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Conversations about pictorial cigarette pack warnings: Theoretical mechanisms of influence

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ABSTRACT

Background: Social interactions are a key mechanism through which health communication campaigns influence behavior. Little research has examined how conversations about pictorial warnings motivate behavior.
Purpose: We sought to establish whether and how smokers' conversations explain the effect of pictorial warnings on quit attempts.
Methods: US adult smokers ($n = 2149$) participated in a controlled trial that randomly assigned them to have their cigarette packs labeled with pictorial or text-only warnings for four weeks. Surveys assessed the number of conversations sparked by pictorial warnings and the theoretical mechanisms cognitive elaboration and social norms at each visit. Analyses used structural equation modeling to test our theorized mediation models.
Results: The number of conversations about the warnings mediated the relationship between exposure to pictorial warnings and quit attempts ($p < .001$). In serial mediation analysis examining possible theoretical mechanisms, the number of conversations was associated with greater cognitive elaboration, which in turn was associated with being more likely to make a quit attempt ($p < .05$). Social norms did not explain the influence of conversations on quit attempts.
Conclusions: Pictorial warnings increased conversations about the warnings, which led to greater cognitive elaboration, which led to greater quit attempts. Our findings suggest designing warnings that increase conversations in order to better inform and motivate smokers. Furthermore, these findings improve our understanding of why conversations matter in health communication.

1. Introduction

Social interactions are increasingly recognized as a key mechanism through which health communication campaigns influence behavior (Hornik and Yanovitzky, 2003; Katz and Lazarsfeld, 2006; Moracco et al., 2016; Noar, 2006; Southwell and Yzer, 2009, 2007) Campaigns reach the public through direct exposure to messages, but viewers discussing this information with others may also be critical to extending the reach of a campaign (Wakefield et al., 2010). Thus, conversations about health communication campaigns may mediate the relationship between exposure to campaigns and their intended outcomes (Southwell and Yzer, 2009, 2007), although much more research is needed to understand this phenomenon.

Three theoretical mechanisms could be responsible for the effect of conversations about a media campaign on behavioral outcomes (Southwell and Yzer, 2007). First, conversations may directly increase *cognitive elaboration* (*i.e.*, thinking about the campaign) because individuals invest more heavily in processing the initial information in order to prepare themselves for the conversation or cognitive elaboration is increased as a result of the conversation (Southwell and Yzer, 2007). Second, people's health behavior, like smoking, may be influenced by a person's perception of *injunctive norms* surrounding that behavior (*i.e.*, whether others approve or disapprove of the behavior) (Ajzen, 1991; Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). Campaigns may instigate conversations that affect normative beliefs (David et al., 2006; Hornik and Yanovitzky, 2003; Valente, 1995;

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Valente and Saba, 1998; Yanovitzky and Stryker, 2001). Third, in addition to hearing and storing information directly from the media for later retrieval, conversations about the campaign's messages may prompt related thoughts and therefore may increase message recall (Dickinson and Givón, 1997; Edwards and Middleton, 1987; Southwell, 2005).

Because smoking is a social behavior, heavily influenced by peer and social networks (Chen et al., 2001; Christakis and Fowler, 2008; Powell et al., 2005), social interactions may be particularly important in the context of anti-smoking communication campaigns and pictorial warnings on cigarette packs (Noar et al., 2017). Smokers are more likely to socialize with other smokers, and smoking influences the behavior of others within a social network (Christakis and Fowler, 2008). Furthermore, smoking behavior frequently happens in social settings (Moran et al., 2004; Schane et al., 2009), offering openings for conversations to take place. Several studies have found face-to-face or online social interactions were positively associated with motivation to stop smoking (Depue et al., 2015; Dunlop et al., 2008a, 2008b; Durkin and Wakefield, 2006; Hafstad et al., 1997, 1996; Ramanadhan et al., 2017; Schuster et al., 2006; Van Den Putte et al., 2011).

Social interactions may be especially important for pictorial cigarette pack warnings. Cigarette packs are an effective communication medium, both for marketing purposes (Slade, 1997; Wakefield et al., 2002) and communicating the health risks of smoking (Hammond, 2011). Compared to text warnings, pictorial warnings elicit a greater likelihood of making a quit attempt and more conversations about warnings compared to text warnings, according to experimental studies (Brewer et al., 2016b; Hall et al., 2015; Morgan et al., 2017). In observational research, participants report more conversations about pictorial warnings after their introduction (Hammond et al., 2003; White et al., 2008). Conversation may reflect deeper cognitive processing that can motivate quitting (Hammond et al., 2003), or reduce intentions to smoke (White et al., 2008). These previous studies did not examine whether conversations mediated the impact of warnings on intentions or behavior. Understanding the role that conversations about warnings play in cessation, and the processes by which they exert their influence, can help policy makers identify the most effective warnings as they implement the warnings required by the US Family Smoking Prevention and Tobacco Control Act ("Family Smoking Prevention and Tobacco Control Act," 2009).

Though other research has explored mediational mechanisms to explain why pictorial cigarette pack warnings change behavior, the effects of conversations about pictorial warnings remain understudied, especially when compared to attention paid to pictorial warnings and emotional reactions provoked by the pictorial warnings (Brewer et al., 2018; Cho et al., 2018; Hall et al., 2018; Skurka et al., 2018). An experimental meta-analysis found zero studies examining conversations about pictorial warnings (Noar et al., 2016b), and a systematic review of observational studies found only two studies that measured pre- and post-exposure conversations (Noar et al., 2016a). Since these meta-analyses were undertaken, other research has examined important correlates of communicating about warnings, including differences across countries (Thrasher et al., 2016), changes pre/post policy implementation (Thrasher et al., 2016), and interplay with media campaigns (Nagelhout et al., 2015). One multi-country longitudinal study demonstrated that having conversations about pictorial warnings was associated with future quit attempts (Thrasher et al., 2016).

We sought to establish how conversations about pictorial warnings impact smoking behavior in a randomized trial with a sample of adult US smokers. We aimed to examine whether conversations mediate the relationship between exposure to pictorial warnings and quit attempts, and, importantly, to understand whether and how the theoretical mechanisms of cognitive elaboration, injunctive norms, and recall may influence quit attempts.

Table 1
Participant characteristics.

Characteristic	Text-Only Warnings (n = 1078)	Pictorial Warnings (n = 1071)
Age in years, mean (SD)	39.7 (13.4)	39.8 (13.7)
Gender		
Female	548 (51.2)	512 (48.2)
Male	507 (47.4)	532 (50.0)
Transgender	15 (1.4)	19 (1.8)
Gay, lesbian or bisexual	173 (16.3)	195 (18.8)
Hispanic	92 (8.6)	89 (8.5)
Race		
Asian	28 (2.7)	42 (4.0)
Black	484 (45.8)	510 (48.9)
White	393 (37.2)	358 (34.3)
Other/multi-racial	152 (14.1)	134 (12.5)
Education		
High school or less	333 (31.1)	344 (32.5)
Some college	519 (48.5)	502 (47.4)
College graduate	156 (14.6)	156 (14.7)
Graduate or professional degree	63 (5.9)	58 (5.5)
Low income (< 150% of federal poverty level)	570 (53.0)	589 (55.2)
Cigarettes smoked per day, mean (SD)	8.8 (6.6)	8.7 (7.3)

Note: Data are reported as number (percentage) of participant unless otherwise noted. Characteristics did not differ by trial arm. Missing demographic data range from 0% to 2%.

2. Methods

2.1. Participants

We recruited a convenience sample of 2149 adult smokers (ages 18 or older) in North Carolina and California, US from September 2014 to August 2015 (Brewer et al., 2016b). The three most effective methods for identifying participants were craigslist, word of mouth, and Facebook (Brodar et al., 2016). Trial participants were diverse in race, sexual orientation, education and income; participant characteristics did not differ by trial arm (Table 1).

2.2. Procedures

We conducted a randomized clinical trial comparing the impact of pictorial warnings versus text-only warnings (clinicaltrials.gov identifier: NCT02247908). The trial methods appear in Brewer et al. (2016a,b) and in brief below. As reported previously, smokers in the pictorial warning arm were more likely to make a quit attempt across the four weeks than those in the text-only warning arm (Brewer et al., 2016b).

Participants brought in an eight-day supply of cigarettes to the baseline visit and received one of eight randomly assigned warnings on their cigarette packs. Participants received the same warning for the duration of the trial. Four pictorial warnings contained text required by the Tobacco Control Act and a picture to illustrate a health harm of smoking selected from the FDA's originally proposed set of images (Fig. 1) (Nonnemaker et al., 2010). Four text-only control warnings used the US Surgeon General's warning statements that have been required on the side of cigarette packs since 1985.

Participants completed computer surveys at the baseline visit and at each subsequent weekly visit. While participants completed the surveys at these appointments, research staff placed the assigned warnings on participants' cigarette packs following a standardized protocol (Brewer et al., 2016a). Participants randomized to the pictorial warning arm had warnings placed on the top 50% of the front and back of their cigarette

Fig. 1. Pictorial cigarette pack warnings used in study.

packs, in accordance with the proposed FDA requirements ("Family Smoking Prevention and Tobacco Control Act," 2009). Participants in the text-only warning arm had warnings placed on the side of the packs covering the existing US Surgeon General's warnings; staff applied the text warnings on top of the existing warnings to control for the effect of putting a label on smokers' packs. All participants provided their written informed consent and The University of North Carolina's institutional review board approved the study procedures.

2.3. Measures

The survey used previously validated items and newly developed survey items that we cognitively tested with 15 adult smokers (Willis, 2004). The baseline survey assessed demographic characteristics and the four weekly follow-up surveys asked about frequency of conversations, quit attempts, cognitive elaboration about the warning, injunctive norms about quitting, and recall of the warning.

2.3.1. Conversation frequency

The weekly surveys assessed frequency of conversations about the warnings with one item, "In the last week, how many times did you talk to other people about the health warning on your cigarette packs?" The response options were "never" (coded as 1), "1–2 times" (coded as 1.5), "3–4 times" (coded as 3.5), "5–9 times" (coded as 7), and "10 or more times" (coded as 10).

2.3.2. Quit attempts

The survey assessed weekly quit attempts with the item "During the last week, did you stop smoking for 1 day or longer because you were trying to quit smoking?" We defined an overall quit attempt as answering "yes" to one of the weekly quit attempt questions. Due to missed or delayed surveys, we also coded participants as having attempted to quit if on the last survey they answered "yes" to the item "Since you started the study, did you stop smoking for 1 day or longer because you were trying to quit smoking?"

2.3.3. Theoretical mechanisms

The weekly surveys assessed cognitive elaboration with three items: "How much did the warning cause you to think about the harmful effects of smoking?", "When you notice your cigarette pack, how often do you think about the message that the warning conveys?", and "When your cigarette pack is not in sight, how often do you think about the message that the warning conveys?" The five-point response scales ranged from "not at all" to "all the time" for the first item and "never" to "all the time" for the other two items (Borland et al., 2009b; Hammond et al., 2003). The weekly surveys used three items to assess injunctive norms: "People who are important to me would approve of my quitting smoking in the next 2 months," "People who are important to me think I should quit smoking in the next 2 months," and "People who are important to me want me to quit smoking in the next 2 months." The five-point response scale for the three items ranged from "strongly disagree" to "strongly agree" (Armitage, 2007).

To measure unaided recall, the survey asked participants in the pictorial warning arm to describe the image on their pack, and participants in both arms to describe the text of the message. Participants answered this question only once throughout the trial on a randomly assigned week. Two coders read the written entries and coded recall as correct or not (kappa = .96); the coders settled discrepancies by consensus. For the pictorial arm, correct recall included recalling either the text or the image accurately.

2.4. Analysis

We examined the number of conversations about pictorial warnings and theoretical mechanisms as mediators of the relationship between pictorial warning and quit attempts using MPLUS version 9.3 (Muthén and Muthén, 2015). We report results as standardized path coefficients (βs). Because the quit attempt outcome is binary, we used the WLSMV estimator with theta parameterization (Muthén and Muthén, 2009). Multiple imputation strategies are not recommended with this approach. We used bootstrapped 95% confidence intervals with 1000 repetitions for mediational analysis, as this approach does not assume that indirect effects are normally distributed (Hayes, 2009). For the theoretical mechanisms model, we assessed measurement models for cognitive elaboration and injunctive norms for adequate fit before estimating the structural model examining theoretical mechanisms as a mediator of the relationship between number of conversations and quit attempts. We evaluated several indicators of acceptable model fit, including the root mean square error of approximation (RMSEA < .08) (Steiger, 1990), the Tucker-Lewis Index (TLI > 0.95) (Tucker and Lewis, 1973), and the Bentler Comparative Fit Index (CFI > 0.95) (Bentler, 1990).

For the theoretical mechanisms model (supplemental figure 1), we used an iterative model building process, looking at each theoretical mechanism individually and examining model fit as additional mediators were added; when mediators were not statistically significant or worsened model fit, we eliminated them from future models. Due to the longitudinal nature of the data, we lagged variables in different patterns to test the mediation of the theoretical mechanisms. First, we tested a non-lagged model where the number of conversations, the theoretical mechanisms, and quit attempts all occurred within the same week. We then examined two alternative lag patterns. Lag A placed the number of conversations and theoretical mechanisms at weeks one, two and three to predict quit attempts at weeks two, three and four. Lag B placed the number of conversations at weeks one and two to predict the theoretical mechanisms at weeks two and three, which in turn would predict quit attempts at weeks three and four. Due to the non-independence of the repeated observations across individuals over time, we allowed residuals for the same items at different time points to covary. We examined modification indices to identify changes that would improve model fit where theoretically plausible (Bollen, 1998; Kline, 2011).

3. Results

3.1. Conversations as a mediator

Smokers with pictorial warnings on their packs had more conversations throughout the trial compared to those with text-only warnings (mean = 8.2, SD = 8.0 vs. mean = 5.0, SD = 6.3 conversations; $\beta_a = 0.22$, $p < .01$; Fig. 2) (Morgan et al., 2017). Having more conversations was associated with being more likely to engage in a quit attempt ($\beta_b = 0.24$, $p < .001$), mediating the relationship between

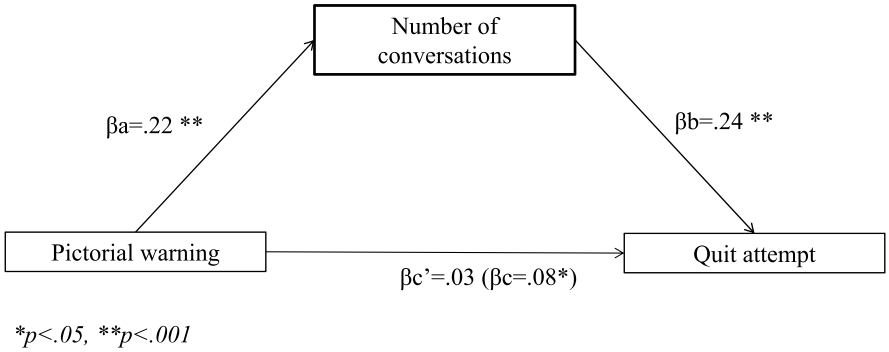

Fig. 2. Frequency of conversations as a mediator of the association between pictorial warning exposure and quit attempts (n = 2149).

exposure to pictorial warnings and quit attempts ($\beta_a \times \beta_b$ = .05 [95% CI 0.04 to 0.07], mediation $p < .001$; Fig. 2). Another way to examine the same findings is to observe that, without number of conversations as a mediator, the effect of pictorial warnings on quit attempts was statistically significant (β_c = 0.08, $p < .05$). When accounting for the mediating effect of number of conversations, the effect of the pictorial warning on quit attempts was no longer statistically significant, indicating full mediation ($\beta_{c'}$ = 0.03, *ns*).

3.2. Theoretical mechanisms for mediation

In analyses that examined theoretical mechanisms explaining the relationship between number of conversations and quit attempts, the non-lagged mediation models were good fits for cognitive elaboration and injunctive norms. However, in the iterative model building process, recall mediation models all demonstrated poor fit, and models failed to converge when included in multiple mediation models; therefore we dropped recall from the final model. The final model including both cognitive elaboration and injunctive norms had good fit (RMSEA = .032 [90% CI = 0.030 to 0.034], CFI/TLI = 0.95/.93; Fig. 3). As a result of modification indices and based on prior theoretical and empirical work, this final model included a pathway controlling for the direct effect of pictorial warnings on cognitive elaboration. Model fit and modification indices did not support a similar path for the direct effect of pictorial warnings on injunctive norms. Models examining different lags (Lag A and B) both had good fit for cognitive elaboration and injunctive norms, with similar or smaller mediational effects (Supplementary Tables 1 and 2). We chose the non-lagged model for parsimony and because it used all available data. The non-lagged model excludes 151 cases due to missing data (n = 1998). Missingness did not differ by trial arm.

Pictorial warnings increased the number of conversations (β_a ranged 0.13 - 0.24, all $p < .001$; Table 2), which was associated with greater cognitive elaboration (β_d ranged 0.60 to 0.84, all $p < .001$), which in turn was associated with being more likely to engage in a quit attempt (β_b ranged 0.47 - 0.50, all $p < .001$). The mediated effect of cognitive elaboration was largest at week one ($\beta_a \times \beta_d \times \beta_b$ = 0.10 [95% CI 0.07 to 0.13]), but remained statistically significant in weeks two through four. The size of the effect decreased after the first week for both the *a* from pictorial warning exposure to number of conversations and the *d* from number of conversations to cognitive elaboration. However, the *b* from cognitive elaboration to quit attempt was consistent across the four weeks of the study. Injunctive norms was not a statistically significant mediator at weeks one, three and four, but had a very small negative mediated effect at week two ($\beta_a \times \beta_d \times \beta_b$ = −0.004 [95% CI -0.01 to −0.001]).

4. Discussion

Pictorial cigarette pack warnings increased quit attempts, in part by increasing the number of conversations about warnings. Previous research has found that people talk about smoking cessation campaigns and pictorial warning labels with others in their social networks (Dunlop, 2011; Dunlop et al., 2014, 2008b; Durkin and Wakefield,

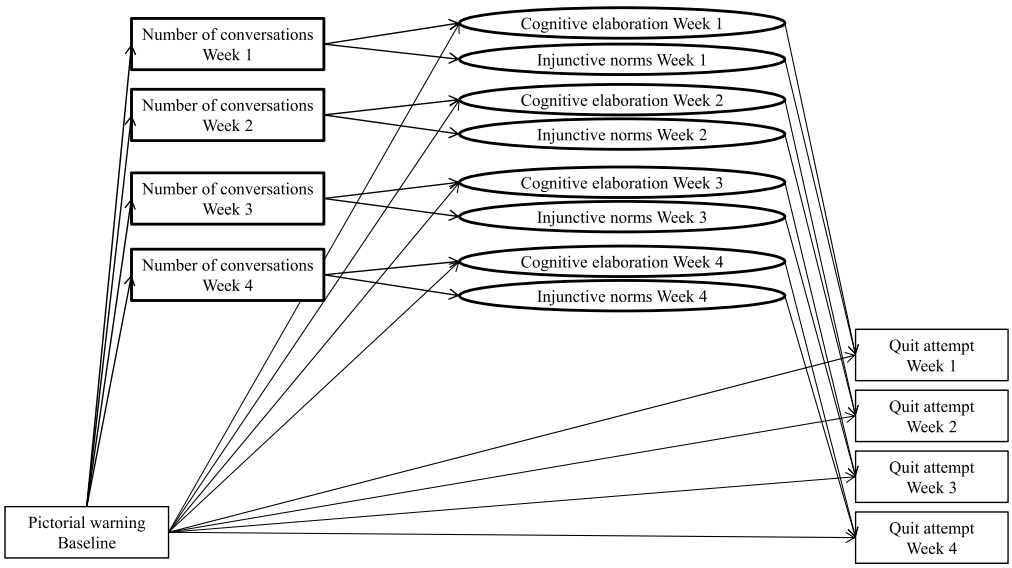

Fig. 3. Structural equation model for theoretical mechanisms as mediators (n = 1998). Squares represent measured variables. Ovals represent latent factors. Indicators for cognitive elaboration and injunctive norms not shown. Residuals for the same variables measured at different times were allowed to covary. Residuals for cognitive elaboration and social interactions at the same time point were allowed to covary.

Table 2
Cognitive elaboration and injunctive norms as mediators of the association between pictorial warning exposure and quit attempts (n = 1998).

Mediation pathways	βa	βd	βb	Mediated effect (95% CI)
Pictorial warning → Number of conversations w1→ Cognitive elaboration w1 → Quit attempt w1	.24**	.84**	.50**	.10* (.07–.13)
Pictorial warning → Number of conversations w1→ Injunctive norms w1 → Quit attempt w1	.24**	.21**	-.08	.00 (−.01 to .00)
Pictorial warning → Number of conversations w2→ Cognitive elaboration w2 → Quit attempt w2	.15**	.60**	.50**	.05* (.03–.06)
Pictorial warning → Number of conversations w2→ Injunctive norms w2 → Quit attempt w2	.15**	.23**	-.11*	-.004* (−.01 to −.001)
Pictorial warning → Number of conversations w3→ Cognitive elaboration w3 → Quit attempt w3	.13**	.62**	.49**	.04* (.02–.06)
Pictorial warning → Number of conversations w3→ Injunctive norms w3 → Quit attempt w3	.13**	.24**	-.08*	.00 (−.01 to .00)
Pictorial warning → Number of conversations w4→ Cognitive elaboration w4 → Quit attempt w4	.13**	.65**	.47**	.04* (.02–.06)
Pictorial warning → Number of conversations w4→ Injunctive norms w4 → Quit attempt w4	.13**	.17**	-.04	.00 (−.00 to .00)

Note. Table reports standardized path coefficients (βs). *a* is the impact of pictorial warnings on number of conversations. *d* is the association of number of conversations to the theoretical mechanism (cognitive elaboration, injuctive norms). *b* is the association of the theoretical mechanism and quit attempts. Mediated effect is *a*d*b*. Model specifications: results came from a multiple serial mediator model; residuals for the same variable measured at different weeks (1 to 4) were allowed to covary; residuals for number of conversations were allowed to vary with cognitive elaboration at the same time point; model controlled for the direct effect of pictorial warnings on cognitive elaboration.

2006; Hafstad et al., 1997; Hwang, 2012; Jeong et al., 2015; Thrasher et al., 2016; Van Den Putte et al., 2011; Wakefield et al., 2003; White et al., 2003). Others have shown that people are more likely to quit if they have had conversations about pictorial warnings or an anti-smoking campaign (Dunlop et al., 2008b; Thrasher et al., 2016). Our study is one of the first to show the role of conversation frequency as a mediator in the context of pictorial warnings. Our findings indicate that conversations sparked by pictorial warnings are an important mechanism through which the warnings influenced quit attempts.

Cognitive elaboration is the main theoretical mechanism that explained how conversations influenced quit attempts, an effect that was larger than for injunctive norms, and controlled for the direct effect of pictorial warnings on cognitive elaboration. We found that the number of conversations about the warning was associated with being more likely to have a quit attempt through the process of cognitive elaboration. A similar effect has been studied in the field of political communication, where conversations about political campaigns increased cognitive elaboration, which in turn increased political knowledge (Eveland, 2004). These findings suggest that conversations lead to quitting because the conversations prompt people to think more about the health effects of smoking and the messages on the warning. By understanding how conversations exert influence on behavior, we can help understand why conversations matter, which can lead to designing warnings that are more effective. In our study, analyses used a non-lagged model for parsimony and to make use of more data, which may less effectively address the temporal ordering of mediators with respect to one another. The lagged model B (Supplementary Table 2) does provide support for the proposed order of constructs, but cannot rule out the possibility that cognitive elaboration might also increase conversations.

Previous work has found that talk about media campaigns has the ability to impact normative beliefs (David et al., 2006; Valente, 1995; Valente and Saba, 1998), and health behavior research suggests that normative beliefs influence behavior (Ajzen, 1991; Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975; Hornik and Yanovitzky, 2003; Yanovitzky and Stryker, 2001). In our trial, talking about the warnings was associated with increased injunctive norms about quitting smoking; however, we did not find support for injunctive norms eliciting quit attempts, and in the second week it had a very small negative mediational effect. Previous research suggests that injunctive norms matter most when noncompliance leads to new social stigmatization (Goffman, 1963). It could be that while conversations increase injunctive norms about quitting, the risk of social stigma from not quitting is not high enough to elicit behavior change or that the stigma against smoking was already well above beyond any threshold for behavior change. It is also possible that injunctive norms may be a theoretical mechanism that takes longer to influence behavior than the four weeks in our trial. Because the messages in our trial did not target normative beliefs, it is possible that conversations about messages designed to target these beliefs would mediate the association between conversations and behavior.

Our analyses did not examine recall as a mediating mechanism. Our measure of recall was limited in that it was binary and thus potentially less sensitive, and we randomly assigned participants to complete it during one of four weeks of the trial. These factors may have contributed to poor fit for models that included recall. Future research should examine recall as a possible theoretical mechanism of action. Finally, conversations could influence behavior through other mechanisms not examined in the trial.

In our trial, the effect of conversations decreased following the first week, though remained statistically significant. This pattern is consistent with work from previous studies that indicate that cigarette pack warnings are most effective when they are new and that responses to the warnings exhibit a partial wear-out effect over the course of months or years (Borland et al., 2009a; Hammond et al., 2007; Hitchman et al., 2013). Research has shown that one way to maintain these effects is to rotate cigarette warnings labels to keep them fresh (Borland et al., 2009a; Thrasher et al., 2016). The wear-out effect we observed may also be partly due to our experimental design that exposed each smoker to one warning during the trial. In practice, countries often put multiple pictorial warnings in circulation, to capture people's attention and lessen wear-out. Also, warnings on the packs of other smokers in their social networks may increase the opportunities for both conversations and secondary diffusion of the messages, presenting an additional way for conversations to impact behavior (Ramanadhan et al., 2017; Southwell and Yzer, 2007).

4.1. Limitations

Strengths of the trial include successful randomization, cognitively-tested measures about social interactions, and a naturalistic pack labeling protocol that exposed smokers to warnings on their actual cigarette packs. However, the trial took place in the US, where pictorial warnings are not currently on cigarette packs, potentially heightening the immediate novelty of the warnings which perhaps sparked more conversations about the warnings. It is encouraging that these findings are largely consistent with observational research carried out in countries that have pictorial health warnings. In Australia, adolescent students reported talking more about new graphic warnings; intentions to smoke were lower among students who had talked about the labels (White et al., 2008). People who recalled the anti-smoking campaign that accompanied the Australian roll-out of the pictorial warnings talked more about the warnings (Nagelhout et al., 2015). In Canada, most people reported talking about the warnings with others within nine months of the introduction new of pictorial warnings (Hammond et al., 2003). In Australia, Canada and Mexico, talking about health warning labels was associated with more quit attempts (Thrasher et al.,

2016). The generalizability of our findings for smokers in a US setting and over a longer period of time merits further study. Finally, we did not manipulate the frequency of conversations, only smokers' exposure to pictorial warnings; therefore, most of the mediated pathways were observational rather than experimental. This limited our ability to draw strong conclusions about causation.

5. Conclusions

Understanding how and why pictorial warnings influence quitting behavior can provide researchers and policy makers with valuable information as they work to design the most effective warnings. We found that conversations about the warnings were a key mechanism through which pictorial warnings influenced quit attempts. US law passed in 2009 requires these warnings ("Family Smoking Prevention and Tobacco Control Act," 2009). However, implementation of pictorial warnings in the US has been stalled due to a 2012 lawsuit by the tobacco industry, and the warnings will likely be redesigned based on the outcome of the litigation (R.J. Reynolds Tobacco Company vs United States Food and Drug Administration, 2011). The decision has prompted a call for social scientists to provide evidence of the effectiveness of tobacco warning labels, with researchers concluding that no single study can provide this evidence, but rather several studies taken together can provide a cumulative picture of the effectiveness of warning label policy (Cappella, 2016). The results of our trial, in conjunction with previous research, contribute to this picture and support designing pictorial warnings intended to increase conversations and spark thinking about the health effects of smoking and the messages the warnings convey. We currently do not know which features of pictorial labels are more likely to spark conversations, but policymakers and health communication campaign creators might benefit from including a measure of the likelihood of a message to trigger a conversation in their message testing phases, similar to the way they include measures of perceived message effectiveness (Bigsby et al., 2013; Davis et al., 2013). Future research on pictorial warning design should examine which features prompt conversations, and focus on ways to optimally stimulate conversations as a way of achieving smoking cessation. More broadly, future research could explore whether the role of cognitive elaboration is unique to tobacco warnings, or if it extends to other health warnings or campaign topics.

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Declaration of interests

KMR and NTB have served as paid expert consultants in litigation against tobacco companies. The other authors declare no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2018.09.063.

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