SUPPLEMENTAL MATERIALS

Supplemental Results

Exploratory analyses. In our exploratory whole-brain analyses, we used multiple regression as implemented in SPM8 to predict whole-brain activation and PPI maps from behavior change, controlling for gender, centered age, ethnicity, and FTND score. These maps were thresholded at $p < 0.005$ and cluster-corrected to $p < 0.05$ (k=121) using AFNI's 3dClustSim program (version 16.2.02). This relatively liberal threshold was used for the exploratory analyses in an effort to reduce Type II error, allow generation of new hypotheses for follow-up experiments, and facilitate future meta-analyses.

Associations between behavior change and neural activation. We performed an exploratory whole-brain analysis using multiple regression to examine whether behavior change was related to activation for GWL > control ads in brain regions other than the MPFC and VS. There were no regions in which greater activation during GWL than control ads related to larger reductions in smoking. In the precentral and postcentral gyri, greater activation during control than GWL ads was related to larger reductions in smoking (see Figure S2).

Associations between behavior change and functional connectivity. To identify regions other than VS that interacted with MPFC during exposure to GWL ads, we performed an exploratory whole-brain PPI analysis. We used multiple regression to test which brain regions' connectivity with MPFC was related to participants' later reductions in smoking. We found that greater connectivity during GWL (compared to control ads) between the MPFC and the caudate, putamen, anterior and middle cingulate cortices, precuneus, parahippocampal gyrus, lateral prefrontal cortex, and motor and supplementary motor cortices was associated with larger reductions in smoking (see Figure S3 and Table S1). This network included regions implicated in the processing of salience and cognitive control (e.g., anterior and middle cingulate, lateral prefrontal cortex; Miller and Cohen, 2001; Seeley et al., 2007; Shenhav et al., 2016), mentalizing and prospection (e.g., parahippocampal gyrus, precuneus; Andrews-Hanna, 2012; Spreng et al., 2008; Yeo et al., 2011), and behavior and action planning (e.g., motor and supplementary motor areas; Desmurget and Sirigu, 2009; Kennerley et al., 2004; Nachev et al., 2008), all of which could relate to the persuasive impact and uptake of messages. For example, those who experience the negative ads as more salient may be more motivated to change their behavior; likewise, changes in a routine and addictive behavior such as smoking would require action planning and cognitive control.

Finally, we defined each of the 7 regions resulting from this analysis in turn as the seed region for PPI analysis to examine connectivity between these nodes (conceptualized as a network), and we estimated the average functional connectivity between all pairs of these regions. Within this network as whole, connectivity during GWL > control ads was related to larger reductions in smoking ($t(39) = -3.99$, $p < 3.5 \times 10^{-4}$). This suggests that connectivity between all of these regions, rather than just each region's connection with MPFC, reflected this relationship with future behavior change. Further, the interactions of all regions other than MPFC with each other during GWL > control ads were also strongly related to reductions in smoking ($t(39) = -4.52$, $p < 7.4 \times 10^{-5}$), indicating that this effect is not driven only by interactions with MPFC. The finding that the interactions between these regions, and not only their interactions with MPFC, are associated with smoking reduction emphasizes that the integration of each of these processes is likely to be important in message-induced behavior change.

Previous investigations into neural responses to GWL-type antismoking messages have highlighted the importance of midline regions such as MPFC and of regions responding to salience in the effectiveness of GWLs (Newman-Norlund et al., 2014; Riddle et al., 2016; Wang et al., 2015), but have not considered how different brain regions interact with one another to forecast behavior change. Likewise, studies of behavior change have primarily not focused on graphic warnings (see (Berkman and Falk, 2013) for a review). Together with prior reports of the relationship between MPFC and parts of the salience system (Jasinska et al., 2012), it is possible that affective cues are particularly important in value computation in the context of *graphic* health messages. Our results highlight connections between systems, which provides new information and explains variance in behavior change not explained by average activation in any single brain region.

Supplemental Figures and Tables

Fig S1. Study flow chart. Participants were screened for eligibility via telephone. Of the 77 deemed eligible, 21 were not able to be scheduled. Two participants were deemed ineligible by the study team after further screening at the first appointment and 4 participants failed to attend their scheduled fMRI appointment. The results reported in Falk et al. (2016) used the same study sample.

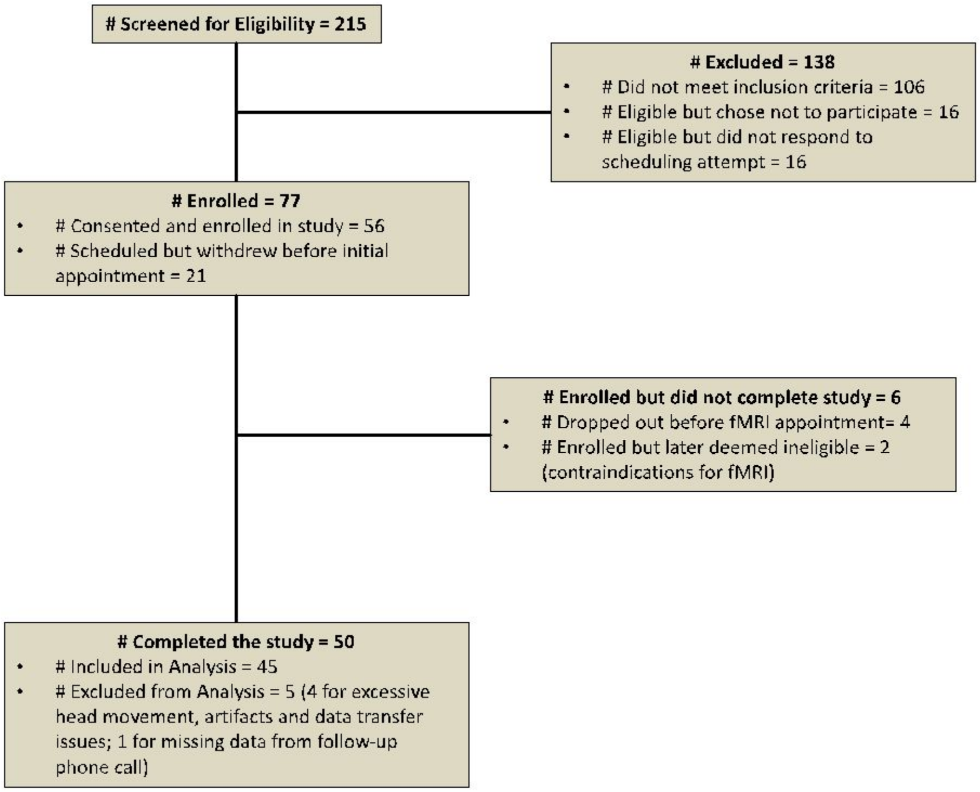

Fig S2. Greater activation during control than GWL ads is related to smoking behavior change. Image thresholded at $p < 0.005$, k=121, corresponding to $p < 0.05$ corrected. Higher t values (yellow) indicate stronger connectivity that is related to more behavioral change (reduced cigarettes per day).

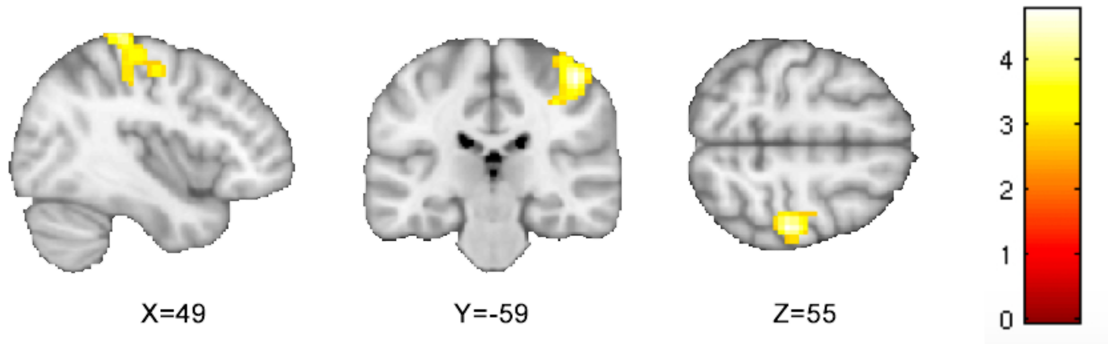

Fig S3. Greater functional connectivity with MPFC during GWL than control ads is related to future reductions in smoking behavior. Image thresholded at $p < 0.005$, $k = 121$, corresponding to $p < 0.05$ corrected. Higher t values (yellow) indicate stronger connectivity that is related to more behavioral change (reduced cigarettes per day). The MPFC seed region for the PPI analysis is displayed in red with an asterisk in the center.

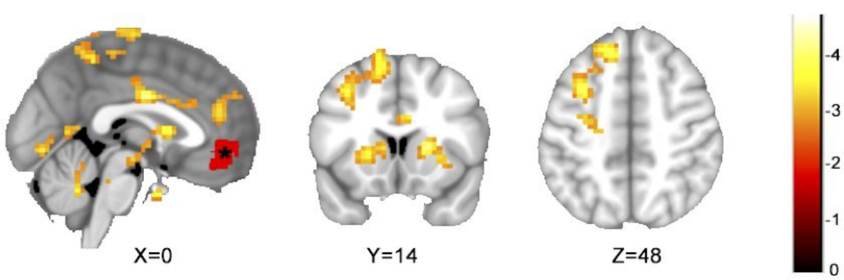

Table S1. Whole-brain results for the relationship between smoking behavior change and functional connectivity with MPFC during GWL *versus* control ads.

Region Name	**Peak *x, y, z***	**Peak *T***	**Cluster Size**

R middle cingulate	4 -5 31	-4.82	299
L frontal superior medial	-6 39 25	-3.87	
R anterior cingulate	5 43 22	-3.46	
R thalamus	8 -5 7	-4.77	711
L thalamus	-16 -16 10	-4.28	
L putamen	-23 -9 10	-4.53	
R putamen	22 15 4	-3.53	
L caudate	-9 12 7	-3.48	
R caudate	8 8 7	-3.82	
L cerebellum	-6 -54 -32	-4.63	178
R cerebellum	11 -40 -26	-3.98	
L parahippocampal gyrus	-16 -2 -35	-4.45	124
L temporal pole	-26 8 -32	-3.41	
L supplementary motor area	-9 19 61	-4.57	428
L middle frontal gyrus	-30 8 49	-3.99	
L superior frontal gyrus	-16 36 49	-3.96	
R precuneus	8 -43 58	-4.24	364
L precuneus	-9 -36 58	-4.15	
L paracentral lobule	-13 -33 55	-4.1	
L lingual gyrus	-16 -88 -14	-4.23	177
R lingual gyrus	1 -78 -5	-3.52	

L inferior occipital gyrus	-30 -98 -11	-3.78	

Notes. Thresholded at $p < 0.005$*, k=121, corresponding to* $p < 0.05$ *corrected. A negative relationship indicates that a greater connectivity difference between ad types relates to a larger reduction in smoking. No regions showed a positive effect in this contrast.*

References for Supplemental Materials

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