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Understanding Smoking after Acute Illness: An Application of the Sentinel Event Method

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Abstract

The Sentinel Event Theory provides a stepwise approach for building models to understand how negative events can spark health behavior change. This study tested a preliminary model using the Sentinel Events Method in a sample ($N = 300$) of smokers who sought care for acute cardiac symptoms. Patients completed measures on: smoking-related causal attribution, perceived severity of the acute illness event, illness-related fear, and intentions to quit smoking. Patients were followed up one week after the health event and a 7 day time line follow back (TLFB) was completed to determine abstinence from tobacco. Structural equation models were performed using average predictor scale scores at baseline, as well as three different time anchors for ratings of illness severity and illness-related fear. Quit intentions, actual illness severity, and age were consistent, positive, independent predictors of 7 day point prevalence abstinence. Additional research on the influences of perceptions and emotional reactions is warranted.

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Keywords

health behavior change; smoking cessation; addiction; cardiac symptoms

Introduction

A change in a person's health behaviors can happen after experiencing a health event, such as an acute illness, an exacerbation of a chronic illness, or receiving a new medical diagnosis. The event itself can act as a motivator, and contact with medical care providers can provide opportunities for education, intervention, and, when indicated, referral to behavioral health specialists. Researchers have explored the impact of important health events, or sentinel events, on a wide range of behaviors (Boudreaux, Bock, & O'Hea, 2012; McBride, Emmons, & Lipkus, 2003; Steward et al., 2009), including smoking cessation after myocardial infarction (MI) (Rigotti, McKool, & Shiffman, 1994; Taylor, Houston-Miller, Killen, & DeBusk, 1990) or a cancer diagnosis (Gritz, Nisenbaum, Elashoff, & Holmes, 1991; Gritz et al., 1993; Ostroff et al., 1995; Sanderson Cox et al., 2002). McBride and colleagues (2003) reviewed the literature and observed that individuals who experienced important health events, such as pregnancy, hospitalization, or a disease diagnosis, were significantly more likely to quit smoking than the general population. Moreover, patients who experienced a serious medical illness that required an inpatient hospitalization were more likely to be successful in smoking cessation than patients who simply attended an outpatient clinic appointment or a routine check-up. In 2012, Boudreaux et al. described the Sentinel Event Method and Theory (referred to as the SEM in previous articles), which outlines a stepwise method of building models to explain how events can spark future health behavior change. In an illustrative example, Boudreaux and colleagues used the method to build a hypothetical model explaining tobacco use after acute cardiac symptoms. The current paper takes the hypothetical model described in the original paper and prospectively tests several of its key components.

Influenced by the Theory of Planned Behavior (Ajzen, 1985) and Self-Regulation Theory (Rothman, Baldwin, Hertel, & Fuglestad, 2010), the model emphasizes the importance of intention as a mediator of behavior change and identifying both the cognitive and emotional responses to a sentinel event as potential mechanisms underlying health behavior change (Boudreaux et al., 2012; McBride et al., 2003). In addition, the Sentinel Event Theory states that these mechanisms should be assessed at multiple time anchors across the event because impactful changes in ways of thinking and feeling can occur as time progresses across the experience of the sentinel event and thereafter. For example, the initial cognitive and emotional reactions during the onset of an acute illness may differ from reactions after treatment has been received and the active symptoms have resolved.

The primary constructs in the model used in this study include: 1) actual illness severity, 2) smoking related causal attributions related to the acute illness, 3) perceived illness severity, 4) illness-related fear and anxiety, and 5) intentions to quit smoking. They are described extensively by Boudreaux and colleagues in theoretical as well as empirical papers (Boudreaux et al., 2012; Boudreaux, Baumann, Camargo, O'Hea, & Ziedonis, 2007;

Boudreaux et al., 2013; Boudreaux, Moon, Baumann, Camargo, O'Hea, & Ziedonis, 2010). Two papers have been published from the present dataset. The first was an exploration of the qualitative interviews data used to craft scales to measure the constructs (Tappe et al., 2012). Second, In Boudreaux et al., 2012, we presented the development and psychometric validation of four scales created to measure smoking-related causal attributions, perceived illness severity, event-related emotions, and intention to quit smoking among patients experiencing acute cardiac symptoms. Factor analyses revealed stable factor structures for each of the four constructs and the scales were found to be valid and internally consistent as well. Finally, explorations of the SEM model from other studies have been published elsewhere (Boudreaux et al., 2013); however, this is the first publication from the larger study to examine the SEM constructs after a health event and their impact on smoking cessation.

Actual Illness Severity

Actual illness severity is a quantification of the seriousness of the illness itself. For most diseases, there is an objective method for quantifying the disease severity, such as the system of staging used for cancers. In the case of acute cardiac symptoms, which are not a disease per se, the assignment of actual illness severity is not standardized. Many patients presenting with cardiac symptoms will not be experiencing a true cardiac event and will be discharged home with some alternative diagnosis like gastroesophageal reflux, while others will be hospitalized for an MI that requires procedures ranging from stent placement to coronary artery bypass graft surgery (CABG). In situations where illness severity is not standardized, it can be assigned based on simple criteria commonly used in clinical settings, such as whether the individual was discharged home or admitted to an inpatient unit from the emergency department (Charlson et al., 1986).

Causal Attribution

Causal attribution is an individual's perception of how specific health behaviors are related to his or her health problems. Support for the importance of causal attributions in relation to smoking cessation (Affleck, Tennen, Croog, & Levine, 1987; DeValle & Norman, 1992; Low, Thoresen, Pattillo, & Fleischmann, 1993; Plotkin-Israel, 1984; Weinman, Petrie, Sharpe, & Walker, 2000; French, James, Horne, & Weinman, 2005) is generally compelling, although some studies have failed to find a link (Attebring et al., 2004; Russo et al., 1996). Further study is needed to clarify the role that causal attributions play in predicting future behavioral choices following an acute illness, and how causal attributions interact with other predictors to influence actual behavior change.

Perceived Illness Severity

Perceived illness severity has been defined as a person's *perception* of the seriousness of the illness or symptoms he or she is experiencing. Numerous studies have established a positive association between perceived severity and subsequent health behavior change such as smoking cessation (Leventhal, Nerenz, & Steele, 1984; Pederson, Wanklin, & Baskerville, 1984; Scott & Lamparski, 1985). However, some studies have not found this association (Schofield, Kerr, & Tolson, 2007; Wang, Borland, & Whelan, 2005). The existing literature is characterized by several weaknesses. Many studies have examined 'hypothetical

situations' or potential future illness and have not studied patients who have actually experienced an event or illness. Furthermore, prospective studies that capture the patient's changes in perception across the health event and examine how these perceptions impact behaviors once the event is over are needed.

Illness-Related Emotional Reactions

Illness-related emotional reactions include any emotional reaction experienced during or after a health event. For example, an increase in anxiety, fear, or sadness can be common negative emotional reactions to experiencing an acute MI (Celano & Huffman, 2011; Frazier et al., 2002; Diemert, Bondy, Brown, & Manske, 2002; Guiry, Conroy, Hickey, & Mulcahy, 1987). However, very few studies have looked at how those emotions are related to subsequent behavioral changes. One exception is a study that followed 264 patients after their first MI (Guiry et al., 1987). The researchers assessed emotions such as anxiety and depression, as well as other variables, at baseline and then followed the patients over 1 year to determine how these variables impacted lifestyle behaviors including smoking. For the smokers enrolled, depression but not anxiety predicted increased likelihood of quitting smoking. Emotional reactions can be volatile and are influenced by a range of factors, which makes it difficult to examine how they influence making health decisions in real-time. As with perceived illness severity, this argues for measuring emotional reactions at multiple time anchors. For the current study, we were interested in how individuals respond emotionally to an acute health event and how those emotions were related to subsequent tobacco use.

Quit Intentions

Numerous studies have examined the relationship between quit smoking intentions and actual behavior change. Overall, the literature suggests that people with stronger quit intentions are more likely to attempt to quit than those with weaker intentions (Fagerstrom, Heatherton, & Kozlowski, 1992; Fagerstrom & Schneider, 1989; Tzilos, Strong, Abrantes, Ramsey, & Brown, 2013; Zhu et al., 2010). Nevertheless, many people who intend to quit smoking do not do so, and much is yet to be learned about predictors of transitioning from intentions to actual behavior change.

Present Study

For the present study, we examined actual illness severity, smoking-related causal attribution, perceived illness severity, illness-related fear, and intentions to quit among 300 patients who were being evaluated for chest pain in the emergency department or inpatient units. Generally, we anticipated that these variables would be positively related to abstinence; however, we were also interested in exploring the differences in the associations across various time anchors for variables that may fluctuate, such as perceived severity and emotions. This is the first paper from our study to evaluate the interactions of these constructs across time and their impact on health behavior change.

Method

Participants

A total of 409 total patients were approached and met all eligibility criteria, 300 (73%) were enrolled from both the emergency department and inpatient units. The average age of participants was 52 (± 11.14) years old, and ranged from 20 to 84 years old. The sample comprised 77% whites and 18% blacks, with 4% of the total sample identifying as Hispanic/Latino. There were no statistically significant differences in age or race between those who did and did not enroll into the study. However, a significant difference was found for ethnicity, such that Hispanic patients were less likely to enroll ($p < 0.05$), perhaps reflecting the fact that some Hispanic individuals living in the catchment areas of both hospitals do not speak fluent English and could not complete the questionnaire.

Procedure

Recruitment for this study took place at four hospitals: one in Camden, NJ, two in Providence, RI, and one in Worcester MA. Patients were enrolled from the emergency department and cardiac inpatient units. The study was approved by each hospital's Institutional Review Board and all participants consented to participate. Inclusion criteria were: (1) adults ≥ 18 years old; (2) presenting with chest pain, chest pressure, shortness of breath, or syncope; (3) having a cardiac evaluation consisting of an electrocardiogram and cardiac enzyme tests; and (4) being an active smoker of ≥ 1 cigarette per day. Exclusion criteria were (1) presentation with illicit drug use or alcohol abuse; (2) chest pain resulting from trauma; and (3) inability to participate in an interview (e.g., severe medical illness, cognitive insufficiency, insurmountable language barrier).

Patients were approached close to the end of their medical visit to ensure that the majority of the acute health event had transpired prior to interview, which was deemed important considering our interest in how perceptions and emotions change over the course of the event. Participants were heterogeneous, and there was a wide range of actual disease severity, from some patients having mild chest pain and being discharged home from the emergency department to some having an acute MI resulting in multi-vessel CABG surgery.

Measures

All participants completed the four cognitive and emotional measures (causal attribution, perceived illness severity, illness-related emotions, quit intentions). The psychometric properties of these scales are published (Boudreaux et al., 2013). As described in previous papers (Boudreaux et al., 2010, 2012, 2013) perceived illness severity and illness-related emotions were hypothesized to fluctuate over the course of the healthcare encounter. Consequently, at the time of enrollment, participants were told to think about three specific time anchors and provide ratings for the same items for each anchor. The anchors were (anchor 1) when they first started experiencing symptoms (retrospective), (anchor 2) when they first arrived to the hospital (retrospective), and (anchor 3) in the present moment (real time). Participants were enrolled as close to discharge as possible, so their "present moment" rating typically occurred after the majority of their acute medical encounter was over. This allowed the three anchors to span the entire chronology of the acute event. Quit intentions,

which also fluctuate over time, were assessed prior to the event (retrospectively) and at the assessment (real time). Qualitative work has suggested that causal attributions are more stable and do not change over the course of the visit, so they were assessed only once.

While retrospective recall of the anchors used for some of the constructs may be associated with recall bias, for the scope of this study it was not feasible to get actual ratings in real time when the patients first began experiencing the symptoms. However, since participants were enrolled during their healthcare visit, not much time had passed between the actual time anchors and when they provided their ratings, minimizing the influence of recall decay or interference by new information. In addition, in a recently published paper we tested the psychometric properties of the scales used in the study. Analyses demonstrated the measures at each time anchor to be reliable, and their factor structures to be sound and consistent across the anchors (Boudreaux et al., 2013). However, there are significant mean differences between the ratings, with marked decreases in the perceived seriousness and negative emotions and marked increases in intentions to quit by the time of the assessment, further justifying the repeated measures. Finally, even though recalled ratings may have some bias, it is actually the perception that is most likely to influence future behavior change, not the true feelings at the time of the actual event. If they were not really afraid when they came to the hospital, but they do recall themselves being afraid when asked, it is likely this recollection of fear that is going to influence their smoking when they get discharged.

Actual illness severity—The sample was highly heterogeneous in their medical diagnoses, which is important for examining the relations among the various predictors. We chose to assign each participant with a categorical disease severity rating that aligned with common clinical distinctions and were coded as: (0) treated in the emergency department and discharged, (1) admitted to an inpatient floor but received no intervention, and (2) admitted with an intervention, including percutaneous stent, balloon angioplasty, or CABG.

Smoking-related causal attribution—Participants were asked to answer seven questions that tapped into their beliefs about the association between smoking and their current health problem. The responses were based on a five-point scale, where one indicated 'no link' and five indicated 'extremely strong link.' Causal attribution was assessed *only once* and was anchored to the "current health problem" that brought the participant to the hospital. Psychometric data, including factor analysis results, can be found in Boudreaux et al., 2012. The smoking related causal attribution scale demonstrated one factor and moderate internal consistency ($\alpha=.75$)

Perceived illness severity—Perceived illness severity was assessed with eight items and was repeated for three different time anchors described above under *Measures*. The items were each rated on a five-point Likert-type response scale, where one indicated 'Strongly Disagree' and five indicated 'Strongly Agree.' Psychometric data, including factor analysis results, can be found in Boudreaux et al., 2012. The perceived illness severity scale demonstrated one factor and Cronbach alphas ranging from .81–.82.

Event-related emotions—Illness or Event-related emotions were assessed using 11-items assessing a variety of positive and negative emotions, such as fear, sadness, anxiety,

and happiness, and was repeated for three different anchors described above. The emotions were each rated on a five-point Likert-type response scale, where one indicated 'Not at All' and five indicated 'Extremely.' For the purpose of this paper, we focused on the three items that assessed fear and anxiety. Psychometric data, including factor analysis results, can be found in Boudreaux et al., 2012. The event related emotions scale demonstrated two factors (one positive emotion and one negative emotion) and Cronbach alphas ranged from .84–.89 for the negative items and .57 to .72 for the positive items.

Intention to quit smoking—Intention to quit smoking was assessed twice using seven items that asked patients about intention to quit smoking. Patients were asked about intention to quit smoking using two time anchors: (1) before their health event began, and (2) at the present time. The items such as 'I intend to quit smoking sometime within the next 30 days' were each rated on a five-point Likert-type response scale, where one indicated less intention and five indicated greater intention. Psychometric data, including factor analysis results, can be found in Boudreaux et al., 2012. The intention to quit smoking scale demonstrated one factor and Cronbach alphas ranging from .82–.87.

Tobacco cessation outcomes—Smoking cessation outcomes were measured at two time periods. First, seven days after the ED visit, participants were called by research staff to assess smoking behaviors and cessation efforts. A TLFB assessment, created for the purposes of this study, was conducted. Participants were considered abstinent only if they had abstained from smoking, even a puff of a cigarette, for the past seven days.

Covariates—Covariates included age, race, sex/gender, level of nicotine addiction as indicated by Heavy Smoking Index (Fagerstrom et al., 1992; Fagerstrom & Schneider, 1989), and whether the individual had a smoking related medical diagnoses, which was assigned using established procedures based on the Surgeon General's classification of ICD-9 codes (Bernstein, 2002; Boudreaux et al., 2007).

Data Analysis

We first examined the descriptive characteristics (means and standard deviations for continuous variables, frequencies and percentages for categorical variables) of the covariates, predictors, and outcomes. Repeated-measures ANOVAs were performed to examine within-person differences in perceived severity and event-related fear across the three time anchors. We used Pearson's correlations to examine the bivariate associations between covariates, predictors, and outcomes. A two-tailed *p-value* <0.05 was considered statistically significant. A series of saturated, manifest structural equation models using Mplus 6.0 (Muthen & Muthen, 1998–2011) were then performed. Since the models were saturated, there was no possibility for model misfit and fit indices, making fit indices non-informative. In the first model, we regressed quit intentions onto the set of covariates, with quit intentions then predicting 7-day abstinence at the 7 day follow-up. The direct effects of covariates on abstinence were included, and those covariates with an effect on either intentions or abstinence at the $p < 0.10$ level were retained in subsequent models. The next four models examined the extent to which causal attribution, perceived severity, illness-related fear, two-way interactions between causal attributions and perceived severity and

illness-related fear, and retained covariates were predictive of quit intentions and abstinence as reported from the TLFB data. We included the interaction effects between causal attribution and perceived illness severity and illness-related fear because they are theoretically important. Some individuals may have very serious illnesses but not quit smoking because they do not perceive their illness to be related to their smoking; therefore, interactions between these two variables may be more important than the individual variables alone. The first model used averaged ratings across the three time anchors, while the remaining three focused on each time anchor separately.

All variables were mean-centered before creating interaction terms in order to reduce unnecessary multicollinearity. Full information maximum likelihood (FIML) estimation was used to account for missing data over time. Standardized beta coefficients were reported in order to allow for efficient comparisons across models and other studies.

As described, we were interested in studying whether the strength of the associations between the predictors and smoking changed over the different time anchors. In order to statistically test for differential prediction across time anchors, we performed multiple groups structural equation models, with groups defined by time anchor, and constrained pathways to be equal across time. For example, the relationship between perceived severity and quit intentions were fixed as equal across the three time points (e.g., perceived severity at time 1 on quit intentions = perceived severity at time 2 on quit intentions), and significant model misfit was interpreted as indicative of a predictor X time interaction. Since the base models were saturated, any observed model misfit, as indexed by the χ^2 , was then due to these constraints. Models were performed constraining paths individually (e.g., perceived severity on 7-day follow up) and simultaneously (e.g., perceived severity, illness-related fear, perceived severity X causal attributions interaction, and illness-related fear X causal attributions interaction on quit intentions), both with and without retained covariates.

Results

Sample Characteristics

Table 1 presents the demographic and substantive descriptive characteristics of the sample. A total of 261 participants provided smoking-related data at the 7 day follow-up (retention = 89%), with 28% reporting abstinence from smoking for the first seven days following discharge. A comparison between participants retained and lost at follow-up found that the only observed difference was on perceived severity at the time of hospital arrival (time 2). The retained sample had a lower initial perceived severity, $t(294) = 1.97, p = 0.050$. The sample was comprised of a range of actual illness severity, with 107 participants (36%) discharged home from the ED, 100 (33%) admitted to an inpatient floor but without receiving an intervention, and 92 (31%) admitted with an intervention.

Significant variability in perceived illness severity and illness-related fear was observed across the three time anchors (means presented in Table 1). On average, perceived severity was lowest at the initial symptom onset (Time 1) and highest at the arrival to the hospital (Time 2), Greenhouse-Geisser $F(1.75, 509.42) = 16.06, p < 0.001$. Illness-related fear was

relatively constant at initial symptom onset and hospital arrival, with a significant drop off at the time of interview (Time 3), Greenhouse-Geisser $F(1.93, 558.30) = 97.08, p < 0.001$.

Bivariate Associations

Table 2 presents bivariate associations between covariates, predictors, quit intentions, and abstinence at the 7-day TLFB assessment. Abstinence was associated with older age, a smoking-related diagnosis, more serious actual illness, greater perceived illness severity at Anchors 1, 2, and 3, greater illness-related fear at Anchor 2, the interaction between causal attribution and perceived severity at Anchor 1, the interaction between causal attribution X illness-related fear at Anchor 2, and stronger intentions to quit smoking. A similar pattern of associations were noted for bivariate predictors of quit intentions, though the strength of the associations were generally stronger, and also included illness-related fear at Anchors 1, 2, and 3.

Multivariable Models

A structural equation model examining only the covariates was performed, including age, sex, race, HSI, and whether a smoking-related diagnosis was present. This model was not shown to reduce the number of figures. Age and sex were associated with quit intentions and/or abstinence at $p < 0.10$ and retained in all subsequent models.

Figure 1 presents the results of the model using perceived illness severity and illness-related fear ratings associated with Anchor Time 1, initial symptom onset. Included are covariates, causal attribution, and intentions to quit (current), as well as key interaction variables. Quit intentions prior to the event, and the change between these were not included to reduce collinearity. This decision was confirmed through multivariable logistic regression showing that current intentions were the strongest predictor, and the others (pre-event, change in intention) were no longer significant once current ratings were entered. In the model depicted in Figure 1, intentions to quit smoking, perceived illness severity, stronger actual illness severity, and age significantly predicted abstinence. Older age was significantly related to abstinence one week after discharge. At anchor 1, the variables that appear to impact intentions to quit smoking include greater causal attributions and actual severity; however, illness-related fear was also marginally significant at a 0.10 level.

Figure 2 presents the results of the model using perceived illness severity and illness-related fear ratings associated with Anchor Time 2, hospital arrival. Similar patterns from the other figures were observed in that intentions to quit smoking, actual severity of illness, and older age were strongest predictors of abstinence. However, for intentions to quit smoking, the association with event related fear became stronger than Anchor 1 and became statistically significant.

Figure 3 presents the results of the model using data from time of enrollment, or Anchor 3. In this model, intentions to quit smoking remained strongly related to abstinence, as did age and actual severity of illness. Causal attribution, perceived illness severity, and actual illness severity were all significantly related to intentions to quit at this third time point.

Despite the variability in the strength of the various paths across the three different time anchors, a formal test suggested that there was no significant time X predictor effect. Specifically, there were no significant differences in the effects of perceived severity (χ^2 [2] = 2.48, p = 0.29), illness-related fear (χ^2 [2] = 3.75, p = 0.15), and interactions with causal attributions (χ^2 [2] = 2.38, p = 0.30) on quit intentions or abstinence.

Discussion

The results of this study provide important new insights into tobacco use after an acute illness. We discuss the consistencies across the four structural equation models, and then explore some of the differences. For all of the models, three variables were most consistently related to seven day abstinence following the health event: 1) intentions to quit smoking, 2) actual illness severity, and 3) age. Also, across all models, intentions to quit smoking, assessed toward the end of the healthcare encounter shortly before discharge, was the strongest predictor of abstinence seven days after leaving the hospital. Previous studies have found a similar positive association between intentions and tobacco cessation (Diemert et al., 2002; Tzilos et al., 2013; Zhu et al., 2010). A relatively recent review of eight studies that measured predictors of successful quit attempts in adult smokers concluded that quit intentions are important in predicting future smoking behaviors (Vangeli, Stapleton, Smith, Borland, & West, 2011). Indeed, the meaningful role of quit intentions has been found in a range of populations such as healthy young adults (Diemert et al., 2002), adolescents with psychiatric disorders (Tzilos et al., 2013), and across a number of different cultures (Fagerstrom et al., 1996; Zhu et al., 2010). If intentions are important, then understanding what influences intentions is also important. The strongest predictor of quit intentions was smoking-related causal attributions, which is similar to other findings in previous studies done by our team (Boudreaux et al., 2010). The models suggest that quit intentions fully mediate the relationship between causal attribution and abstinence. That is, those individuals who felt that their smoking was strongly related to their current illness had markedly stronger intentions to quit smoking, and were therefore more likely to quit smoking immediately upon discharge.

The second strongest predictor of abstinence across the models was actual illness severity. Patients who had serious cardiac events leading to hospitalization or an intervention, such as stent placement or CABG surgery, were more likely to quit smoking than those who had cardiac-related symptoms but were discharged home straight from the ED. Notably, this association is only partially mediated by intentions to quit smoking, suggesting that, while serious events may increase intentions, they may also help propel the individual from intention to action. Although smoking interventions cannot directly impact disease severity, it may be possible to tailor interventions for patients of different disease severity. Interventions geared toward inpatients in cardiac intervention units, for example, could move very quickly to focus on taking actions to quit, while those of patients discharged from the ED may need to focus on more rudimentary motivation enhancement. Studies that have provided bedside interventions for hospitalized patients have shown promising results. For example, Smith and Burgess examined an intensive smoking cessation intervention with patients after they were admitted to the hospital because of an MI (2009). Participants who were randomized to the intensive intervention received advice from medical staff regarding

smoking cessation, printed educational materials, 60 minutes of inpatient counseling, and 7 brief nurse counseling phone calls for 2 months post discharge from the hospital. At 12 months, patients who received the intensive intervention had a 57% confirmed abstinence rate, which was greater than the abstinence rate (39%) in the minimal intervention group. Interventions targeting ED patients who are being discharged will, because of the setting, need to be briefer and more focused on enhancing motivation and linking motivated individuals to outpatient care (Bernstein & Becker, 2002). Age was consistently related to abstinence, demonstrating that individuals who are older and experiencing a potentially smoking related health event, are more likely to quit smoking immediately after the event. Age was not related to greater quit intentions, however, which may suggest that older smokers are more likely to take action immediately following a health event, without the need for specific intentions. Previous studies have demonstrated that overall older smokers, as well as younger smokers, are more likely to initiate attempts as compared to middle-aged smokers (Fidler, Ferguson, Brown, Stapleton, & West, 2013). Further, an increase in quit attempts following a cardiac diagnoses in older adults has also been documented (Keenan, 2009).

Qualitative studies have suggested that perceptions of severity and emotional reactions change rapidly over the course of the event, warranting separate examination (Tappe et al., 2012). Blending these ratings into a single aggregate indicator has the potential to obscure nuances in the relations between these time-varying constructs and tobacco-related outcomes. It is feasible, for example, that the lingering perceptions of severity after the illness has been treated and the symptoms have subsided may not have as much of an influence on subsequent behavior as the maximum peak perceptions of severity during the worst part of the health crisis. This is the reason four models were constructed. While the formal test of a Time X Predictor interaction suggested the strength of the associations between perceived illness severity, illness-related fear, and tobacco-related outcomes did not differ greater than chance, we chose to present the three models separately because of their heuristic value and the early stages of this line of inquiry. This is an emerging area of study and to revert to a model where the different time anchored ratings are blended into a single score has the potential to discourage future examination of time-varying prediction models, which have been encouraged by theoretical developments in dynamic model building (Rothman, 2000). For example, when comparing the three figures, perceived illness severity's direct influence on smoking cessation is strongest when anchored to initial symptom onset. In other words, patients who thought their symptoms were serious when they first began having symptoms were more likely to quit smoking, even after controlling for intentions to quit. In contrast, perceptions of severity at the end of the visit no longer exert a direct effect on abstinence, but continue to exert an indirect effect through quit intentions. While actual illness severity is not a modifiable factor, perceptions of illness severity might be. Within our sample, for example, the correlations between actual illness severity and perceived illness severity ranged from 0.11 to 0.32. While significant, these correlations imply that there is a disconnection among many patients who do not rate their illnesses as serious, even after having an MI with an intervention. An intervention strategy that has not received much attention is helping to connect patient's perceptions with reality. In addition, one can potentially use a less serious event as a teachable moment to describe

the “potential” serious event they “missed.” Rather than simply discharging the gastrointestinal reflux patient with assurances that he or she is not having a serious MI, the physician can not only explain the link between smoking and reflux but also the potential for developing a serious MI, with advice on how to avoid both through smoking cessation.

Null Findings and Limitations

At one week post health event the interactions of the causal attribution and perceived severity and event-related fear were not predictive of intentions or behavioral change. None of the six possible interactions tested showed significant associations with the outcomes. Although our findings are likely null findings, our outcome assessment was only 7 days post event and longer term follow up may result in different results. Additional investigation is needed to understand how both cognitive *and* emotional reactions, and their inter-relations with one another, translate an event into short and *long-term* behavior change. There are also weaknesses in the methodology of this study that could account for the null findings. As mentioned in the methods, the ratings for the first two anchors, initial symptom onset and hospital arrival, were, by necessity, retrospective. Ideally, cognitions and emotions would be assessed in real time and not after time has passed, which may change the salience of the event. Future research in this area may benefit from more advanced assessment approaches, such as Ecological Momentary Assessment (EMA), of potentially dynamic constructs such as those evaluated in this paper. We did not collect biological data to validate the patients' self reports of abstinence. In 2002, the SRNT Subcommittee on Biochemical Verification (2002) concluded that using TLFB (as was used in this study) is likely to produce accurate estimates of cessation rates and are similar to what you would find from biological validation. This is particularly true when the pressure to exaggerate abstinence is low, as in non-interventional trials like this one. Biological validation is highly unlikely to alter the results significantly.

Conclusion

Our results extend previous findings pertaining to predictors of smoking cessation after a sentinel health event. Several innovations in our methods allowed a more thorough examination of the complex interplay between cognitive factors, emotional states, covariates, quit intentions, and tobacco use outcomes. It is evident that factors related to behavioral intentions are not necessarily the same constructs that impact the movement from intentions to actual behavior change and that different emotions or cognitions may hold more importance depending on the time they are experienced (i.e., at the beginning of symptoms, when arriving to the hospital, or when resolution of the crisis).

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Figure 1. Predicting intentions and smoking abstinence using perceived illness severity and illness-related fear ratings for initial symptom onset (Anchor 1)

Note: Values presented represent standardized beta coefficients. Bolded boxes and arrows used to call attention to associations with a p value less than 0.05.

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 2. Predicting intentions and smoking abstinence using perceived illness severity and illness-related fear ratings at hospital arrival (Anchor 2)

Note: Values presented represent standardized beta coefficients. Bolded boxes and arrows used to call attention to associations with a p value less than 0.05.

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 3. Predicting intentions and smoking abstinence using perceived illness severity and illness-related fear ratings at Anchor of enrollment (Anchor 3)

Note: Values presented represent standardized beta coefficients. Bolded boxes and arrows used to call attention to associations with a p value less than 0.05.

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 1

Covariate, predictor, and outcome descriptive statistics (n=300)

	Frequency	Percentage	Mean	Standard Deviation
Age			52.00	11.14
Sex (Male)	156	52.0%		
Race (White)	232	77.3%		
HSI			2.81	1.59
Any Smoking-Related Diagnosis	206	68.7%		
Actual Severity			1.59	1.25
Discharged from ED	107	35.7%		
Admitted, no intervention	100	33.3%		
Admitted, intervention	92	30.7%		
Causal Attribution			3.55	0.72
Perceived Severity – Anchor 1			3.39	0.83
Perceived Severity – Anchor 2			3.62	0.73
Perceived Severity – Anchor 3			3.47	0.74
Perceived Severity – Average			3.50	0.64
Illness-related fear – Anchor 1			3.07	1.14
Illness-related fear – Anchor 2			3.03	1.15
Illness-related fear – Anchor 3			2.27	1.09
Illness-related fear – Average			2.80	0.94
Quit Intentions – Prior to Event			3.02	0.87
Quit Intentions – Current			3.49	0.90
Change in Quit Intentions			0.47	0.79
7-Day Point Prevalence ^a	84	31.5%		
Number of Days Abstinent in Week Following Discharge			3.08	0.31

^aPercentage of retained participants at 7 day follow-up (i.e., 84/267 participants)

Anchor 1 = Initial symptom onset (retrospective)

Anchor 2 = Upon hospital arrival (retrospective)

Anchor 3 = At enrollment (real Anchor, near discharge)

Table 2

Bivariate correlations between covariates/predictors and outcomes (n=300)

	Quit Intentions, Pre-event	Quit Intentions, Current	Change in Quit Intentions	7-Day Point Prevalence
Age	-0.02	-0.03	-0.03	0.18 **
Sex (Male)	-0.01	0.06	0.07	-0.08
Race (White)	0.14 *	0.02	-0.14 *	-0.10
HIS	-0.13 *	-0.04	0.10	-0.05
Any Smoking-Related Diagnosis	-0.05	0.07	0.14 *	0.21 **
Actual Severity	0.02	0.26 ***	0.27 ***	0.29 ***
Causal Attribution	0.17 **	0.38 ***	0.25 ***	0.10
Perceived Severity – Anchor 1	0.09	0.12 *	0.04	0.17 **
Perceived Severity – Anchor 2	0.08	0.24 ***	0.18 **	0.17 **
Perceived Severity – Anchor 3	0.05	0.29 ***	0.26 ***	0.18 **
Perceived Severity – Average	0.09	0.26 ***	0.19 **	0.22 ***
Causal Att. X Perceived Severity-Anchor 1	0.06	0.05	-0.01	0.15 *
Causal Att. X Perceived Severity-Anchor 2	-0.08	0.00	0.09	0.04
Causal Att. X Perceived Severity-Anchor 3	-0.06	0.02	0.08	0.07
Causal Att. X Perceived Severity – Average	-0.04	0.02	0.06	0.09
Illness-related Fear – Anchor 1	0.14 *	0.19 **	0.06	0.01
Illness-related Fear – Anchor 2	0.16 **	0.26 ***	0.11	0.12 *
Illness-related Fear – Anchor 3	0.14 *	0.14 *	-0.01	0.09
Illness-related Fear – Average	0.18 **	0.23 ***	0.06	0.10
Causal Att. X Illness-related Fear - Anchor 1	0.04	0.00	-0.05	0.06
Causal Att. X Illness-related Fear-Anchor 2	-0.12 *	-0.04	0.08	0.12 *
Causal Att. X Illness-related Fear - Anchor 3	-0.07	-0.06	0.00	0.06
Causal Att. X Illness-related Fear – Average	-0.03	0.02	0.05	0.06
Quit Intentions, Pre-event	N/A	0.60 ***	-0.42 ***	0.15 *
Quit Intentions, Current	0.60 ***	N/A	0.48 ***	0.26 ***
Change in Quit Intentions	-0.42 ***	0.48 ***	N/A	0.13 *

*
 $p < 0.05$ **
 $p < 0.01$ ***
 $p < 0.001$

Anchor 1 = Initial symptom onset (retrospective)

Anchor 2 = Upon hospital arrival (retrospective)

Anchor 3 = At enrollment (real Anchor, near discharge)

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