson, Leddy, & Haaga, 2012; Zvolensky, Yartz, Gregor, Gonzalez, & Bernstein, 2008). One study found no effect of CBT treatment on distress tolerance (Kapson et al., 2012) but the other found that compared to a standard CBT cessation treatment, a treatment focused on reducing anxiety *was* associated with increased physical discomfort tolerance over time, an increase which was also associated with abstinence at three months following a quit attempt (Farris et al., 2016). It may be that practice over time matters for improving distress tolerance, as several studies using brief laboratory interventions found no effect of a 10 min mindfulness condition (Luberto & McLeish, 2018) or brief (30 min) acceptance based-treatment (Murray, 2007).

7.1. Summary

The work on altering distress tolerance to improve cessation treatment is fairly new. If distress tolerance is associated with cessation lapse, then strengthening distress tolerance prior to a quit attempt may help people avoid lapse. Or, perhaps even more importantly, perhaps strengthening distress tolerance could prevent a single lapse from becoming a full-fledged relapse. Distress tolerance treatments appear to be in progress for other substance use disorders in addition to smoking (Bornovalova, Gratz, Daughters, Hunt, & Lejuez, 2012), and there are also distress tolerance-focused trials in progress that may prepare smokers for cessation (Paz, Zvielli, Goldstein, & Bernstein, 2017) and prevent at-risk youth from smoking (Otto et al., 2018). In short, this is an area of current focus in cessation research.

8. Distress tolerance and smoking behavior

Beyond the relationship between distress tolerance and smoking cessation, it is also important to understand distress tolerance during the earlier stages of smoking, particularly as distress tolerance has been identified as a transdiagnostic vulnerability factor for smoking initiation and maintenance (Leventhal & Zvolensky, 2015). The research here can be grouped by studies examining distress tolerance as a function of smoking status, correlational work examining associations

between distress tolerance and degree of smoking behavior (cigarettes per day, dependence) and laboratory studies examining the effect of distress tolerance on smoking outcomes (e.g., puff volume). Compared to the prior sections, the majority of work here focuses on smokers' regular smoking behavior outside the context of a quit attempt.

8.1. Smoking status

All of the studies which compared smokers and non-smokers on behavioral distress tolerance measures found that smokers appear to have lower persistence than non-smokers, with differences found on the anagram persistence task (Quinn et al., 1996), the mirror tracing task (Quinn et al., 1996; Raglan, 2013), the PASAT (Dahne et al., 2014; Daughters et al., 2017) and a cold pressor task (Pulvers, Hood, Limas, & Thomas, 2012).

In terms of self-reported distress tolerance, several studies found that daily smokers had lower self-reported persistence compared to former smokers (Etter, Pelissolo, Pomerleau, & De Saint-Hilaire, 2003; Mathew, Yount, Kalhan, & Hitsman, 2018) and non-smokers (Leventhal et al., 2016; Steinberg et al., 2007). Three of these studies have large sample sizes (above 800 people); the studies with smaller sample sizes did not find significant group differences between current and former smokers (Lubetkin et al., 2018; Sabol et al., 1999). In addition, several of these studies focus on adolescent samples (Leventhal et al., 2016; Steinberg et al., 2007), providing initial evidence that youth who use cigarettes have lower distress tolerance than youth who do not smoke or youth who only smoke e-cigarettes (Leventhal et al., 2016), corroborated by a study which found that adolescent smokers also had lower frustration tolerance when the adolescents were rated by their teachers (Marcynyszyn, Evans, & Eckenrode, 2008).

8.2. Smoking frequency and dependence

Perhaps the most consistent finding in this entire review is that across many studies, neither behavioral nor self-reported distress tolerance are associated with increased smoking behavior. The lack of relationship was found whether smoking was measured by number of cigarettes smoked per day (Etter et al., 2003; Farris et al., 2015; Kauffman et al., 2017; Kraemer, McLeish, Jeffries, Avallone, & Luberto, 2013; Leyro et al., 2011), self-reported dependence (Daughters et al., 2017; Farris, Vujanovic, Hogan, Schmidt, & Zvolensky, 2014; Kahler et al., 2013; Kraemer et al., 2013; Luberto et al., 2014; Perkins, Karelitz, Giedgowd, Conklin, & Sayette, 2010; Raglan, 2013; Sirota et al., 2013), expired CO_2 level (Kahler et al., 2013) or longevity of smoking (Kahler et al., 2013). There are a few exceptions; lower breath holding (Brandt, Johnson, Schmidt, & Zvolensky, 2012; Hogan et al., 2015), and mirror tracing persistence (Hogan et al., 2015) were associated with higher smoking rates, though effect sizes were small in magnitude (see Table 1).

In terms of self-report measures, a few studies found that low distress tolerance was associated with greater dependence (Kahler et al., 2013; Trujillo et al., 2017) and greater reasons for smoking (Leyro, Zvolensky, Vujanovic, & Bernstein, 2008). However, the relationships between distress tolerance and smoking were not significant after controlling for anxiety symptoms in one of these studies (Leyro et al., 2008), and evidence in this domain is limited.

In addition, a few studies examined the psychometrics of self-report distress tolerance measures in smoking samples. In one (Leyro et al., 2011), which evaluated the factor structure of the oft-used self-report Distress Tolerance Scale (DTS; Simons & Gaher, 2005) in smokers, lower distress tolerance was significantly associated with higher dependence and more years smoking, although correlations were low in magnitude (below 0.30). Two additional studies (Sirota et al., 2010; Sirota et al., 2013) measured smoking-specific distress tolerance via items relating to distress around nicotine withdrawal and coping with nicotine withdrawal. Lower smoking-specific distress tolerance was

associated with greater cigarettes per day, and higher dependence ratings. It is notable that these two studies were focused on understanding the psychometric structure of distress tolerance in smokers specifically, but when *general* distress tolerance self-report measures are used, they do not seem to be consistently associated with dependence.

8.2.1. Demographic differences

Examination of distress tolerance and smoking in other cultures (Azizi, 2010; Kauffman et al., 2017) and/or exploring demographic moderators can potentially help us understand the relationship between distress tolerance and smoking. One of the more striking exceptions to the predominantly non-significant relationships between distress tolerance and dependence was found in a study of Iranian smokers, where high distress tolerance was strongly associated with decreased dependence (Azizi, 2010), a result consistent with the smoking-specific distress tolerance found in Western samples, but higher in magnitude and using an index of general (e.g., DTS) distress tolerance rather than smoking-specific distress tolerance.

Other work demonstrated that lower PASAT scores predicted smoking status for African Americans but not Whites (Dahne et al., 2014), and that men lower in self-reported distress tolerance inhaled a greater volume of smoke after a negative mood induction compared to men high in self-reported distress tolerance (Perkins, Giedgowd, Karelitz, Conklin, & Lerman, 2012), effects that were not found during neutral mood induction or for women. In general, men tend to have a higher tolerance of physical discomfort than women (Bold, Yoon, Chapman, & McCarthy, 2013; Hogan et al., 2015; Pulvers et al., 2012) and report higher self-reported distress tolerance (Perkins et al., 2012), but male smokers with lower physical discomfort tolerance are more likely to drop out of treatment (MacPherson et al., 2008).

8.3. Predicting smoking behavior

A few studies have gone beyond examination of smoking status or correlational analyses to examine the role of distress tolerance in predicting smoking and smoking-related behavior in the laboratory. For example, one study of deprived smokers (i.e., smokers asked to abstain from smoking for 12 h) who were offered monetary incentives for delaying smoking ($1 for every 5 min of delay; Kahler et al., 2013) found that longer breath holding predicted a greater ability to delay smoking. A similar study with a small sample size found no effect of breath holding on delay ability (Bold et al., 2013), though the latter study used a smoke/no-smoke choice task which limited variability both because it was a dichotomous outcome and because the majority of the deprived smokers chose to smoke.

There is also some evidence that low self-reported distress tolerance may predict greater smoking behavior measured via smoking topography. One study of overnight deprived smokers found that the regulation subscale of the DTS predicted total number of puffs (Bold et al., 2013), though this was a small sample and the findings did not hold for the overall DTS. Another study found that smokers low in distress tolerance as measured by the DTS smoked more (greater puff volume) after overnight abstinence compared to smokers high in distress tolerance (Perkins et al., 2010). This result is important because this study used a within subject design such that participants provided smoking topography ratings after abstinence and after several other negative emotion inductions over a series of five laboratory visits. The DTS is a general measure of perceived emotional distress tolerance and it would logically follow that smokers with low tolerance on the DTS might smoke more when in a negative mood, which is not what occurred. Rather, it was only under conditions of physical withdrawal and deprivation that low perceived distress tolerance influenced smoking behavior.

9. Summary

There is evidence suggesting that smokers have lower distress tolerance than non-smokers, whether measured behaviorally or via self-report. However, there does not seem to be a "dose-dependent" relationship; greater frequency of smoking and/or nicotine dependence is not consistently correlated with lower distress tolerance. This suggests that there is something about "being a smoker" that is associated with problems tolerating distress. In addition, the limited corpus of work thus far suggests that the relationship between smoking and distress tolerance may have a cultural component. Cultural values and norms (including gender) influence the experience and expression of emotion (Butler, Lee, & Gross, 2007; Lafrance & Banaji, 1992; Matsumoto, Yoo, & Nakagawa, 2008), and thus cultural values may influence people's willingness to sit with distress and effort around tolerating distress. Further exploration of culture, smoking and distress tolerance is likely warranted. Finally, there is simply very little published work connecting distress tolerance to momentary smoking behavior, particularly for non-deprived smokers. It may be that other work has been conducted but not published due to null findings. Regular smokers have habitual smoking patterns, and it may be that individual differences in distress tolerance—whether self-report or behavioral—do not predict smoking behavior that is habitually controlled, consistent with the finding that there does not seem to be an association between distress tolerance and dependence. This *may* be a useful area of future research, though placing attention onto contextual fluctuations in both smoking behavior and distress tolerance (see next section) will likely be more fruitful in elucidating how distress tolerance influences smoking and vice versa.

10. Distress tolerance and context

As stated previously, most of the research on distress tolerance and smoking looks at distress tolerance as a trait-like characteristic (Farris et al., 2016). This makes sense if distress tolerance is reliably assessed and stable enough that there is minimal fluctuation in distress tolerance across contexts. This is, however, an assumption that is likely not true; others have touted the importance of examining distress tolerance dynamically (Bernstein, Vujanovic, et al., 2011; Leventhal & Zvolensky, 2015; Trafton & Gifford, 2011), and recent empirical work using experience sampling found that self-reported distress intolerance varies over time (Veilleux et al., 2018). Distress, whether physical or emotional discomfort, changes based on environmental inputs, so it follows that distress tolerance likely also changes over time and across contexts.

One important context for smokers is deprivation, and it appears that deprivation can impair distress tolerance. For example, a few studies found lower breath holding during deprivation compared to when smokers were not deprived (Bernstein, Trafton, Ilgen, & Zvolensky, 2008; Cosci, Aldi, & Nardi, 2015). In addition, one novel study examined the interaction between smoking restriction and self-control depletion on task persistence (Heckman, Ditre, & Brandon, 2012). When restricted from smoking *and* depleted of self-control, smokers persisted less on a mirror tracing task compared to when they were allowed to smoke or not depleted, suggesting that at smokers with fewer self-control resources may exhibit lower distress tolerance when their desired strategy for managing distress (i.e., smoking) is taken away.

Other important contexts may involve other kinds of physical or emotional stress not brought about by deprivation. For example, one study found that persistence on a second hyperventilation challenge was lower for smokers who experienced a panic attack to an initial hyperventilation session (Marshall et al., 2008). Another study found that undergoing passive heat stress, where the body is heated by a water-profused suit, lowered breath holding compared to a within-subjects control session, though this effect was not specific to smokers (Veilleux et al., 2018). Emotion regulation strategies may also have a

carryover effect onto distress tolerance. Compared to smokers assigned to suppress their emotions or accept their emotions, smokers assigned to reappraise or reframe their emotions had longer task persistence on the PASAT following a craving manipulation (Szasz, Szentagotai, & Hofmann, 2012). However, a brief mindfulness induction (i.e., a 10 min sitting meditation) did not improve either breath holding or mirror tracing compared to a control condition (Luberto & McLeish, 2018), although smokers in the mindfulness condition did self-report increased mindfulness after the manipulation.

10.1. Summary

Compared to the prior section, which examined the role of distress tolerance in predicting momentary smoking, the work reviewed in this section addressed almost the opposite; how distress tolerance may change based on momentary or contextual factors in smokers. The dearth of studies here suggest significant gaps to be addressed by future work.

11. Lingering issues

The review of existing literature highlights several important gaps in our knowledge about distress tolerance and smoking. In addition, there are lingering conceptual issues that would behoove researchers to consider when designing and implementing distress tolerance and smoking studies, which are outlined in detail below.

11.1. Smokers versus non-smokers: Implications for causality

Why might simply "being a smoker" relate to lower distress tolerance? One perspective is that distress tolerance is construed as a vulnerability factor for smoking initiation and escalation (Leventhal & Zvolensky, 2015), such that people with lower tolerance for distress may be more susceptible to smoking. However, the field is currently lacking developmental work evaluating distress tolerance as a prospective predictor of smoking escalation such has been done for mood variability (Weinstein, Mermelstein, Shiffman, & Flay, 2008) and the expectancies people hold about smoking (Heinz, Kassel, Berbaum, & Mermelstein, 2010).

A competing explanation, which has received even less empirical attention, is that regular smoking lowers distress tolerance; this would be consistent with a learning theory perspective (Eisenberger, 1992) and with theories suggesting that smoking alters reward responsivity (Trafton & Gifford, 2011). Smoking may increase the frequency and intensity of negative affect (Kassel, Stroud, & Paronis, 2003), and increased negative affect may feel more difficult to tolerate, particularly when people learn that smoking can alleviate distress (Baker et al., 2004). From this perspective, perhaps it is the regular, habitual smoking that contributes to lowered distress tolerance, and after habits are established, increased frequency of smoking does not significantly shift distress tolerance.

Most likely, distress tolerance is both a vulnerability factor *and* a consequence of habitual smoking, but the how the link between distress tolerance and smoking is established, strengthened and maintained remains an important empirical question. It is notable that most of the studies reviewed here used daily smokers who smoked for over one year and typically smoked > 10 cigarettes per day. Future work will likely want to expand the smoking populations studied, such as by comparing distress tolerance in intermittent or non-daily smokers with daily smokers, consistent with one large-*N* study using an adolescent sample which found that daily smokers self-reported lower task persistence than occasional and non-smokers (Steinberg et al., 2007). This kind of research could facilitate future theory development about the casual influence of smoking on distress tolerance, and may be an important step prior to more extensive longitudinal developmental work.

11.2. The issue of persistence

One conceptual issue of importance to consider at the intersection of distress tolerance and smoking is that of persistence. Persistence is essential to consider because persistence is what is being measured in the behavioral distress tolerance tasks, and is also important for smoking cessation—smokers must persist through the withdrawal symptoms and heightened negative affect without smoking. Persistence may thus be why the behavioral tasks seem to be favored by researchers studying the relationship between distress tolerance and cessation, as the self-report measures mostly assess discomfort with distress, judgment toward distress and a desire to escape from distress (Simons & Gaher, 2005).

However, persistence through a behavioral distress tolerance task and persistence through a quit attempt are not exactly the same thing. The self-control dilemma in the behavioral distress tolerance tasks is to approach a task that might be irritating, uncomfortable or distressing, and the hedonic impulse is to escape. Many of these tasks also have a goal—in the mirror tracing task, the goal is to complete the backward trace of the geometric figures and the task ends when the goal is complete. A quit attempt is qualitatively different. The self-control dilemma with a quit attempt is to avoid smoking, and the hedonic impulse is to engage. Yes, a smoker could frame a quit attempt as approaching abstinence rather than avoiding smoking, and goal framing certainly matters in self-regulation challenges, including smoking cessation (Higgins, 1997). However, most smokers probably construe smoking cessation as an avoidance goal, which is not as easily "checked off" like completing a lab task. When is the goal complete? Compared to the other behavioral measures, breath holding is the most analogous—the goal is to hold your breath "as long as you can" just as the implicit idea of cessation is to deal with the craving and withdrawal for "as long as you can."

The behavioral distress tolerance tasks and smoking cessation also differ somewhat in "what" is being persisted. With all of the distress tolerance tasks, the goal is to continue engaging in a distress-eliciting task, where ceasing the task will also cease the distress. In the real world, however, distress tolerance sometimes involves sitting with distress elicited by a different stimulus, a point that has been raised in the basic distress tolerance literature (Veilleux et al., 2017). This distinction is obvious in the realm of smoking; if the goal is to persist on a quit attempt, some of the distress elicited is directly related to the quit attempt (physical withdrawal, negative affect). But some of it (life stressors, other kinds of physical pain, emotional distress from other sources) is not.

These distinctions matter because the existing distress tolerance tasks are not, perhaps, ideal analogues of the cessation situation. To be clear, distress tolerance tasks were not designed to mimic cessation processes. Distress tolerance is a broad construct assessing withstanding distress (Zvolensky et al., 2010), and cessation is a goal-driven process that involves distress (Hughes, 2007). However, the inconsistent findings linking performance on behavioral distress tolerance tasks to cessation attempts may occur because the tasks are assessing different aspects of persistence. If the goal is to find identify people at risk of lapse due to difficulties tolerating distress, future work may benefit from developing additional distress tolerance tasks that use avoidance goals with hedonic impulses to approach reward, and/or measuring the influence of emotion or physical discomfort on persistence by decoupling the persistence task from the discomfort (e.g., evaluate persistence on a cognitive or physical task during a negative mood induction). These kinds of paradigms may predict smoking behavior and/or lapses differently than the existing distress tolerance measures.

11.3. Capturing context

If persistence is a trait-like characteristic, then nuanced distinctions between the behavioral distress tolerance tasks and the goals of
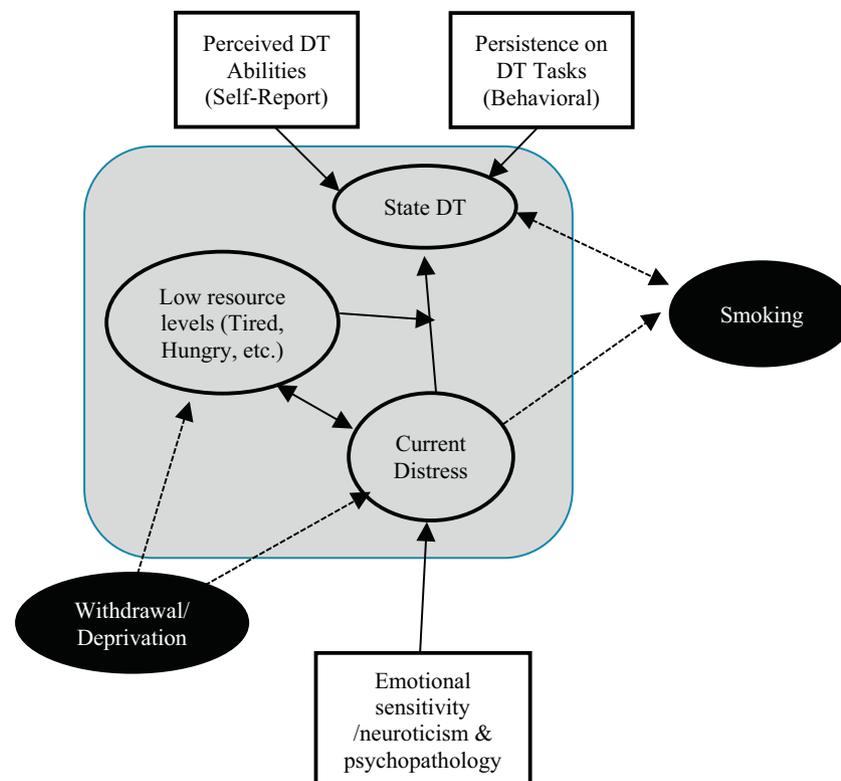
Grey shaded area: general model of state distress tolerance
Black circles: smoking elements

Fig. 2. Model of momentary state distress tolerance during smoking escalation and maintainence.

cessation shouldn't matter. However, the assumption that persistence operates like a trait, consistent over time and situation, is almost certainly false. Of course, examining individual differences in distress tolerance is not fruitless; traits reflect tendencies and rank-order differences among people. However, in addition to the studies reviewed in this paper which provide some evidence of distress tolerance shifting by context, and new work using experience sampling which demonstrates that distress tolerance does change over time (Veilleux, Hill, et al., 2018) there are also theoretical reasons to consider distress tolerance dynamically (Trafton & Gifford, 2011).

Particularly when thinking about the behavioral persistence tasks, distress tolerance can be construed from a self-control lens (Fujita, 2011). The theory of ego depletion (Muraven & Baumeister, 2000) suggests that an initial use of self-control "depletes" or reduces self-control resources such that fewer resources are available for later self-control. Tasks used to measure distress tolerance (e.g., mirror tracing, cold pressor) are used as outcome variables in self-control studies, including studies of ego depletion (Hagger, Wood, Stiff, & Chatzisarantis, 2010). That is, after exerting self-control, people can show less persistence in breath holding (Vohs & Schmeichel, 2003), less persistence on the cold pressor task (Schmeichel & Vohs, 2009), and less persistence on unsolvable anagram tasks (Muraven, Tice, & Baumeister, 1998). Extrapolating further, depletion theories are momentary based, where exerting self-control in one moment is thought to decrease motivation for subsequent self-control (Inzlicht & Schmeichel, 2012) and increase both attention to reward and motivation for reward (Inzlicht & Schmeichel, 2012). Moreover, when depleted of self-control, environmental cues (e.g., triggers, contextual factors) may be more likely to influence behavior (Blázquez, Botella, & Suero, 2017). It should be noted that data supporting ego depletion has come under fire in recent years with a failed registered replication report (Hagger &

Chatzisarantis, 2016; though see reubuttal by Blázquez et al., 2017). Regardless, more generally, the idea that self-control can fluctuate over time and context is consistent with social psychological research on goal pursuit (Mann, de Ridder, & Fujita, 2013) and emotion regulation (Tamir, 2016).

The view advanced here is that distress tolerance can be construed as example of a momentary self-control process. Distressing situations typically do involve self-control, as negative mood signals a short term problem "needing" to be solved, pushing longer term goals to the background (Tice & Bratslavsky, 2000). Indeed, theorists have suggested that distress tolerance may be a special example of self-control in the face of negative reinforcement rewards (Trafton & Gifford, 2011). The implications are that self-control efforts in other domains (e.g., resisting snapping at a co-worker, attempting to refrain from taking a smoke break) should reduce momentary distress tolerance. Indeed, a few of the smoking studies that addressed the effect of context on distress tolerance support this (Marshall et al., 2008; Szasz et al., 2012). Second, active efforts to tolerate distress (e.g., trying to "sit with" a strong negative emotion rather than engage in habitual avoidance behavior) should reduce subsequent self-control. The implications for smoking cessation are clear—in the early stages of a quit attempt when withdrawal symptoms are at their highest (Hughes, 2007), managing those physical and psychological withdrawal symptoms should prompt a decline in momentary distress tolerance. In addition, trying to tolerate the distress of withdrawal will make subsequent self-control efforts more difficult, such that it will be harder for a person to resist reaching for a cigarette.

11.4. Model of state distress tolerance

A model of momentary or "state" distress tolerance and smoking,

based on existing theoretical and empirical work, could explain how links between distress tolerance, heightened distress and smoking behavior develop through smoking escalation and maintenance stages.

Provided that distress tolerance operates similarly for smokers as it does for people in general, consistent with a trandisagnostic view of distress tolerance (Leventhal & Zvolensky, 2015; Leyro et al., 2010; Zvolensky et al., 2010), it is likely first important to think about a general model of state distress tolerance (see Fig. 2, grey shaded portion). The central model advanced here is that state distress tolerance, or the ability to tolerate distress in a given moment, will vary based on contextual factors; this portion of the model is not unique to smokers or smoking. Heightened current distress should be associated with lower momentary distress tolerance at a within-person level (Veilleux, Hill, et al., 2018). That is, for a given person, when they experience distress that is stronger or more intense than usual, they will likely feel less capable of managing that distress, particularly at extremely high levels of negative emotion. Thus, there is a direct connection between current distress and state distress tolerance. However, it is also predicted that momentary distress intolerance, particularly at moderate levels of distress, may vary by context and is likely moderated by resource levels. Consider a person who experiences moderate distress on two separate occasions. On one occasion, she feels and is capable of tolerating or managing the distress, and on another occasion, the distress is not tolerable. Background contextual factors, here called "resource levels" (consistent with the notion of self-regulation as a resource; Muraven & Baumeister, 2000) may be the difference—when someone is physiologically low in resources (tired, hungry) or psychologically low in resources (e.g., limited social support, significant life stressors, prior engagement in self-control), state distress tolerance will be lowered. Of course, low resources may also make current distress more intense, and dealing with current distress may likewise influence resources (Hagger et al., 2010), which is why the relationship between the two contextual factors is likely bidirectional.

How, then, does state distress tolerance become associated with smoking? When a smoker has developed a habitual smoking pattern, even short instances of abstinence or deprivation can incite the withdrawal syndrome, manifesting in increased current distress in the form of increased negative affect and physical symptoms (Baker et al., 2004). Smoking then relieves those symptoms of distress and withdrawal via negative reinforcement processes. This model suggests that over repeated exposure to smoking, smokers learn to associate low state distress tolerance with smoking. Specifically, smoking may temporarily relieve distress intolerance by helping the person feel more capable of handling their feelings. Over time, however, this process reinforces the idea that the person is not able to tolerate distress without smoking, and thus regular smoking should likely decrease state distress tolerance via learning processes over time. People *also* learn that at times when they feel less able to withstand their feelings, smoking is an available low-effort resource, and thus at times that state distress tolerance is compromised, smoking may increase. This model proposes how smoking behavior may escalate over time via changes in distress tolerance.

Finally, it is important to note that the momentary pieces are also influenced by individual differences (rectangles in Fig. 1). Both perceived and behavioral distress tolerance likely influence state distress tolerance; people who see themselves as less judgmental of distress and who can persist through distress on laboratory tasks are also more likely to be able to tolerate distress in a given moment (Veilleux, Hill, et al., 2018). In addition, current distress will be higher for people who are emotionally reactive and/or who have personality features that predispose them to heightened emotional responses (e.g., neuroticism, anxiety sensitivity), just as distress is likely to be higher for people with current psychopathology (e.g., anxiety and depression). The mechanisms by which these individual differences influence states are also ripe for theoretical and empirical development; it may be that people's perceptions of their own abilities influence momentary tolerance via expectancies, whereas behavioral persistence individual differences

likely influence momentary behavior via learning processes. These predictions about how trait distress tolerance influences state distress tolerance are hypotheses; they deserve to be tested in non-addictive behavior populations as well as in populations of smokers (and drinkers, drug users, etc.) to determine if the trait influence on behavior is similar across clinical populations.

A contextual or momentary model of distress tolerance likely interacts with trait tendencies in other ways. Some people may just have a perpetually low level of distress tolerance—whenever distress increases, they cannot tolerate it. These people should show consistency in momentary distress tolerance over time, and exhibit consistently poor performance on trait measures. Smokers who exhibit this pattern are likely to lapse—and relapse—quickly. These smokers could be identified by low momentary distress tolerance and limited momentary distress tolerance variability.

For others, momentary distress tolerance may vary more by contextual factors, and identifying those factors may be important to understanding when a particular smoker is more susceptible to lapse. For these smokers, trait measures are unlikely to predict outcomes because the trait measures are unlikely to accurately model situational demands that influence cessation risk. This idea that within-person variability in self-regulation processes—including distress tolerance—almost certainly relates to success in behavior change is consistent with other research work suggesting that greater attention to contextual processes and within person variability may be essential for improving addiction treatment (Roos & Witkiewitz, 2017).

11.5. Treatment implications

Issues of persistence and potential dynamic fluctuations in distress tolerance have significant implications for distress tolerance treatments. The current distress tolerance treatments in the smoking realm (Bloom et al., 2017; Brown et al., 2009) focus on acceptance via Acceptance and Commitment Therapy (ACT; Hayes et al., 1999) based skills; if people can accept their distressing feelings or physical sensations, acknowledge them and let them rise and fall naturally, they should reduce the "need" to smoke to relieve the distress. Considering the comorbidity between anxiety and smoking (Leventhal & Zvolensky, 2015) and the utility of acceptance-based strategies to manage escape and withdrawal tendencies associated with anxiety, ACT strategies thus also likely have useful transdiagnostic treatment implications (Farris et al., 2016). However, accepting distressing experiences is difficult and effortful for many, and in the short term may actually *increase* risk. That is, if the person is attending to their physical or emotional sensations, the effort used to accept and allow negative feelings may be taxing enough that a person finds the behavior of resisting a cigarette more difficult. Attention to dynamic issues surrounding acceptance, potentially by helping people automatize acceptance skills prior to attempting cessation, may be important.

In addition, ACT does not directly address behavioral persistence. A related acceptance-based treatment, Dialectical Behavior Therapy (DBT; Linehan, 1993), includes an entire module on improving distress tolerance which teaches clients to refrain from engaging in problematic behavior when distressed. Some of the DBT skills teach people distraction or self-soothing processes and other skills focus on acceptance or "sitting with" distress. An important distinction between DBT and ACT is that DBT is explicitly focused on addressing behavioral problems, by helping clients use skills to avoid engaging in behavior that they will ultimately regret and to increase "effective" behavior consistent with long term goals. In short, DBT teaches clients how to persist toward long term goals via persisting through distress. DBT-based distress tolerance treatment has shown some efficacy in treating substance use disorders (Bornovalova et al., 2012), and could be adapted for smoking cessation treatment as well.

Regardless of the treatment framework, the issue of "what" must be persisted should be clearly identified for smokers in distress tolerance

treatment. Is the goal to persist through the distress without smoking? When does the smoker know the goal has been achieved? Research evaluating the outcomes of distress-tolerance focused treatment approaches should likewise consider these questions, and potentially try to isolate the persistence component of treatment (e.g., DBT skills focused on "sitting with" distress to decrease problematic behavior versus self-soothing or distraction skills) when designing treatment studies.

11.6. Additional future directions

There are certainly additional areas where future work on smoking and distress tolerance could extend knowledge. Future research can expand assessment of self-reported distress tolerance, potentially explicitly examining differences between general self-reported perceptions of distress tolerance from smoking-specific tolerance (Schloss & Haaga, 2011; Sirota et al., 2010), and looking at other related constructs such as grit, passion and perseverance for long term goals (Duckworth, Peterson, Matthews, & Kelly, 2007) which conceptually overlaps with the idea of persistence but has not yet been investigated in the context of smoking. How these self-report measures—which assess perceived abilities—differ from actual abilities (e.g., the oft-cited discrepancy between self-report and behavioral measures of distress tolerance (Ameral et al., 2014; Bernstein, Marshall, & Zvolensky, 2011; Cougle et al., 2012; Kiselica et al., 2015) could be examined further in the context of both smoking behavior and in smokers. The position advanced here, that self-report measures assess judgments of abilities whereas the behavioral measures assess persistence, can be subjected to additional theoretical musing and empirical investigation. This work would thus contribute to the basic research on distress tolerance in addition to the specific application of distress tolerance to smoking. In addition, future work can investigate moderators of the links between distress tolerance and smoking, including gender and ethnicity but also considering additional moderators such as emotional sensitivity, daily versus intermittent smoking, etc.

12. Conclusion

The intention of this review was to evaluate the existing research on distress tolerance and smoking to identify gaps in the literature to be addressed in future research, which culminated in a new theoretical model linking state distress intolerance to smoking behavior. In terms of the review, the central conclusions are that (a) lower persistence on behavioral distress tolerance tasks *can* predict smoking cessation lapse, though these effects are inconsistent, (b) treatments focusing on increasing distress tolerance show promise but need additional research, and (c) smokers tend to have lower persistence on behavioral distress tolerance measures compared to non-smokers, without any clear consistent relationship between frequency or quantity of smoking and distress tolerance, In addition, more work is needed to evaluate moderators (ethnicity, country of origin, gender) of the distress tolerance and smoking relationship, including potential moderation by measurement type, such that the differences between behavioral persistence tasks and self-reported perceived distress tolerance may provide important information about smoking behavior. Finally, and perhaps most centrally, more work is needed linking distress tolerance to momentary smoking behavior in early smokers and continuing smokers (i.e., smokers not attempting cessation) and examining contextual fluctuations in the relationships between distress tolerance and smoking. The theoretical model developed here provides a potential roadmap for examining momentary distress tolerance and related smoking behaviors. Ultimately, there is considerably more left to learn about the relationship between smoking and distress tolerance, and future efforts in this area may be key to decreasing the public health impact of smoking by identifying specific ways in which emotional management can contribute to decreased smoking behavior and more successful cessation.

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